2024 Annual Groundwater Monitoring and Corrective Action Report

CCR Landfill

R.M. Heskett Station
Mandan, North Dakota

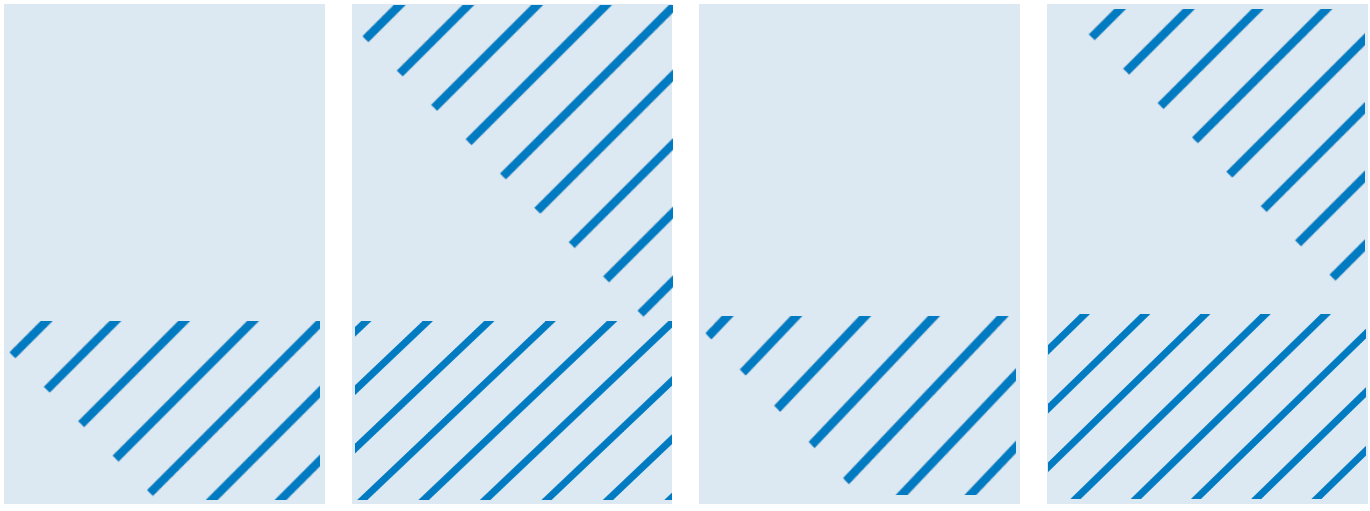
Prepared for Montana-Dakota Utilities Co.

Barr Engineering Co.

January 2025

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435

barr.com



2024 Annual Groundwater Monitoring and Corrective Action Report

CCR Landfill

R.M. Heskett Station

Mandan, North Dakota

January 2025

Contents

Tables

Figures

Appendices

Abbreviations

Acronym	Description
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
MDU	Montana-Dakota Utilities Co.
NDAC	North Dakota Administrative Code
NDDEQ	North Dakota Department of Environmental Quality
SSI	Statistically Significant Increase
TDF	Tire-Derived Fuel
TDS	Total Dissolved Solids

Executive Summary

This 2024 Annual Groundwater Monitoring and Corrective Action Report (Annual Report) describes the monitoring program and results for the Coal Combustion Residuals (CCR) landfill at Montana-Dakota Utilities Co. (MDU's) R.M. Heskett Station (Site). The permitted landfill is the only CCR Unit at this Site. Content of this report is to satisfy requirements of the federal CCR rule and the State of North Dakota Permit Number 0087.

At the beginning, end, and throughout 2024, the CCR Unit was operating under a detection monitoring program as described in 40 CFR 257.94 and NDAC 33.1-20-08-06-04. Pursuant to § 257.94 and NDAC 33.1-20-08-06-04, statistically significant increases (SSIs) were determined for:

- August 2023: fluoride, sulfate, and total dissolved solids (TDS) at MW1-90, calcium at MW2-90, MW3-90, and MW-80R, and chloride at MW-80R
- May 2024: fluoride, sulfate, and TDS at MW1-90, and fluoride at MW2-90
- August 2024: fluoride, sulfate, and TDS at MW1-90 and fluoride at MW2-90

Subsequent determinations and actions (if any) will be addressed in the 2025 Annual Report. Successful alternative source demonstrations (ASDs) were completed for the August 2023 and May 2024 SSIs. The ASD documentation is included in this report under Appendix B. An ASD for the August 2024 detection monitoring results is in progress, and results of the ASD are anticipated in 2025. Therefore, no assessment monitoring program (§ 257.95 and NDAC 33.1-20-08-06-04) or related corrective or remedial measures (§§ 257.96, 257.97, and 257.98; NDAC 33.1-20-08-06-06, -07, and -08) were necessary.

1 Introduction

Montana-Dakota Utilities Co. (MDU) owns and operates R.M. Heskett Station (Site) located in Mandan, Morton County, North Dakota (Figure 1). The Site was comprised of two coal-fired electric generating units which are now decommissioned, demolished, and the areas reclaimed. One coal combustion residual (CCR) unit, as defined by 40 CFR 257.53 and North Dakota Administrative Code (NDAC) 33.1-20-08-01, is located on the property. The CCR unit is a lined landfill containing coal combustion by-products, asbestos wastes generated from construction activity associated with MDU-owned facilities, decommissioning wastes, and ash derived from burning tire-derived fuel (TDF). Final closure of the landfill was competed in 2024. The CCR unit is required to comply with the provisions of the US Environmental Protection Agency (EPA) CCR Rule (40 CFR Parts 257 and 261, Disposal of Coal Combustion Residuals from Electric Utilities) and the North Dakota Department of Environmental Quality (NDDEQ) CCR Rule (NDAC Title 33.1, Article 20, Chapter 8).

This 2024 Annual Groundwater Monitoring and Corrective Action Report (Annual Report) describes the monitoring program and results for the CCR landfill at the Site.

1.1 Purpose

As stated in § 257.90(e) and NDAC 33.1-20-08-06-01(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) and NDAC 33.1-20-08-06-01(e), and this Site's compliance with the CCR Rules, are summarized in Table 1.

Table 1 CCR Rule Requirements and Compliance

EPA CCR Rule Reference (40 CFR)	NDDEQ CCR Rule Reference (NDAC)	Content Required in Report	Location
§ 257.90(e)(1)	§ 33.1-20-08-06-01(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 2.1 Groundwater Monitoring System; see Figure 1
§ 257.90(e)(2)	§ 33.1-20-08-06-01(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 2.1.1 Changes to Groundwater Monitoring System
§ 257.90(e)(3)	§ 33.1-20-08-06-01(e)(3)	**Data and Collection Summary**: In addition to all the monitoring data obtained under § 257.90 through § 257.98 and § 33.1-20-08-06, 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 2.3 Data and Collection Summary; monitoring data included in Table 2, Table 3, Appendix A, and Appendix C
§ 257.90(e)(4)	§ 33.1-20-08-06-01(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).	Not applicable – No transition between monitoring programs was necessary
§ 257.90(e)(5)	§ 33.1-20-08-06-01(e)(5)	**Other Information**: Other information required, if applicable, to be included in the annual report as specified in § 257.90 through § 257.98 and § 33.1-20-08-06.	Section 2.2 Actions Completed/ Problems Encountered; Appendix B
§ 257.90(e)(6)	n/a	**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.	Executive Summary

2 Groundwater Monitoring Program

This section documents the status of the groundwater monitoring and corrective action program for the CCR unit in 2024. A description of the groundwater monitoring system is included in Section 2.1, key actions completed and problems encountered are described in Section 2.2, the monitoring and analytical results are described in Section 2.3, and key activities planned for 2025 are described in Section 2.4.

2.1 Groundwater Monitoring System

The certified groundwater monitoring well network around the CCR unit consisted of one upgradient well (MW-13) and four downgradient wells (MW-80R, MW1-90, MW2-90, and MW3-90) for the fall 2023 detection monitoring event. In 2024, upgradient well MW-103 and cross-gradient well MW-44R were added to the network. Well MW-44R serves as an upgradient for the Site. The additional, existing

upgradient and cross gradient wells were included in the 2024 monitoring program to augment the background dataset and provide a more representative background distribution. The groundwater monitoring well network consists of three upgradient/cross-gradient wells (MW-13, MW-103, and MW-44R) and four downgradient wells (MW-80R, MW1-90, MW2-90, and MW3-90). Well locations are shown on Figure 1.

2.1.1 Changes to Groundwater Monitoring System

In 2021, MDU applied for a modification to Permit 0087 from NDDEQ. The permit application included an updated groundwater monitoring network for the CCR unit. The modified permit was issued on February 14, 2022 and the monitoring network was used through 2023. In 2024, the groundwater monitoring network was updated as described in Section 2.1 and shown on Figure 1 supplanted the groundwater monitoring system described in the Groundwater Monitoring System Certification (Barr, 2017a).

2.2 Actions Completed/Problems Encountered

The following actions were completed in 2024:

- **Background Update:** Background was statistically evaluated and updated to include data through 2023 from upgradient wells MW-13, MW-103, and MW-44R in accordance with the Groundwater Statistical Method Selection Certification (Statistical Certification; Barr, 2017b). The updated prediction limits were used for the spring and fall 2024 detection monitoring events.

- **Detection Monitoring Sampling:** Groundwater samples were collected from each well in the groundwater monitoring system on August 28-29, 2023, May 22, 2024, and August 28, 2024. Groundwater samples were analyzed for Appendix III constituents, per the detection monitoring program of the CCR Rules (§ 257.94 and NDAC 33.1-20-08-06-04) (Table 3).

- **SSI Evaluation:** SSI evaluations were conducted in accordance with the Groundwater Statistical Method Selection Certification (Statistical Certification; Barr, 2017b) for the August 2023, May 2024, and August 2024 detection monitoring events. All three detection monitoring events resulted in verified SSIs.

- **Verification Retesting:** Verification resampling was not conducted for the August 2023 or May 2024 detection monitoring events. Verification resampling was completed for the August 2024 detection monitoring event on November 26, 2024.

- **Alternative Source Demonstration (ASD):** ASDs were conducted on the verified SSIs for the August 2023 and May 2024 detection monitoring events. The ASDs demonstrated an alternative source for both sampling events, as allowed by the CCR Rules (§ 257.94(e)(2) and NDAC 33.1-20-08-06-04(e)(2)). An ASD for the August 2024 detection monitoring event is in progress and will be completed within 90 days of the SSI determination. More details are provided in Section 2.3. Subsequent determinations and actions (if any) will be addressed in the 2025 Annual Report.

2.3 Data and Collection Summary

2.3.1 August 2023 Detection Monitoring Event

As mentioned in the 2023 Annual Report (Barr, 2024a), an SSI evaluation was conducted on the results of the August 2023 detection monitoring event. Groundwater samples were collected from the five groundwater monitoring network wells (MW-13, MW1-90, MW2-90, MW3-90, and MW-80R) at the Site on August 28 - 29, 2023. Seven potential SSIs (fluoride, sulfate, and TDS at MW1-90, calcium at MW2-90, MW3-90, and MW-80R, and chloride at MW-80R) were identified. No verification resampling was performed. A summary of results is included in Table 2. Field data sheets and analytical laboratory reports for detection monitoring sampling are included in Appendix A. Water level contours are shown on Figure 2, and flow calculations are included in Appendix C.

An 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" and/or statistical methods resulted in the SSIs, as allowed by § 257.94(e)(2) and NDAC 33.1-20-08-06-04(e)(2). The Alternative Source Demonstration: August 2023 Event Report is included in Appendix B.

2.3.2 May 2024 Detection Monitoring Event

Groundwater samples were collected from the seven groundwater monitoring network wells at the Site on May 22, 2024. Four potential SSIs (fluoride, sulfate, and TDS at MW1-90, and fluoride at MW2-90) were identified. No verification resampling was performed. A summary of results is included in Table 2. Field data sheets and analytical laboratory reports for detection monitoring sampling are included in Appendix A. Water level contours are shown on Figure 3, and flow calculations are included in Appendix C.

An 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)(2) and NDAC 33.1-20-08-06-04(e)(2). The Alternative Source Demonstration: May 2024 Event Report is included in Appendix B.

2.3.3 August 2024 Detection Monitoring Event

Groundwater samples were collected from the seven groundwater monitoring network wells at the Site on August 28, 2024. Nine potential SSIs (fluoride, pH, sulfate, and TDS at MW1-90; pH and fluoride at MW2-90; calcium and pH at MW3-90; and pH at MW-80R) were identified. Verification resampling was conducted on November 26, 2024, and verified four SSIs (fluoride, sulfate, and TDS at MW1-90 and fluoride at MW2-90). A summary of results is included in Table 2. Field data sheets and analytical laboratory reports for detection monitoring sampling are included in Appendix A. Water level contours are shown on Figure 4, and flow calculations are included in Appendix C.

An ASD was ongoing at the end of 2024. If the ASD is not successful, appropriate actions will be initiated per the CCR Rule as applicable.

2.4 Activities for Upcoming Year

The following key activities for analytical results and statistical evaluations are planned for 2025:

- Complete the ASD or assessment monitoring determination for the August 2024 detection monitoring event in accordance with the Statistical Certification (Barr, 2017b).

- Evaluate analytical results from 2025 semi-annual detection monitoring events for SSIs according to the Statistical Certification (Barr, 2017b).

3 Operational Activity

Coal-fired unit operation at Heskett Station ceased by March 2022. Remaining landfill capacity was consumed in 2023 by waste generated during decommissioning activities. Final closure of the remaining open area of the landfill began in October 2023 with the geomembrane cover and sand drainage layer installed before halting construction due to winter conditions; final closure was completed in 2024.

3.1 Asbestos Disposal and Other Materials

No asbestos or any other material was disposed of in the Landfill in 2024.

3.2 Inspections and Maintenance

As previously stated, closure was initiated for the CCR unit in 2023. During closure, MDU staff conducted weekly inspections of the CCR landfill. When closure was certified by a qualified professional engineer, inspections moved to monthly in accordance with the post-closure care plan (Barr, 2024b). The inspections found the Site to be in good order, with no appearances of an actual or potential structural weakness of the landfill. During 2024, the landfill was covered, at minimum, with a geomembrane and sand layer, and no CCR was hauled, created, or otherwise handled to create CCR fugitive dust emissions.

Phase I and II leachate systems were each flushed with approximately 2,000 gallons of water in August 2024. The system was flushed from the standpipes to the Evaporation Pond. There were no obstructions of flow.

The Landfill cover was inspected for erosion during 2024. No erosion was observed on the seeded areas, and vegetation is well established around Phases I and II. The covers of the ash disposal site are in good condition on all closed slots. The ash slot expansion area has good coverage. Portions of the established vegetation were hayed on the closed slots in July 2024.

Minor rill erosion was noted on an interior bank of the Evaporation Pond in 2023 and was repaired in the spring 2024.

3.3 Leachate Sampling

A leachate sample was not collected from the Evaporation Pond in 2024 as it was dry for most of the year.

4 References

Barr Engineering Co. (Barr), 2017a. Groundwater Monitoring System Certification, R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. October 2017.

Barr, 2017b. Statistical Method Selection Certification, R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. October 2017.

Barr, 2024a. 2023 Annual Groundwater Monitoring and Corrective Action Report: CCR Landfill, R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2024.

Barr, 2024b. Post-Closure Care Plan for Existing Landfill. Prepared for Montana-Dakota Utilities Co. March 2024.

Tables

Table 2 Water Quality Analytical Data Summary

Table 2
Water Quality Analytical Data Summary
2024 Annual Monitoring Report
Heskett CCR Groundwater Compliance

		Location	MW1-90	MW1-90	MW1-90	MW1-90	MW2-90	MW2-90	MW2-90	MW2-90	MW3-90	MW3-90	MW3-90	MW3-90
		Date	8/29/23	5/22/24	8/28/24	11/26/24	8/29/23	5/22/24	8/28/24	11/26/24	8/29/23	5/22/24	8/28/24	11/26/24
		Sample Type	N	N	N	R	N	N	N	R	N	N	N	R
Parameter	Analysis Location	Units												
Appendix III														
Boron, total	Lab	mg/l	< 0.5 U	< 0.5 U	< 0.5 U	--	< 0.5 U	< 0.5 U	< 0.5 U	--	< 0.1 U	< 0.5 U	< 0.5 U	--
Calcium, total	Lab	mg/l	**406**	**406**	**419**	--	**477**	**514**	**518**	--	**470**	**522**	**604**	**580**
Chloride	Lab	mg/l	**90.7**	**74.5**	**90.6**	--	**80.5**	**66.6**	**74.4**	--	**39.5**	**37.1**	**42.3**	--
Fluoride	Lab	mg/l	**1.14**	**1.11**	**1.15**	--	**1.03**	**1.05**	**1.05**	--	**0.13**	**0.14**	**0.12**	--
pH	Field	pH units	**6.86**	**6.93**	**7.3**	**6.84**	**7.04**	**6.99**	**7.52**	**6.97**	**6.98**	**6.97**	**7.58**	**6.84**
Solids, total dissolved	Lab	mg/l	**13100**	**12600**	**13200**	--	**8600**	**9460**	**9920**	--	**4670**	**5170**	**5630**	--
Sulfate, as SO4	Lab	mg/l	**7710**	**8350**	**9000**	--	**4940**	**5720**	**6980**	--	**2660**	**3280**	**3550**	--

-- Not analyzed/Not available.
N Sample Type: Normal
R Sample Type: Resample
FB Sample Type: Field Blank
FD: Sample Type: Field Duplicate
U: The analyte was analyzed for, but was not detected.

Table 2
Water Quality Analytical Data Summary
2024 Annual Monitoring Report
Heskett CCR Groundwater Compliance

		Location	MW13		MW13		MW13		MW13	MW44R	MW44R	MW44R	MW80R	MW80R	MW80R	MW-80R	MW103	MW103	MW103	QC	QC	QC
		Date	8/28/23		5/22/24		8/28/24		11/26/24	5/22/24	8/28/24	11/26/24	8/28/23	5/22/24	8/28/24	11/26/24	5/22/24	8/28/24	11/26/24	8/29/23	5/22/24	8/28/24
		Sample Type	N	FD	N	FD	N	FD	R	N	N	R	N	N	N	R	N	N	R	FB	FB	FB
Parameter	Analysis Location	Units																				
Appendix III																						
Boron, total	Lab	mg/l	< 0.5 U	< 0.5 U	**0.52**	**0.54**	**0.62**	**0.63**	--	< 0.5 U	< 0.5 U	--	< 0.5 U	< 0.5 U	< 0.5 U	--	**0.15**	**0.16**	--	< 0.1 U	< 0.1 U	< 0.1 U
Calcium, total	Lab	mg/l	**398**	**385**	**407**	**410**	**371**	**420**	--	**451**	**439**	--	**528**	**476**	**450**	--	**619**	**595**	--	< 1 U	< 1 U	< 1 U
Chloride	Lab	mg/l	**117**	**117**	**85.5**	**85.4**	**89.2**	**89.1**	--	**194**	**204**	--	**193**	**141**	**154**	--	**124**	**138**	--	< 2.0 U	< 2.0 U	< 2.0 U
Fluoride	Lab	mg/l	**0.74**	**0.74**	**0.85**	**0.86**	**0.87**	**0.89**	--	**0.66**	**0.66**	--	**0.23**	**0.23**	**0.23**	--	**0.12**	**0.11**	--	< 0.1 U	< 0.1 U	< 0.1 U
pH	Field	pH units	**7.03**	--	**7.03**	--	**7.52**	--	**6.93**	**6.65**	**7.27**	**6.61**	**7.01**	**7.03**	**7.84**	**6.96**	**6.86**	**7.66**	**6.84**	--	--	--
Solids, total dissolved	Lab	mg/l	**12700**	**12500**	**11300**	**11300**	**10800**	**10700**	--	**10300**	**10800**	--	**7240**	**6180**	**5680**	--	**4450**	**4410**	--	< 10 U	< 10 U	< 10 U
Sulfate, as SO4	Lab	mg/l	**7490**	**7840**	**7320**	**7490**	**7670**	**7550**	--	**6410**	**7390**	--	**4130**	**3660**	**3680**	--	**2560**	**2580**	--	< 5 U	< 5 U	< 5 U

-- Not analyzed/Not available.
N Sample Type: Normal
R Sample Type: Resample
FB Sample Type: Field Blank
FD: Sample Type: Field Duplicate
U: The analyte was analyzed for, but was not detected.

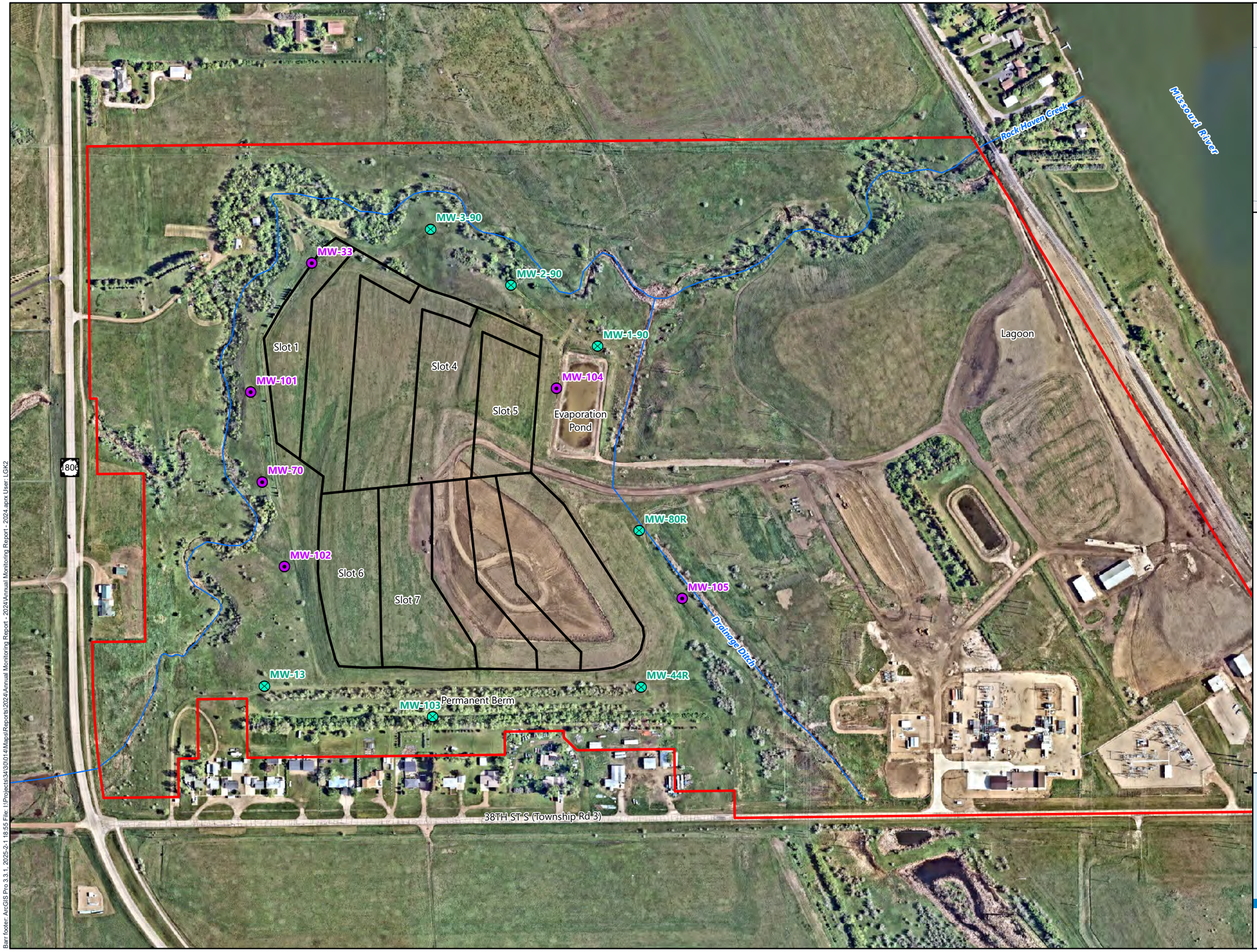
Table 3 Sample Summary

Table 3
Sampling Event Summary
2024 Annual Monitoring Report
Heskett CCR Groundwater Compliance

Event Classification and Number	Monitoring Well	Up or Down Gradient	Event date	No. Samples
Detection Monitoring Event #1	MW-13	Up	5/22/2024	1
Detection Monitoring Event #1	MW-103	Up	5/22/2024	2
Detection Monitoring Event #1	MW-44R	Up	5/22/2024	1
Detection Monitoring Event #1	MW1-90	Down	5/22/2024	1
Detection Monitoring Event #1	MW2-90	Down	5/22/2024	1
Detection Monitoring Event #1	MW3-90	Down	5/22/2024	1
Detection Monitoring Event #1	MW-80R	Down	5/22/2024	1
Detection Monitoring Event #2	MW-13	Up	8/28/2024	2
Detection Monitoring Event #2	MW-103	Up	8/28/2024	1
Detection Monitoring Event #2	MW-44R	Up	8/28/2024	1
Detection Monitoring Event #2	MW1-90	Down	8/28/2024	1
Detection Monitoring Event #2	MW2-90	Down	8/28/2024	1
Detection Monitoring Event #2	MW3-90	Down	8/28/2024	1
Detection Monitoring Event #2	MW-80R	Down	8/28/2024	1
Detection Monitoring Event #2, Resample	MW-13	Up	11/26/2024	1
Detection Monitoring Event #2, Resample	MW-103	Up	11/26/2024	1
Detection Monitoring Event #2, Resample	MW-44R	Up	11/26/2024	1
Detection Monitoring Event #2, Resample	MW1-90	Down	11/26/2024	1
Detection Monitoring Event #2, Resample	MW2-90	Down	11/26/2024	1
Detection Monitoring Event #2, Resample	MW3-90	Down	11/26/2024	1
Detection Monitoring Event #2, Resample	MW-80R	Down	11/26/2024	1

Figures

Figure 1 Site Layout and CCR Monitoring Network



Monitoring Well Location

Monitoring Well Location - Water Level Only

Property Boundary

Note: MW-103 and MW-44R were water level only monitoring locations for the August 2023 monitoring event.

0 200 400

Feet

Imagery: NearMap 4/25/2024

SITE LAYOUT AND CCR MONITORING NETWORK

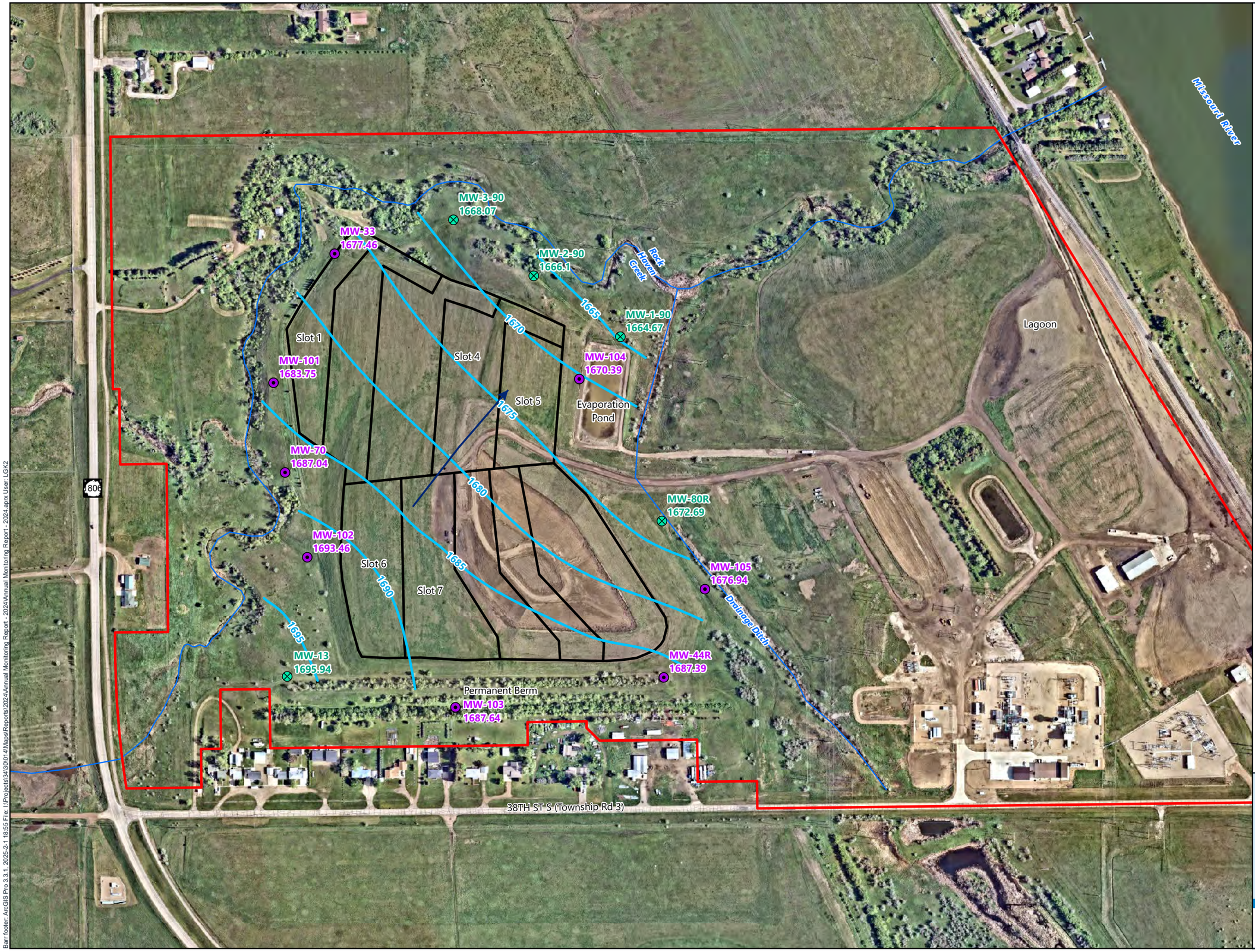
Heskett Station
2024 Annual Monitoring Report
Montana Dakota Utilities
Mandan, North Dakota

FIGURE 1

BARR

Barr footer: ArcGIS Pro 3.3.1, 2025-2-1 18:55 File: I:\Projects\34\30\014\Maps\Reports\2024\Annual Monitoring Report - 2024\Annual Monitoring Report - 2024.aprx User: LGK2

Figure 2 August 2023 Groundwater Elevations

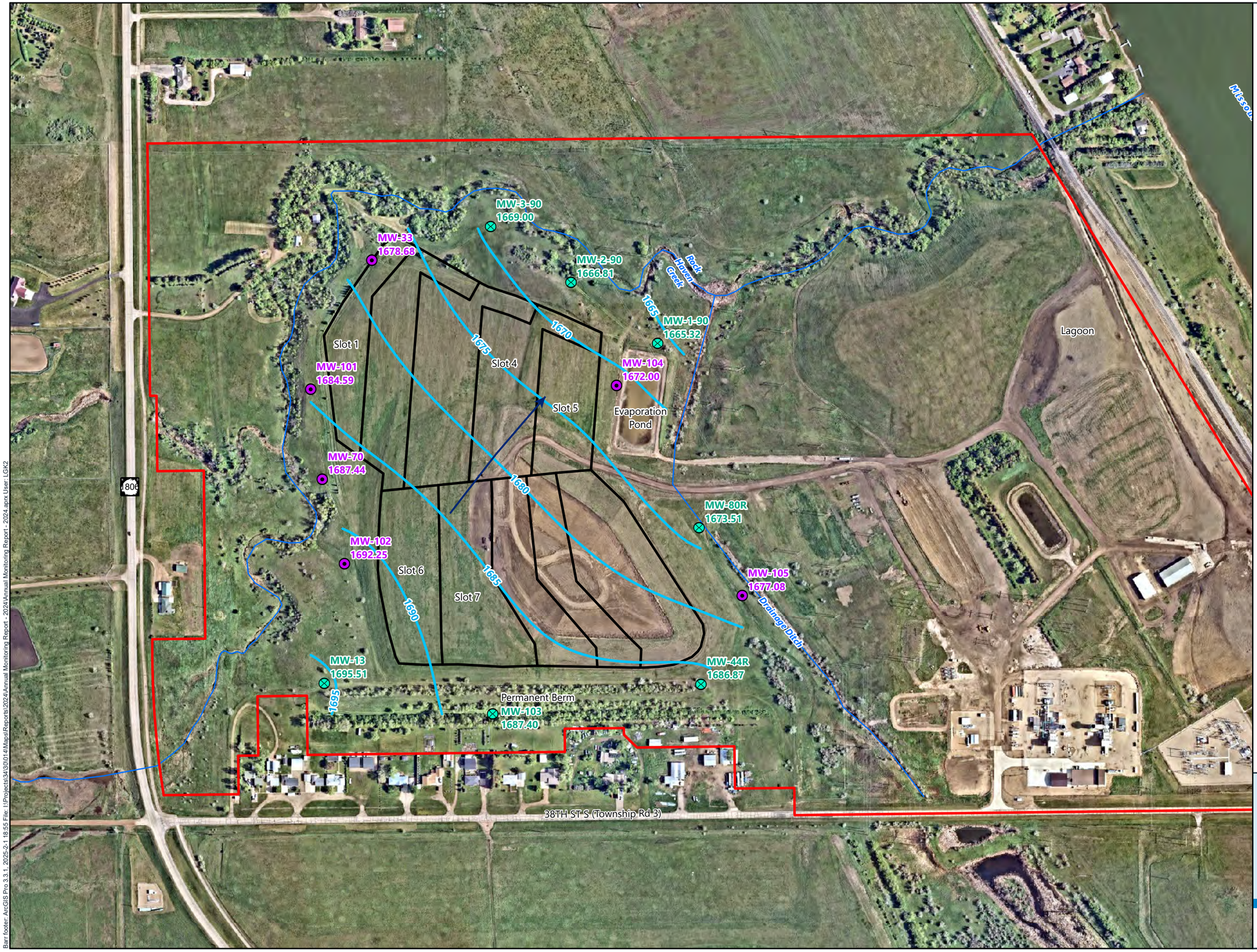


AUGUST 2023 GROUNDWATER ELEVATIONS
Heskett Station
2024 Annual Monitoring Report
Montana Dakota Utilities
Mandan, North Dakota

FIGURE 2

BARR

Figure 3 May 2024 Groundwater Elevations

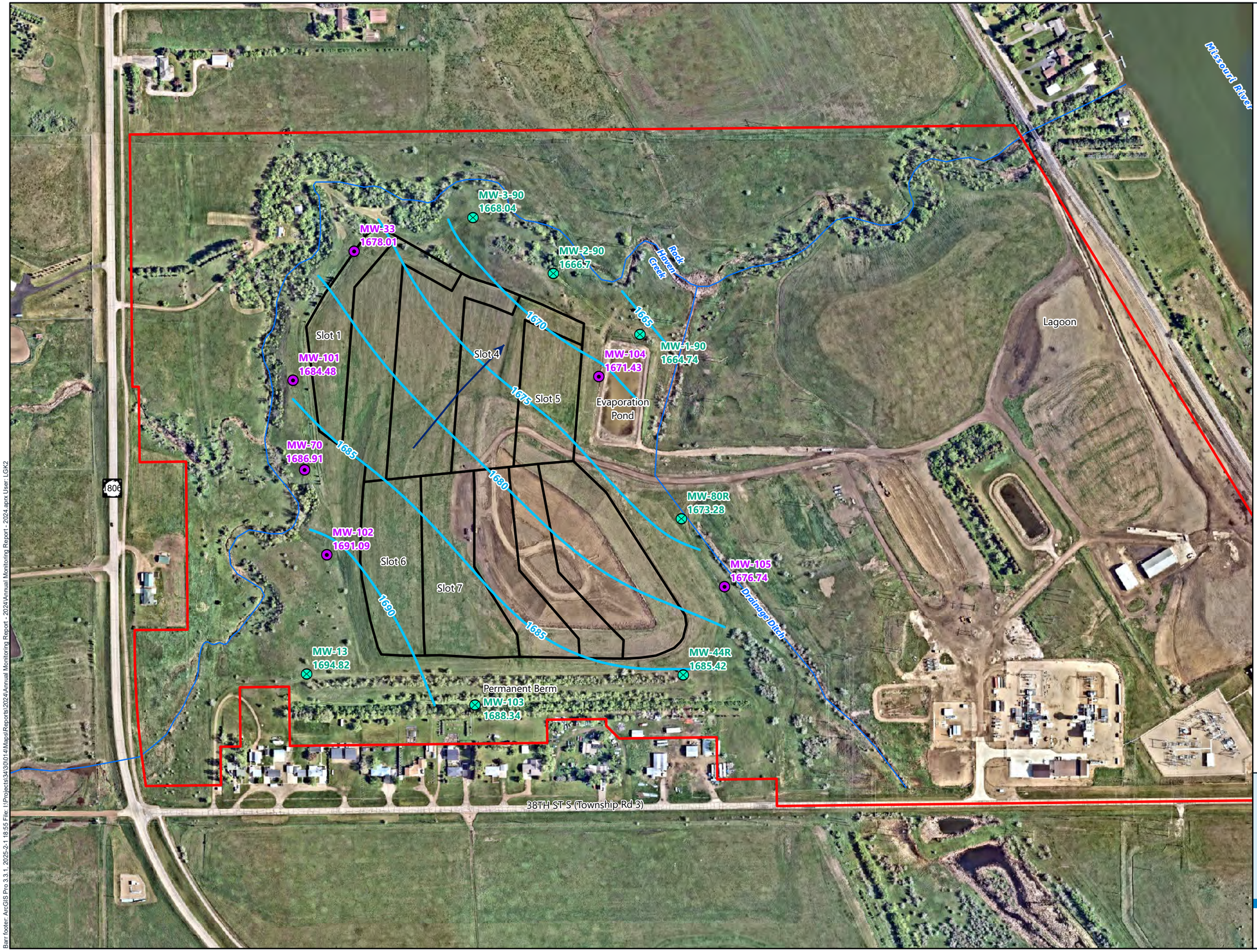


MAY 2024 GROUNDWATER ELEVATIONS
Heskett Station
2024 Annual Monitoring Report
Montana Dakota Utilities
Mandan, North Dakota

FIGURE 3

BARR

Figure 4 August 2024 Groundwater Elevations



Monitoring Well Location

Monitoring Well Location - Water Level Only

Groundwater Elevation Contours (ft MSL)

Groundwater Flow Direction

Property Boundary

N

0 200 400

Feet

Imagery: NearMap 4/25/2024

AUGUST 2024 GROUNDWATER ELEVATIONS

Heskett Station
2024 Annual Monitoring Report
Montana Dakota Utilities
Mandan, North Dakota

FIGURE 4

BARR

Appendices

Appendix A Laboratory Reports and Field Sheets: 2024

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck
Workorder: MDU Heskett (49353) **PO:** 200301 OP

Brandon Schafer
Montana-Dakota Utilities Co.
400 North Fourth Street
Bismarck, ND 58501

Certificate of Analysis

Approval

All data reported has been reviewed and approved by:

Claudette Carroll, Lab Manager Bismarck, ND

Analyses performed under Minnesota Department of Health Accreditation conforms to the current TNI standards.

NEW ULM LAB CERTIFICATIONS:
MN LAB # 027-015-125 ND WW/DW # R-040

BISMARCK LAB CERTIFICATIONS:
MN LAB # 038-999-267 ND W/DW # ND-016

Workorder Comments

All analytes with dilution factors greater than 1 (displayed in DF column) required dilution due to matrix or high concentration of target analyte unless otherwise noted and reporting limits (RDL column) have been adjusted accordingly.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353001 **Date Collected:** 05/22/2024 12:33 **Matrix:** Groundwater
Sample ID: MW13 **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**10935**	umhos/cm	1	1		05/22/2024 12:33	
Method: 150.2							
pH - Field	**7.03**	units	0.01	1		05/22/2024 12:33	
Method: 170.1							
Temperature - Field C	**12.21**	degrees C		1		05/22/2024 12:33	
Method: ASTM D516-16							
Sulfate	**7320**	mg/L	250	50		05/29/2024 10:28	
Method: EPA 6010D							
Boron	**0.52**	mg/L	0.5	5	05/23/2024 16:35	05/29/2024 10:06	
Calcium	**407**	mg/L	5	5	05/23/2024 16:35	05/30/2024 12:20	
Method: SM4500 H+ B-2011							
pH	**7.2**	units	0.1	1		05/23/2024 12:23	*
Method: SM4500-Cl-E 2011							
Chloride	**85.5**	mg/L	2.0	1		05/29/2024 15:41	
Method: SM4500-F-C-2011							
Fluoride	**0.85**	mg/L	0.1	1		05/23/2024 12:23	
Method: USGS I-1750-85							
Total Dissolved Solids	**11300**	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353002 **Date Collected:** 05/22/2024 15:06 **Matrix:** Groundwater
Sample ID: MW1-90 **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**11109**	umhos/cm	1	1		05/22/2024 15:06	
Method: 150.2							
pH - Field	**6.93**	units	0.01	1		05/22/2024 15:06	
Method: 170.1							
Temperature - Field C	**10.39**	degrees C		1		05/22/2024 15:06	
Method: ASTM D516-16							
Sulfate	**8350**	mg/L	250	50		05/29/2024 10:29	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	05/23/2024 16:35	05/29/2024 10:08	
Calcium	**406**	mg/L	5	5	05/23/2024 16:35	05/30/2024 12:21	
Method: SM4500 H+ B-2011							
pH	**7.1**	units	0.1	1		05/23/2024 12:29	*
Method: SM4500-Cl-E 2011							
Chloride	**74.5**	mg/L	2.0	1		05/29/2024 15:49	
Method: SM4500-F-C-2011							
Fluoride	**1.11**	mg/L	0.1	1		05/23/2024 12:29	
Method: USGS I-1750-85							
Total Dissolved Solids	**12600**	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353003 **Date Collected:** 05/22/2024 15:57 **Matrix:** Groundwater
Sample ID: MW2-90 **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**8446**	umhos/cm	1	1		05/22/2024 15:57	
Method: 150.2							
pH - Field	**6.99**	units	0.01	1		05/22/2024 15:57	
Method: 170.1							
Temperature - Field C	**14.67**	degrees C		1		05/22/2024 15:57	
Method: ASTM D516-16							
Sulfate	**5720**	mg/L	250	50		05/29/2024 10:30	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	05/23/2024 16:35	05/29/2024 10:09	
Calcium	**514**	mg/L	5	5	05/23/2024 16:35	05/30/2024 12:22	
Method: SM4500 H+ B-2011							
pH	**7.2**	units	0.1	1		05/23/2024 12:34	*
Method: SM4500-Cl-E 2011							
Chloride	**66.6**	mg/L	2.0	1		05/29/2024 15:50	
Method: SM4500-F-C-2011							
Fluoride	**1.05**	mg/L	0.1	1		05/23/2024 12:34	
Method: USGS I-1750-85							
Total Dissolved Solids	**9460**	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353004 **Date Collected:** 05/22/2024 17:01 **Matrix:** Groundwater
Sample ID: MW3-90 **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**5490**	umhos/cm	1	1		05/22/2024 17:01	
Method: 150.2							
pH - Field	**6.97**	units	0.01	1		05/22/2024 17:01	
Method: 170.1							
Temperature - Field C	**11.18**	degrees C		1		05/22/2024 17:01	
Method: ASTM D516-16							
Sulfate	**3280**	mg/L	200	40		05/29/2024 10:32	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	05/23/2024 16:35	05/29/2024 10:09	
Calcium	**522**	mg/L	5	5	05/23/2024 16:35	05/30/2024 12:23	
Method: SM4500 H+ B-2011							
pH	**7.2**	units	0.1	1		05/23/2024 12:40	*
Method: SM4500-Cl-E 2011							
Chloride	**37.1**	mg/L	2.0	1		05/29/2024 15:51	
Method: SM4500-F-C-2011							
Fluoride	**0.14**	mg/L	0.1	1		05/23/2024 12:40	
Method: USGS I-1750-85							
Total Dissolved Solids	**5170**	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353005 **Date Collected:** 05/22/2024 11:21 **Matrix:** Groundwater
Sample ID: MW-44R **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**9357**	umhos/cm	1	1		05/22/2024 11:21	
Method: 150.2							
pH - Field	**6.65**	units	0.01	1		05/22/2024 11:21	
Method: 170.1							
Temperature - Field C	**11.73**	degrees C		1		05/22/2024 11:21	
Method: ASTM D516-16							
Sulfate	**6410**	mg/L	200	40		05/29/2024 10:33	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	05/23/2024 16:35	05/29/2024 10:10	
Calcium	**451**	mg/L	5	5	05/23/2024 16:35	05/30/2024 12:25	
Method: SM4500 H+ B-2011							
pH	**6.9**	units	0.1	1		05/23/2024 12:46	*
Method: SM4500-Cl-E 2011							
Chloride	**194**	mg/L	2.0	1		05/29/2024 15:52	
Method: SM4500-F-C-2011							
Fluoride	**0.66**	mg/L	0.1	1		05/23/2024 12:46	
Method: USGS I-1750-85							
Total Dissolved Solids	**10300**	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353006 **Date Collected:** 05/22/2024 14:01 **Matrix:** Groundwater
Sample ID: MW-80R **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**6095**	umhos/cm	1	1		05/22/2024 14:01	
Method: 150.2							
pH - Field	**7.03**	units	0.01	1		05/22/2024 14:01	
Method: 170.1							
Temperature - Field C	**9.12**	degrees C		1		05/22/2024 14:01	
Method: ASTM D516-16							
Sulfate	**3660**	mg/L	200	40		05/29/2024 10:34	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	05/23/2024 16:35	05/29/2024 10:11	
Calcium	**476**	mg/L	5	5	05/23/2024 16:35	05/30/2024 12:28	
Method: SM4500 H+ B-2011							
pH	**7.2**	units	0.1	1		05/23/2024 12:52	*
Method: SM4500-Cl-E 2011							
Chloride	**141**	mg/L	2.0	1		05/29/2024 15:54	
Method: SM4500-F-C-2011							
Fluoride	**0.23**	mg/L	0.1	1		05/23/2024 12:52	
Method: USGS I-1750-85							
Total Dissolved Solids	**6180**	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353007 **Date Collected:** 05/22/2024 10:25 **Matrix:** Groundwater
Sample ID: MW-103 **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**4860**	umhos/cm	1	1		05/22/2024 10:25	
Method: 150.2							
pH - Field	**6.86**	units	0.01	1		05/22/2024 10:25	
Method: 170.1							
Temperature - Field C	**10.34**	degrees C		1		05/22/2024 10:25	
Method: ASTM D516-16							
Sulfate	**2560**	mg/L	100	20		05/29/2024 10:57	
Method: EPA 6010D							
Boron	**0.15**	mg/L	0.1	1	05/23/2024 16:35	05/29/2024 10:11	
Calcium	**619**	mg/L	5	5	05/23/2024 16:35	05/30/2024 12:29	
Method: SM4500 H+ B-2011							
pH	**7.1**	units	0.1	1		05/23/2024 12:58	*
Method: SM4500-Cl-E 2011							
Chloride	**124**	mg/L	2.0	1		05/29/2024 15:55	
Method: SM4500-F-C-2011							
Fluoride	**0.12**	mg/L	0.1	1		05/23/2024 12:58	
Method: USGS I-1750-85							
Total Dissolved Solids	**4450**	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353008 **Date Collected:** 05/22/2024 12:33 **Matrix:** Groundwater
Sample ID: Dup 1 **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: ASTM D516-16							
Sulfate	**7490**	mg/L	200	40		05/29/2024 10:58	
Method: EPA 6010D							
Boron	**0.54**	mg/L	0.5	5	05/23/2024 16:35	05/29/2024 10:12	
Calcium	**410**	mg/L	5	5	05/23/2024 16:35	05/30/2024 12:32	
Method: SM4500 H+ B-2011							
pH	**7.3**	units	0.1	1		05/23/2024 13:04	*
Method: SM4500-Cl-E 2011							
Chloride	**85.4**	mg/L	2.0	1		05/29/2024 15:56	
Method: SM4500-F-C-2011							
Fluoride	**0.86**	mg/L	0.1	1		05/23/2024 13:04	
Method: USGS I-1750-85							
Total Dissolved Solids	**11300**	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 49353009 **Date Collected:** 05/22/2024 10:55 **Matrix:** Groundwater
Sample ID: Field Blank (FB) **Date Received:** 05/22/2024 18:24 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.8 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: ASTM D516-16							
Sulfate	<5	mg/L	5	1		05/29/2024 11:11	
Method: EPA 6010D							
Boron	<0.1	mg/L	0.1	1	05/23/2024 16:35	05/29/2024 10:13	
Calcium	<1	mg/L	1	1	05/23/2024 16:35	05/30/2024 12:33	
Method: SM4500 H+ B-2011							
pH	**7.1**	units	0.1	1		05/23/2024 13:10	*
Method: SM4500-Cl-E 2011							
Chloride	<2.0	mg/L	2.0	1		05/29/2024 15:57	
Method: SM4500-F-C-2011							
Fluoride	<0.1	mg/L	0.1	1		05/23/2024 13:10	
Method: USGS I-1750-85							
Total Dissolved Solids	<10	mg/L	10	1		05/24/2024 09:20	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

QC Results Summary

WO #: 49353

Sulfate Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB			100	105.0		85	115		
LFB			100	101.0		85	115		
LFB			100	106.0		85	115		
LFB			100	104.0		85	115		
LFB			100	109.0		85	115		
LFB			100	108.0		85	115		
LFB			100	100.0		85	115		
MB		<5							
MB		<5							
MB		<5							
MB		<5							
MB		<5							
MB		<5							
MB		<5							
MS/MSD	49107006		100	107.8	106.0	85	115	1.9	20
MS/MSD	49141003		1000	93.8	86.4	85	115	2.9	20
MS/MSD	49354001		100	94.5	103.2	85	115	8.8	20
MS/MSD	49505001		500	106.5	109.4	85	115	2.1	20
MS/MSD	49505012		500	94.6	93.7	85	115	0.5	20
MS/MSD	49511001		500	81.0	86.7	85	115	3.5	20

Chloride Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB			30	93.4		90	110		
LFB			30	93.2		90	110		
LFB			30	93.0		90	110		
LFB			30	92.8		90	110		
LFB			30	92.3		90	110		
MB		<2.0							
MB		<2.0							

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Chloride — Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
MB		<2.0							
MB		<2.0							
MB		<2.0							
MS/MSD	48978001		30	94.8	95.2	80	120	0.3	20
MS/MSD	49353009		30	90.7	69.7	80	120	11	20

Boron — Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB-DE			0.4	107.0		85	115		
MB		<0.1							

Calcium — Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB-MI			100	110.0		85	115		
MB		<1							
DUP	49344001							1.3	20
DUP	49353007							2.2	20

Boron — Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
PDS/PDSD	48680001		4	79.9	79.7	75	125	0.2	20
PDS/PDSD	49353001		2	88.8	87.9	75	125	0.6	20
PDS/PDSD	49354001		4	94.0	93.7	75	125	0.2	20
PDS/PDSD	49483001		2	110.0	109.0	75	125	1.0	20
PDS/PDSD	49483010		2	108.0	109.0	75	125	0.4	20

Calcium — Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
PDS/PDSD	49353004		500	107.0	107.0	75	125	0.1	20
PDS/PDSD	49353007		500	99.6	101.0	75	125	0.4	20
PDS/PDSD	49596001		100	100.0	100.0	75	125	0.0	20
PDS/PDSD	49596004		100	101.0	101.0	75	125	0.5	20
PDS/PDSD	49788004		500	106.0	104.0	75	125	0.8	20

pH — Units: units

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
DUP	49353001							1.9	20
DUP	49368001							0.3	20

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

pH Units: units

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
CRM-PH			6	100.3		98.33	101.67		
CRM-PH			6	100.3		98.33	101.67		
CRM-PH			6	100.5		98.33	101.67		

Fluoride Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
CRM-F			3.06	106.0		88.99	111.11		
LFB-F			0.5	108.0		90	110		
LFB-F			0.5	106.0		90	110		
LFB-F			0.5	104.0		90	110		
MB-F		<0.1							
MB-F		<0.1							
MB-F		<0.1							
MS/MSD	49353004		0.5	104.0	102.0	80	120	1.9	20
MS/MSD	49483010		0.5	110.0	110.0	80	120	0.0	20

Total Dissolved Solids Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
CRM			736	107.0		90.35	110.1		
MB		<10							
DUP	49353001							0.9	20
DUP	49483010							0.6	20

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.MVTL.com

Member ACIL

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Minnesota Valley Testing Laboratories
2616 E. Broadway Ave
Bismarck, ND 58501
(701) 258-9720

Montana – Dakota Utilities
WO: 49353

Chain of Custody Record

Report To:	MDU	CC:	Project Name: MDU Heskett
Attn:	Brandon Schafer		Event: Spring 2024
Address:	400 N. 4th St Bismarck, ND 58501		Sampled By: Dakota Kottsick
Phone:	701-391-3812		
Email:	Brandon.Schafer@mdu.com		

	Sample Information				Sample Containers									Field Readings				
Lab Number	Sample ID	Date	Time	Sample Type	1 Liter Raw	500 mL HNO3	500 mL HNO3 (filtered)	250 mL H2SO4						Temp (°C)	Spec. Cond.	pH	Turbidity (NTU)	Analysis Required
001	MW13	22 May 24	1233	GW	X	X								12.21	10,935	7.03	0.0	Boron, Calcium, Chlooride, Flouride, Sulfate, TDS, pH
002	MW1-90	22 May 24	1506	GW	X	X								10.39	11,169	6.93	0.0	
003	MW2-90	22 May 24	1557	GW	X	X								14.67	8446	6.99	0.0	
004	MW3-90	22 May 24	1701	GW	X	X								11.18	5490	6.97	0.0	
005	MW-44R	22 May 24	1121	GW	X	X								11.73	9357	6.65	0.0	
006	MW-80R	22 May 24	1461	GW	X	X								9.12	6095	7.03	0.0	
007	MW-103	22 May 24	1025	GW	X	X								10.34	4860	6.86	0.0	
008	Dup 1	22 May 24	1233	GW	X	X								NA	NA	NA	NA	
009	Field Blank (FB)	22 May 24	1055	GW	X	X								NA	NA	NA	NA	

Comments:

	Relinquished By		Sample Condition		Received By	
	Name	Date/Time	Location	Temp (°C)	Name	Date/Time
1		22 May 24 1824	Log In Walk In #2	RGI 3.3 TM562 TM805	H Horst	23 May 24 0800
2						

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Jeremy Meyer

From: Schafer, Brandon <Brandon.Schafer@mdu.com>
Sent: Tuesday, May 7, 2024 2:37 PM
To: Paula Gores; Jeremy Meyer
Cc: McDonald, Andy
Subject: RE: Heskett GW Monitoring DRAFT Quote

CAUTION: This email originated from outside your organization. Exercise caution when opening attachments or clicking links, especially from unknown senders.

Hi Paula and Jeremy,

Paula please call if you have any questions for the revised quote on this sampling job that I describe below! Paula, I don't believe Todd would've had a "saved list" that was this paired down, but maybe? Please include Jeremy's costs as well. Details are below:

We have our plan for Heskett as far as Groundwater sampling. We will sample wells 13, 103, 44R, 80R, 1-90, 2-90, 3-90. Wells 103 and 44R would be the additions in comparison to the last handful of years.

Analysis for all wells will be the State Appendix I aka Federal Appendix III for the CCR rule (total, not dissolved) as groundwater samples cannot be filtered prior to analysis to comply with the rule:
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
TDS
*field pH, EC, turbidity, temperature too please. Also, in case it should be said, please follow the same Duplicate/Blank procedure that you have in the past.
Other Notes: **This will occur twice this year a spring and late summer/fall**. Each event has the possibility to require a follow-up to confirm sample results at certain wells.

Jeremy, this is a map of the wells and I can send a PDF if you would like.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

MVTL
2616 E. Broadway Ave, Bismarck, ND
Phone: (701) 258-9720

Field Datasheet

Surface water Assessment

Company: MDU Heskett
Event: Spring 2024
Sampling Personal: Dakota Kottsick

Weather Conditions: Temp: 64 °F Wind: N @ 0-5 Precip: Sunny / Partly Cloudy / Cloudy

Well ID	Date	Time	Casing Diameter	Water Level (ft)		Comments
MW70	12 May 24	1149	2"	18.90		
MW33		1625	2"	39.27		
MW101		1151	2"	34.94		
MW102		1146	2"	14.39		
MW104		~~1449~~	2"	12.51		
MW105		1324	2"	12.06		

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Spring 2024
Sample ID:	13
Sampling Personal:	Dakota Kottsick

Weather Conditions: Temp: 103 °F Wind: N @ 0-5 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?		
Casing Diameter:	2"	
Water Level Before Purge:	28.76	ft
Total Depth of Well:	—	ft
Well Volume:	~~37.19~~ 5.2	liters
Depth to Top of Pump:	37.19	ft
Water Level After Sample:	29.05	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:	37	Sec.
PSI:	25	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / NO
Duplicate Sample ID:
Dup-1

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL 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
22 May 24	1203	Start of Well Purge									
	1218	11.84	10.937	7.05	5.19	266.7	0.0	28.85	100.0	1500.0	Clear
	1223	12.01	10.914	7.07	6.15	267.2	0.0	28.90	100.0	500.0	Clear
	1228	12.19	10.937	7.03	4.85	268.0	0.0	28.90	100.0	500.0	Clear
	1233	12.21	10.935	7.03	5.04	268.8	0.0	28.93	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 3000.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
22 May 24	1233	12.21	10.935	7.03			0.0				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Spring 2024
Sample ID:	1-90
Sampling Personal:	DaKota Kuffsick

Weather Conditions: Temp: 64 °F Wind: N @ 0-5 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	(YES)	NO
Well Labeled?	(YES)	NO
Repairs Necessary?	—	
Casing Diameter:	2"	
Water Level Before Purge:	10.54	ft
Total Depth of Well:	—	ft
Well Volume:	1.4	liters
Depth to Top of Pump:	17.77	ft
Water Level After Sample:	10.84	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:		
Purge:	7	Sec.
Recover:	58	Sec.
PSI:	25	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		clear, slightly turbid, turbid
22 May 24	1431	Start of Well Purge									
	1451	10.74	10.826	6.97	3.16	261.8	0.0	10.68	100.0	2000.0	Clear
	1456	10.45	10.983	6.96	2.99	261.6	0.0	10.71	100.0	500.0	Clear
	1501	10.28	11.045	6.95	2.88	261.0	0.0	10.74	100.0	500.0	Clear
	1506	10.39	11.109	6.93	2.81	257.7	0.0	10.80	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 3500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
22 May 24	1506	10.39	11.109	6.93			0.0				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

MVTL
2616 E. Broadway Ave, Bismarck, ND
Phone: (701) 258-9720

Field Datasheet
Groundwater Assessment

Company:	MDU Heskett
Event:	Spring 2024
Sample ID:	2-90
Sampling Personal:	Dakota Kottsick

Weather Conditions: Temp: 64 °F Wind: N @ 0-5 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	(YES)	NO
Well Labeled?	(YES)	NO
Repairs Necessary?	—	
Casing Diameter:	2"	
Water Level Before Purge:	20.27	ft
Total Depth of Well:	—	ft
Well Volume:	1.3	liters
Depth to Top of Pump:	22.39	ft
Water Level After Sample:	16.65	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:		
Purge:	7	Sec.
Recover:	58	Sec.
PSI:	25	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		Clarity, Color, Odor, Ect. clear, slightly turbid, turbid
22May24	1532	Start of Well Purge									
	1542	14.53	8435	7.02	4.92	263.5	0.0	20.33	100.0	1000.0	Clear
	1547	15.17	8444	7.05	4.93	263.8	0.0	20.28	100.0	500.0	Clear
	1552	14.99	8413	6.97	4.95	264.1	0.0	20.30	100.0	500.0	Clear
	1557	14.67	8446	6.99	4.90	263.8	0.0	20.26	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
22May24	1557	14.67	8446	6.99			0.0				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Spring 2024
Sample ID:	3-90
Sampling Personal:	Dakota Kottsick

Weather Conditions: Temp: 64 °F Wind: N @ 0-5 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	(YES)	NO
Well Labeled?	(YES)	NO
Repairs Necessary?	—	
Casing Diameter:	2"	
Water Level Before Purge:	17.46	ft
Total Depth of Well:	—	ft
Well Volume:	1.7	liters
Depth to Top of Pump:	70.71	ft
Water Level After Sample:	17.54	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:	37	Sec.
PSI:	25	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		clear, slightly turbid, turbid
22 May 24	1631	Start of Well Purge									
	1646	11.50	5487	6.98	2.41	239.0	0.0	17.54	100.0	1500.0	Clear
	1631	11.21	5497	6.98	2.40	229.0	0.0	17.59	100.0	500.0	Clear
	1656	11.05	5493	6.98	2.37	226.1	0.0	17.58	100.0	500.0	Clear
	1701	11.18	5496	6.97	2.35	220.1	0.0	17.65	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 3000.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
22 May 24	1701	11.18	5490	6.97			0.0				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

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

Field Datasheet

Groundwater Assessment

Company:	MDU Heskett
Event:	Spring 2024
Sample ID:	
Sampling Personal:	

Weather Conditions: Temp: °F Wind: @ Precip: **Sunny / Partly Cloudy / Cloudy**

WELL INFORMATION

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

SAMPLING INFORMATION

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

Control Settings:	
Purge:	Sec.
Recover:	Sec.
PSI:	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / NO
Duplicate Sample ID:

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		clear, slightly turbid, turbid
		Start of Well Purge									

Well Stabilized? YES NO Total Volume Purged: _____ mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.

Comments:	

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

MVTL
2616 E. Broadway Ave, Bismarck, ND
Phone: (701) 258-9720

Field Datasheet

Groundwater Assessment

Company:	MDU Heskett
Event:	Spring 2024
Sample ID:	44R
Sampling Personal:	DaKota Kottsick

Weather Conditions: Temp: 61 °F Wind: N @ 0-5 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?	—	
Casing Diameter:	2"	
Water Level Before Purge:	24.70	ft
Total Depth of Well:	—	ft
Well Volume:	6.6	liters
Depth to Top of Pump:	55.38	ft
Water Level After Sample:	24.74	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:		
Purge:	2	Sec.
Recover:	58	Sec.
PSI:		

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / NO
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		clear, slightly turbid, turbid
22 May 24	1056	Start of Well Purge			1.01						
	1101	12.33	9385	6.65	774+	274.1	0.0	24.72	100.0	1000.0	Clear
	1111	12.06	9406	6.65	0.77	271.9	0.0	24.75	100.0	500.0	Clear
	1116	12.00	9379	6.65	0.76	269.1	0.0	24.86	100.0	500.0	Clear
	1121	11.73	9357	6.65	0.72	266.7	0.0	24.90	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
22 May 24	1121	11.73	9357	6.65			0.0				Clear

Comments: Field Blank collected @ 1055

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Spring 2024
Sample ID:	80R
Sampling Personal:	Dakota Koltsick

Weather Conditions: Temp: 64 °F Wind: N @ 0-5 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?		

Casing Diameter:	2"	
Water Level Before Purge:	13.27	ft
Total Depth of Well:	—	ft
Well Volume:	~~19.45~~ 3.8	liters
Depth to Top of Pump:	~~19.45~~	ft
Water Level After Sample:	13.71	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:	57	Sec.
PSI:	25	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / NO
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		Clarity, Color, Odor, Ect. clear, slightly turbid, turbid
22 May 24	1331	Start of Well Purge									
	1346	9.40	6118	7.04	0.40	259.2	0.0	13.52	100.0	1500.0	Clear
	1351	9.21	6091	7.04	0.39	258.6	0.0	13.56	100.0	1000.0	Clear
	1356	9.14	6091	7.04	0.38	257.9	0.0	13.63	100.0	500.0	Clear
	1401	9.12	6095	7.03	0.36	257.1	0.0	13.68	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 3000.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
22 May 24	1401	9.12	6095	7.03			0.0				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Spring 2024
Sample ID:	103
Sampling Personal:	Dakota Kottsick

Weather Conditions: Temp: 55 °F Wind: N @ 0-5 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	(YES)	NO
Well Labeled?	(YES)	NO
Repairs Necessary?	—	
Casing Diameter:	2"	
Water Level Before Purge:	30.13	ft
Total Depth of Well:	~~40.85~~	ft
Well Volume:	6.6	liters
Depth to Top of Pump:	40.85	ft
Water Level After Sample:	30.32	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:	57	Sec.
PSI:		

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL 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
22 May 24	0950	Start of Well Purge									
	1010	10.25	4897	6.85	4.07	792.2	19.93	30.16	100.0	2000.0	Clear
	1015	10.56	4890	6.85	4.12	790.1	18.09	30.17	100.0	500.0	Clear
	1020	10.28	4877	6.86	4.11	790.0	5.02	30.17	100.0	500.0	Clear
	1025	10.34	4860	6.86	4.16	789.6	0.00	30.22	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 3500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
22 May 24	1025	10.34	4860	6.86			0.00				Clear

Comments:

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.MVTL.com

Member ACIL

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck
Workorder: MDU Heskett Fall 2024 (61346) **PO:** 200301 OP

Brandon Schafer
Montana-Dakota Utilities Co.
400 North Fourth Street
Bismarck, ND 58501

Certificate of Analysis

Approval

All data reported has been reviewed and approved by:

Claudette Carroll, Lab Manager Bismarck, ND

Analyses performed under Minnesota Department of Health Accreditation conforms to the current TNI standards.

NEW ULM LAB CERTIFICATIONS:
MN LAB # 027-015-125 ND WW/DW # R-040

BISMARCK LAB CERTIFICATIONS:
MN LAB # 038-999-267 ND W/DW # ND-016

Workorder Comments

All analytes with dilution factors greater than 1 (displayed in DF column) required dilution due to matrix or high concentration of target analyte unless otherwise noted and reporting limits (RDL column) have been adjusted accordingly.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346001 **Date Collected:** 08/28/2024 09:40 **Matrix:** Groundwater
Sample ID: MW13 **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**10831**	umhos/cm	1	1		08/28/2024 09:40	
Method: 150.2							
pH - Field	**7.52**	units	0.01	1		08/28/2024 09:40	
Method: 170.1							
Temperature - Field C	**11**	degrees C		1		08/28/2024 09:40	
Method: ASTM D516-16							
Sulfate	**7670**	mg/L	250	50		09/04/2024 10:54	
Method: EPA 6010D							
Boron	**0.62**	mg/L	0.5	5	08/29/2024 16:00	09/05/2024 10:44	
Calcium	**371**	mg/L	1	1	08/29/2024 16:00	09/05/2024 09:28	
Method: SM4500 H+ B-2011							
pH	**7.3**	units	0.1	1		08/29/2024 17:10	*
Method: SM4500-Cl-E 2011							
Chloride	**89.2**	mg/L	2.0	1		09/05/2024 12:03	
Method: SM4500-F-C-2011							
Fluoride	**0.87**	mg/L	0.1	1		08/29/2024 17:10	
Method: USGS I-1750-85							
Total Dissolved Solids	**10800**	mg/L	10	1		09/04/2024 11:45	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346002 **Date Collected:** 08/28/2024 14:33 **Matrix:** Groundwater
Sample ID: MW1-90 **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**12062**	umhos/cm	1	1		08/28/2024 14:33	
Method: 150.2							
pH - Field	**7.3**	units	0.01	1		08/28/2024 14:33	
Method: 170.1							
Temperature - Field C	**11.66**	degrees C		1		08/28/2024 14:33	
Method: ASTM D516-16							
Sulfate	**9000**	mg/L	250	50		09/04/2024 10:55	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	08/29/2024 16:00	09/05/2024 10:46	
Calcium	**419**	mg/L	5	5	08/29/2024 16:00	09/05/2024 09:47	
Method: SM4500 H+ B-2011							
pH	**7.1**	units	0.1	1		08/29/2024 17:15	*
Method: SM4500-Cl-E 2011							
Chloride	**90.6**	mg/L	2.0	1		09/05/2024 12:04	
Method: SM4500-F-C-2011							
Fluoride	**1.15**	mg/L	0.1	1		08/29/2024 17:15	*
Method: USGS I-1750-85							
Total Dissolved Solids	**13200**	mg/L	10	1		09/04/2024 11:45	

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Analysis Results Comments

Fluoride

Matrix spike and/or matrix spike duplicate recovery was low; the associated laboratory control sample recovery was acceptable.

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346003 **Date Collected:** 08/28/2024 13:45 **Matrix:** Groundwater
Sample ID: MW2-90 **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**9186**	umhos/cm	1	1		08/28/2024 13:45	
Method: 150.2							
pH - Field	**7.52**	units	0.01	1		08/28/2024 13:45	
Method: 170.1							
Temperature - Field C	**13.63**	degrees C		1		08/28/2024 13:45	
Method: ASTM D516-16							
Sulfate	**6980**	mg/L	250	50		09/04/2024 10:56	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	08/29/2024 16:00	09/05/2024 10:47	
Calcium	**518**	mg/L	5	5	08/29/2024 16:00	09/05/2024 09:50	
Method: SM4500 H+ B-2011							
pH	**7.3**	units	0.1	1		08/29/2024 17:21	*
Method: SM4500-Cl-E 2011							
Chloride	**74.4**	mg/L	2.0	1		09/05/2024 12:06	
Method: SM4500-F-C-2011							
Fluoride	**1.05**	mg/L	0.1	1		08/29/2024 17:21	
Method: USGS I-1750-85							
Total Dissolved Solids	**9920**	mg/L	10	1		09/04/2024 11:45	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346004 **Date Collected:** 08/28/2024 12:57 **Matrix:** Groundwater
Sample ID: MW3-90 **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**5949**	umhos/cm	1	1		08/28/2024 12:57	
Method: 150.2							
pH - Field	**7.58**	units	0.01	1		08/28/2024 12:57	
Method: 170.1							
Temperature - Field C	**11.98**	degrees C		1		08/28/2024 12:57	
Method: ASTM D516-16							
Sulfate	**3550**	mg/L	250	50		09/04/2024 10:57	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	08/29/2024 16:00	09/05/2024 10:47	
Calcium	**604**	mg/L	5	5	08/29/2024 16:00	09/05/2024 09:52	
Method: SM4500 H+ B-2011							
pH	**7.2**	units	0.1	1		08/29/2024 17:27	*
Method: SM4500-Cl-E 2011							
Chloride	**42.3**	mg/L	2.0	1		09/05/2024 12:07	
Method: SM4500-F-C-2011							
Fluoride	**0.12**	mg/L	0.1	1		08/29/2024 17:27	
Method: USGS I-1750-85							
Total Dissolved Solids	**5630**	mg/L	10	1		09/04/2024 11:45	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346005 **Date Collected:** 08/28/2024 10:28 **Matrix:** Groundwater
Sample ID: MW-44R **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**9791**	umhos/cm	1	1		08/28/2024 10:28	
Method: 150.2							
pH - Field	**7.27**	units	0.01	1		08/28/2024 10:28	
Method: 170.1							
Temperature - Field C	**11.61**	degrees C		1		08/28/2024 10:28	
Method: ASTM D516-16							
Sulfate	**7390**	mg/L	250	50		09/04/2024 10:58	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	08/29/2024 16:00	09/05/2024 10:48	
Calcium	**439**	mg/L	5	5	08/29/2024 16:00	09/05/2024 09:54	
Method: SM4500 H+ B-2011							
pH	**6.9**	units	0.1	1		08/29/2024 17:33	*
Method: SM4500-Cl-E 2011							
Chloride	**204**	mg/L	2.0	1		09/05/2024 12:14	
Method: SM4500-F-C-2011							
Fluoride	**0.66**	mg/L	0.1	1		08/29/2024 17:33	
Method: USGS I-1750-85							
Total Dissolved Solids	**10800**	mg/L	10	1		09/04/2024 11:45	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346006 **Date Collected:** 08/28/2024 12:16 **Matrix:** Groundwater
Sample ID: MW-80R **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**6047**	umhos/cm	1	1		08/28/2024 12:16	
Method: 150.2							
pH - Field	**7.84**	units	0.01	1		08/28/2024 12:16	
Method: 170.1							
Temperature - Field C	**10.56**	degrees C		1		08/28/2024 12:16	
Method: ASTM D516-16							
Sulfate	**3680**	mg/L	250	50		09/04/2024 11:00	
Method: EPA 6010D							
Boron	<0.5	mg/L	0.5	5	08/29/2024 16:00	09/05/2024 10:50	
Calcium	**450**	mg/L	5	5	08/29/2024 16:00	09/05/2024 09:56	
Method: SM4500 H+ B-2011							
pH	**7.3**	units	0.1	1		08/29/2024 17:39	*
Method: SM4500-Cl-E 2011							
Chloride	**154**	mg/L	2.0	1		09/05/2024 12:15	
Method: SM4500-F-C-2011							
Fluoride	**0.23**	mg/L	0.1	1		08/29/2024 17:39	
Method: USGS I-1750-85							
Total Dissolved Solids	**5680**	mg/L	10	1		09/04/2024 11:45	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346007 **Date Collected:** 08/28/2024 11:20 **Matrix:** Groundwater
Sample ID: MW-103 **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**4944**	umhos/cm	1	1		08/28/2024 11:20	
Method: 150.2							
pH - Field	**7.66**	units	0.01	1		08/28/2024 11:20	
Method: 170.1							
Temperature - Field C	**11.32**	degrees C		1		08/28/2024 11:20	
Method: ASTM D516-16							
Sulfate	**2580**	mg/L	250	50		09/04/2024 11:01	
Method: EPA 6010D							
Boron	**0.16**	mg/L	0.1	1	08/29/2024 16:00	09/05/2024 10:55	
Calcium	**595**	mg/L	1	1	08/29/2024 16:00	09/05/2024 10:03	
Method: SM4500 H+ B-2011							
pH	**7.2**	units	0.1	1		08/29/2024 17:45	*
Method: SM4500-Cl-E 2011							
Chloride	**138**	mg/L	2.0	1		09/05/2024 12:16	
Method: SM4500-F-C-2011							
Fluoride	**0.11**	mg/L	0.1	1		08/29/2024 17:45	
Method: USGS I-1750-85							
Total Dissolved Solids	**4410**	mg/L	10	1		09/04/2024 11:45	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346008 **Date Collected:** 08/28/2024 09:40 **Matrix:** Groundwater
Sample ID: Dup 1 **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: ASTM D516-16							
Sulfate	**7550**	mg/L	250	50		09/04/2024 11:06	
Method: EPA 6010D							
Boron	**0.63**	mg/L	0.5	5	08/29/2024 16:00	09/05/2024 10:56	
Calcium	**420**	mg/L	5	5	08/29/2024 16:00	09/05/2024 10:07	
Method: SM4500 H+ B-2011							
pH	**7.3**	units	0.1	1		08/29/2024 17:51	*
Method: SM4500-Cl-E 2011							
Chloride	**89.1**	mg/L	2.0	1		09/05/2024 12:17	
Method: SM4500-F-C-2011							
Fluoride	**0.89**	mg/L	0.1	1		08/29/2024 17:51	
Method: USGS I-1750-85							
Total Dissolved Solids	**10700**	mg/L	10	1		09/04/2024 11:45	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 61346009 **Date Collected:** 08/28/2024 11:45 **Matrix:** Groundwater
Sample ID: Field Blank (FB) **Date Received:** 08/29/2024 08:21 **Collector:** MVTL Field Service

Temp @ Receipt (C): 3.7 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: ASTM D516-16							
Sulfate	<5	mg/L	5	1		09/04/2024 11:12	
Method: EPA 6010D							
Boron	<0.1	mg/L	0.1	1	08/29/2024 16:00	09/05/2024 10:57	
Calcium	<1	mg/L	1	1	08/29/2024 16:00	09/05/2024 10:13	
Method: SM4500 H+ B-2011							
pH	**6.3**	units	0.1	1		08/29/2024 17:56	*
Method: SM4500-Cl-E 2011							
Chloride	<2.0	mg/L	2.0	1		09/05/2024 12:19	
Method: SM4500-F-C-2011							
Fluoride	<0.1	mg/L	0.1	1		08/29/2024 17:56	
Method: USGS I-1750-85							
Total Dissolved Solids	<10	mg/L	10	1		09/04/2024 11:45	

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

QC Results Summary

WO #: 61346

Sulfate Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB			100	102.0		85	115		
LFB			100	103.0		85	115		
LFB			100	103.0		85	115		
LFB			100	108.0		85	115		
LFB			100	108.0		85	115		
MB		<5							
MB		<5							
MB		<5							
MB		<5							
MB		<5							
MS/MSD	61345003		500	116.3	116.5	85	115	0.0	20
MS/MSD	61345005		500	96.2	94.7	85	115	0.8	20
MS/MSD	61684003		500	112.2	112.8	85	115	0.4	20
MS/MSD	61684005		500	102.0	103.7	85	115	1.0	20

Chloride Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB			30	100.0		90	110		
LFB			30	99.6		90	110		
LFB			30	100.0		90	110		
LFB			30	99.1		90	110		
LFB			30	99.8		90	110		
LFB			30	98.3		90	110		
LFB			30	98.5		90	110		
LFB			30	99.3		90	110		
LFB			30	99.9		90	110		
MB		<2.0							
MB		<2.0							
MB		<2.0							
MB		<2.0							

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Chloride — Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
MB		<2.0							
MB		<2.0							
MB		<2.0							
MB		<2.0							
MB		<2.0							
MS/MSD	61324001		90	106.9	104.7	80	120	2.2	20
MS/MSD	61946016		90	120.6	122.9	80	120	0.7	20

Boron — Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB-DF			0.4	111.0		85	115		
LFB-DF			0.4	112.0		85	115		
MB		<0.1							
MB		<0.1							
PDS/PDSD	61348001		1	88.8	93.1	75	125	4.5	20
PDS/PDSD	61346006		1	111.0	111.0	75	125	0.3	20
PDS/PDSD	61679001		4	94.9	101.0	75	125	3.3	20

Calcium — Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB-MI			100	107.0		85	115		
LFB-MI			100	108.0		85	115		
MB		<1							
MB		<1							
DUP	61339001							1.9	20
DUP	61345001							1.0	20
DUP	61346007							1.5	20
PDS/PDSD	61346003		800	86.5	87.3	75	125	0.8	20
PDS/PDSD	61679001		100	108.0	108.0	75	125	0.1	20

pH — Units: units

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
CRM-PH			6	100.0		98.33	101.67		
CRM-PH			6	99.0		98.33	101.67		

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

pH Units: units

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
CRM-PH			6	99.2		98.33	101.67		
DUP	61345001							2.2	20
DUP	61348001							0.1	20

Fluoride Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
CRM-F			3.06	106.0		88.99	111.11		
LFB-F			0.5	104.0		90	110		
LFB-F			0.5	106.0		90	110		
LFB-F			0.5	104.0		90	110		
MB-F		<0.1							
MB-F		<0.1							
MB-F		<0.1							
MS/MSD	61345001		0.5	104.0	104.0	80	120	0.0	20
MS/MSD	61348002		0.5	76.0	80.0	80	120	1.3	20

Total Dissolved Solids Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
CRM			736	101.9		90.35	110.33		
MB		<10							
DUP	61332001							1.5	20
DUP	61346009							0.0	20

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.MVTL.com

Member ACIL

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Minnesota Valley Testing Laboratories
2616 E. Broadway Ave
Bismarck, ND 58501
(701) 258-9720

Montana – Dakota Utilities
WO: 61346

Chain of Custody Record

Report To:	MDU	CC:	Project Name: MDU Heskett
Attn:	Brandon Schafer		Event: Fall 2024
Address:	400 N. 4th St Bismarck, ND 58501		Sampled By:
Phone:	701-391-3812		
Email:	Brandon.Schafer@mdu.com		

Lab Number	Sample ID	Date	Time	Sample Type	1 Liter Raw	500 mL HNO3	500 mL HNO3 (filtered)	250 mL H2SO4	Temp (°C)	Spec. Cond.	pH	Turbidity (NTU)	Analysis Required
001	MW13	28 Aug 24	0940	GW	X	X			11.00	10,831	7.52	2.58	Boron, Calcium, Chloride, Fluoride, Sulfate, TDS, pH (App. III, see attachement)
002	MW1-90	28 Aug 24	1433	GW	X	X			11.66	12,062	7.30	0.64	
003	MW2-90	28 Aug 24	1345	GW	X	X			13.63	9186	7.52	0.31	
004	MW3-90	28 Aug 24	1257	GW	X	X			11.98	5948	7.58	1.56	
005	MW-44R	28 Aug 24	1028	GW	X	X			11.61	9791	7.27	0.52	
006	MW-80R	28 Aug 24	1216	GW	X	X			10.56	6047	7.84	0.32	
007	MW-103	28 Aug 24	1120	GW	X	X			11.32	4944	7.66	2.66	
008	Dup 1	28 Aug 24	0940	GW	X	X			NA	NA	NA	NA	
009	Field Blank (FB)	28 Aug 24	1145	GW	X	X			NA	NA	NA	NA	

Comments:

Relinquished By		Sample Condition		Received By	
Name	Date/Time	Location	Temp (°C)	Name	Date/Time
1	29 Aug 24 0821	~~Log-In~~ Walk In #2	3.7 °C/TM 805 ROI Y/N	C. Arnold	29 Aug 24 0821
2					

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Monitoring Parameters, Frequency, and Network

Heskett Station
Montana-Dakota Utilities
Mandan, North Dakota

Spring Monitoring Points	Fall Monitoring Points
Upgradient Wells (sample)	**Upgradient Wells (sample)**
MWs: 13, 103, 44R	MWs: 13, 103, 44R
Downgradient Wells (sample)	**Downgradient Wells (sample)**
MWs: 80R, 1-90, 2-90, 3-90	MWs: 80R, 1-90, 2-90, 3-90
Water-Level Only	**Water-Level Only**
MWs: 102, 70, 101, 33, 104, 105	MWs: 102, 70, 101, 33, 104, 105

Water Level Monitoring: All Wells, semi-annually. Please note where the distance was taken.
Ex) From top of riser to water surface 28.2 feet, riser is 2.5' above ground surface.

Field Parameters (Always)

Appearance	Water Elevation	Well Depth
Dissolved Oxygen	Turbidity	Temperature
pH	Specific Conductance	Eh

Routine Parameters (total, not dissolved)

Fed. App. III aka State App. I (Always, unless noted)

Boron	Chloride	pH	Total Dissolved Solids (TDS)
Calcium	Fluoride	Sulfate	

Fed. App. IV aka State App. II (Never, unless noted)

Antimony	Beryllium	Cobalt	Lithium	Selenium
Arsenic	Cadmium	Fluoride**	Mercury	Thallium
Barium	Chromium	Lead	Molybdenum	

Radium 226 and 228 Combined

*App. III/I and IV/II should always be on separate CoC's and reports when sampling both
**Fluoride is listed in both Appendices and should be reported on both, if necessary

Parameters for Statistics and Comparison (Never, unless noted)

Alkalinity	Magnesium	Potassium
Bicarbonate	Manganese	SAR
Calcium	Nitrate-Nitrite, as N	Silver
Hardness (as CACO3)	Phosphate	Sodium
Iron		

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

MVTL
2616 E. Broadway Ave, Bismarck, ND
Phone: (701) 258-9720

Field Datasheet

Groundwater Assessment

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	MW13
Sampling Personal:	Jerry

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

WELL INFORMATION

Well Locked?	YES	(NO)
Well Labeled?	(YES)	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	29.45	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	30.05	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:	57	Sec.
PSI:	—	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
(YES) / NO
Duplicate Sample ID:
Dup 1

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		Clarity, Color, Odor, Ect. clear, slightly turbid, turbid
28 Aug 24	0910	Start of Well Purge									
	0920	11.47	10,900	7.79	2.65	164.0	2.04	29.95	100.0	1000.0	Clear
	0925	11.12	10,875	7.67	2.92	170.1	1.41	29.98	100.0	500.0	Clear
	0930	11.07	10,866	7.61	2.91	177.8	0.66	30.00	100.0	500.0	Clear
	0935	11.18	10,844	7.54	2.98	179.4	2.27	30.02	100.0	500.0	Clear
	0940	11.00	10,831	7.52	2.99	182.4	2.58	30.05	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 3000.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
28 Aug 24	0940	11.00	10,831	7.52			2.58				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

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

Field Datasheet

Groundwater Assessment

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	1-90
Sampling Personal:	

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

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	11.12	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	11.33	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:	57	Sec.
PSI:	—	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / NO
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		clear, slightly turbid, turbid
28 Aug 24	1403	Start of Well Purge									
	1413	11.88	12,019	7.53	0.79	193.0	1.57	11.18	100.0	1000.0	Clear
	1418	11.90	12,003	7.44	0.68	189.8	0.69	11.25	100.0	500.0	Clear
	1423	11.92	12,052	7.37	0.82	189.0	1.21	11.28	100.0	500.0	Clear
	1428	11.78	12,109	7.33	0.79	187.3	0.99	11.29	100.0	500.0	Clear
	1433	11.66	12,062	7.30	0.72	189.2	0.64	11.32	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 3000.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
28 Aug 24	1433	11.66	12,062	7.30			0.64				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	2-90
Sampling Personal:	JH

Weather Conditions: Temp: 70 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	20.38	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	20.85	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:		
Purge:	2	Sec.
Recover:	58	Sec.
PSI:	—	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / NO
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		clear, slightly turbid, turbid
28 Aug 24	1320	Start of Well Purge									
	1325	15.47	8931	7.55	4.29	158.8	0.52	20.51	100.0	500.0	Clear
	1330	13.89	9160	7.58	3.96	192.0	0.21	20.65	100.0	500.0	Clear
	1335	13.95	9166	7.55	3.94	199.3	1.15	20.78	100.0	500.0	Clear
	1340	13.57	9173	7.55	3.65	204.3	0.23	20.83	100.0	500.0	Clear
	1345	13.63	9186	7.52	3.66	208.1	0.31	20.85	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 2500 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
28 Aug 24	1345	13.63	9186	7.52			0.31				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	3-90
Sampling Personal:	JH

Weather Conditions: Temp: 70 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	(NO)
Well Labeled?	(YES)	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	18.42	ft
Depth to Top of Pump:	20.20	ft
Well Volume:	—	liters
Water Level After Sample:	18.58	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:		
Purge:	2	Sec.
Recover:	58	Sec.
PSI:		

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		clear, slightly turbid, turbid
28 Aug 24	1232	Start of Well Purge									
	1237	12.65	5881	7.76	1.14	8.4	14.37	18.55	100.0	500.0	Clear
	1242	12.26	5937	7.76	1.47	-14.8	3.37	18.56	100.0	500.0	Clear
	1247	11.99	5934	7.67	1.42	-20.1	2.62	18.57	100.0	500.0	Clear
	1252	12.23	5925	7.62	1.40	-16.3	3.49	18.58	100.0	500.0	Clear
	1257	11.98	5949	7.58	1.49	-13.5	1.56	18.58	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
28 Aug 24	1257	11.98	5949	7.58			1.56				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	MW 44R
Sampling Personal:	JH

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

WELL INFORMATION

Well Locked?	YES (NO)
Well Labeled?	(YES) NO
Repairs Necessary?	
Casing Diameter:	2"
Measurements are from top of well riser	
Water Level Before Purge:	26.15 ft
Depth to Top of Pump:	— ft
Well Volume:	— liters
Water Level After Sample:	26.20 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:	57 Sec.
PSI:	—

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		Clarity, Color, Odor, Ect.
											clear, slightly turbid, turbid
28 Aug 24	1003	Start of Well Purge									
	1018	11.60	9766	7.32	0.30	180.0	0.59	26.16	100.0	1000.0	Clear
	1018	11.73	9801	7.28	0.16	168.8	0.54	26.17	100.0	500.0	Clear
	1023	11.70	9788	7.28	0.10	161.7	0.59	26.19	100.0	500.0	Clear
	1028	11.61	9791	7.27	0.06	165.0	0.52	26.20	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
28 Aug 24	1028	11.61	9791	7.27			0.52				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	MW80R
Sampling Personal:	JM

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

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	13.50	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	13.96	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:	57	Sec.
PSI:	—	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / NO
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		clear, slightly turbid, turbid
28 Aug 24	1141	Start of Well Purge									
	1151	10.78	6027	7.97	0.10	158.3	0.39	13.59	100.0	1000.0	Clear
	1156	10.90	6034	7.91	0.00	146.1	0.23	13.68	100.0	500.0	Clear
	1201	10.59	6043	7.90	0.00	134.8	0.42	13.73	100.0	500.0	Clear
	1206	10.63	6040	7.88	0.00	126.0	0.55	13.80	100.0	500.0	Clear
	1211	10.70	6057	7.85	0.00	120.4	0.29	13.88	100.0	500.0	Clear
	1216	10.56	6047	7.84	0.00	117.8	0.32	13.95	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 3500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
28 Aug 24	1216	10.56	6047	7.84			0.32				Clear

Comments: Collected field Blank @ 1145

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.MVTL.com

Member ACIL

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

MVTL
2616 E. Broadway Ave, Bismarck, ND
Phone: (701) 258-9720

Field Datasheet

Groundwater Assessment

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	MW103
Sampling Personal:	JM

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

WELL INFORMATION

Well Locked?	YES	(NO)
Well Labeled?	(YES)	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	29.19	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	30.50	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:	57	Sec.
PSI:	—	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		Clarity, Color, Odor, Ect. clear, slightly turbid, turbid
28 Aug 24	1055	Start of Well Purge									
	1105	11.68	5064	7.77	4.36	232.1	1.06	29.92	100.0	1000.0	Clear
	1110	11.58	5052	7.72	4.38	230.6	1.11	30.15	100.0	500.0	Clear
	1115	11.25	5033	7.68	4.29	234.2	2.14	30.36	100.0	500.0	Clear
	1120	11.32	4944	7.66	4.27	239.3	2.66	30.46	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
28 Aug 24	1120	11.32	4944	7.66			2.66				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

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

Field Datasheet

Surface water Assessment

Company: MDU Heskett
Event: Fall 2024
Sampling Personal:

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

Well ID	Date	Time	Casing Diameter	Water Level (ft)		Comments
MW70	28 Aug 24	1045	2"	19.43		
MW33		1228	2"	39.94		
MW101		1047	2"	35.05		
MW102		1043	2"	15.55		
MW104		1441	2"	13.08		
MW105		1225	2"	12.40		

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck
Workorder: MDU Heskett (72300) **PO:** 200301

Brandon Schafer
Montana-Dakota Utilities Co.
400 North Fourth Street
Bismarck, ND 58501

Certificate of Analysis

Approval

All data reported has been reviewed and approved by:

Claudette Carroll, Lab Manager Bismarck, ND

Analyses performed under Minnesota Department of Health Accreditation conforms to the current TNI standards.

NEW ULM LAB CERTIFICATIONS:
MN LAB # 027-015-125 ND WW/DW # R-040

BISMARCK LAB CERTIFICATIONS:
MN LAB # 038-999-267 ND W/DW # ND-016

Workorder Comments

All analytes with dilution factors greater than 1 (displayed in DF column) required dilution due to matrix or high concentration of target analyte unless otherwise noted and reporting limits (RDL column) have been adjusted accordingly.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 72300001 **Date Collected:** 11/26/2024 16:55 **Matrix:** Groundwater
Sample ID: MW13 **Date Received:** 11/26/2024 17:30 **Collector:** MVTL Field Service

Temp @ Receipt (C): 0.9 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**11505**	umhos/cm	1	1		11/26/2024 16:55	
Method: 150.2							
pH - Field	**6.93**	units	0.01	1		11/26/2024 16:55	
Method: 170.1							
Temperature - Field C	**6.94**	degrees C		1		11/26/2024 16:55	
Method: SM4500 H+ B-2011							
pH	**7.4**	units	0.1	1		11/27/2024 18:55	*

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 72300002 **Date Collected:** 11/26/2024 14:32 **Matrix:** Groundwater
Sample ID: MW1-90 **Date Received:** 11/26/2024 17:30 **Collector:** MVTL Field Service

Temp @ Receipt (C): 0.9 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**12894**	umhos/cm	1	1		11/26/2024 14:32	
Method: 150.2							
pH - Field	**6.84**	units	0.01	1		11/26/2024 14:32	
Method: 170.1							
Temperature - Field C	**9.09**	degrees C		1		11/26/2024 14:32	
Method: SM4500 H+ B-2011							
pH	**7.4**	units	0.1	1		11/27/2024 19:00	*

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 72300003 **Date Collected:** 11/26/2024 13:55 **Matrix:** Groundwater
Sample ID: MW2-90 **Date Received:** 11/26/2024 17:30 **Collector:** MVTL Field Service

Temp @ Receipt (C): 0.9 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**10043**	umhos/cm	1	1		11/26/2024 13:55	
Method: 150.2							
pH - Field	**6.97**	units	0.01	1		11/26/2024 13:55	
Method: 170.1							
Temperature - Field C	**4.42**	degrees C		1		11/26/2024 13:55	
Method: SM4500 H+ B-2011							
pH	**7.6**	units	0.1	1		11/27/2024 19:06	*

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 72300004 **Date Collected:** 11/26/2024 13:10 **Matrix:** Groundwater
Sample ID: MW3-90 **Date Received:** 11/26/2024 17:30 **Collector:** MVTL Field Service

Temp @ Receipt (C): 0.9 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**6245**	umhos/cm	1	1		11/26/2024 13:10	
Method: 150.2							
pH - Field	**6.84**	units	0.01	1		11/26/2024 13:10	
Method: 170.1							
Temperature - Field C	**5.15**	degrees C		1		11/26/2024 13:10	
Method: EPA 6010D							
Calcium	**580**	mg/L	5	5	11/29/2024 16:15	12/04/2024 09:29	
Method: SM4500 H+ B-2011							
pH	**7.4**	units	0.1	1		11/27/2024 19:12	*

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 72300005 **Date Collected:** 11/26/2024 16:20 **Matrix:** Groundwater
Sample ID: MW-44R **Date Received:** 11/26/2024 17:30 **Collector:** MVTL Field Service

Temp @ Receipt (C): 0.9 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**10604**	umhos/cm	1	1		11/26/2024 16:20	
Method: 150.2							
pH - Field	**6.61**	units	0.01	1		11/26/2024 16:20	
Method: 170.1							
Temperature - Field C	**6.87**	degrees C		1		11/26/2024 16:20	
Method: SM4500 H+ B-2011							
pH	**7.2**	units	0.1	1		11/27/2024 19:18	*

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 72300006 **Date Collected:** 11/26/2024 15:10 **Matrix:** Groundwater
Sample ID: MW-80R **Date Received:** 11/26/2024 17:30 **Collector:** MVTL Field Service

Temp @ Receipt (C): 0.9 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**6251**	umhos/cm	1	1		11/26/2024 15:10	
Method: 150.2							
pH - Field	**6.96**	units	0.01	1		11/26/2024 15:10	
Method: 170.1							
Temperature - Field C	**8.03**	degrees C		1		11/26/2024 15:10	
Method: SM4500 H+ B-2011							
pH	**7.5**	units	0.1	1		11/27/2024 19:23	*

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Analytical Results

Lab ID: 72300007 **Date Collected:** 11/26/2024 15:46 **Matrix:** Groundwater
Sample ID: MW-103 **Date Received:** 11/26/2024 17:30 **Collector:** MVTL Field Service

Temp @ Receipt (C): 0.9 **Received on Ice:** Yes

Parameter	Results	Units	RDL	DF	Prepared	Analyzed	Qual
Method: 120.1							
Specific Conductance - Field	**5584**	umhos/cm	1	1		11/26/2024 15:46	
Method: 150.2							
pH - Field	**6.84**	units	0.01	1		11/26/2024 15:46	
Method: 170.1							
Temperature - Field C	**7.02**	degrees C		1		11/26/2024 15:46	
Method: SM4500 H+ B-2011							
pH	**7.5**	units	0.1	1		11/27/2024 19:29	*

Analysis Results Comments

pH

Sample analyzed beyond holding time.

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

QC Results Summary WO #: 72300

Calcium Units: mg/L

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
LFB-MI			100	106.0		85	115		
MB		<1							
PDS/PDSD	72148001		100	92.9	89.9	75	125	1.0	20
DUP	72300004							3.2	20
PDS/PDSD	72533001		100	102.0	102.0	75	125	0.1	20

pH Units: units

QC Type	Original Sample ID	Blank Result	Spike Amount	Spike % Recovery	Spike Duplicate % Recovery	Lower Control Limit (%)	Upper Control Limit (%)	RPD (%)	RPD Limit (%)
CRM-PH			6	99.2		98.33	101.67		
CRM-PH			6	99.0		98.33	101.67		
CRM-PH			6	99.5		98.33	101.67		
DUP	72287001							0.5	20
DUP	72300002							0.3	20

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.MVTL.com

Member ACIL

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Minnesota Valley Testing Laboratories
2616 E. Broadway Ave
Bismarck, ND 58501
(701) 258-9720

Montana – Dakota Utilities
WO: 72300

Chain of Custody Record

Report To:	MDU	CC:	Project Name: MDU Heskett
Attn:	Brandon Schafer		Event: Fall 2024
Address:	400 N. 4th St Bismarck, ND 58501		Sampled By: J. ML
Phone:	701-391-3812		
Email:	Brandon.Schafer@mdu.com		

Sample Information					Sample Containers									Field Readings				
Lab Number	Sample ID	Date	Time	Sample Type	1 Liter Raw	500 mL HNO3	500 mL HNO3 (filtered)	250 mL H2SO4						Temp (°C)	Spec. Cond.	pH	Turbidity (NTU)	Analysis Required
001	MW13	26 Nov 24	1655	GW	X									6.94	11,505	6.93	1.42	pH
002	MW1-90	26 Nov 24	1432	GW	X									9.09	12,894	6.84	0.54	pH
003	MW2-90	26 Nov 24	1355	GW	X									4.42	10,043	6.97	0.01	pH
004	MW3-90	26 Nov 24	1310	GW	X	X								5.15	6245	6.84	0.45	pH, Calcium
005	MW-44R	26 Nov 24	1620	GW	X									6.87	10,604	6.61	0.14	pH
006	MW-80R	26 Nov 24	1510	GW	X									8.03	6251	6.96	0.11	pH
007	MW-103	26 Nov 24	1546	GW	X									7.02	5584	6.84	0.27	pH

Comments:

Relinquished By		Sample Condition		Received By	
Name	Date/Time	Location	Temp (°C)	Name	Date/Time
1 ML	26 Nov 24 1730	Log In ~~Walk In #2~~	0.9 °C/TM 805 ROI YAN	Grace Spieker	27 Nov 24 0800
2					

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	13
Sampling Personal:	JM

Weather Conditions: Temp: 20 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	(NO)
Well Labeled?	(YES)	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	30.29	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	31.15	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:	
Purge: 4	Sec.
Recover: 56	Sec.
PSI: —	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL 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
26 Nov 24	1630	Start of Well Purge									
	1635	6.95	11,591	6.95	1.40	170.1	2.03	30.70	100.0	500.0	Clear
	1640	6.91	11,570	6.93	0.70	160.5	1.02	30.85	100.0	500.0	Clear
	1645	6.80	11,471	6.92	0.77	162.5	0.66	30.96	100.0	500.0	Clear
	1650	6.94	11,515	6.92	0.66	166.6	0.74	31.10	100.0	500.0	Clear
	1655	6.94	11,505	6.93	0.69	168.1	1.42	31.11	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
26 Nov 24	1655	6.94	11,505	6.93			1.42				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	1-90
Sampling Personal:	JJ/MH

Weather Conditions: Temp: 15 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES (NO)
Well Labeled?	(YES) NO
Repairs Necessary?	
Casing Diameter:	2"
Measurements are from top of well riser	
Water Level Before Purge:	11.35 ft
Depth to Top of Pump:	— ft
Well Volume:	— liters
Water Level After Sample:	11.55 ft
Measurement Method:	Electric Water Level Indicator

SAMPLING INFORMATION

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

Control Settings:	
Purge: 2	Sec.
Recover: 58	Sec.
PSI: —	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL 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
26 Nov 24	1407	Start of Well Purge									
	1412	8.48	13,097	6.84	0.91	155.4	0.46	11.50	100.0	500.0	Clear
	1417	8.95	13,132	6.83	0.37	144.4	0.33	11.53	100.0	500.0	Clear
	1422	8.98	13,036	6.83	0.43	142.3	0.27	11.53	100.0	500.0	Clear
	1427	9.00	12,921	6.83	0.48	145.2	0.44	11.54	100.0	500.0	Clear
	1432	9.09	12,894	6.84	0.51	139.8	0.54	11.55	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
26 Nov 24	1432	9.09	12,894	6.84			0.54				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

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

Field Datasheet

Groundwater Assessment

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	Z-90
Sampling Personal:	JTMeyer

Weather Conditions: Temp: 15 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	20.70	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	21.00	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:	
Purge: 2	Sec.
Recover: 58	Sec.
PSI: —	

Bottle List:
1 Liter Raw
~~500mL Nitric~~

Duplicate Sample? YES / NO
Duplicate Sample ID: —

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL Removed	Appearance or Comment
Purge Date	Time	±0.5°	±5%	±0.1	±10%	±10		(ft)	mL/Min		Clarity, Color, Odor, Ect.
	1330	Start of Well Purge									clear, slightly turbid, turbid
26 Nov 24	1335	2.32	7914	6.99	6.00	86.9	8.02	20.75	100.0	500.0	Clear
	1340	3.39	9782	6.98	4.82	119.0	0.21	20.83	100.0	500.0	Clear
	1345	4.16	9992	6.98	4.09	146.2	0.08	20.87	100.0	500.0	Clear
	1350	4.36	10,028	6.97	3.98	149.7	0.02	20.91	100.0	500.0	Clear
	1355	4.42	10,043	6.97	3.96	150.5	0.01	20.98	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 2,500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment
											Clarity, Color, Odor, Ect.
26 Nov 24	1355	4.42	10,043	6.97			0.01				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	3-90
Sampling Personal:	JM

Weather Conditions: Temp: 15 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	(NO)
Well Labeled?	(YES)	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	19.25	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	19.28	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:	
Purge: 2	Sec.
Recover: 56	Sec.
PSI: —	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES / (NO)
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL 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
26 Nov 24	1245	Start of Well Purge									
	1250	5.75	6176	6.86	1.37	126.8	3.25	19.28	100.0	500.0	Clear
	1255	5.39	6220	6.84	1.31	145.8	0.59	19.28	100.0	500.0	Clear
	1300	5.51	6226	6.83	1.29	86.4	0.48	19.28	100.0	500.0	Clear
	1305	5.29	6241	6.84	1.26	82.6	0.44	19.28	100.0	500.0	Clear
	1310	5.15	6245	6.84	1.25	79.8	0.45	19.28	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 2,500 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
26 Nov 24	1310	5.15	6245	6.84			0.45				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	44R
Sampling Personal:	

Weather Conditions: Temp: 20 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	27.51	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	27.63	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:	
Purge: 4	Sec.
Recover: 56	Sec.
PSI: —	

Bottle List:
1 Liter Raw
500mL Nitric

Duplicate Sample?
YES (NO)
Duplicate Sample ID:
✓

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL 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
26 Nov 24	1555	Start of Well Purge									
	1600	6.69	10,464	6.63	1.37	198.8	0.14	27.55	100.0	500.0	Clear
	1605	6.89	10,469	6.62	0.45	175.5	0.05	27.59	100.0	500.0	Clear
	1610	6.83	10,597	6.62	0.33	159.3	0.10	27.60	100.0	500.0	Clear
	1615	6.93	10,616	6.61	0.23	155.4	0.10	27.61	100.0	500.0	Clear
	1620	6.87	10,604	6.61	0.21	154.7	0.14	27.62	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
26 Nov 24	1620	6.87	10,604	6.61			0.14				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

Field Datasheet

Groundwater Assessment

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

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	BOR
Sampling Personal:	JTH

Weather Conditions: Temp: 15 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	(NO)
Well Labeled?	(YES)	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	13.85	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	14.20	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:	57 Sec.
PSI:	—

Bottle List:
1 Liter Raw
~~500mL Nitric~~

Duplicate Sample? YES / (NO)
Duplicate Sample ID: —

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL 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
26 Nov 24	1445	Start of Well Purge									
	1450	8.22	6280	6.96	0.71	158.2	0.21	14.00	100.0	500.0	Clear
	1455	8.13	6275	6.96	0.52	149.2	0.16	14.15	100.0	500.0	Clear
	1500	8.19	6238	6.96	0.37	142.7	0.16	14.16	100.0	500.0	Clear
	1505	8.05	6258	6.96	0.34	138.5	0.22	14.17	100.0	500.0	Clear
	1510	8.03	6251	6.96	0.31	137.8	0.11	14.18	100.0	500.0	Clear

Well Stabilized? (YES) NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
26 Nov 24	1510	8.03	6251	6.96	@		0.11				Clear

Comments:

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.MVTL.com

Account #: 2800 **Client:** Montana-Dakota Utilities - Bismarck

MVTL
2616 E. Broadway Ave, Bismarck, ND
Phone: (701) 258-9720

Field Datasheet

Groundwater Assessment

Company:	MDU Heskett
Event:	Fall 2024
Sample ID:	103
Sampling Personal:	JH

Weather Conditions: Temp: 20 °F Wind: N @ 5-10 Precip: Sunny / Partly Cloudy / Cloudy

WELL INFORMATION

Well Locked?	YES	NO
Well Labeled?	YES	NO
Repairs Necessary?		
Casing Diameter:	2"	
Measurements are from top of well riser		
Water Level Before Purge:	30.04	ft
Depth to Top of Pump:	—	ft
Well Volume:	—	liters
Water Level After Sample:	31.50	ft
Measurement Method:	Electric Water Level Indicator	

SAMPLING INFORMATION

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

Control Settings:	
Purge: 87	Sec.
Recover: 56	Sec.
PSI: —	

Bottle List:
1 Liter Raw
500mL Nitric.

Duplicate Sample?
YES / NO
Duplicate Sample ID:
—

FIELD READINGS

Stabilization Parameters (3 Consecutive)		Temp. (°C)	Spec. Cond.	pH	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Water Level	Pumping Rate	mL 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
26Nov 24	1521	Start of Well Purge									
	1526	6.46	5430	6.87	4.56	186.3	0.28	30.37	100.0	500.0	Clear
	1531	6.93	5558	6.84	3.77	196.2	0.03	30.85	100.0	500.0	Clear
	1536	7.09	5584	6.84	3.59	197.2	0.00	31.11	100.0	500.0	Clear
	1541	7.08	5577	6.84	3.54	194.3	0.01	31.25	100.0	500.0	Clear
	1546	7.02	5584	6.84	3.58	199.5	0.27	31.42	100.0	500.0	Clear

Well Stabilized? YES NO Total Volume Purged: 2500.0 mL

Sample Date	Time	Temp. (°C)	Spec. Cond.	pH			Turbidity (NTU)				Appearance or Comment Clarity, Color, Odor, Ect.
26Nov24	1546	7.02	5584	6.84			0.27				Clear

Comments:	

Appendix B Alternative Source Demonstration Reports

Alternative Source Demonstration: August 2023 Event

R.M. Heskett Station

Prepared for
Montana-Dakota Utilities Co.

May 2024

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
952.832.2600
www.barr.com

Certification

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	May 13, 2024	August 2023 Event Alternative Source Demonstration

Alternative Source Demonstration: August 2023 Event

May 2024

Contents

List of Tables

List of Figures

List of Appendices

Abbreviations

ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
NDDEQ	North Dakota Department of Environmental Quality
MDU	Montana-Dakota Utilities Co.
SPLP	Synthetic Precipitation Leaching Procedure
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
US EPA	United States Environmental Protection Agency

1 Introduction

Montana-Dakota Utilities Co. (MDU) owns and operated R.M. Heskett Station (Site), comprised of a substantially decommissioned coal-fired generating station and a gas-fired turbine located in Mandan, Morton County, North Dakota (Figure 1). Coal unit operations at the Site ended in March 2022, and decommissioning tasks have been ongoing through 2023. One coal combustion residual (CCR) unit, as defined by 40 CFR 257.53 and North Dakota Administrative Code (NDAC) 33.1-20-08-01, is located on the property. The CCR unit is a landfill containing coal combustion by-products, asbestos wastes generated from construction activity associated with MDU-owned facilities, decommissioning wastes, and ash derived from burning tire-derived fuel at the facility. Final closure of the remaining open area of the landfill began in October 2023 with the geomembrane cover and sand drainage layer installed; final closure is expected to be compete in 2024.

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 August 2023 monitoring event, along with historical data, to demonstrate if the SSIs are the results of a "source other than the CCR unit" or due to natural variation in groundwater quality or an error in sampling, analysis, or statistical evaluation. Nothing in the foregoing citation of the rule requires that the owner/operator disprove any and all potential counter-arguments that EPA or others may offer to refute this demonstration. Such arguments if valid, would need to follow requirements of the rule to show a basis in fact that includes rule requirements that are based on site-specific information, and must be certified by a North Dakota licensed professional engineer.

2 August 2023 SSIs

Sampling for the second detection monitoring event in 2023 was conducted August 28-29, 2023. Final laboratory results were received November 15, 2023. Seven potential SSIs over background were identified as SSIs (see time series plots in Appendix A and prediction limit plots in Appendix B):

- calcium and chloride at MW-80R
- fluoride, sulfate, and TDS at MW1-90
- calcium at MW2-90
- calcium at MW3-90

Evaluations were undertaken to review potential alternative sources for the SSI. 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, groundwater quality data from additional site wells, and groundwater quality data collected at the Site prior to construction of the CCR unit.

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

A successful demonstration of alternative sources for the SSI are discussed in Section 3.

2.1 August 2023 Sampling Event

Concentrations for potential SSIs observed in August 2023 are presented in Table 1 and are consistent with those observed during the prior detection monitoring events.

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

Well	Parameter	PL (mg/L)	Detection Monitoring Results (mg/L)									
			Apr. 2019	Sept. 2019	Apr. 2020	Sept. 2020	Mar. 2021	Aug. 2021	May 2022	Oct. 2022	May 2023	Aug. 2023
MW-80R	Calcium	442	313	350	320	322	336	340	409	418	**458**	**528**
MW2-90	Calcium	442	450	494	477	510	500	505	**451**	Dry	469	**477**
MW3-90	Calcium	442	442	464	386	486	505	Dry	**506**	Dry	428	**470**
MW-80R	Chloride	95.9	**146**	**146**	**143**	**147**	**134**	**155**	**162**	**149**	**182**	**193**
MW1-90	Fluoride	1.04	**1.06**	**1.1**	1.03	**1.08**	1.03	**1.09**	**1.12**	Dry	**1.13**	**1.14**
MW1-90	Sulfate	7370	6730	7120	7720	7880	7030	7670	6490	Dry	6540	**7710**
MW1-90	TDS	11,100	9740	10,300	11,000	11,200	12,200	11,000	**11,600**	Dry	10,700	**13,100**

Bolded values indicate concentrations exceed the associated interwell prediction limits (PL).
Dry: sample was not collected due to insufficient volume of water in well.

Trend analysis results through 2023 indicate:

- that calcium at MW-80R has a statistically significant increasing trend
- that calcium at MW2-90, though above the prediction limit, does not have a statistically significant trend
- that calcium at MW3-90, though above the prediction limit, has a significant decreasing trend
- that chloride at MW-80R, though above the prediction limit, has a significant decreasing trend
- that fluoride at MW1-90 has a statistically significant increasing trend
- that sulfate at MW1-90, though above the prediction limit, does not have a statistically significant trend
- that TDS at MW1-90 has a statistically significant increasing trend

Methods used to evaluate potential alternative sources as the basis for chloride concentrations over background from the August 2023 detection monitoring event are discussed in Section 3.

2.2 Verification Sampling

Verification resampling was not conducted.

3 Alternative Source Demonstration

The purpose of this ASD Report is to evaluate whether the August 2023 SSIs were due to a CCR unit release or due to another source or to error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. For each SSI, four hypotheses regarding the potential source of the SSI are assessed: (1) a release of leachate from the CCR unit, (2) natural variations in non-landfill or regional groundwater quality are the source of one or more of the SSIs, (3) a release of leachate from the Evaporation Pond (a source other than a CCR unit) is the source of one or more of the SSIs, and (4) statistical bias due to background well selection.

Successful demonstrations of alternative sources have previously been documented for four of the five parameters with SSIs at locations within the previous monitoring network. The associated ASD Reports (included as appendices to Barr, 2019; Barr, 2020; Barr, 2021; Barr, 2022; Barr, 2023; and Barr, 2024) 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 (from specific geology present at site), and/or associated with a release from the Evaporation Pond (non-CCR unit). Note that in this and previous ASDs the lines of evidence are intended to provide sufficient weight of evidence in demonstration of the ASD. This means that if one or more lines of evidence are refuted, sufficient evidence remains to support validity of the ASD.

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 the SSI, it would be assumed that groundwater chemistry at one or more potentially impacted wells (MW-80R, MW1-90, MW2-90, and/or MW3-90) would be geochemically similar to impacted water from the CCR unit represented by leach testing results. However, if these liquids are geochemically dissimilar, this indicates that a source "other than the CCR unit" may be responsible for the SSI. Therefore, major ion chemistry from the CCR groundwater monitoring locations (upgradient and downgradient) was compared to CCR Synthetic Precipitation Leaching Procedure (SPLP; EPA Method 1312) data collected July 2011 (Appendix C).

The SPLP results indicate that chloride is a relatively minor component of the ash leachate, accounting for 1% or less of total dissolved solids (TDS) by mass. In contrast, the chloride concentration in the groundwater sample from MW-80R accounted for over 2% of TDS and was measured at a level higher than those in the ash SPLP leachates at all downgradient wells. This finding is opposite what one would expect if impacted water from the CCR unit were being released and impacting groundwater because dilution and dispersion would tend to reduce the release concentrations between the CCR unit and the downgradient wells.

To further test the hypothesis of a source other than the CCR unit, a Piper diagram (Figure 2) was used to visually compare the CCR SPLP results (Appendix C) and the measured groundwater quality at the Site. Piper diagrams are plots of major ion chemistry of water samples (calcium, magnesium, potassium, sodium, chloride, sulfate, and [bi]carbonate) that are used to differentiate between water types and to

identify potential mixing of water types. The Piper diagram provides 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 et al., 2020). On the Piper diagram depicted in Figure 2, downgradient well compositions are shown as circular points, CCR SPLP compositions as orange triangles, and the range of upgradient compositions as a yellow polygon. All of the downgradient wells plot within the range of upgradient groundwater chemistry. The CCR SPLP results do not.

Downgradient water quality (including the SSI parameter-well pairs) is characterized as an intermediate-sulfate type water, whereas the ash SPLP results are sodium-sulfate type water. The major difference observed between the downgradient water quality and the SPLP results is the dominant cation composition (no cation strongly dominant vs. heavily dominant sodium). All of the SSI well-parameter pairs are clustered with data from that of the upgradient wells, which are intermediate-sulfate water, rather than near the ash SPLP results, which are high sulfate. These results indicate that the water chemistry at the downgradient locations are more like upgradient groundwater than would be expected from a potential release from the CCR unit. **Therefore, we reject the hypothesis that the CCR unit is the source of the calcium observed at MW-80R, MW2-90, and MW3-90, chloride observed at MW-80R, and sulfate observed at MW1-90.**

The EPA has offered criticism of ASDs using Piper Plots, as part of its determinations under Part A and Part B exemptions under the CCR rule. In these determinations, the EPA has made the argument without accompanying supporting evidence that Piper Plots are not suitable for ASDs because of one or more of the following reasons:

a. *Leachate is not groundwater, and therefore different water types cannot be directly compared*. This position is inconsistent with the fundamental premise within the CCR Rule that SSIs are due to changes that occur in groundwater due to a release of leachate from a CCR unit. Statistical methods are a means of making this comparison, Piper Plots are another. The utility of Piper Plots is that they are useful means of visualizing data and are part of the professional standard of care for comparing the dissolved constituents for any type of solution chemistry for any type of water. If the groundwater were influenced by a release of leachate, it is likely that the change in equilibrium chemistry within the flow system would show some influence on major ion composition. Therefore, Piper Plots are a valuable tool for comparing leachate and groundwater chemistry.

b. *There may be reactions in the subsurface that might influence the results and thereby reduce or add constituents to the downgradient groundwater*. While this may be true at some scale for some parameters, it is generally not true of Appendix III parameters which are major ions that are generally not reactive in the subsurface. Chloride addressed in this ASD has been widely considered a conservative "tracer" parameter in groundwater by professional hydrogeologists for decades. As stated in the preamble to the CCR Rule, EPA states that it selected the Appendix III parameters as indicators of coal ash leachate because they are mobile (and hence not reactive) in the subsurface.

c. *Using a single leach test cannot represent the water quality found at a downgradient monitoring well*. The issue is whether a single leach sample is representative of leachate as a distinct water type. As long as the

leachate sample is sufficiently different from groundwater, it is useful in assessing the potential effects of a release on downgradient groundwater. In this ASD, several leach tests are used, and they are all more similar to each other than they are to groundwater samples in terms of both the overall concentration of parameters and the proportionate ratios of various parameters along the flow path (which generally do not change along the flow path due to dilution). Therefore, Piper Plots not only show the differences between the two water types; they can also demonstrate the effects of dilution that allows for assessment of a release.

3.2 Source Hypothesis #2: Natural Variations in Pre-Landfill and Site-Specific Background Water Quality

As Source Hypothesis #1 (CCR Unit Release) was rejected as a potential source of the SSIs, a second hypothesis was evaluated to identify the potential source of concentrations of SSI parameters and further reinforce the demonstration that the SSIs were not related to the CCR unit. To do this, we evaluated the SSIs by comparison to historical groundwater quality data collected at the Site before the landfill was constructed (pre-landfill data), additional upgradient well 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.

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 current CCR unit is undisturbed (Appendix D) on the date that this image was taken.

Discussion of pre-landfill groundwater samples in the Permit Application notes that high calcium, chloride, fluoride, sulfate, TDS, and other parameters were observed at the Site.

3.2.1 Calcium at MW-80R, MW2-90, and MW3-90

Pre-landfill calcium concentrations collected from groundwater at the Site were measured as high as 648 mg/L (Well 44, 1986), indicating that high calcium concentrations were present at the Site that pre-date construction of the CCR unit.

The mineralogy of the underlying Fort Union Group which is the specific geologic formation present at the Site) may yield an explanation for the elevated calcium concentrations. This is important information that is required in order to establish a professional standard of care. Ignoring these data would be inconsistent with a professional standard of care. The dominant lithology observed at the Site is unconsolidated silt in a clay matrix with interspersed fine- to medium-grained sand (10% to 30%). Calcareous (calcium-carbonate-bearing) materials and small gypsum (hydrated calcium sulfate) 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). The presence of these minerals can be a source of high calcium concentrations in groundwater.

The boring logs for CCR wells and pre-landfill wells note calcareous material and gypsum occurrences across the Site (Appendix E). As groundwater fluctuates and surface water infiltration occurs, periodic dissolution of these calcium-bearing minerals into the water column may occur, resulting in elevated calcium concentrations.

In 2022, the Site received a new permit from the North Dakota Department of Environmental Quality (NDDEQ). Under the previous permit, the monitoring network included seven upgradient wells to define background rather than the one upgradient well (MW-13) included in the current network. The high degree of heterogeneity in historical background concentrations, including for calcium, means that the long-term monitoring record includes background data that may exceed statistically determined thresholds. The maximum and median concentrations measured in the seven background wells while the previous groundwater monitoring system was operating are shown below in Table 2.

Table 2 Previously Measured Upgradient Concentration Results for SSI Parameters

Parameter	Interwell Prediction Limit (mg/L)	August 2023 SSI (mg/L)	Maximum upgradient concentration, 2016-2021 (mg/L)	Median upgradient concentration, 2016-2021 (mg/L)
Calcium	442	477 (MW2-90), 470 (MW3-90), and 528 (MW-80R)	600 (MW-103)	438
Chloride	95.9	193 (MW-80R)	271 (MW-44R)	35.8
Fluoride	1.04	1.14 (MW1-90)	1.01 (MW-13)	0.25
Sulfate	7370	7710 (MW1-90)	7300 (MW-13)	3,190
TDS	11,100	13,100 (MW1-90)	10,800 (MW-44R)	5,070

Based on 123 samples collected from seven upgradient/background wells (Barr, 2017) between 2016 and 2021 (Barr, 2018-2022).

The data in Table 2 indicate that higher calcium concentrations than those leading to the August 2023 SSI have been measured in upgradient/background wells at the Site. Therefore, the degree of natural variability in groundwater calcium concentrations at the Site encompasses the SSIs at MW-80R, MW2-90, and MW3-90.

The presence of soluble calcium-bearing minerals in native subsurface deposits and documentation of elevated calcium in pre-landfill and upgradient groundwater provide multiple lines of evidence substantiating the hypothesis that the SSIs for calcium at MW-80R, MW2-90, and MW3-90 are due to natural variation in groundwater quality. **Therefore, we accept the hypothesis that the calcium concentrations at MW-80R, MW2-90, and MW3-90 are due to variability in natural conditions and are consistent with regional and Site background groundwater data.**

3.2.2 Chloride at MW-80R

As with calcium and other parameters, heterogeneity in chloride concentrations have been observed at the Site prior to landfill construction and within additional upgradient measurements. Pre-landfill chloride concentrations collected from groundwater at the Site and reported in the 1989 Permit Application were measured as high as 558 mg/L (Well 44, 1986), indicating that high chloride concentrations pre-date construction of the CCR unit. This conclusion is substantiated by concentrations measured in samples from the additional upgradient/background wells at the Site, which have been as high as 271 mg/L (MW-44R, Table 2), exceeding 193 mg/L measured at MW-80R in August 2023. These results support the hypothesis that the SSI for chloride at MW-80R is due to natural variation in groundwater quality. **Therefore, we accept the hypothesis that chloride concentrations observed at MW-80R are due to variability in natural conditions and are consistent with regional and Site background groundwater data.**

3.2.3 Fluoride at MW1-90

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 is included in Table 3 below. As above, the Cannonball is the specific geologic formation present at the Site and the results are specific to the local area of the Site and consideration of this information is required to establish a professional standard of care.

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 Klausing, 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 MW1-90 in August 2023 (1.14 mg/L) is within the range of values consistent with naturally occurring concentrations of fluoride associated with the Cannonball Formation in Morton County. However, a statistically significant increasing trend for fluoride at MW1-90 was observed. **Therefore, we accept the hypothesis that fluoride concentrations observed at MW1-90 are consistent with regional (background) groundwater data; however, additional source considerations were evaluated, as described in Section 3.3.**

3.2.4 TDS at MW1-90

As noted in previous sections, high variability and concentrations of various parameters have been noted in groundwater at the Site and in the region. This observation extends to TDS. The maximum TDS concentration reported in the 1989 Permit Application from 1986 (pre-landfill) was 14,917 mg/L (Well 60), with similar concentrations observed two years later, indicating that high TDS pre-dates landfill construction.

Based on presence of gypsum in native subsurface deposits and documentation of elevated TDS in pre-landfill groundwater, the hypothesis that the SSI for TDS at MW1-90 may be due to natural conditions is probable. significantly increasing TDS concentrations were observed in other monitoring system wells, including upgradient well MW-13. **TDS concentrations at MW1-90 may be due to natural conditions; however, additional source considerations were evaluated, as described in Section 3.3.**

3.2.5 Sulfate at MW1-90

Like the other parameters discussed, there is variable sulfate concentrations both at the Site and in the region. The maximum sulfate concentration reported in the 1989 Permit Application from 1986 (pre-landfill) was 11,632 mg/L (Well 60), indicating that high sulfate concentrations pre-date construction of the CCR unit.

sulfate and TDS concentrations are strongly related as sulfate accounts for 50-70% of TDS. Gypsum, a source of groundwater sulfate, is well-documented on site as discussed in Section 3.2.1 and Section 3.2.4. As noted, the boring logs for CCR wells and pre-landfill wells note gypsum occurrences across the Site (Appendix E). As groundwater fluctuates and surface water infiltration occurs, periodic dissolution of gypsum into the water column may occur, resulting in elevated sulfate.

These results support the hypothesis that the SSI for sulfate at MW1-90 is due to natural variation in groundwater quality. **Therefore, we accept the hypothesis that sulfate concentrations observed at MW1-90 are due to variability in natural conditions and are consistent with regional and Site background groundwater data.**

3.3 Source Hypothesis #3: Evaporation Pond Release

Two conditions are necessary to accept the hypothesis that a release of Evaporation Pond water is the source of one or more of the SSIs: (1) mechanism of release (such as an issue with the 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 MW1-90 (fluoride, sulfate, and TDS) are being evaluated for this potential source.

3.3.1 Fluoride, Sulfate, and TDS at MW1-90

A statistically significant increasing trend in fluoride and TDS was observed at MW1-90 following the August 2023 detection monitoring event. Past ASD Reports (Barr, 2020; Barr, 2021; Barr, 2022) attributed elevated 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),

approximately 225 feet southwest of MW1-90, which is located north of the Evaporation Pond. The Evaporation Pond was designed and constructed to collect surface water run-off from the Site as well as leachate from the CCR Unit. It is not a CCR unit as defined in § 257.53. Due to the relative proximity of MW1-90 to the Evaporation Pond and MW-104, an evaluation was conducted to assess the Evaporation Pond liner integrity and potential impacts to downgradient wells and determine the geochemical feasibility of Evaporation Pond water contributing to the conditions observed at MW1-90.

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; 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, whether the erosion cuts were 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 well MW1-90 (Appendix F) show an increase in sodium; this increase is most apparent at MW1-90 between 2012 and 2023. 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.

Potential Downgradient Effects

The base of the Evaporation Pond sits at approximately 1675 feet above MSL, whereas historical groundwater elevations in MW-104 and MW1-90 remain below 1675 feet MSL. Therefore, any water leaking from the Evaporation Pond would move radially outward from the pond through the unsaturated

zone downward into the groundwater, toward both MW-104 and MW1-90, reaching both wells downgradient of the Pond.

Groundwater monitoring data have consistently been collected from MW1-90 since 1990. As seen in the time series plots (Appendix F; 1990-2023), in approximately 2010 the 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 continued, despite reports of the erosional cuts being repaired in 2013, except for chloride, which has since leveled off.

Geochemical Feasibility

A simple mixing model was developed in April 2019 (Barr, 2020) to determine the potential of producing a similar water quality to that observed at MW-104 and MW1-90 when mixing Evaporation Pond water with unimpacted upgradient water. This mixing model was conducted in Geochemist's Workbench® v.12.0, using data from water samples collected from the Evaporation Pond and upgradient monitoring well MW-103. 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 upgradient groundwater concentrations used in the model were from a sample from upgradient monitoring well MW-103 collected in April 2019, which is assumed to represent the long-term composition of groundwater in that vicinity due to the fairly stable concentrations of major ions exhibited in samples from MW-103 (Barr, 2020). The Evaporation Pond concentrations used in the model were from a sample collected from the pond in September 2014, which is assumed for the purposes of the model to represent a typical Evaporation Pond water composition during the period when the pond liner was compromised.

The results of the model are provided in Appendix G. Figure G.1 shows the results of the mixing model on a Piper diagram. 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 (represented by a blue triangle) with the Evaporation Pond (represented by a red circle). The black circles 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 G.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 MW1-90 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" groundwater from upgradient to get a similar chemistry as observed downgradient in MW1-90. The geometry of the Stiff plots in Figure G.2 shows the similarity in ionic composition in the mixing models.

Recorded measurements of fluoride concentrations in the Evaporation Pond have generally been low (<0.3 mg/L), and therefore a release from the Evaporation Pond is unlikely to be a direct source of fluoride to groundwater. However, the Evaporation Pond water has several characteristics that can lead to the release of fluoride from clays and other minerals in aquifer sediments. The pH of the Evaporation Pond is high (≥10), meaning that the water has a high concentration of hydroxide ions. Hydroxide and fluoride have similar ionic radii and charge. Mineralogically, this means that fluoride can easily substitute for hydroxide within mineral structures. In addition, fluoride can sorb to clay, particularly in slightly acidic conditions. A release of high-pH water provides ample hydroxide that can replace fluoride in mineral structures and cause the desorption of fluoride from clay minerals, leading to an increase in fluoride concentrations in groundwater (Edmunds and Smedley, 2013; McMahon et al., 2020).

Based on the description of erosional features extending upwards of 48 inches into 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 MW1-90 relative to the Evaporation Pond support the hypothesis that the SSI for fluoride, sulfate, and TDS at MW1-90 are due to a "source other than the CCR unit." **Therefore, we accept the hypothesis that the fluoride, sulfate, and TDS concentrations observed at MW1-90 are consistent with a potential release from the Evaporation Pond, a non-CCR unit.**

3.4 Source Hypothesis #4: Statistical Methods (bias due to use of MW-13 for upgradient background instead of MW-44R and MW-103)

The data from upgradient MW-13 forms the interwell prediction limit used as the basis for the SSIs in August 2023. While MW-13 serves as an adequate upgradient well for the majority of the Site, there is heterogeneity in all geologic environments that cannot be captured by a single upgradient well. Therefore, a hypothesis for the chloride and calcium SSIs are that the exclusion of MW-44R and MW-103 from the background data set may have resulted in bias in the background data that underrepresents the statistical variation in chloride and calcium concentrations.

In 2022, the Site received a new permit from the North Dakota Department of Environmental Quality (NDDEQ). Under the previous permit, the monitoring network included seven upgradient wells to define background rather than the one upgradient well (MW-13) included in the current network. The historical background concentrations from these six additional wells indicate a higher degree of heterogeneity than is represented statistically by MW-13 alone. Two wells in particular (MW-44/MW-44R and MW-103) have shown consistently high concentrations in chloride and calcium that indicate a bias toward lower concentrations for both parameters due to the selection of MW-13 as the lone background well.

In order to better understand the range of background concentrations, the maximum and median concentrations measured in the seven background wells while the previous groundwater monitoring system was operating are shown above in Table 2.

The data in Table 2 indicate that higher chloride and calcium concentrations than that leading to the August 2023 SSIs have been measured in upgradient/background wells at the Site. In addition, chloride concentrations near the location of upgradient MW-44 have historically ranged as high as 558 mg/L. Similarly, calcium concentrations near MW-103 have historically ranged as high as 600 mg/L. Both upgradient wells have higher concentrations than the maximum cited above for calcium and chloride in the 2016-2021 data. The median value shows that pooling of the upgradient data hides the influence of higher upgradient calcium and chloride concentrations that have been documented at the Site in the background. **Therefore, we accept the hypothesis that chloride and calcium concentrations observed at MW-80R are a statistical artifact related to the selection of MW-13 as the lone upgradient well which has shown lower concentrations of chloride than MW-44R and calcium than MW-103.**

4 Conclusions

Seven SSIs were identified from the August 2023 detection monitoring event. This report demonstrates that a "source other than the CCR unit" caused the SSIs (natural variation in background 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 Table 4 below.

Table 4 Summary of SSIs and Alternative Sources

Well	Parameter	Report Section	Evidence for Alternative Source
MW-80R	Calcium	3.2.1, 3.4	Natural variation (pre-landfill values, upgradient groundwater, and geologic background) and statistical methods
MW2-90	Calcium	3.2.1, 3.4	Natural variation (pre-landfill values, upgradient groundwater, and geologic background) and statistical methods
MW3-90	Calcium	3.2.1, 3.4	Natural variation (pre-landfill values, upgradient groundwater, and geologic background) and statistical methods
MW-80R	Chloride	3.2.2, 3.4	Natural variation (pre-landfill values, upgradient groundwater, and geologic background) and statistical methods
MW1-90	Fluoride	3.2.3, 3.3.1	Natural variation (geologic background) and/or Other (Evaporation Pond, a non-CCR unit)
MW1-90	Sulfate	3.2.5, 3.3.1	Natural variation (pre-landfill values, upgradient groundwater, and geologic background) and/or Other (Evaporation Pond, a non-CCR unit)
MW1-90	TDS	3.2.4, 3.3.1	Natural variation (pre-landfill values, upgradient groundwater, and geologic background) 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).

5 References

Barr Engineering Co., 2017, Groundwater Monitoring System Documentation. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. October 2017.

Barr Engineering Co., 2018, 2017 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2018.

Barr Engineering Co., 2019, 2018 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2019.

Barr Engineering Co., 2020, 2019 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2020.

Barr Engineering Co., 2021, 2020 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2021.

Barr Engineering Co., 2022, 2021 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2022.

Barr Engineering Co., 2023, 2022 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2023.

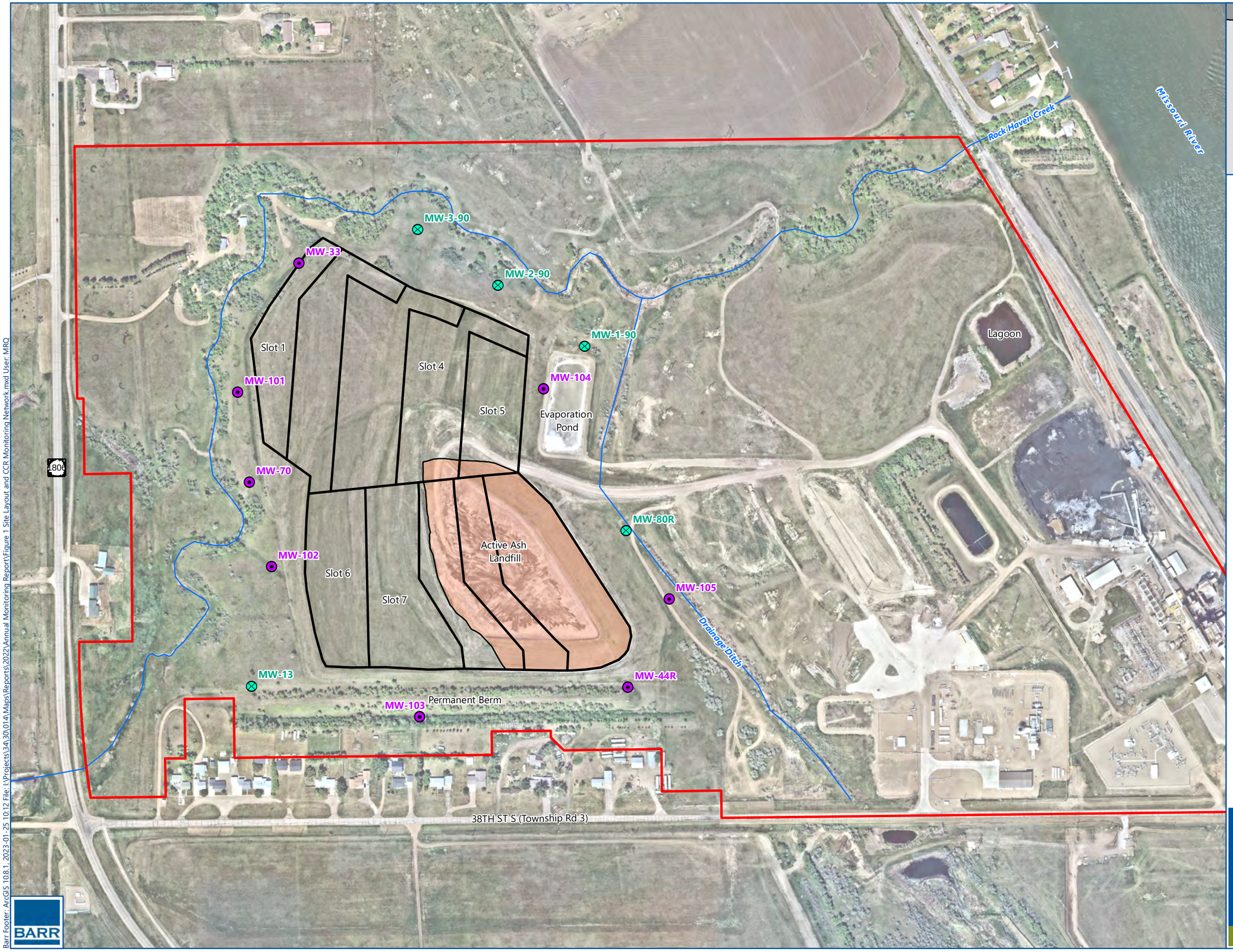
Helsel, D.R., Hirsch, R.M., Ryberg, K.R., Archfield, S.A., and Gilroy, E.J., 2020, Statistical methods in water resources: U.S. Geological Survey Techniques and Methods, book 4, chapter A3, 458 p.

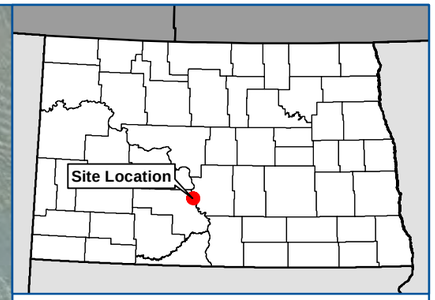
Montana-Dakota Utilities Co. (MDU), 1989, R.M. Heskett Station Special Use Disposal Site Permit Application. Submitted to North Dakota State Department of Health, March 1, 1989.

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

Figure 1 **Site Layout and CCR Monitoring Well Network**





- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Property Boundary
- Existing Slot Boundaries
- Active Portion of Landfill

Image Source: NearMap June 2022

N

0 350 700

Feet

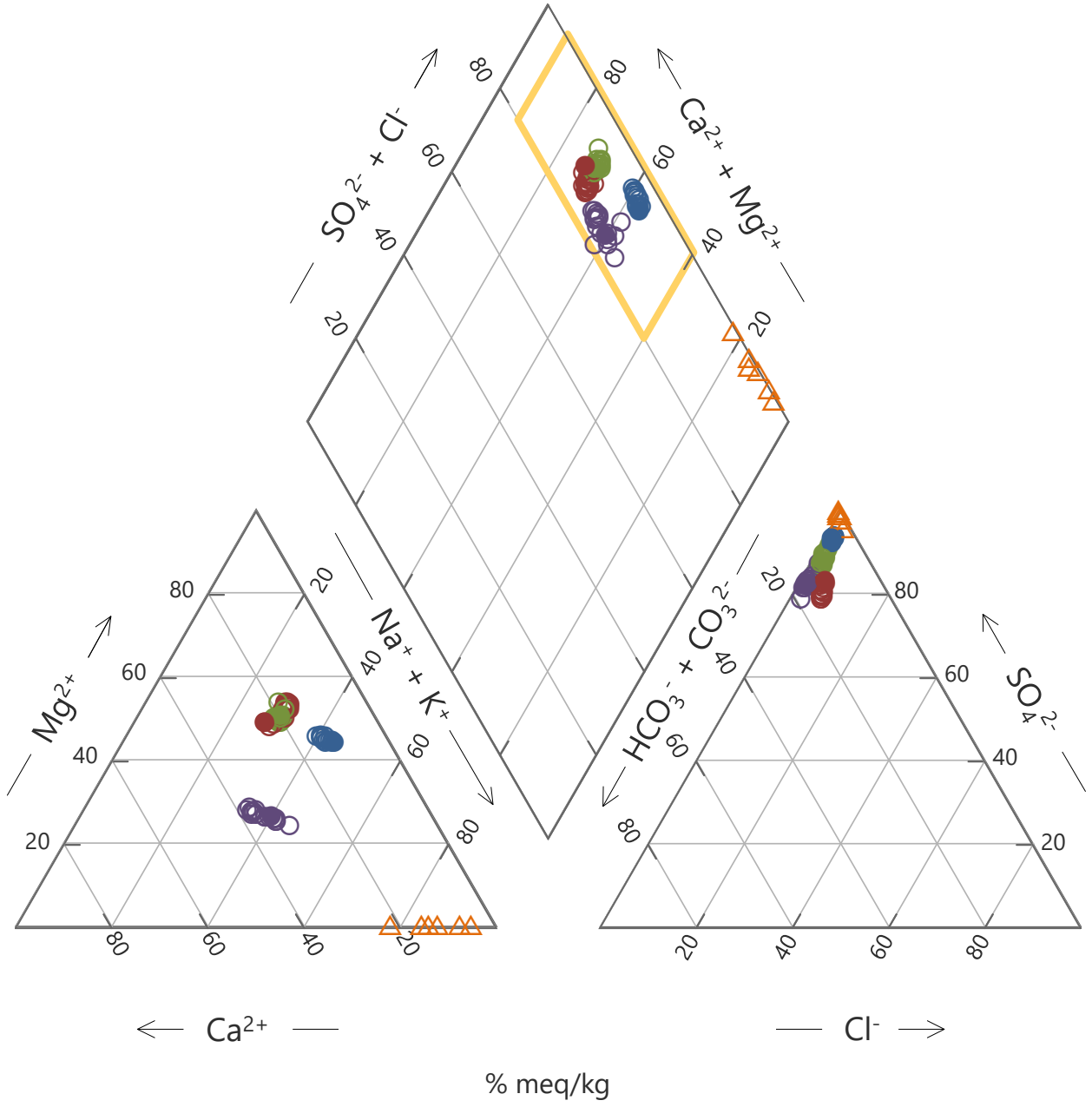
SITE LAYOUT AND CCR MONITORING NETWORK
Heskett Station
Montana Dakota Utilities
Mandan, North Dakota

FIGURE 1

BARR

Barr Footer: ArcGIS 10.8.1, 2023-01-25 10:12 File: I:\Projects\34\30\014\Maps\Reports\2022\Annual Monitoring Report\Figure 1 Site Layout and CCR Monitoring Network.mxd User: MRQ

Figure 2 **Piper Plot: Alternative Source Demonstration**



Ash SPLP
MW1–90
MW2–90
MW3–90
MW80R
Upgradient Range

Solid symbols are August 2023 samples

Figure 2
PIPER PLOT: ALTERNATIVE SOURCE DEMONSTRATION
R.M. Heskett Station
Mandan, North Dakota

BARR

Appendices

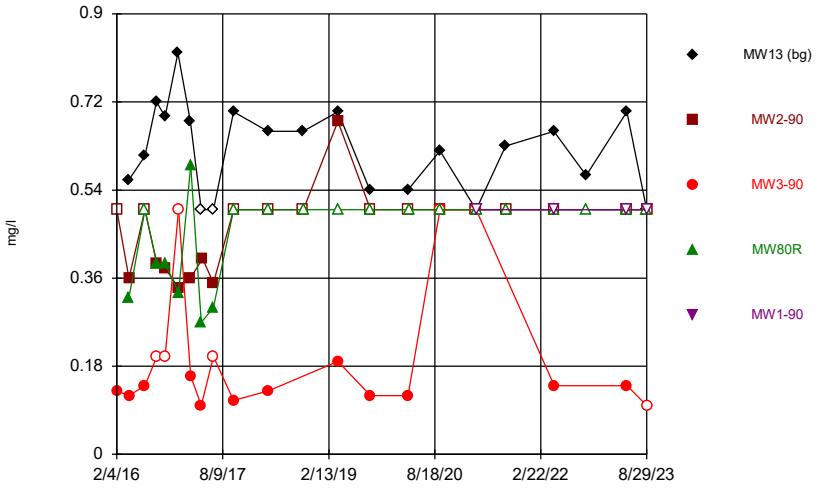
Appendix A

Appendix III Time Series Plots

Appendix A Appendix III Time Series Plots

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG
Hollow symbols indicate censored values.

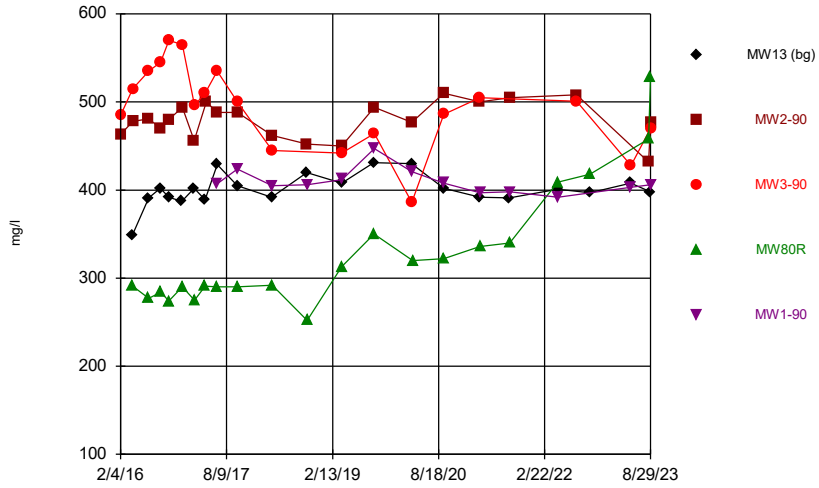
Boron



Time Series Analysis Run 12/27/2023 11:27 AM View: Time series
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

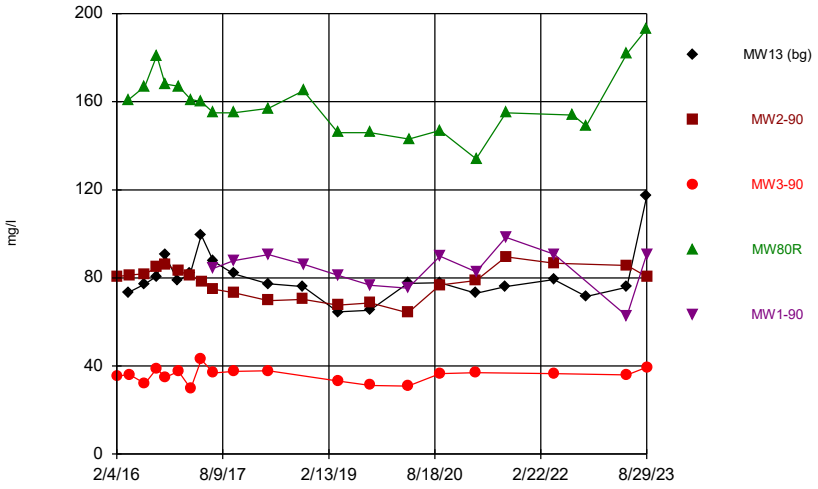
Calcium, Total



Time Series Analysis Run 12/27/2023 11:27 AM View: Time series
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

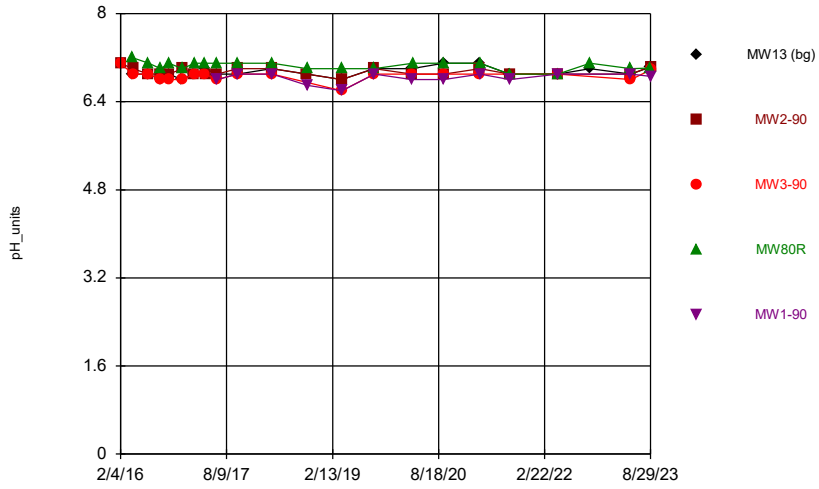
Chloride



Time Series Analysis Run 12/27/2023 11:27 AM View: Time series
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

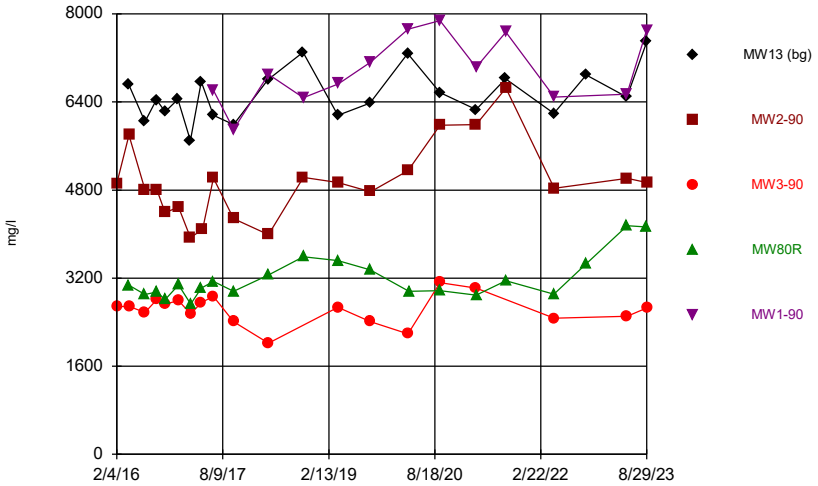
Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

pH, Field



Time Series Analysis Run 12/27/2023 11:27 AM View: Time series
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

Sulfate

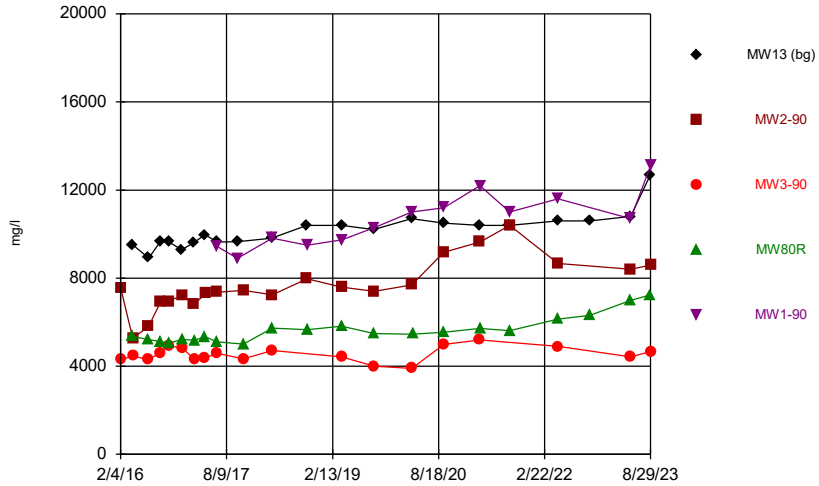


Time Series Analysis Run 12/27/2023 11:27 AM View: Time series

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

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

Total Dissolved Solids



Time Series Analysis Run 12/27/2023 11:27 AM View: Time series

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

Appendix B

Prediction Limit Plots

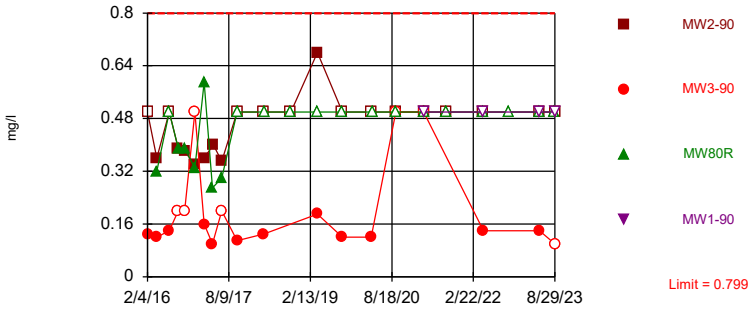
Appendix B Prediction Limit Plots

Hollow symbols indicate censored values.

Within Limit

Boron

Interwell Parametric



Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.6095, Std. Dev.=0.09284, n=17, 17.65% NDs. Seasonality was not detected with 95% confidence. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9408, critical = 0.892. Kappa = 2.04 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Comparing 4 points to limit.

Prediction Limit Analysis Run 12/27/2023 1:46 PM View: Prediction limits

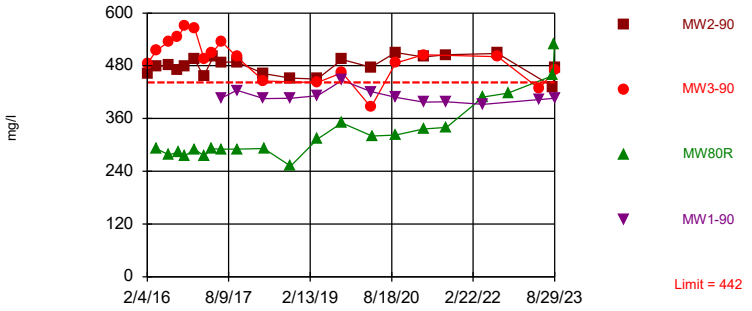
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

Exceeds Limit: MW2-90, MW3-90, MW80R

Calcium, Total

Interwell Parametric



Background Data Summary: Mean=400.7, Std. Dev.=20.06, n=17. Seasonality was not detected with 95% confidence. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8935, critical = 0.892. Kappa = 2.04 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Comparing 4 points to limit.

Prediction Limit Analysis Run 12/27/2023 1:46 PM View: Prediction limits

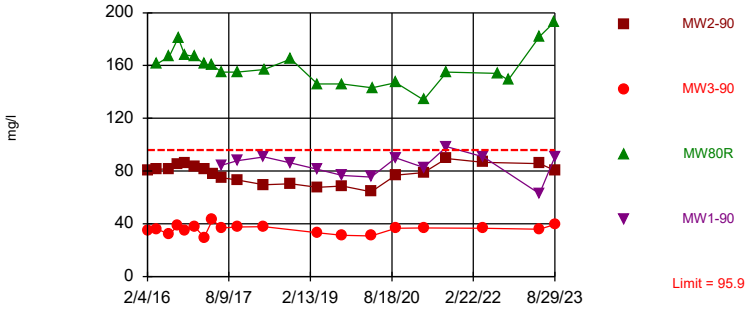
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

Exceeds Limit: MW80R

Chloride

Interwell Parametric



Background Data Summary: Mean=78.76, Std. Dev.=8.397, n=17. Seasonality was not detected with 95% confidence. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9338, critical = 0.892. Kappa = 2.04 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Comparing 4 points to limit.

Prediction Limit Analysis Run 12/27/2023 1:46 PM View: Prediction limits

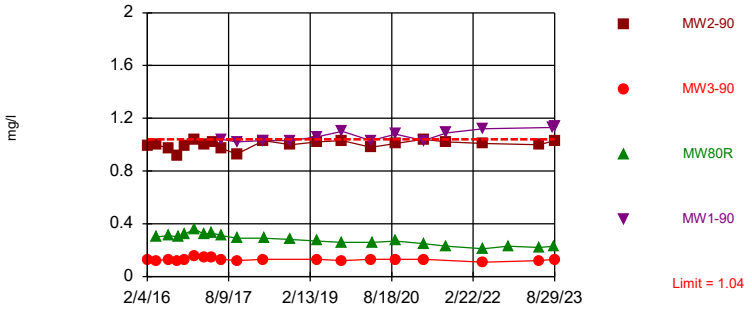
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

Exceeds Limit: MW1-90

Fluoride

Interwell Parametric



Background Data Summary: Mean=0.8953, Std. Dev.=0.06956, n=17. Seasonality was not detected with 95% confidence. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9654, critical = 0.892. Kappa = 2.04 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Comparing 4 points to limit.

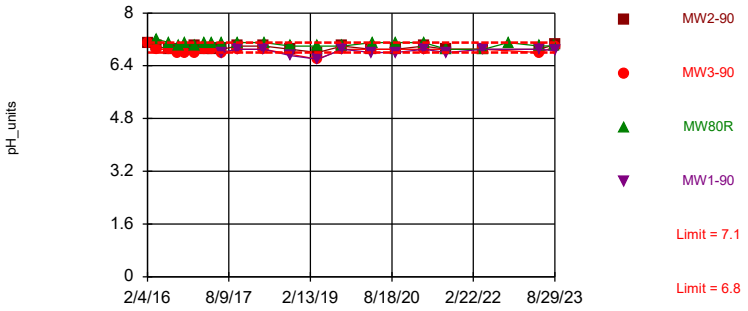
Prediction Limit Analysis Run 12/27/2023 1:46 PM View: Prediction limits

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

Within Limits

pH, Field

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limits are highest and lowest of 17 background values. Annual per-constituent alpha = 0.08687. Individual comparison alpha = 0.01107 (1 of 2). Comparing 4 points to limit. Seasonality was not detected with 95% confidence.

Prediction Limit Analysis Run 12/27/2023 1:46 PM View: Prediction limits

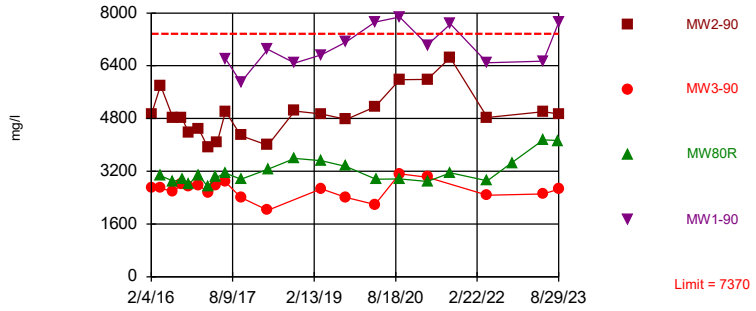
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

Exceeds Limit: MW1-90

Sulfate

Interwell Parametric



Background Data Summary: Mean=6474, Std. Dev.=437, n=17. Seasonality was not detected with 95% confidence. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9637, critical = 0.892. Kappa = 2.04 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Comparing 4 points to limit.

Prediction Limit Analysis Run 12/27/2023 1:46 PM View: Prediction limits

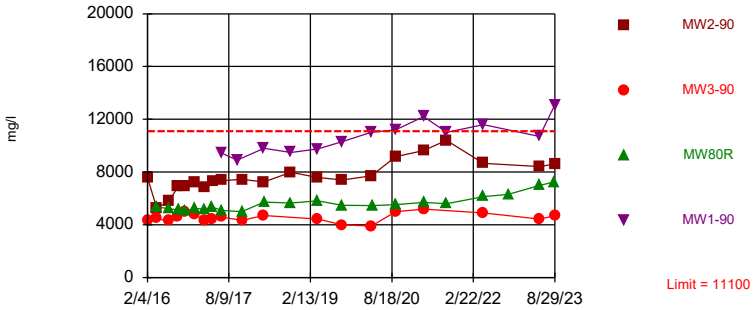
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new

Sanitas™ v.9.6.32 For the statistical analyses of ground water by Barr Engineering Company only. UG

Exceeds Limit: MW1-90

Total Dissolved Solids

Interwell Parametric



Background Data Summary: Mean=10276, Std. Dev.=332.5, n=9. Seasonality was not detected with 95% confidence. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.8605, critical = 0.829. Kappa = 2.447 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.00188. Comparing 4 points to limit.

Prediction Limit Analysis Run 12/27/2023 1:46 PM View: Prediction limits

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

Interwell Prediction Limit

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII_new Printed 12/27/2023, 1:47 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	%NDs	Transform	Alpha	Method
Boron (mg/l)	MW2-90	0.799	n/a	8/29/2023	0.5ND	No	17	17.65	No	0.00188	Param 1 of 2
Boron (mg/l)	MW3-90	0.799	n/a	8/29/2023	0.1ND	No	17	17.65	No	0.00188	Param 1 of 2
Boron (mg/l)	MW80R	0.799	n/a	8/28/2023	0.5ND	No	17	17.65	No	0.00188	Param 1 of 2
Boron (mg/l)	MW1-90	0.799	n/a	8/29/2023	0.5ND	No	17	17.65	No	0.00188	Param 1 of 2
Calcium, Total (mg/l)	**MW2-90**	**442**	**n/a**	**8/29/2023**	**477**	**Yes**	**17**	**0**	**No**	**0.00188**	Param 1 of 2
Calcium, Total (mg/l)	**MW3-90**	**442**	**n/a**	**8/29/2023**	**470**	**Yes**	**17**	**0**	**No**	**0.00188**	Param 1 of 2
Calcium, Total (mg/l)	**MW80R**	**442**	**n/a**	**8/28/2023**	**528**	**Yes**	**17**	**0**	**No**	**0.00188**	Param 1 of 2
Calcium, Total (mg/l)	MW1-90	442	n/a	8/29/2023	406	No	17	0	No	0.00188	Param 1 of 2
Chloride (mg/l)	MW2-90	95.9	n/a	8/29/2023	80.5	No	17	0	No	0.00188	Param 1 of 2
Chloride (mg/l)	MW3-90	95.9	n/a	8/29/2023	39.5	No	17	0	No	0.00188	Param 1 of 2
Chloride (mg/l)	**MW80R**	**95.9**	**n/a**	**8/28/2023**	**193**	**Yes**	**17**	**0**	**No**	**0.00188**	Param 1 of 2
Chloride (mg/l)	MW1-90	95.9	n/a	8/29/2023	90.7	No	17	0	No	0.00188	Param 1 of 2
Fluoride (mg/l)	MW2-90	1.04	n/a	8/29/2023	1.03	No	17	0	No	0.00188	Param 1 of 2
Fluoride (mg/l)	MW3-90	1.04	n/a	8/29/2023	0.13	No	17	0	No	0.00188	Param 1 of 2
Fluoride (mg/l)	MW80R	1.04	n/a	8/28/2023	0.23	No	17	0	No	0.00188	Param 1 of 2
Fluoride (mg/l)	**MW1-90**	**1.04**	**n/a**	**8/29/2023**	**1.14**	**Yes**	**17**	**0**	**No**	**0.00188**	Param 1 of 2
pH, Field (pH_units)	MW2-90	7.1	6.8	8/29/2023	7.04	No	17	0	n/a	0.01107	NP (normality) 1 of 2
pH, Field (pH_units)	MW3-90	7.1	6.8	8/29/2023	6.98	No	17	0	n/a	0.01107	NP (normality) 1 of 2
pH, Field (pH_units)	MW80R	7.1	6.8	8/28/2023	7.01	No	17	0	n/a	0.01107	NP (normality) 1 of 2
pH, Field (pH_units)	MW1-90	7.1	6.8	8/29/2023	6.86	No	17	0	n/a	0.01107	NP (normality) 1 of 2
Sulfate (mg/l)	MW2-90	7370	n/a	8/29/2023	4940	No	17	0	No	0.00188	Param 1 of 2
Sulfate (mg/l)	MW3-90	7370	n/a	8/29/2023	2660	No	17	0	No	0.00188	Param 1 of 2
Sulfate (mg/l)	MW80R	7370	n/a	8/28/2023	4130	No	17	0	No	0.00188	Param 1 of 2
Sulfate (mg/l)	**MW1-90**	**7370**	**n/a**	**8/29/2023**	**7710**	**Yes**	**17**	**0**	**No**	**0.00188**	Param 1 of 2
Total Dissolved Solids (mg/l)	MW2-90	11100	n/a	8/29/2023	8600	No	9	0	No	0.00188	Param 1 of 2
Total Dissolved Solids (mg/l)	MW3-90	11100	n/a	8/29/2023	4670	No	9	0	No	0.00188	Param 1 of 2
Total Dissolved Solids (mg/l)	MW80R	11100	n/a	8/28/2023	7240	No	9	0	No	0.00188	Param 1 of 2
Total Dissolved Solids (mg/l)	**MW1-90**	**11100**	**n/a**	**8/29/2023**	**13100**	**Yes**	**9**	**0**	**No**	**0.00188**	Param 1 of 2

Appendix C

Ash SPLP Laboratory Report (2011)

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

MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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.
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
www.mvtl.com
MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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. Zander

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
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
www.mvtl.com
MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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.
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
www.mvtl.com
MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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: D. Zander

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
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
www.mvtl.com

MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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
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
www.mvtl.com

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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: 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.
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
www.mvtl.com

MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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

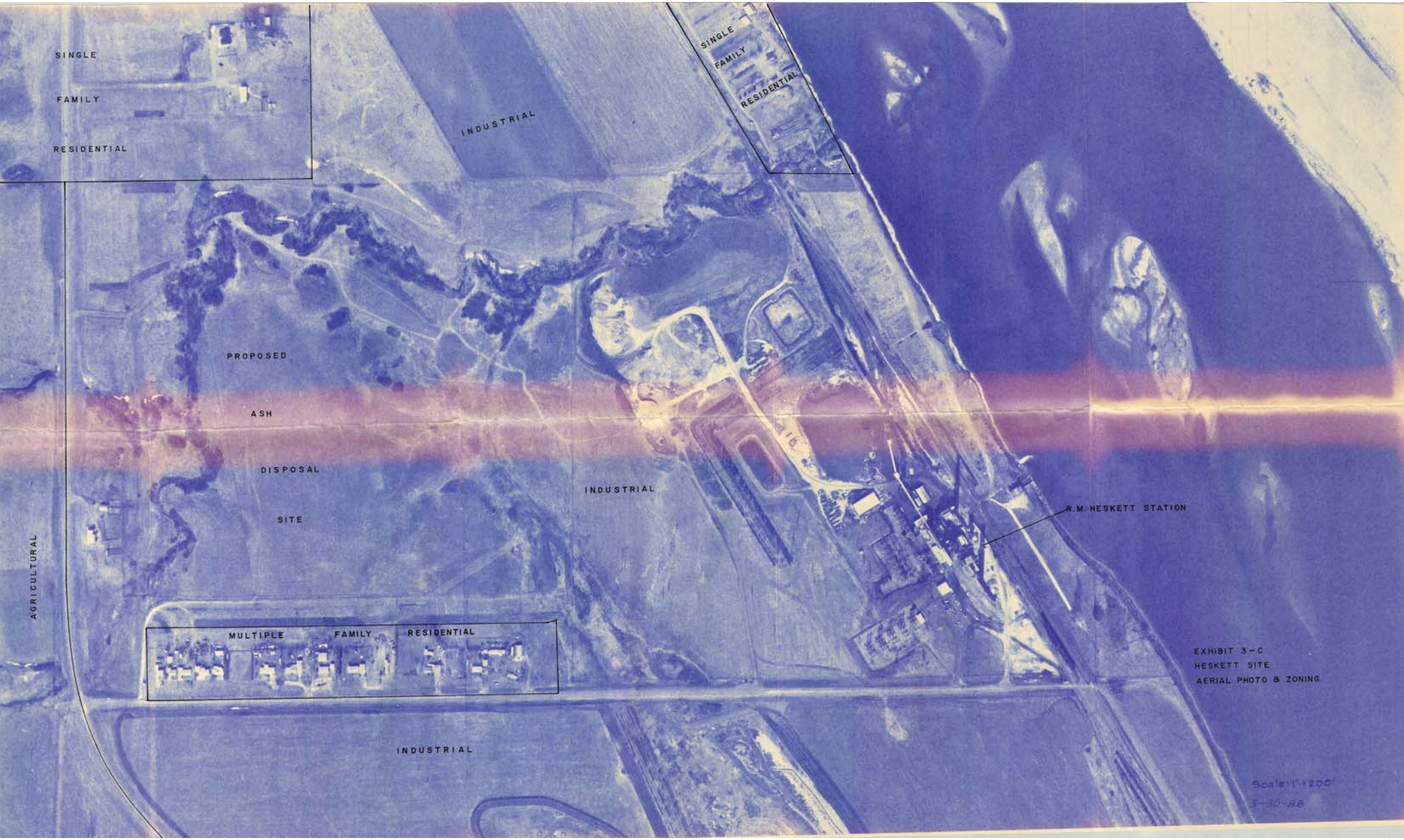
Elevated "Less Than Result" (<): @ = Due to sample matrix
! = Due to sample quantity
= Due to sample concentration
+ = Due to extract volume

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

Appendix D

Aerial Photo (March 30, 1998)

Appendix D Aerial Photo (March 30, 1998)


SINGLE
FAMILY
RESIDENTIAL
INDUSTRIAL
SINGLE
FAMILY
RESIDENTIAL
PROPOSED
ASH
DISPOSAL
SITE
INDUSTRIAL
R.M. HESKETT STATION
AGRICULTURAL
MULTIPLE FAMILY RESIDENTIAL
INDUSTRIAL
EXHIBIT 3-C
HESKETT SITE
AERIAL PHOTO & ZONING
Scale 1"=200'
1-30-88

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 litnologic 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.

WEll 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.

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

LOG OF BORING MW-44 R

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION
0		1	3-3-5-8.	OL/OH		0-1': TOPSOIL (OL/OH): Very Dark Brown (2.5/2 7.5YR); low to medium plasticity; roots, fine to medium grained sand.
						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.
		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.			
20		9	10-10-13-16.			At 20': Interbedded layer of sand.
25		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.

WELL OR PIEZOMETER CONSTRUCTION DETAIL

PRO. CASING
Diameter: 4" by 4"
Type: Steel
Interval: 3' up & 3' down

RISER CASING
Diameter: 2"
Type: Schd 40 PVC
Interval: Stick up to screen (23')

GROUT
Type: Cement
Interval: 0-0.5' BGS

SEAL
Type: Bentonite Chips
Interval: 0.5-21' BGS

SANDPACK
Type: Granusil
Interval: 21-46' BGS

SCREEN
Diameter: 2"
Type: No. 10 Slot
Interval: 23-43' BGS

Elevation, feet

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:

O:\GINT\PROJECTS\34301012.GPJ BARR.LIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-44 R

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.	USCS	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.		
35		12	8-13-16-27.			(CL): At 32': Color change to dark gray (4/1 7.5YR).		
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).		
50								
55								

PRO. CASING
Diameter: **4" by 4"**
Type: **Steel**
Interval: **3' up & 3' down**

RISER CASING
Diameter: **2"**
Type: **Schd 40 PVC**
Interval: **Stick up to screen (23')**

GROUT
Type: **Cement**
Interval: **0-0.5' BGS**

SEAL
Type: **Bentonite**
Interval: **Chips 0.5-21' BGS**

SANDPACK
Type: **Granusil**
Interval: **21-46' BGS**

SCREEN
Diameter: **2"**
Type: **No. 10 Slot**
Interval: **23-43' BGS**

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:

O:\GINT\PROJECTS\34301012.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

State of North Dakota

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58505

MONITORING WELL REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

Name MDU-Heskett Station

Address 2025 38th Street

Mandan, North Dakota

2. WELL LOCATION **(MW-44R)**

Address (if in city) (see attached drawing)

County Morton

SE ¼ SE ¼ SW ¼ Sec. 10 Twp. 139 N. Rge. 81 W.

Lat. 46.86620 Long.: -100.89313

Altitude:

3. METHOD DRILLED

■ Auger Other

4. WELL CONSTRUCTION

Diameter of Hole 8 inches Depth 46 feet

Riser: ■ PVC □ Other

■ Threaded □ Solvent □ Other

Riser rating SDR Schedule 40

Diameter 2.0 inches

From +2 ft. to 23 ft.

Was a well screen installed? ■ Yes □ No

Material Schedule 40 PVC Diameter 2.0 inches

Slot Size #10 set from 23 feet to 43 feet

Sand packed from 21 ft to 46 ft

Depth grouted from 1 ft to 21 ft

Grouting Material

Bentonite x Other

If other explain:

One foot concrete collar at surface

Well head completion:

24" above grade Other x

If other, specify 4" x 4" x 5' steel cover

Was protective casing installed? ■ Yes □ No

Was well disinfected upon completion? □ Yes ■ No

5. WATER LEVEL

Static water level 28.5 feet below surface

If flowing: closed in pressure psi or ft. above land surface

6. WELL LOG

Formation	Depth (Ft.) From	To
Topsoil	0	0.5
Sandy lean clay	0.5	5
Sandy fat clay	5	46

(Use separate sheet if necessary)

7. WAS THE HOLE PLUGGED OR ABANDONED?

□ Yes ■ No

If so, how?

8. REMARKS

3 steel bumpers installed around well head

9. DATE COMPLETED 10-21-14

10. CONTRACTOR CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Midwest Testing Laboratory, Inc. 444

Monitoring Well Contractor Certificate No.

P.O. Box 2084, Bismarck, ND 58502-2084

Address

Signature 10-22-14

Date

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/6in.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0				OL/OH		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.	PRO. CASING Diameter: 4" by 4" Type: Steel Interval: 3' up & 3' down	
		2	4-5-7-9.			At 2': Gravel inclusions. Moist; 10% gravel, 30% sand, 60% fines.		
5		3	4-4-5-8.	CL		Moist; 0% gravel, 20% sand, 80% fines.	RISER CASING Diameter: 2" Type: Schd 40 PVC Interval: Stick up to screen (7')	
		4	4-4-6-6.					
		5	3-4-5-6.	CL		(CL): At 8': Color change to 2.5/1 7.5YR black, no odor.	GROUT Type: Cement Interval: 0-0.5' BGS	
10		6	1-3-3-4.	CL		(CL): At 9': Color change to 2.5/2 7.5YR very dark brown. Moist; 0% gravel, 20% sand, 80% fines.	SEAL Type: Bentonite Interval: Chips 0.5-5' BGS	
		7	1-1-2-1.	CL		(CL): At 11': Color change to 3/3 7.5YR dark brown. Moist; 0% gravel, 20% sand, 80% fines.	SANDPACK Type: Granusil Interval: 5-27' BGS	
15		8	1-2-2-1.			(CL): At 13': Color change to 4/4 7.5YR brown. Wet; 0% gravel, 20% sand, 80% fines.	SCREEN Diameter: 2" Type: No 10 Slot Interval: 7-27' BGS	
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.		

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:

O:\GINT\PROJECTS\34301012.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

State of North Dakota

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58505

MONITORING WELL REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

Name MDU-Heskett Station

Address 2025 38th Street

Mandan, North Dakota

2. WELL LOCATION **(MW-80R)**

Address (if in city) (see attached drawing)

County Morton

NE ¼ SE ¼ SW ¼ Sec. 10 Twp. 139 N. Rge. 81 W.

Lat. 46.86789 Long.: -100.89320

Altitude:

3. METHOD DRILLED

■ Auger Other

4. WELL CONSTRUCTION

Diameter of Hole 8 inches Depth 27 feet

Riser: ■ PVC □ Other

■ Threaded □ Solvent □ Other

Riser rating SDR Schedule 40

Diameter 2.0 inches

From +2.5 ft. to 7 ft.

Was a well screen installed? ■ Yes □ No

Material Schedule 40 PVC Diameter 2.0 inches

Slot Size #10 set from 7 feet to 27 feet

Sand packed from 5 ft to 27 ft

Depth grouted from 1 ft to 5 ft

Grouting Material

Bentonite x Other

If other explain:

One foot concrete collar at surface

Well head completion:

24" above grade Other x

If other, specify 4" x 4" x 5' steel cover

Was protective casing installed? ■ Yes □ No

Was well disinfected upon completion? □ Yes ■ No

5. WATER LEVEL

Static water level 12 feet below surface

If flowing: closed in pressure psi or ft. above land surface

6. WELL LOG

Formation	Depth (Ft.) From	To
Topsoil	0	0.5
Sandy lean clay	0.5	27

(Use separate sheet if necessary)

7. WAS THE HOLE PLUGGED OR ABANDONED?

□ Yes ■ No

If so, how?

8. REMARKS

3 steel bumpers installed around well head

9. DATE COMPLETED 10-21-14

10. CONTRACTOR CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Midwest Testing Laboratory, Inc. 444

Monitoring Well Contractor Certificate No.

P.O. Box 2084, Bismarck, ND 58502-2084

Address

Signature 10-22-14

Date

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

LOG OF BORING MW-101
DRAFT

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

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-101
DRAFT

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

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-101
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
50				CH		FAT CLAY (CH): Black (2.5/1 7.5YR); very stiff; hight plasticity; wet at 43'; [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: **2.98' 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**	1665
55								1660
60						End of boring 58.0 feet		
65								
70								
75								

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-102
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
		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**	
		2	3-2-2-3.					1700
5		3	3-3-4-5.	CL			RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **2.85' ags - 10' bgs**	
		4	3-4-5-7.				GROUT Type: **None** Interval: **None**	
		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
10		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].	SEAL Type: **Bentonite chips** Interval: **0 - 8' bgs**	
		7	3-5-7-9.			LEAN CLAY (CL): Dark Brown (3/2 7.5YR); medium to high plasticity; [Cannonball Formation].	SANDPACK Type: **Silica 40-70** Interval: **8 - 31' bgs**	
15		8	6-8-12-14.				SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **20 - 30' bgs**	1690
		9	6-10-12-16.					
		10	5-9-14-16.	CL				1685
20		11	5-12-15-18.			At 21': Color changes to Black (2.5/1).		
		12	9-15-18-22.					1680
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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-102
DRAFT

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.	USCS	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**	
		14	10-17-18-24.					
		15	6-15-18-26.			At 29': Gypsum.		1675
30		16	7-14-18-22.				RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **2.85' ags - 10' bgs**	
		17	11-16-20-27.			At 33.5' and 34': Gypsum.	GROUT Type: **None** Interval: **None**	1670
35		18	10-14-15-24.	CL			SEAL Type: **Bentonite chips** Interval: **0 - 8' bgs**	
		19	13-19-25-35.				SANDPACK Type: **Silica 40-70** Interval: **8 - 31' bgs**	
		20	8-17-26-31.					1665
40		21	10-20-27-38.				SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **20 - 30' bgs**	
		22	13-20-27-37.					1660
45		23	15-27-27-32.	SM		SILTY SAND (SM): fine to medium grained; Dark Gray (4/1 7.5YR); wet; [Cannonball Formation].		
						End of boring 46.0 feet		
50								

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-103
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0				OL/OH		TOPSOIL (OL/OH): Brown (5/4 7.5YR).		
		1	3-4-5-5.			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**	
		2	5-5-8-8.	CL			RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **2.79' ags - 24' bgs**	1710
5		3	5-8-10-11.				GROUT Type: **Neat cement** Interval: **0 - 19' bgs**	
		4	6-9-15-15.			POORLY GRADED SAND WITH GRAVEL (SP): fine to coarse grained; Brown (5/4 7.5YR); some oxidized staining, some mottling; [Cannonball Formation].	SEAL Type: **Bentonite chips** Interval: **19 - 22' bgs**	
		5	5-6-5-4.	SP			SANDPACK Type: **Silica 40-70** Interval: **22 - 44' bgs**	1705
10		6	4-5-5-7.				SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **24 - 44' bgs**	
		7	2-2-2-3.	SP-SM		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; Brown (5/4 7.5YR); [Cannonball Formation].		
15		8	3-3-3-3.					1700
						NO RECOVERY (16 - 20').		
20		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].		1695
25								1690

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-103
DRAFT

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.	USCS	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]. *(continued)*	PRO. CASING Diameter: **4"** Type: **Steel pipe** Interval: **3.5' ags - 1.5' bgs**	
30				SM		SILTY SAND WITH GRAVEL (SM): wet; [Cannonball Formation].	RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **2.79' ags - 24' bgs**	1685
		11	10-10-7-9.			LEAN CLAY (CL): Brown (4/4 7.5YR); moist; oxidized staining; medium to high plasticity; [Cannonball Formation].	GROUT Type: **Neat cement** Interval: **0 - 19' bgs**	
		12	8-15-17-22.			At 32.5': Sand lens, color changes to Black (2.5/1 7.5YR).		
35		13	7-19-15-25.			At 33.5': Sand lens. At 34': Interbedded sand with oxidized staining.	SEAL Type: **Bentonite chips** Interval: **19 - 22' bgs**	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.	SANDPACK Type: **Silica 40-70** Interval: **22 - 44' bgs**	
		15	50 for 2"`-.				SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **24 - 44' bgs**	
40		16	12-17-22-30.			At 42-42.5': Silt layer.		1675
		17	9-18-24-50.			At 43.5-44': Silt layer.		
45						End of boring 44.0 feet		
50								

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-104
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
		1	4-5-5-5.	CL		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	3-5-6-8.					
5		3	3-7-9-10.	CL		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	5-7-9-10.				GROUT Type: **None** Interval: **None**	
		5	5-9-9-10.				SEAL Type: **Bentonite chips** Interval: **0 - 7' bgs**	
10		6	5-7-9-10.			At 12': Heavily oxidized.		1670
		7	5-8-8-12.				SANDPACK Type: **Silica 40-70** Interval: **7 - 32' bgs**	
15		8	5-9-11-15.			At 15': Start seeing black staining.	SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **9 - 29' bgs**	
		9	6-9-11-13.			At 17': Heavily oxidized.		1665
		10	4-7-16-19.	SM		SILTY SAND (SM): Strong Brown (5/6 7.5YR); wet; [Cannonball Formation].		
20						At 19.5': Color change to Brown (5/4 7.5YR).		
		11	5-16-22-26.			At 21': Oxidized layer.		1660
		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].		
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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-104
DRAFT

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.	USCS	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)*		1655
		14	8-12-16-21.	CH				
		15	8-12-16-20.					
30		16				Driller notes: sluff.		1650
						End of boring 32.0 feet		
35								
40								
45								
50								

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**

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:

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

LOG OF BORING MW-105
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
		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**	1685
		2	5-5-5-6.					
		3	3-2-4-5.	CL			RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **3.16' ags - 10' bgs**	1680
5		4	2-2-2-3.					
		5	2-1-2-2.			LEAN CLAY (CL): Brown (4/2 7.5YR); soft; high plasticity; wet at 16'; [Cannonball Formation].	GROUT Type: **None** Interval: **None**	
10 ▼		6	2-1-2-1.			At 10.5': Color change to Reddish-Yellow (6/6 7.5YR).	SEAL Type: **Bentonite chips** ▼ Interval: **0 - 7' bgs**	1675
		7	2-1-1-3.				SANDPACK Type: **Silica 40-70** Interval: **7 - 30' bgs**	
15		8	4-3-5-5.	CL		At 14.5-15.5': Gravel inclusions. At 15.5': Color change to Brown (4/3 7.5YR).	SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **10 - 30' bgs**	1670
		9	7-9-11-13.					
		10	7-9-11-13.			At 18': Color change to Brown (5/3 7.5YR).		
20		11	7-9-13-15.					1665
		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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-105
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
25		13	15-25-31-40.					
		14	10-15-18-30.	CL		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
		15	11-16-22-32.					
30						End of boring 30.0 feet		
35								
40								
45								
50								

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**

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

STATE OF NORTH DAKOTA

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58501

WELL DRILLER'S REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

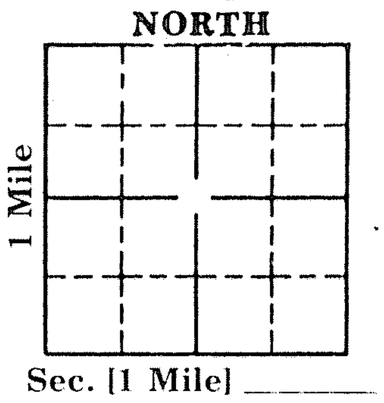
Name Montana Dakota Utilities

Address Bismarck, ND

2. WELL LOCATION

Sketch map location must agree with written location.

Heskett Ash
Dispoal Site
#1-90
139-81-10CAD
Top nof pipe
1675.54
Ground level
1673.6



County Morton

SE ¼ NE ¼ SW ¼ Sec. 10 Twp. 139 N. Rg. 81 W.

3. PROPOSED USE

☐ Domestic ☐ Geothermal ☒ Monitoring
☐ Stock ☐ Irrigation ☐ Industrial
☐ Municipal ☐ Test Hole

4. METHOD DRILLED

☐ Cable ☐ Reverse Rotary ☐ Bored
☒ Forward Rotary ☐ Jetted ☐ Auger

If other, specify

5. WATER QUALITY

Was a water sample collected for:
Chemical Analysis? ☐ Yes ☐ No
Bacteriological Analysis? ☐ Yes ☐ No
If so, to what laboratory was it sent

6. WELL CONSTRUCTION

Diameter of hole 5 inches. Depth 15 feet.

Casing: ☐ Steel ☒ Plastic ☐ Concrete
☐ Threaded ☐ Welded ☐ Other

If other, specify

Pipe Weight:	Diameter:	From:	To:
SDR-21 lb/ft.	2 inches	±2.0 feet	5 feet
lb/ft.	inches	feet	feet
lb/ft.	inches	feet	feet

Was perforated pipe used? ☐ Yes ☒ No

Perforated pipe set from ft to feet

Was casing left open end? ☐ Yes ☒ No

Was a well screened installed? ☒ Yes ☐ No

Material PVC Diameter 2 inches
(stainless steel, bronze, etc.)

Slot size 10 set from 5 feet to 15 feet

Slot size set from feet to feet

Was a packer or seal used? ☒ Yes ☐ No

If so, what material cse bentonite Depth 3 to 4 Ft.

Type of well: Straight screen ☐ Gravel packed ☒

Depth grouted: From 3 To surface

Grouting Material: Cement X Other

If other explain: w/bentonite

Well head completion: Pitless unit

12" above grade X Other

If other, specify

Was pump installed: ☐ Yes ☒ No

Was well disinfected upon completion? ☐ Yes ☒ No

7. WATER LEVEL

Static water level 12.3 feet below land surface

If flowing: closed-in pressure psi

GPM flow through inch pipe

Controlled by: ☐ Valve ☐ Reducers ☐ Other

If other, specify

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Other

Pumping level below land surface:

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

9. WELL LOG

Formation	Depth (ft.) From	To
Clay, fill	0	3
Sand, fine to medium, yellowish brown	3	6
Clay, silty, yellowish brown, bedrock	6	13
Clay, silty, medium gray	13	15

(Use separate sheet if necessary.)

10. DATE COMPLETED 2/5/90

11. WAS WELL PLUGGED OR ABANDONED?

☐ Yes ☒ No

If so, how

12. REMARKS:

2" PVC cap on bottom of screen
160# of silica sand pack

13. DRILLER'S CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Water Supply, Inc. 46
Driller's or Firm's Name Certificate No

Box 1191 - Bismarck, ND 58502
Address

Lewis Knutson 2/5/90
Signed by Lewis Knutson Date

WHITE—DRILLER'S COPY YELLOW—BOARD'S COPY PINK—CUSTOMER'S COPY

STATE OF NORTH DAKOTA

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58501

WELL DRILLER'S REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

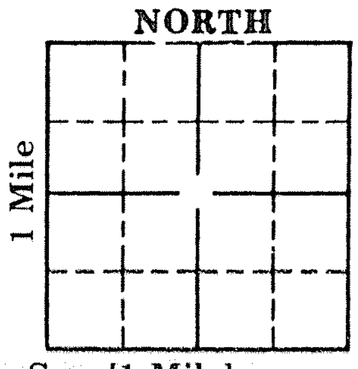
Name Montana Dakota Utilities

Address Bismarck, ND

2. WELL LOCATION

Sketch map location must agree with written location.

Heskett Ash
Disposal Site
#2-90
139--81-10CAB1
Top of pipe
1686.54
Ground level
1684.3



County Morton

SW ¼NE ¼ NW ¼ Sec. 10 Twp. 139 N. Rg. 81 W.

3. PROPOSED USE

☐ Domestic ☐ Geothermal ☒ Monitoring
☐ Stock ☐ Irrigation ☐ Industrial
☐ Municipal ☐ Test Hole

4. METHOD DRILLED

☐ Cable ☐ Reverse Rotary ☐ Bored
☒ Forward Rotary ☐ Jetted ☐ Auger

If other, specify

5. WATER QUALITY

Was a water sample collected for:
Chemical Analysis? ☐ Yes ☐ No
Bacteriological Analysis? ☐ Yes ☐ No
If so, to what laboratory was it sent

6. WELL CONSTRUCTION

Diameter of hole 5 inches. Depth 23 feet.

Casing: ☐ Steel ☒ Plastic ☐ Concrete
☐ Threaded ☐ Welded ☐ Other

If other, specify

Pipe Weight:	Diameter:	From:	To:
SDR-21 ~~lb/ft.~~	2 inches	+2.3 feet	13 feet
lb/ft.	inches	feet	feet
lb/ft.	inches	feet	feet

Was perforated pipe used? ☐ Yes ☒ No

Perforated pipe set from ft to feet

Was casing left open end? ☐ Yes ☒ No

Was a well screened installed? ☒ Yes ☐ No

Material PVC Diameter 2 inches
(stainless steel, bronze, etc.)

Slot size 10 set from 13 feet to 23 feet

Slot size set from feet to feet

Was a packer or seal used? ☒ Yes ☐ No

If so, what material ~~cse~~ bentonite Depth 11 to 12 Ft.

Type of well: Straight screen ☐ Gravel packed ☒

Depth grouted: From 11 To surface

Grouting Material: Cement X Other

If other explain: w/bentonite

Well head completion: Pitless unit

12" above grade X Other

If other, specify

Was pump installed: ☐ Yes ☒ No

Was well disinfected upon completion? ☐ Yes ☒ No

7. WATER LEVEL

Static water level dry feet below land surface

If flowing: closed-in pressure psi

GPM flow through inch pipe

Controlled by: ☐ Valve ☐ Reducers ☐ Other

If other, specify

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Other

Pumping level below land surface:

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

9. WELL LOG

Formation	Depth (ft.) From	To
Topsoil, silty, black	0	1
Sand, fine, yellowish gray	1	6.5
Clay, silty, yellowish brown, till	6.5	11
Clay, silty, medium gray	11	13
Sand	13	15.5
Clay, silty, medium gray, bedrock	15.5	23

(Use separate sheet if necessary.)

10. DATE COMPLETED 2/5/90

11. WAS WELL PLUGGED OR ABANDONED?

☐ Yes ☒ No

If so, how

12. REMARKS:

2" PVC cap on bottom of screen
160# silica sand pack

13. DRILLER'S CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Water Supply, Inc. 46
Driller's or Firm's Name Certificate No.

Box 1191 - Bismarck, ND 58502
Address

Lewis Knutson 2/5/90
Signed by Lewis Knutson Date

WHITE—DRILLER'S COPY YELLOW—BOARD'S COPY PINK—CUSTOMER'S COPY

STATE OF NORTH DAKOTA

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58501

WELL DRILLER'S REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

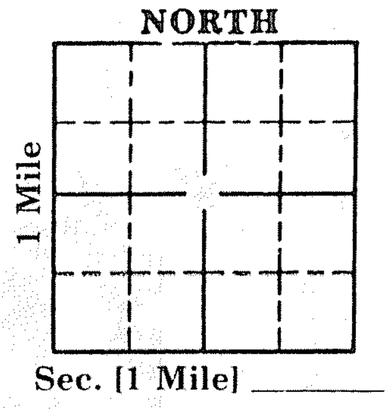
Name Montana Dakota Utilities

Address Bismarck, ND

2. WELL LOCATION

Sketch map location must agree with written location.

Heskett Ash Disposal Site #3-90
139-81-10CAB2
Top of pipe 1685.92
Ground level 1683.6



County Morton

SW ¼ NE ¼ NW ¼ Sec. 10 Twp. 139 N. Rg. 81 W.

3. PROPOSED USE

☐ Domestic ☐ Stock ☐ Geothermal ☐ Irrigation ☐ Municipal ☒ Monitoring ☐ Industrial ☐ Test Hole

4. METHOD DRILLED

☐ Cable ☐ Reverse Rotary ☐ Bored
☒ Forward Rotary ☐ Jetted ☐ Auger

If other, specify

5. WATER QUALITY

Was a water sample collected for:
Chemical Analysis? ☐ Yes ☐ No
Bacteriological Analysis? ☐ Yes ☐ No
If so, to what laboratory was it sent

6. WELL CONSTRUCTION

Diameter of hole 5 inches. Depth 20 feet.

Casing: ☐ Steel ☒ Plastic ☐ Concrete ☐ Threaded ☐ Welded ☐ Other

If other, specify

Pipe Weight:	Diameter:	From:	To:
SDR-21 ~~XXXX~~ lb/ft.	2 inches	+2.3 feet	10 feet
lb/ft.	inches	feet	feet
lb/ft.	inches	feet	feet

Was perforated pipe used? ☐ Yes ☒ No

Perforated pipe set from ft to feet

Was casing left open end? ☐ Yes ☒ No

Was a well screened installed? ☒ Yes ☐ No

Material PVC Diameter 2 inches
(stainless steel, bronze, etc.)

Slot size 10 set from 10 feet to 20 feet

Slot size set from feet to feet

Was a packer or seal used? ☒ Yes ☐ No

If so, what material cse bentonite Depth 7.5 to 9 Ft.

Type of well: Straight screen ☐ Gravel packed ☒

Depth grouted: From 7.5 To surface

Grouting Material: Cement X Other

If other explain: w/bentonite

Well head completion: Pitless unit

12" above grade X Other

If other, specify

Was pump installed: ☐ Yes ☒ No

Was well disinfected upon completion? ☐ Yes ☒ No

7. WATER LEVEL

Static water level dry feet below land surface

If flowing: closed-in pressure psi

GPM flow through inch pipe

Controlled by: ☐ Valve ☐ Reducers ☐ Other

If other, specify

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Other

Pumping level below land surface:

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

9. WELL LOG

Formation	Depth (ft.) From	To
Topsoil, silty, black	0	1
Clay, silty, yellowish brown, till	1	7
Sand, fine, yellowish brown	7	8
Clay, silty, medium gray, till	8	15
Clay, silty to sandy, medium gray, abt 40% sand	15	20

(Use separate sheet if necessary.)

10. DATE COMPLETED 2/5/90

11. WAS WELL PLUGGED OR ABANDONED?

☐ Yes ☒ No

If so, how

12. REMARKS:

2" PVC cap on bottom of screen
160# silica sand pack

13. DRILLER'S CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Water Supply, Inc. 46
Driller's or Firm's Name Certificate No.

Box 1191 - Bismarck, ND 58502
Address

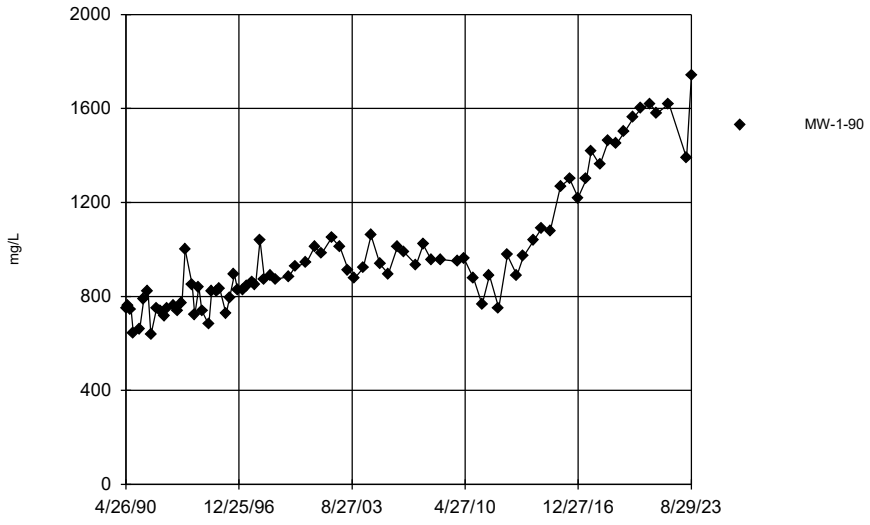
Lewis Knutson 2/5/90
Signed by Lewis Knutson Date

WHITE: DRILLER'S COPY YELLOW: BOARD'S COPY PINK: CUSTOMER'S COPY

Appendix F

MW1-90 Time Series Plots

Sodium

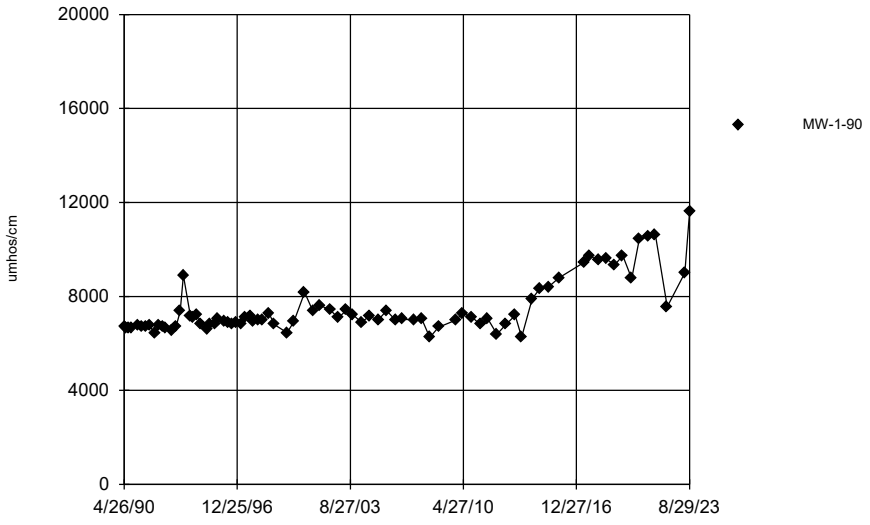


Time Series Analysis Run 5/6/2024 10:54 AM

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

Sanitas™ v.10.0.16 Software licensed to Barr Engineering Company. UG

Specific conductance

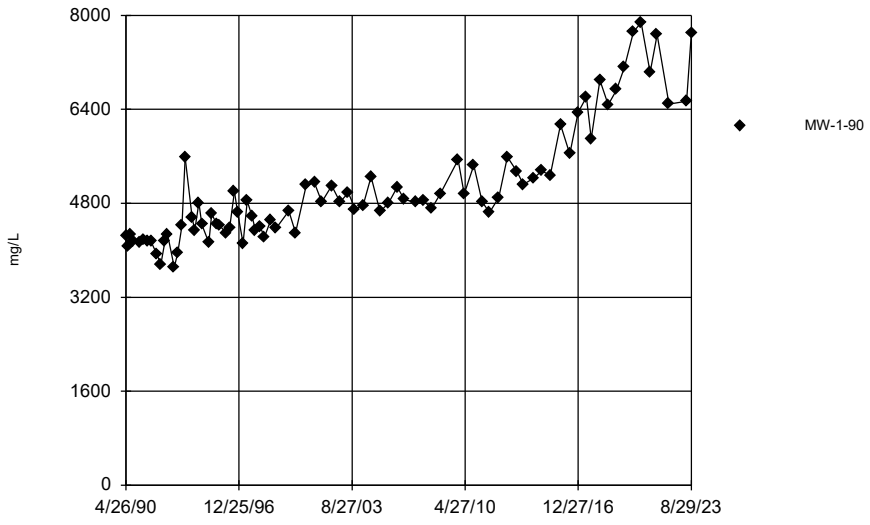


Time Series Analysis Run 5/6/2024 10:54 AM

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

Sanitas™ v.10.0.16 Software licensed to Barr Engineering Company. UG

Sulfate

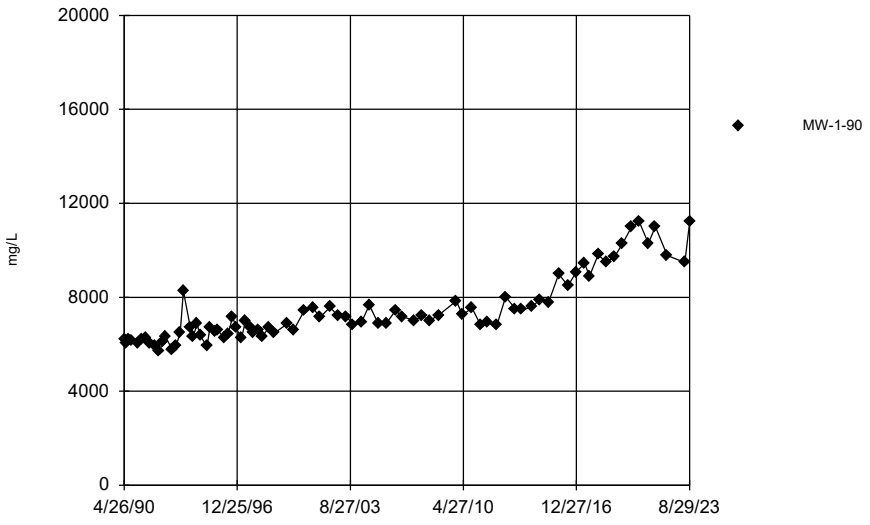


Time Series Analysis Run 5/6/2024 10:54 AM

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

Sanitas™ v.10.0.16 Software licensed to Barr Engineering Company. UG

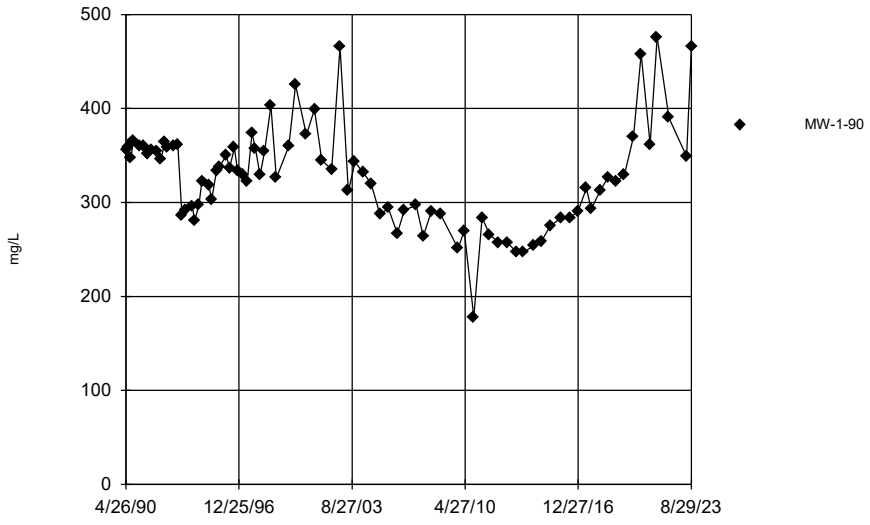
TDS



Time Series Analysis Run 5/6/2024 10:54 AM

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

Alkalinity, bicarbonate

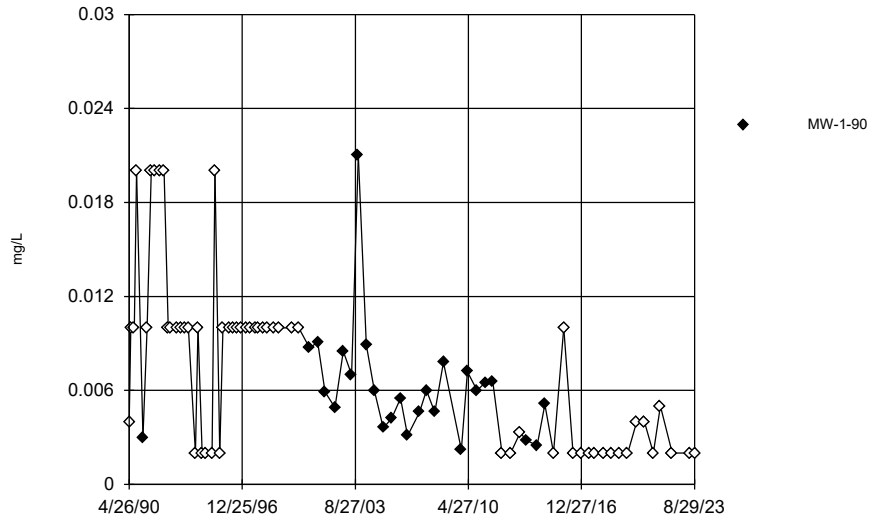


Time Series Analysis Run 5/6/2024 10:54 AM

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

Hollow symbols indicate censored values.

Arsenic

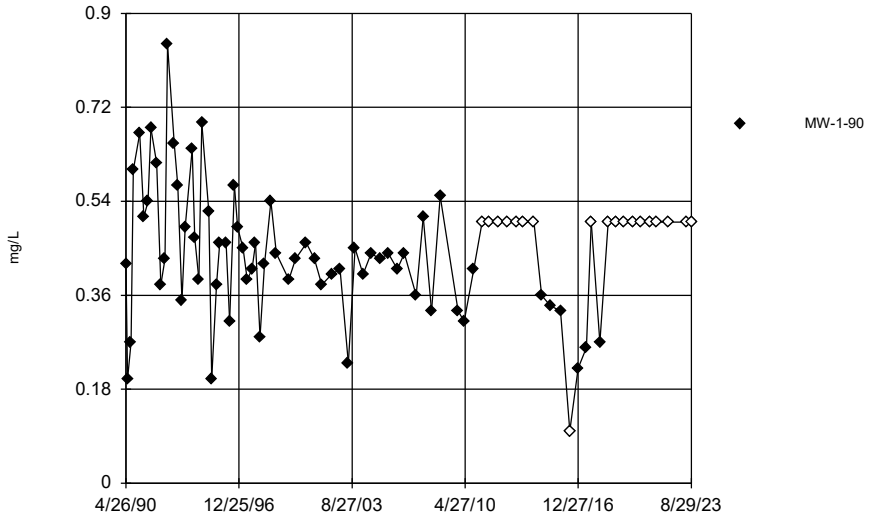


Time Series Analysis Run 5/6/2024 10:54 AM

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

Hollow symbols indicate censored values.

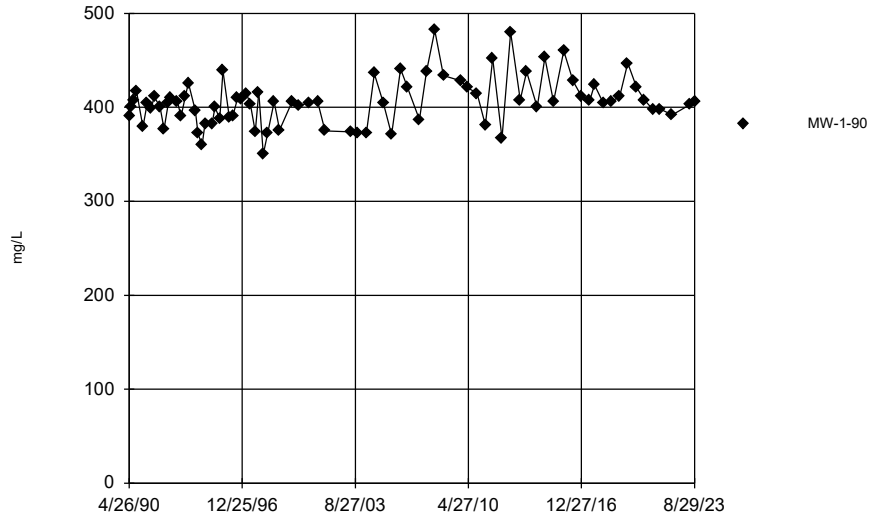
Boron



Time Series Analysis Run 5/6/2024 10:54 AM

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

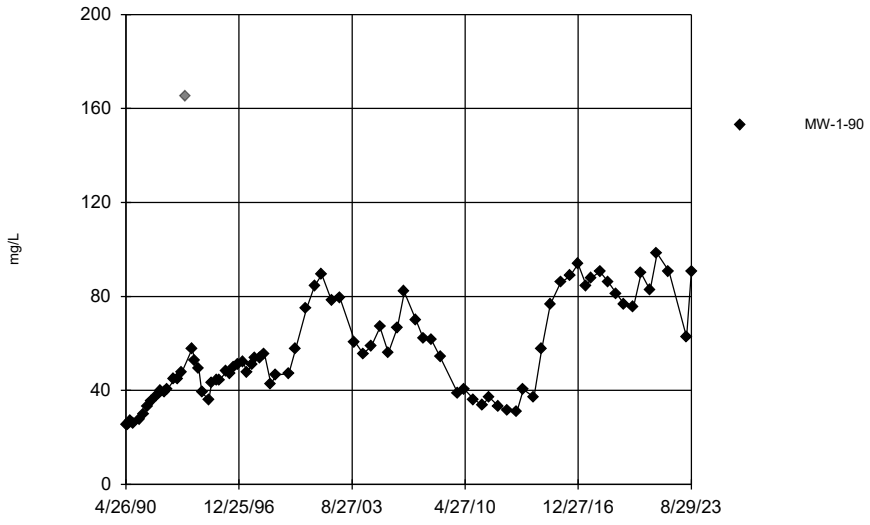
Calcium



Time Series Analysis Run 5/6/2024 10:54 AM

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

Chloride

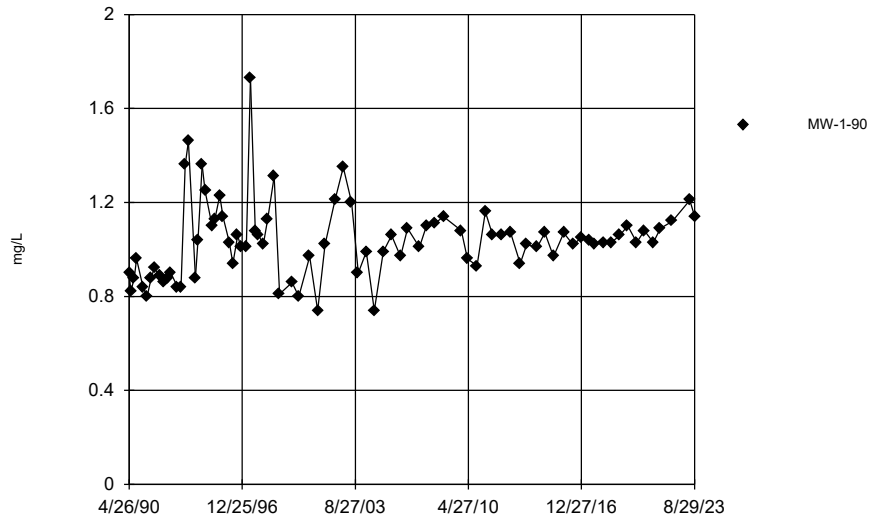


Time Series Analysis Run 5/6/2024 10:54 AM

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

Sanitas™ v.10.0.16 Software licensed to Barr Engineering Company. UG

Fluoride

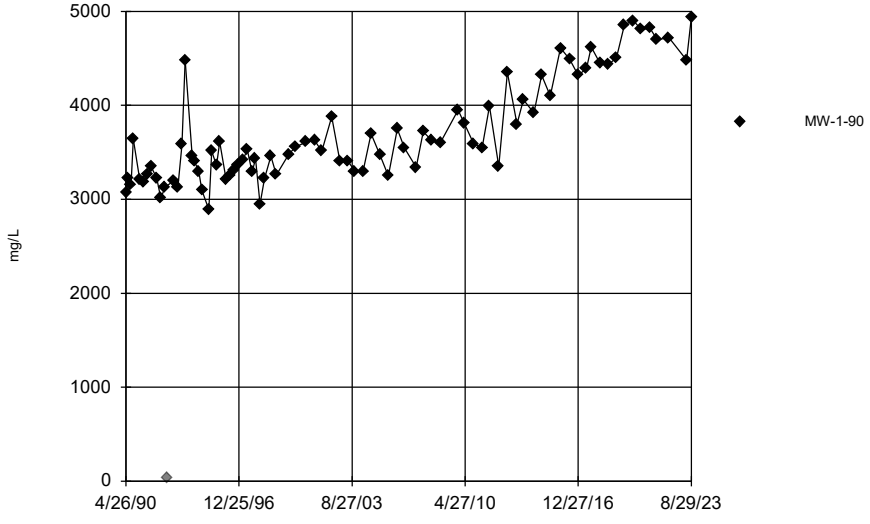


Time Series Analysis Run 5/6/2024 10:54 AM

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

Sanitas™ v.10.0.16 Software licensed to Barr Engineering Company. UG

Hardness

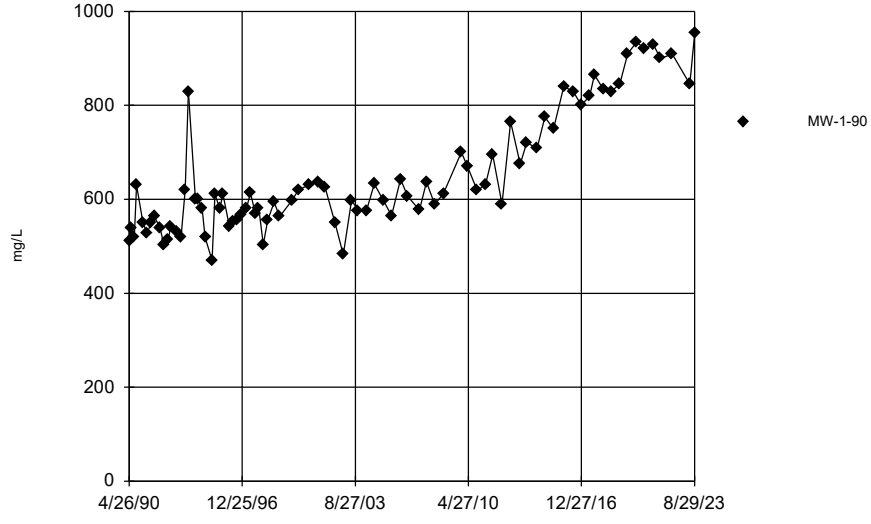


Time Series Analysis Run 5/6/2024 10:54 AM

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

Sanitas™ v.10.0.16 Software licensed to Barr Engineering Company. UG

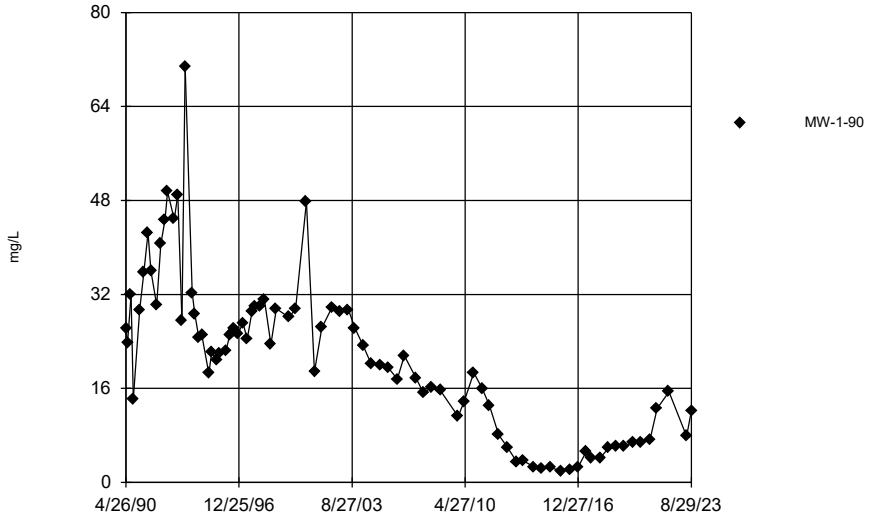
Magnesium



Time Series Analysis Run 5/6/2024 10:54 AM

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

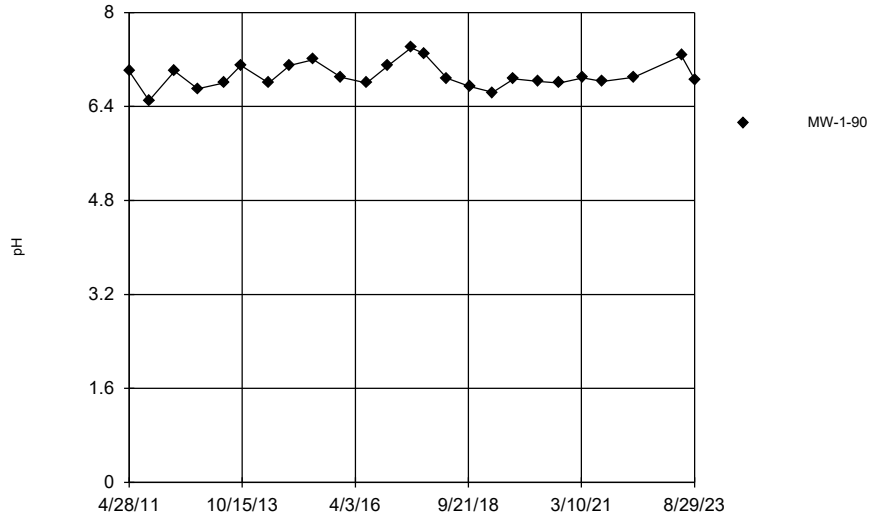
Nitrogen



Time Series Analysis Run 5/6/2024 10:54 AM

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

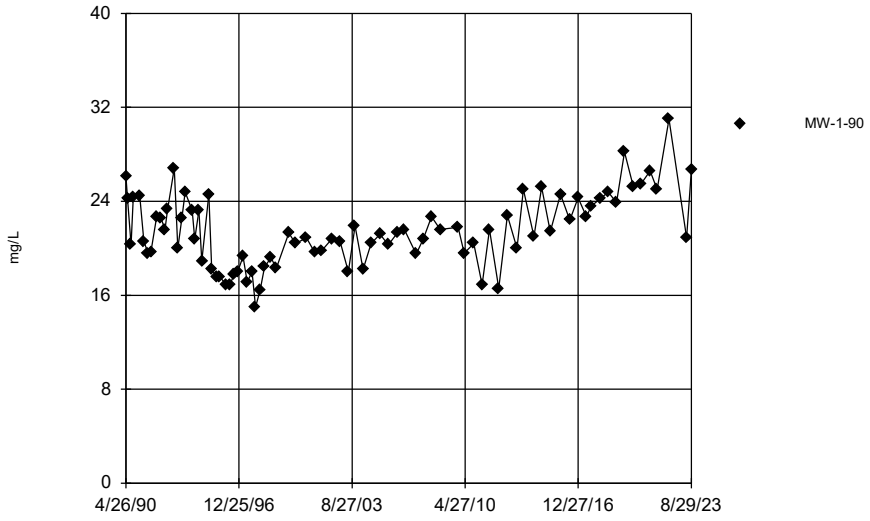
pH



Time Series Analysis Run 5/6/2024 10:54 AM

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

Potassium

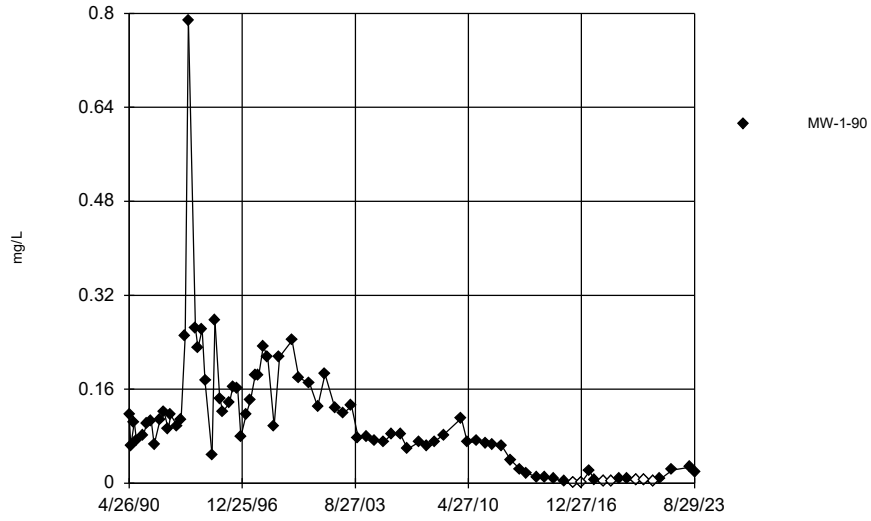


Time Series Analysis Run 5/6/2024 10:54 AM

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

Hollow symbols indicate censored values.

Selenium



Time Series Analysis Run 5/6/2024 10:54 AM

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

Appendix G

Geochemist's Workbench Results

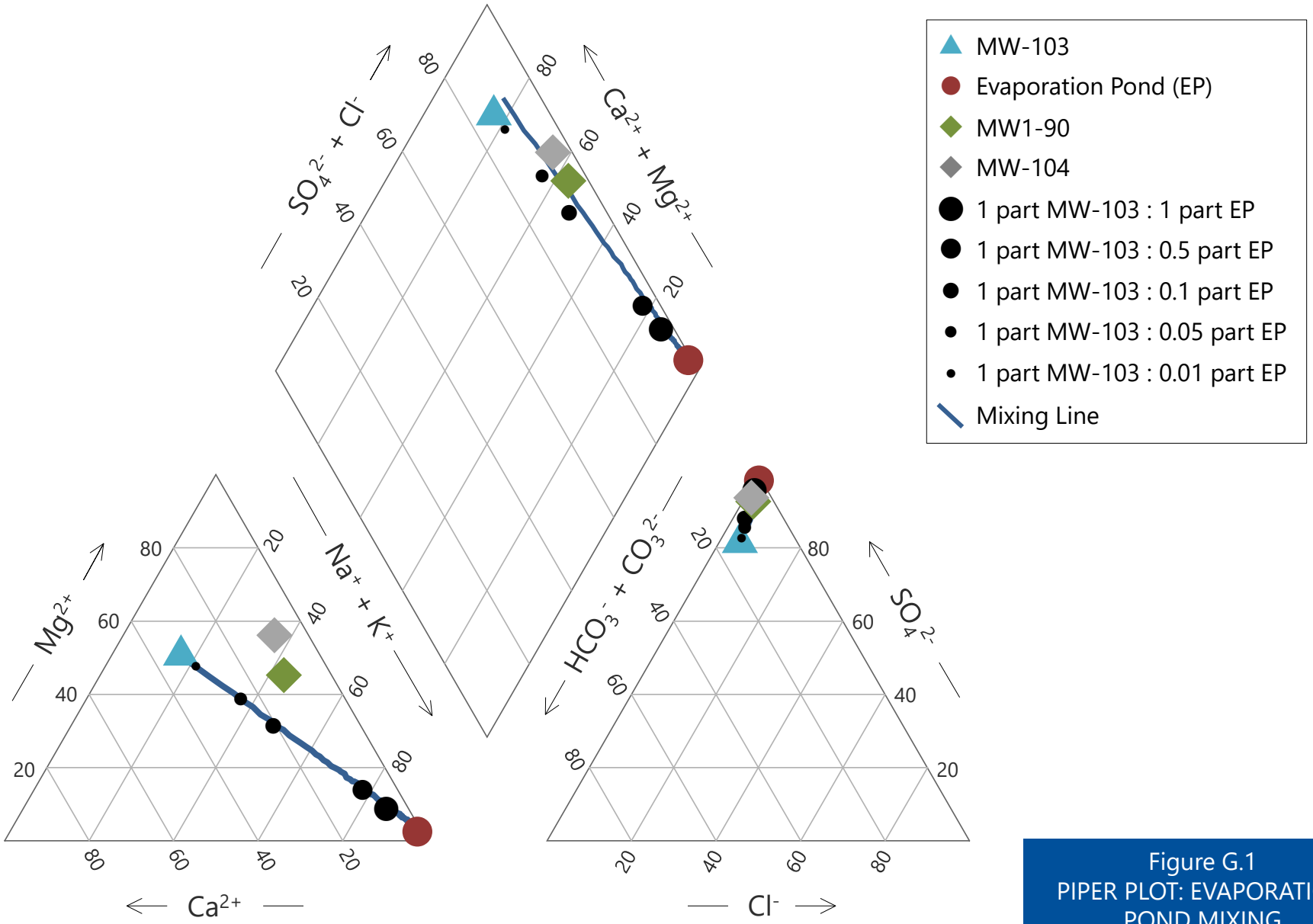
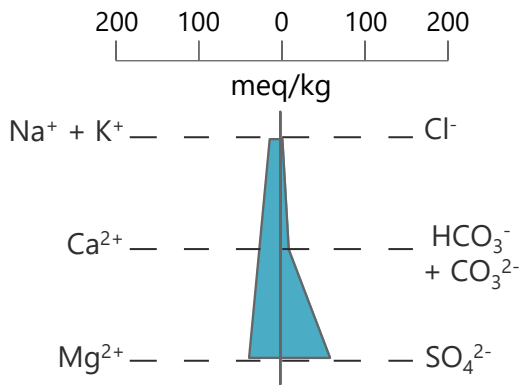
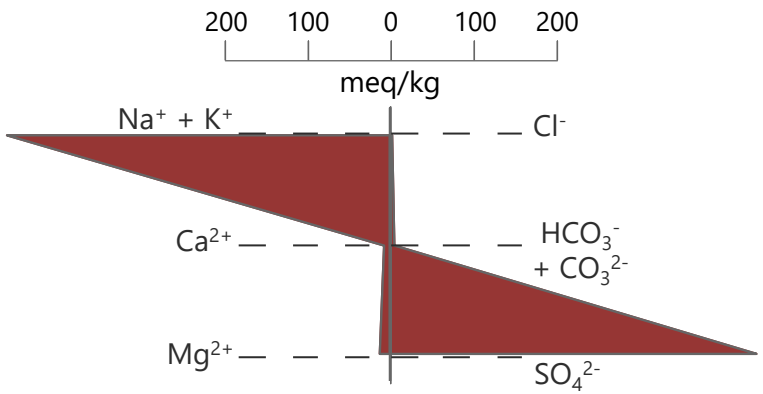


Figure G.1
PIPER PLOT: EVAPORATION POND MIXING
R.M. Heskett Station
Mandan, North Dakota

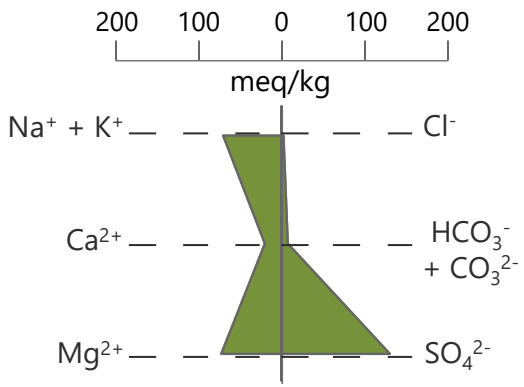
BARR



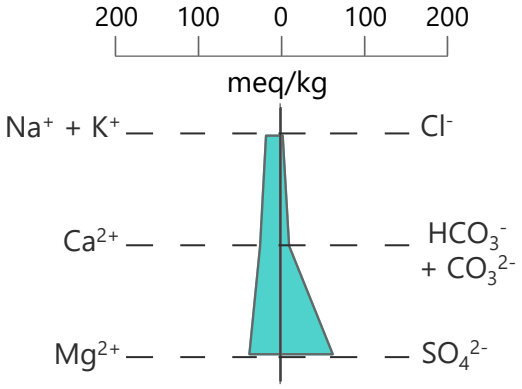
MW103



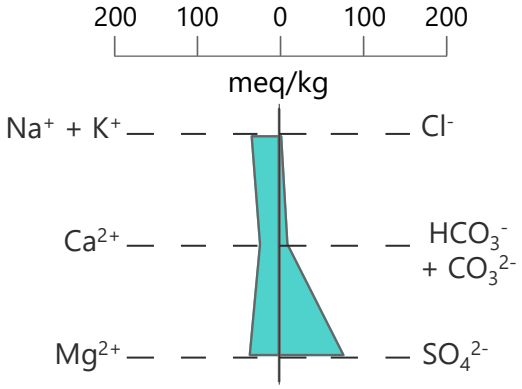
Evaporation Pond (EP)



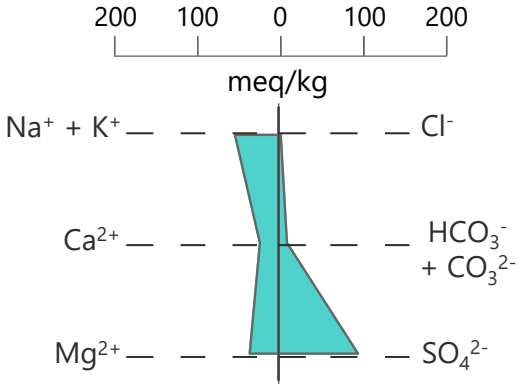
MW1-90



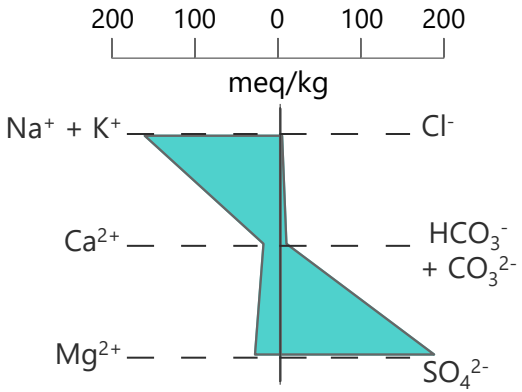
1 part MW-103 : 0.01 part EP



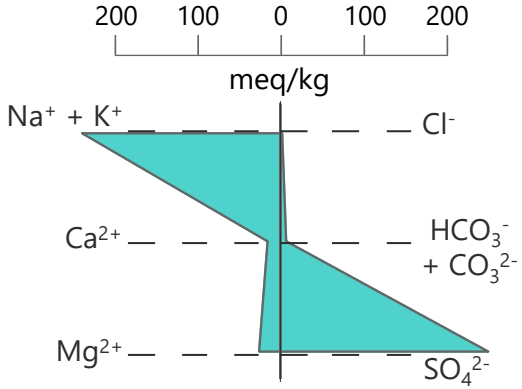
1 part MW-103 : 0.05 part EP



1 part MW-103 : 0.1 part EP



1 part MW-103 : 0.5 part EP



1 part MW-103 : 1 part EP

BARR

Figure G.2
STIFF PLOT: EVAPORATION POND MIXING
R.M. Heskett Station
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		MW-103	Evap Pond	1 : 0.01	1 : 0.05	1 : 0.1	1 : 0.5	1 : 1	MW1-90	MW-104
Sample Date		8/23/2021	9/16/2014	n/a					8/28/2023	8/24/2021
HCO3-	mg/l	645	340	642	630	617	543	492	568	820
Ca++	mg/l	500	125	496	482	466	375	313	406	422
Cl-	mg/l	119	79.8	119	117	115	106	99	90.7	94.1
F-	mg/l	0.30	0.1	0.30	0.29	0.28	0.23	0.20	1.14	0.54
Mg++	mg/l	464	165	461	450	437	364	315	953	1,640
K+	mg/l	20.0	734	27.1	54.0	84.9	258	377	26.7	34
Na+	mg/l	266	10,600	368	758	1,210	3,710	5,430	1,740	1,940
SO4--	mg/l	3,000	22,100	3,190	3,910	4,740	9,370	12,500	7,710	11,600
pH	SU	6.6	10.7	6.6	6.7	6.7	7.4	8.9	6.9	6.9
TDS	mg/kg	4,950	34,100	5,240	6,350	7,610	14,700	19,600	13,100	16,500

Alternative Source Demonstration: May 2024 Event

R.M. Heskett Station

Prepared for
Montana-Dakota Utilities Co.

November 2024

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
952.832.2600
www.barr.com

Certification

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	November 28, 2024	May 2024 Event Alternative Source Demonstration

Alternative Source Demonstration: May 2024 Event

November 2024

Contents

List of Tables

List of Figures

List of Appendices

Abbreviations

ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
NDDEQ	North Dakota Department of Environmental Quality
MDU	Montana-Dakota Utilities Co.
SPLP	Synthetic Precipitation Leaching Procedure
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
US EPA	United States Environmental Protection Agency

1 Introduction

Montana-Dakota Utilities Co. (MDU) owns and operated R.M. Heskett Station (Site), comprised of a substantially decommissioned coal-fired generating station and a gas-fired turbine located in Mandan, Morton County, North Dakota (Figure 1). Coal unit operations at the Site ended in March 2022, and decommissioning tasks have been ongoing through 2024. One coal combustion residual (CCR) unit, as defined by 40 CFR 257.53 and North Dakota Administrative Code (NDAC) 33.1-20-08-01, is located on the property. The CCR unit is a landfill containing coal combustion by-products, asbestos wastes generated from construction activity associated with MDU-owned facilities, decommissioning wastes, and ash derived from burning tire-derived fuel at the facility. Final closure of the landfill was competed in 2024.

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 May 2024 monitoring event, along with historical data, to demonstrate if the SSIs are the results of a "source other than the CCR unit" or due to natural variation in groundwater quality or an error in sampling, analysis, or statistical evaluation. Nothing in the foregoing citation of the rule requires that the owner/operator disprove any and all potential counter-arguments that EPA or others may offer to refute this demonstration. Such arguments if valid, would need to follow requirements of the rule to show a basis in fact that includes rule requirements that are based on site-specific information, and must be certified by a North Dakota licensed professional engineer.

2 May 2024 SSIs

Sampling for the first detection monitoring event in 2024 was conducted May 22, 2024. Final laboratory results were received September 4, 2024. Four potential SSIs over background were identified as SSIs (see time series plots in Appendix A and prediction limit plots in Appendix B):

- fluoride, sulfate, and TDS at MW1-90
- fluoride at MW2-90

Evaluations were undertaken to review potential alternative sources for the SSI. 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, groundwater quality data from additional site wells, and groundwater quality data collected at the Site prior to construction of the CCR unit.

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

A successful demonstration of alternative sources for the SSI are discussed in Section 3.

2.1 May 2024 Sampling Event

Concentrations for potential SSIs observed in May 2024 are shown on time series graphs in Appendix A and are consistent with those observed during the prior detection monitoring events.

Trend analysis results through 2023 indicate:

- that fluoride at MW2-90, though above the prediction limit, does not have a statistically significant trend
- that fluoride at MW1-90 has a statistically significant increasing trend
- that sulfate at MW1-90, though above the prediction limit, does not have a statistically significant trend
- that TDS at MW1-90 has a statistically significant increasing trend

2.2 Verification Sampling

Verification resampling was not conducted.

3 Alternative Source Demonstration

The purpose of this ASD Report is to evaluate whether the May 2024 SSIs were due to a CCR unit release or due to another source or to error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. For each SSI, four hypotheses regarding the potential source of the SSI are assessed: (1) a release of leachate from the CCR unit, (2) natural variations in non-landfill or regional groundwater quality are the source of one or more of the SSIs, (3) a release of leachate from the Evaporation Pond (a source other than a CCR unit) is the source of one or more of the SSIs, and (4) statistical bias due to background well selection.

Successful demonstrations of alternative sources have previously been documented for all three parameters with SSIs at locations within the previous monitoring network. The associated ASD Reports (included as appendices to Barr, 2019; Barr, 2020; Barr, 2021; Barr, 2022; Barr, 2023; and Barr, 2024) 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 (from specific geology present at site), and/or associated with a release from the Evaporation Pond (non-CCR unit). Note that in this and previous ASDs the lines of evidence are intended to provide sufficient weight of evidence in demonstration of the ASD. This means that if one or more lines of evidence are refuted, sufficient evidence remains to support validity of the ASD.

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 the SSI, it would be assumed that groundwater chemistry at one or more potentially impacted wells (MW1-90 and/or MW2-90) would be geochemically similar to impacted water from the CCR unit represented by leach testing results. However, if these liquids are geochemically dissimilar, this indicates that a source "other than the CCR unit" may be responsible for the SSI. Therefore, major ion chemistry from the CCR groundwater monitoring locations (upgradient and downgradient) was compared to CCR Synthetic Precipitation Leaching Procedure (SPLP; EPA Method 1312) data collected July 2011 (Appendix C).

To further test the hypothesis of a source other than the CCR unit, a Piper diagram (Figure 2) was used to visually compare the CCR SPLP results (Appendix C) and the measured groundwater quality at the Site. Piper diagrams are plots of major ion chemistry of water samples (calcium, magnesium, potassium, sodium, chloride, sulfate, and [bi]carbonate) that are used to differentiate between water types and to identify potential mixing of water types. The Piper diagram provides 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 et al., 2020). On the Piper diagram depicted in Figure 2, downgradient well compositions are shown as circular points, CCR SPLP compositions as orange triangles, and the range of upgradient compositions as a yellow polygon. All of the downgradient wells plot within the range of upgradient groundwater chemistry. The CCR SPLP results do not.

Downgradient water quality (including the SSI parameter-well pairs) is characterized as an intermediate-sulfate type water, whereas the ash SPLP results are sodium-sulfate type water. The major difference

observed between the downgradient water quality and the SPLP results is the dominant cation composition (no cation strongly dominant vs. heavily dominant sodium). All of the SSI well-parameter pairs are clustered with data from that of the upgradient wells, which are intermediate-sulfate water, rather than near the ash SPLP results, which are high sulfate. These results indicate that the water chemistry at the downgradient locations is more like upgradient groundwater than would be expected from a potential release from the CCR unit. **Therefore, we reject the hypothesis that the CCR unit is the source of the sulfate observed at MW1-90.**

The EPA has offered criticism of ASDs using Piper Plots, as part of its determinations under Part A and Part B exemptions under the CCR rule. In these determinations, the EPA has made the argument without accompanying supporting evidence that Piper Plots are not suitable for ASDs because of one or more of the following reasons:

a. *Leachate is not groundwater, and therefore different water types cannot be directly compared*. This position is inconsistent with the fundamental premise within the CCR Rule that SSIs are due to changes that occur in groundwater due to a release of leachate from a CCR unit. Statistical methods are a means of making this comparison, Piper Plots are another. The utility of Piper Plots is that they are useful means of visualizing data and are part of the professional standard of care for comparing the dissolved constituents for any type of solution chemistry for any type of water. If the groundwater were influenced by a release of leachate, it is likely that the change in equilibrium chemistry within the flow system would show some influence on major ion composition. Therefore, Piper Plots are a valuable tool for comparing leachate and groundwater chemistry.

b. *There may be reactions in the subsurface that might influence the results and thereby reduce or add constituents to the downgradient groundwater*. While this may be true at some scale for some parameters, it is generally not true of Appendix III parameters which are major ions that are generally not reactive in the subsurface. As stated in the preamble to the CCR Rule, EPA states that it selected the Appendix III parameters as indicators of coal ash leachate because they are mobile (and hence not reactive) in the subsurface.

c. *Using a single leach test cannot represent the water quality found at a downgradient monitoring well*. The issue is whether a single leach sample is representative of leachate as a distinct water type. As long as the leachate sample is sufficiently different from groundwater, it is useful in assessing the potential effects of a release on downgradient groundwater. In this ASD, several leach tests are used, and they are all more similar to each other than they are to groundwater samples in terms of both the overall concentration of parameters and the proportionate ratios of various parameters along the flow path (which generally do not change along the flow path due to dilution). Therefore, Piper Plots not only show the differences between the two water types; they can also demonstrate the effects of dilution that allows for assessment of a release.

3.2 Source Hypothesis #2: Natural Variations in Pre-Landfill and Site-Specific Background Water Quality

As Source Hypothesis #1 (CCR Unit Release) was rejected as a potential source of the SSIs, a second hypothesis was evaluated to identify the potential source of concentrations of SSI parameters and further reinforce the demonstration that the SSIs were not related to the CCR unit. To do this, we evaluated the SSIs by comparison to historical groundwater quality data collected at the Site before the landfill was constructed (pre-landfill data), additional upgradient well 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.

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 current CCR unit is undisturbed (Appendix D) on the date that this image was taken.

Discussion of pre-landfill groundwater samples in the Permit Application notes that high calcium, chloride, fluoride, sulfate, TDS, and other parameters were observed at the Site.

3.2.1 Fluoride at MW1-90 and 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 is included in Table 1 below. As above, the Cannonball is the specific geologic formation present at the Site, and the results are specific to the local area of the Site. Consideration of this information is required to establish a professional standard of care.

Table 1 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 Klausing, 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 MW1-90 and MW2-90 in May

2023 (1.11 mg/L and 1.05 mg/L, respectively) are within the range of values consistent with naturally occurring concentrations of fluoride associated with the Cannonball Formation in Morton County. However, a statistically significant increasing trend for fluoride at MW1-90 was observed, while no trend was observed at MW2-90. **Therefore, we accept the hypothesis that fluoride concentrations observed at MW1-90 and MW2-90 are consistent with regional (background) groundwater data; however, additional source considerations were evaluated, as described in Section 3.3.**

3.2.2 TDS at MW1-90

As noted in previous sections, high variability and concentrations of various parameters have been noted in groundwater at the Site and in the region. This observation extends to TDS. The maximum TDS concentration reported in the 1989 Permit Application from 1986 (pre-landfill) was 14,917 mg/L (Well 60), with similar concentrations observed two years later, indicating that high TDS pre-dates landfill construction.

Based on presence of gypsum in native subsurface deposits and documentation of elevated TDS in pre-landfill groundwater, the hypothesis that the SSI for TDS at MW1-90 may be due to natural conditions is probable. Significantly increasing TDS concentrations were observed in other monitoring system wells, including upgradient wells MW-13, MW-103, and MW-44R. Because the elevated TDS was documented prior to the placement of ash, there is evidence that elevated TDS was present at the landfill in concentrations that explain the concentrations observed more recently as due to natural or pre-existing conditions unrelated to the CCR Unit. **TDS concentrations at MW1-90 may be due to natural conditions; however, additional source considerations were evaluated, as described in Section 3.3.**

3.2.3 Sulfate at MW1-90

Like the other parameters discussed, there is variable sulfate concentrations both at the Site and in the region. The maximum sulfate concentration reported in the 1989 Permit Application from 1986 (pre-landfill) was 11,632 mg/L (Well 60), indicating that high sulfate concentrations pre-date construction of the CCR unit.

Sulfate and TDS concentrations are strongly related as sulfate accounts for 50-70% of TDS. Gypsum, a source of groundwater sulfate, is well-documented on site as discussed in Section 3.2.1 and Section 3.2.4. As noted, the boring logs for CCR wells and pre-landfill wells note gypsum occurrences across the Site (Appendix E). As groundwater fluctuates and surface water infiltration occurs, periodic dissolution of gypsum into the water column may occur, resulting in elevated sulfate. Because the elevated sulfate was documented prior to the placement of ash, there is evidence that elevated sulfate was present at the landfill in concentrations that explain the concentrations observed more recently as due to natural or pre-existing conditions unrelated to the CCR Unit.

These results support the hypothesis that the SSI for sulfate at MW1-90 is due to natural variation in groundwater quality. **Therefore, we accept the hypothesis that sulfate concentrations observed at MW1-90 are due to variability in natural conditions and are consistent with regional and Site background groundwater data.**

3.3 Source Hypothesis #3: Evaporation Pond Release

Two conditions are necessary to accept the hypothesis that a release of Evaporation Pond water is the source of one or more of the SSIs: (1) mechanism of release (such as an issue with the 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 MW1-90 (fluoride, sulfate, and TDS) are being evaluated for this potential source.

3.3.1 Fluoride, Sulfate, and TDS at MW1-90

A statistically significant increasing trend in fluoride and TDS was observed at MW1-90 following the May 2024 detection monitoring event. Past ASD Reports (Barr, 2020; Barr, 2021; Barr, 2022) attributed elevated 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), approximately 225 feet southwest of MW1-90, which is located north of the Evaporation Pond. The Evaporation Pond was designed and constructed to collect surface water run-off from the Site as well as leachate from the CCR Unit. It is not a CCR unit as defined in § 257.53. Due to the relative proximity of MW1-90 to the Evaporation Pond and MW-104, an evaluation was conducted to assess the Evaporation Pond liner integrity and potential impacts to downgradient wells and determine the geochemical feasibility of Evaporation Pond water contributing to the conditions observed at MW1-90.

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; 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, whether the erosion cuts were 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 well MW1-90 (Appendix F) show an increase in sodium; this increase is most apparent at MW1-90 between 2012 and 2024. 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.

Potential Downgradient Effects

The base of the Evaporation Pond sits at approximately 1675 feet above MSL, whereas historical groundwater elevations in MW-104 and MW1-90 remain below 1675 feet MSL. Therefore, any water leaking from the Evaporation Pond would move radially outward from the pond through the unsaturated zone downward into the groundwater, toward both MW-104 and MW1-90, reaching both wells downgradient of the Pond.

Groundwater monitoring data have consistently been collected from MW1-90 since 1990. As seen in the time series plots (Appendix F; 1990-2024), in approximately 2010 the 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 continued, despite reports of the erosional cuts being repaired in 2013, except for chloride, which has since leveled off.

Geochemical Feasibility

A simple mixing model was developed in April 2019 (Barr, 2020) to determine the potential of producing a similar water quality to that observed at MW-104 and MW1-90 when mixing Evaporation Pond water with unimpacted upgradient water. This mixing model was conducted in Geochemist's Workbench® v.12.0, using data from water samples collected from the Evaporation Pond and upgradient monitoring well MW-103. 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 upgradient groundwater concentrations used in the model were from a sample from upgradient monitoring well MW-103 collected in April 2019, which is assumed to represent the long-term composition of groundwater in that vicinity due to the fairly stable concentrations of major ions exhibited in samples from MW-103 (Barr, 2020). The Evaporation Pond concentrations used in the model were from a sample collected from the pond in September 2014, which is assumed for the purposes of the model to represent a typical Evaporation Pond water composition during the period when the pond liner was compromised.

The results of the model are provided in Appendix G. Figure G.1 shows the results of the mixing model on a Piper diagram. 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 (represented by a blue triangle) with the Evaporation Pond (represented by a red circle). The black circles 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 G.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 MW1-90 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" groundwater from upgradient to get a similar chemistry as observed downgradient in MW1-90. The geometry of the Stiff plots in Figure G.2 shows the similarity in ionic composition in the mixing models.

Recorded measurements of fluoride concentrations in the Evaporation Pond have generally been low (<0.3 mg/L), and therefore a release from the Evaporation Pond is unlikely to be a direct source of fluoride to groundwater. However, the Evaporation Pond water has several characteristics that can lead to the release of fluoride from clays and other minerals in aquifer sediments. The pH of the Evaporation Pond is high (≥10), meaning that the water has a high concentration of hydroxide ions. Hydroxide and fluoride have similar ionic radii and charge. Mineralogically, this means that fluoride can easily substitute for hydroxide within mineral structures. In addition, fluoride can sorb to clay, particularly in slightly acidic conditions. A release of high-pH water provides ample hydroxide that can replace fluoride in mineral structures and cause the desorption of fluoride from clay minerals, leading to an increase in fluoride concentrations in groundwater (Edmunds and Smedley, 2013; McMahon et al., 2020).

Based on the description of erosional features extending upwards of 48 inches into 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 MW1-90 relative to the Evaporation Pond support the hypothesis that the SSI for fluoride, sulfate, and TDS at MW1-90 are due to a "source other than the CCR unit." **Therefore, we accept the hypothesis that the fluoride, sulfate, and TDS concentrations observed at MW1-90 are consistent with a potential release from the Evaporation Pond, a non-CCR unit.**

4 Conclusions

Four SSIs were identified from the May 2024 detection monitoring event. This report demonstrates that a "source other than the CCR unit" caused the SSIs (natural variation in background 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 Table 2 below.

Table 2 Summary of SSIs and Alternative Sources

Well	Parameter	Report Section	Evidence for Alternative Source
MW2-90	Fluoride	3.2.1	Natural variation (geologic background)
MW1-90	Fluoride	3.2.1, 3.3.1	Natural variation (geologic background) and/or Other (Evaporation Pond, a non-CCR unit)
MW1-90	Sulfate	3.2.3, 3.3.1	Natural variation (pre-landfill values, upgradient groundwater, and geologic background) and/or Other (Evaporation Pond, a non-CCR unit)
MW1-90	TDS	3.2.2, 3.3.1	Natural variation (pre-landfill values, upgradient groundwater, and geologic background) 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).

5 References

Barr Engineering Co., 2017, Groundwater Monitoring System Documentation. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. October 2017.

Barr Engineering Co., 2018, 2017 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2018.

Barr Engineering Co., 2019, 2018 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2019.

Barr Engineering Co., 2020, 2019 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2020.

Barr Engineering Co., 2021, 2020 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2021.

Barr Engineering Co., 2022, 2021 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2022.

Barr Engineering Co., 2023, 2022 Annual Groundwater Monitoring and Corrective Action Report. R.M. Heskett Station. Prepared for Montana-Dakota Utilities Co. January 2023.

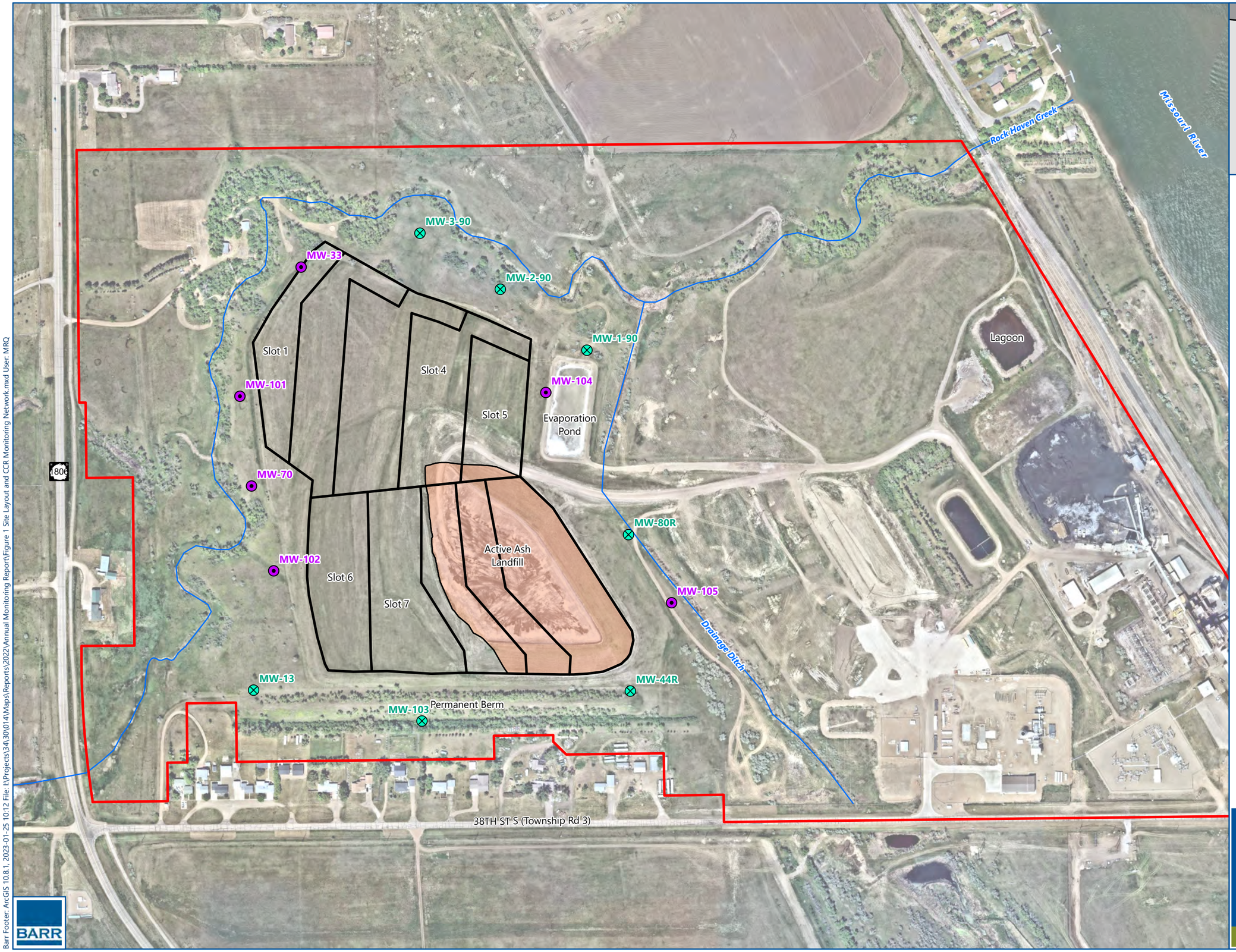
Helsel, D.R., Hirsch, R.M., Ryberg, K.R., Archfield, S.A., and Gilroy, E.J., 2020, Statistical methods in water resources: U.S. Geological Survey Techniques and Methods, book 4, chapter A3, 458 p.

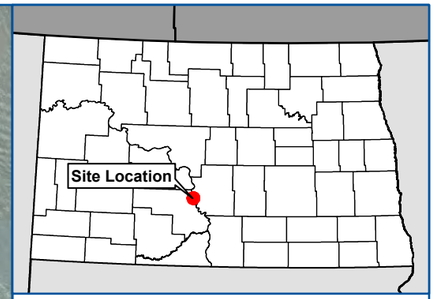
Montana-Dakota Utilities Co. (MDU), 1989, R.M. Heskett Station Special Use Disposal Site Permit Application. Submitted to North Dakota State Department of Health, March 1, 1989.

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

Figure 1 **Site Layout and CCR Monitoring Well Network**





- Monitoring Well Location
- Monitoring Well Location - Water Level Only
- Property Boundary
- Existing Slot Boundaries
- Active Portion of Landfill

Image Source: NearMap June 2022

0 350 700
Feet

SITE LAYOUT AND CCR MONITORING NETWORK
Heskett Station
Montana Dakota Utilities
Mandan, North Dakota

FIGURE 1

BARR

Figure 2 **Piper Plot: Alternative Source Demonstration**

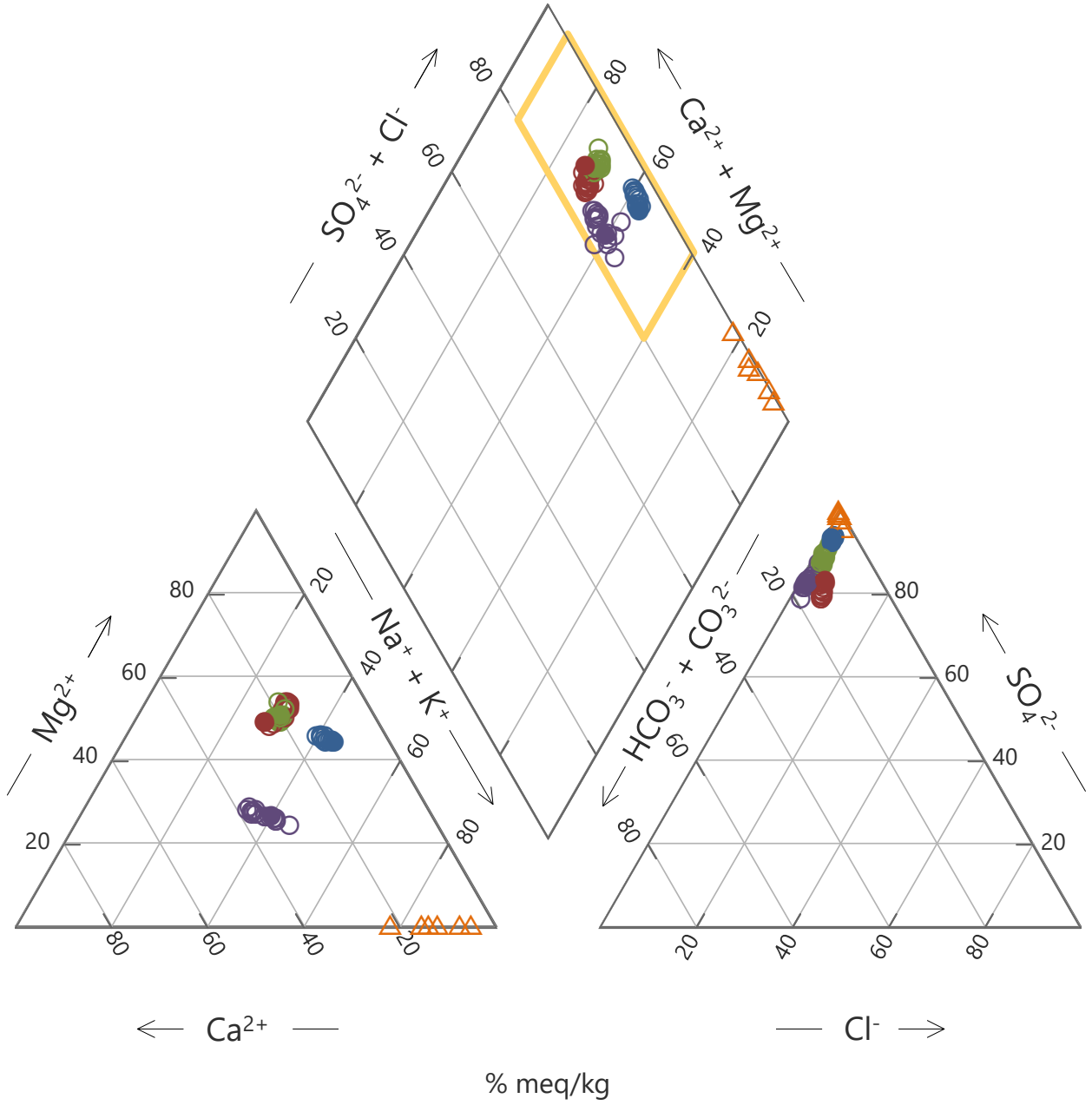


Figure 2
PIPER PLOT: ALTERNATIVE SOURCE DEMONSTRATION
R.M. Heskett Station
Mandan, North Dakota

BARR

Appendices

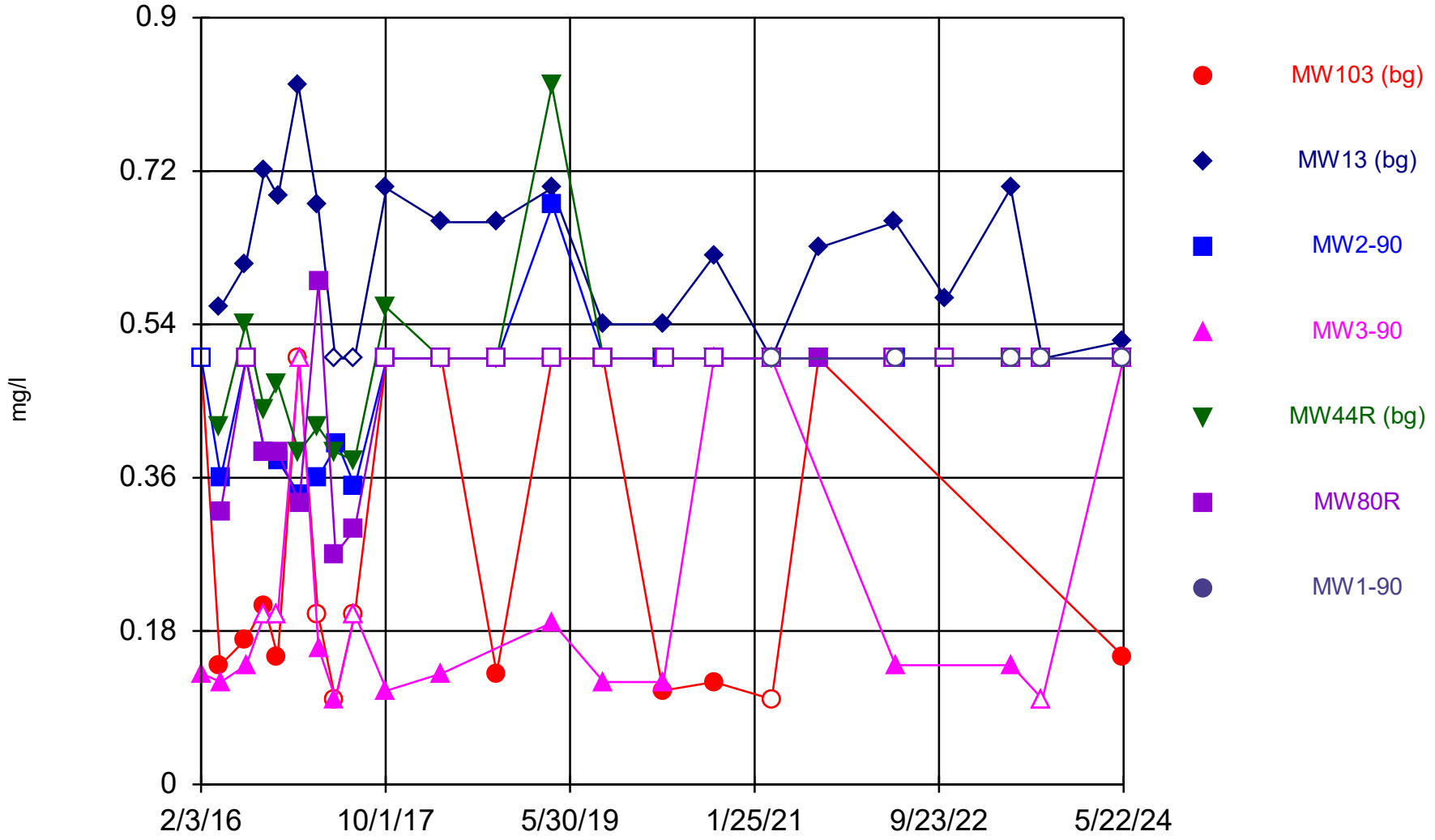
Appendix A

Appendix III Time Series Plots

Appendix A Appendix III Time Series Plots

Hollow symbols indicate censored values.

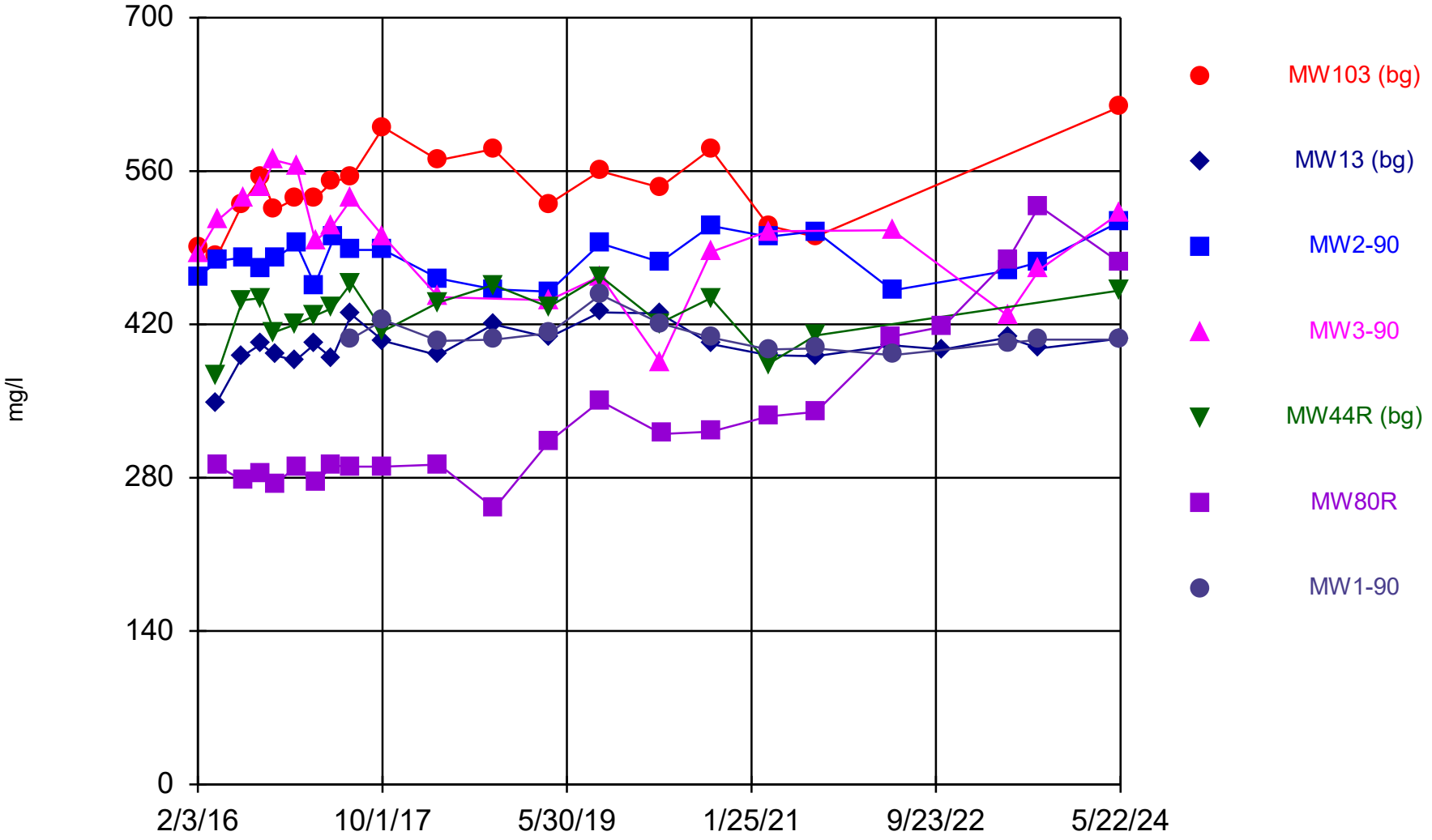
Boron, total



Time Series Analysis Run 8/12/2024 10:52 AM

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

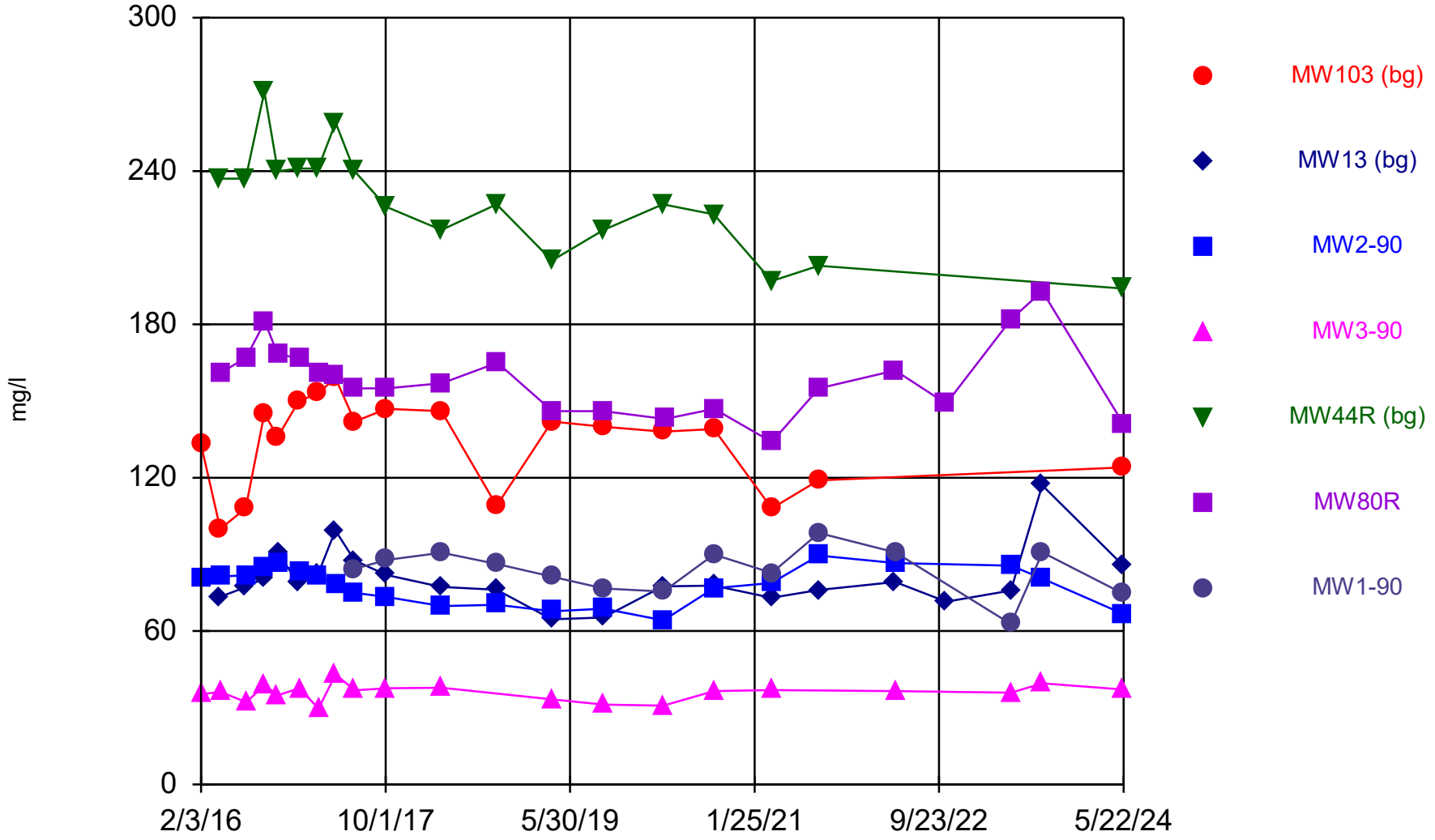
Calcium, Total



Time Series Analysis Run 8/12/2024 10:52 AM

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

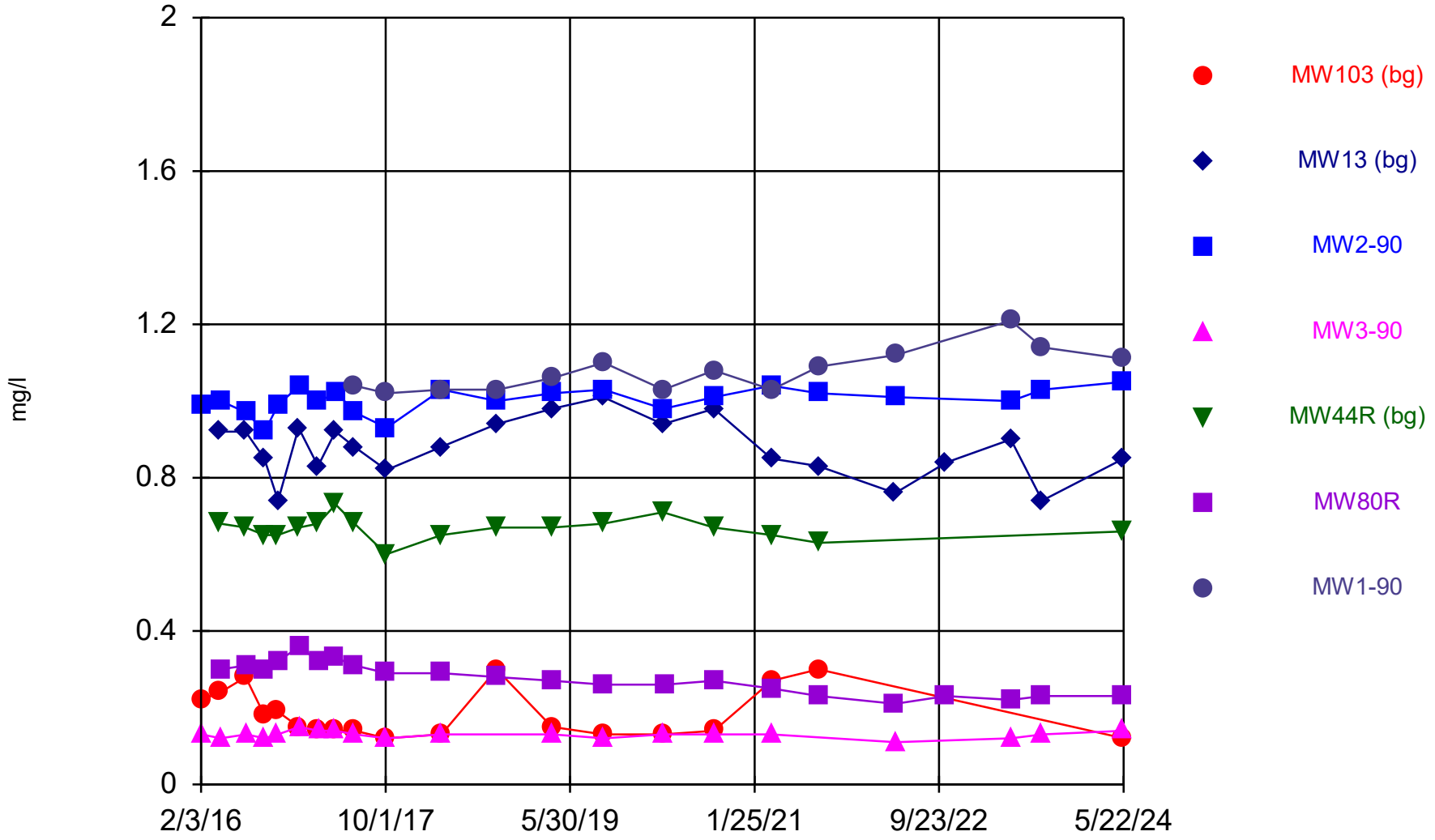
Chloride



Time Series Analysis Run 8/12/2024 10:52 AM

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

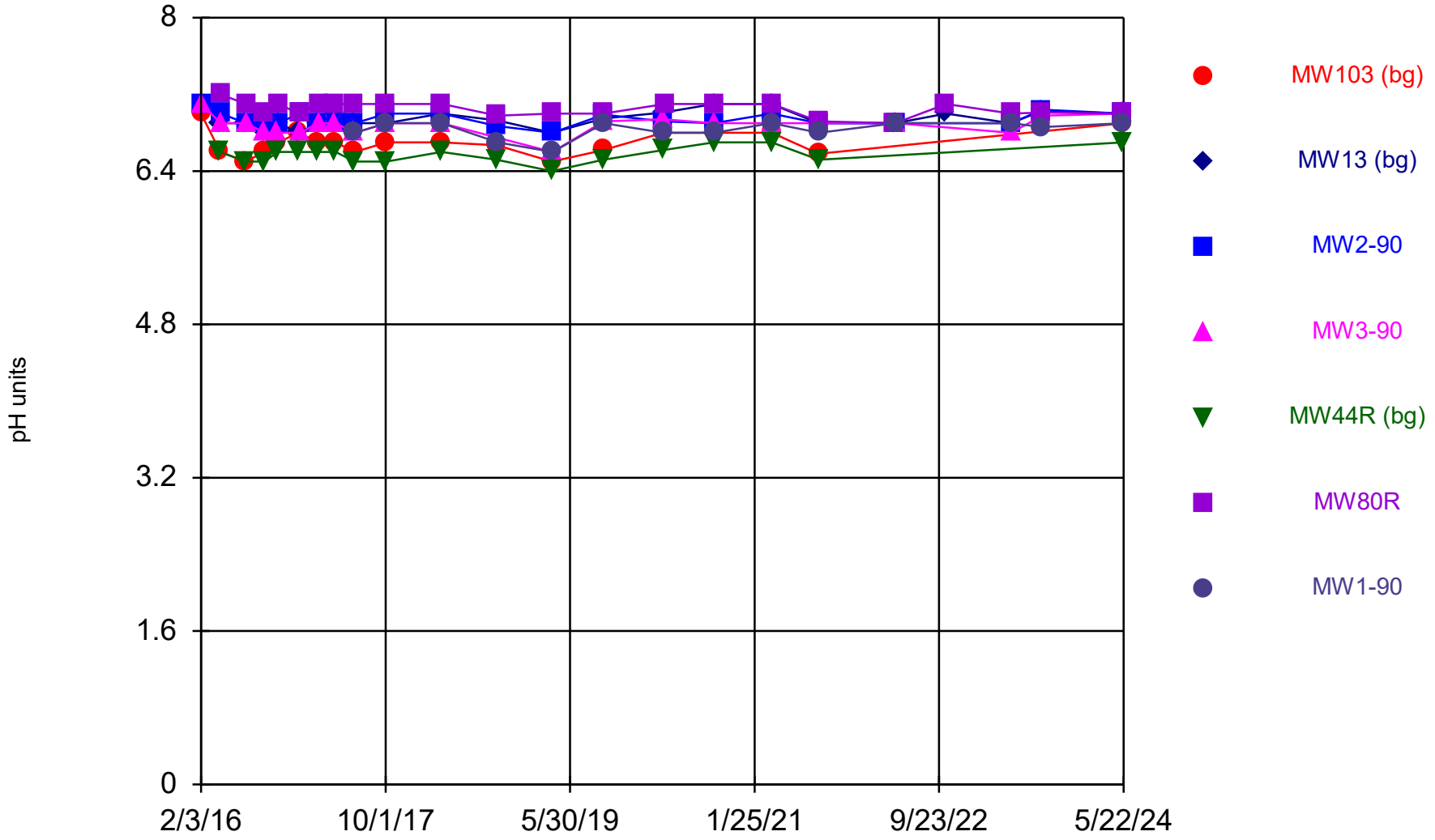
Fluoride



Time Series Analysis Run 8/12/2024 10:52 AM

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

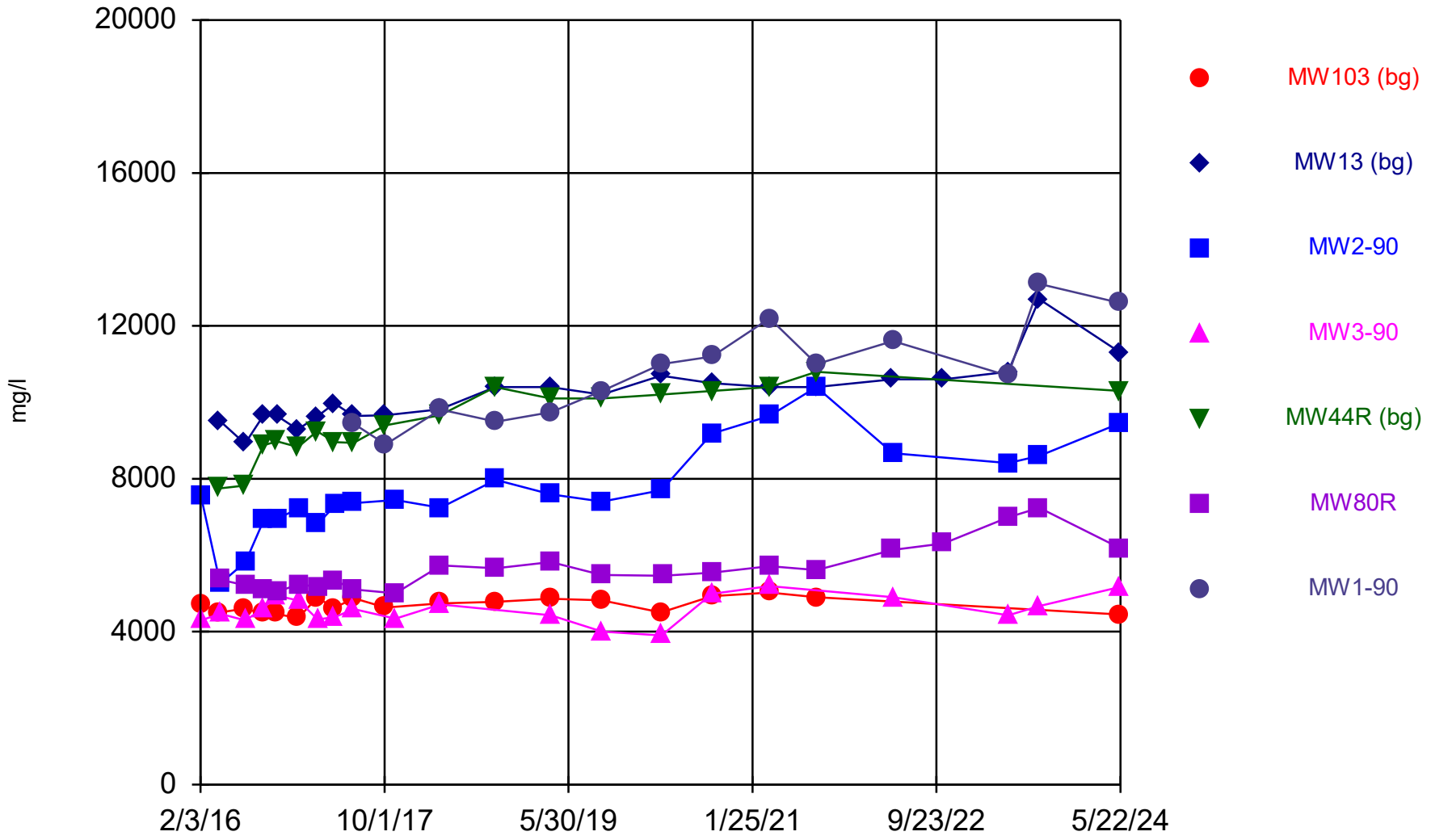
pH, Field



Time Series Analysis Run 8/12/2024 10:52 AM

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

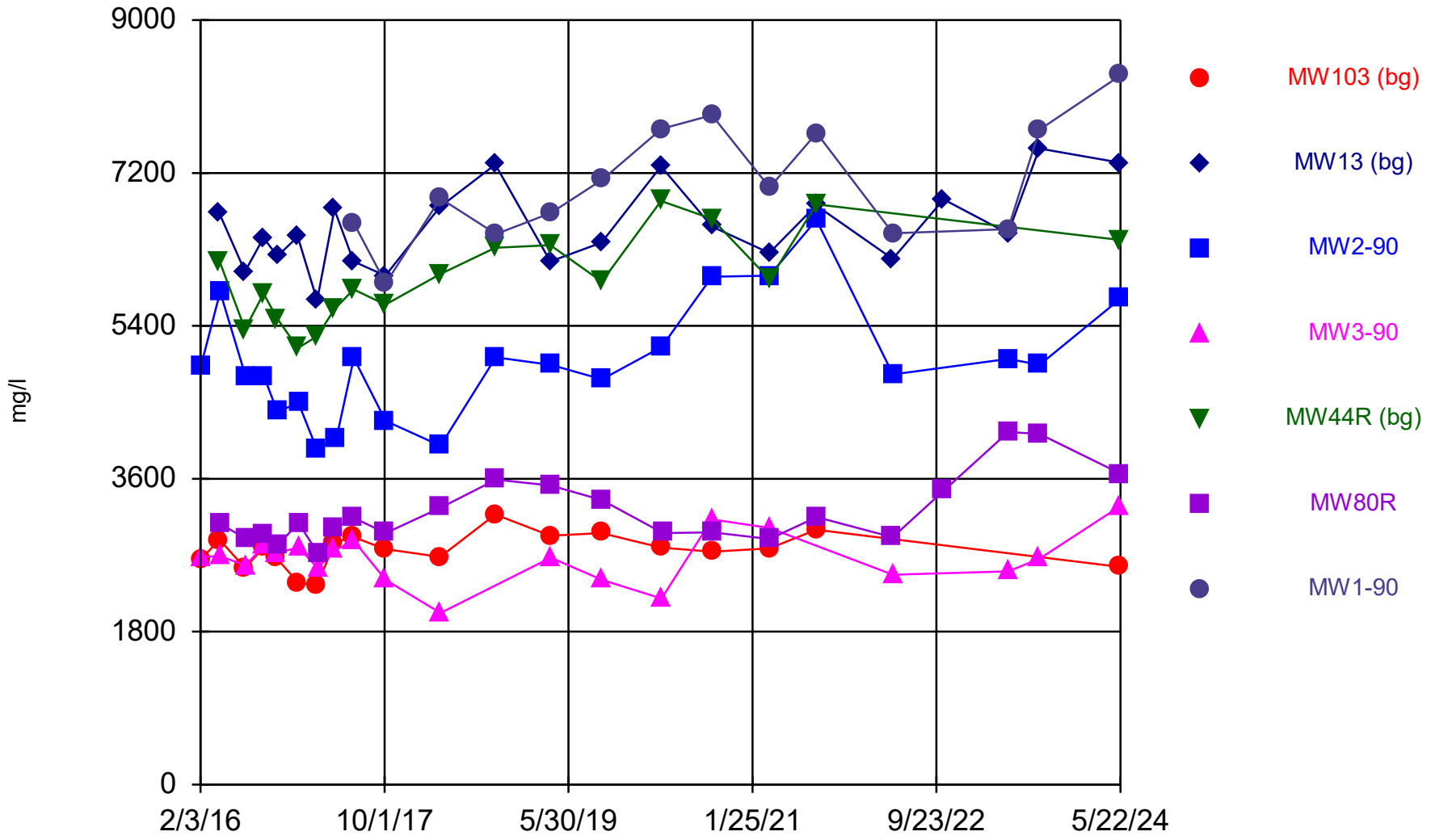
Solids, total dissolved



Time Series Analysis Run 8/12/2024 10:52 AM

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

Sulfate, as SO4



Time Series Analysis Run 8/12/2024 10:52 AM

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

Appendix B

Prediction Limit Plots

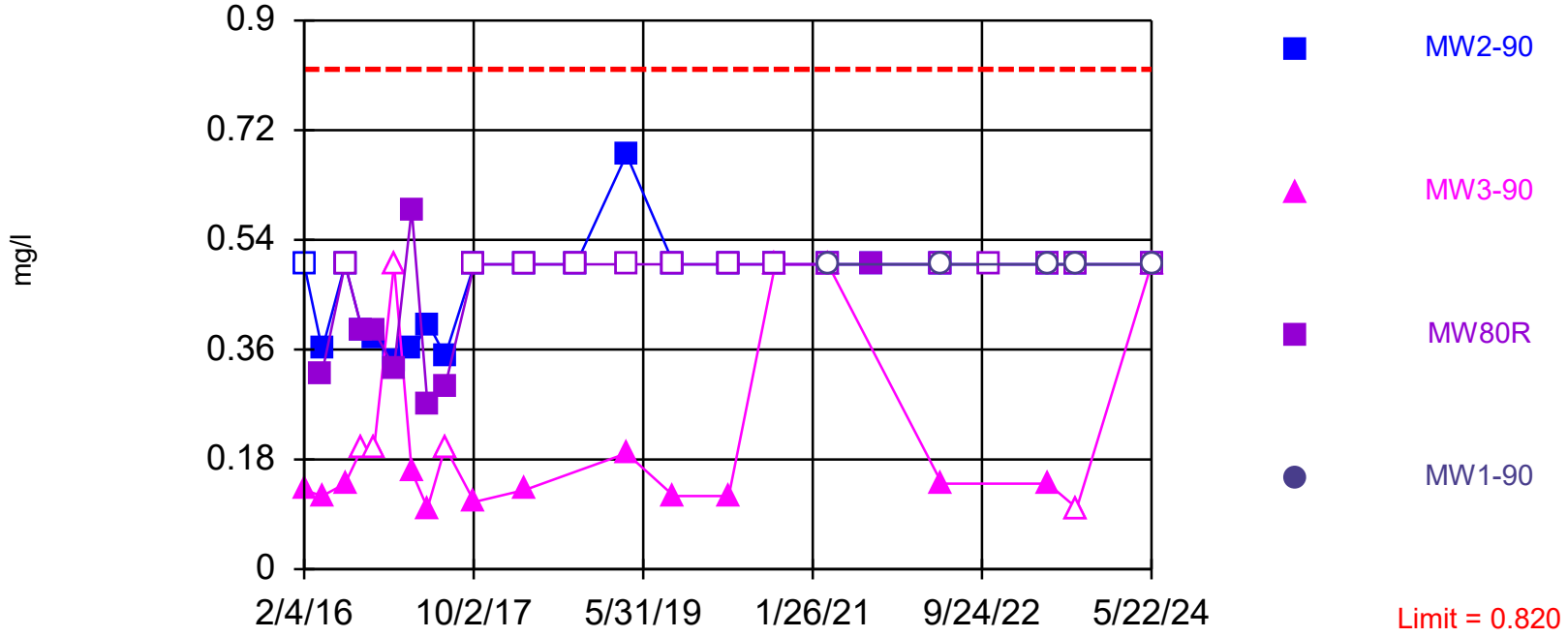
Appendix B Prediction Limit Plots

Hollow symbols indicate censored values.

Within Limit

Boron, total

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 56 background values. 35.71% NDs. Annual per-constituent alpha = 0.004891. Individual comparison alpha = 0.0006126 (1 of 2). Comparing 4 points to limit. Seasonality was not detected with 95% confidence.

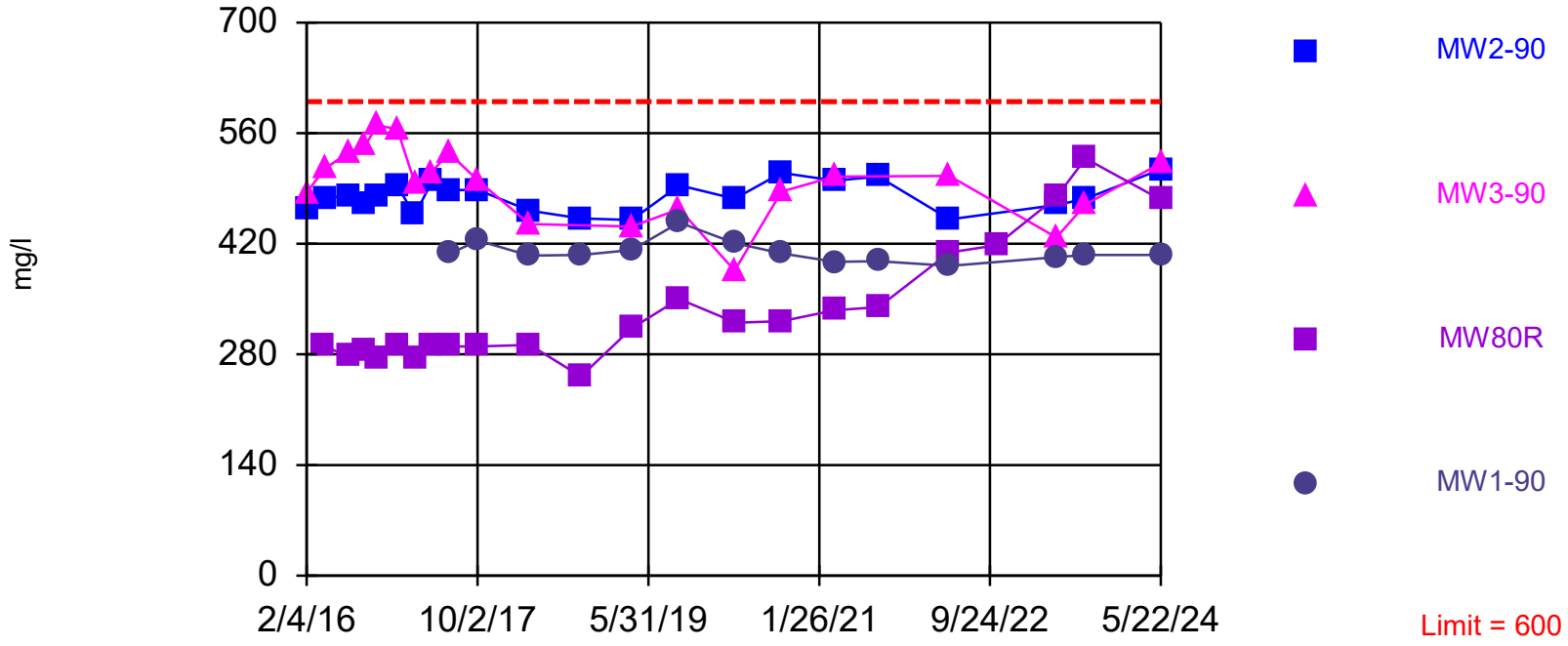
Prediction Limit Analysis Run 8/12/2024 1:51 PM

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

Within Limit

Calcium, Total

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 56 background values. Annual per-constituent alpha = 0.004891. Individual comparison alpha = 0.0006126 (1 of 2). Comparing 4 points to limit. Seasonality was not detected with 95% confidence.

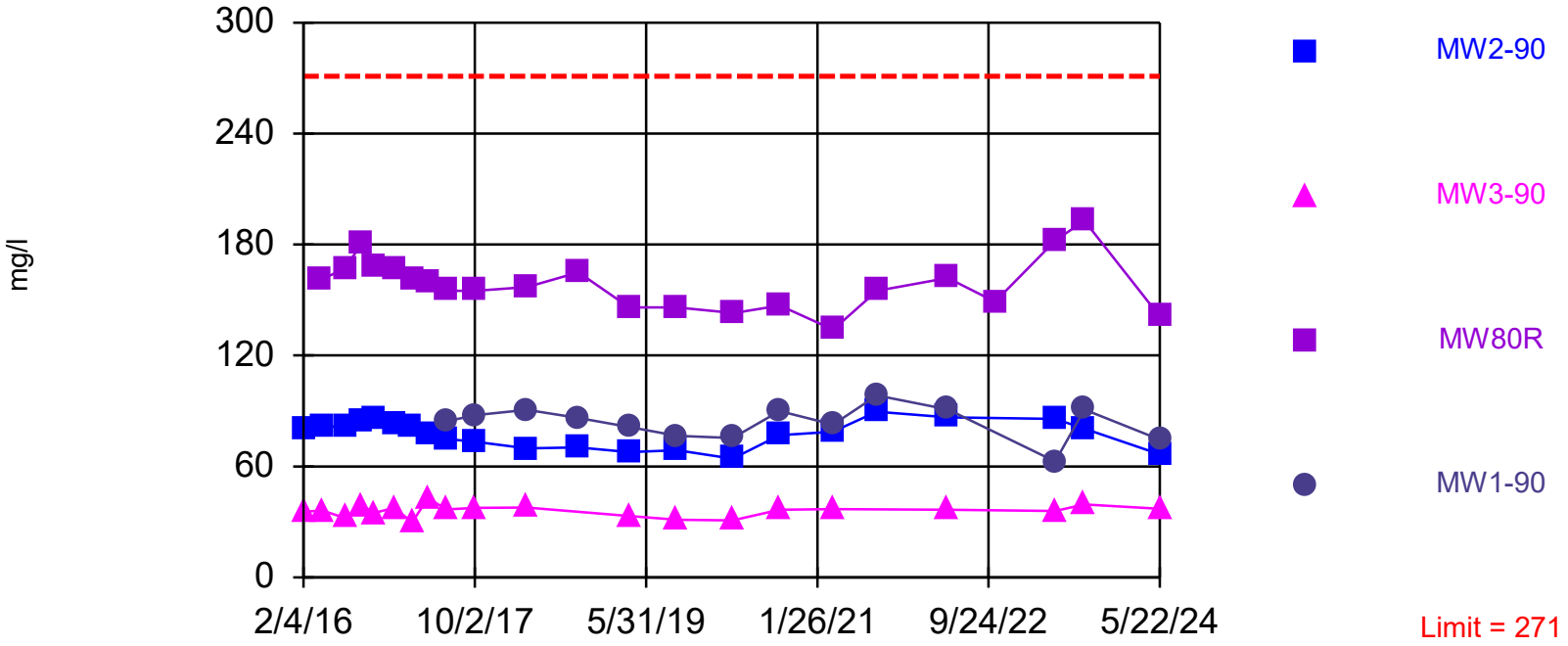
Prediction Limit Analysis Run 8/12/2024 1:51 PM

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

Within Limit

Chloride

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 56 background values. Annual per-constituent alpha = 0.004891. Individual comparison alpha = 0.0006126 (1 of 2). Comparing 4 points to limit. Seasonality was not detected with 95% confidence.

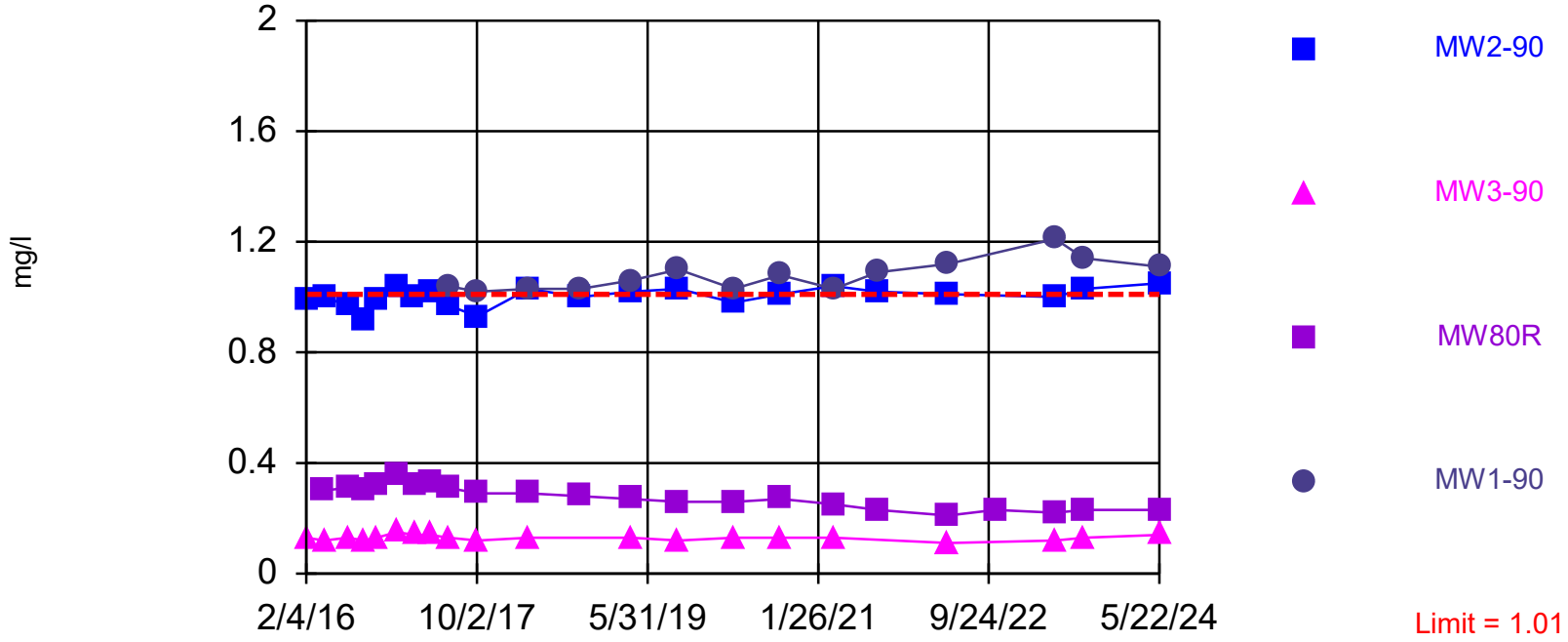
Prediction Limit Analysis Run 8/12/2024 1:51 PM

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

Exceeds Limit: MW2-90, MW1-90

Fluoride

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 56 background values. Annual per-constituent alpha = 0.004891. Individual comparison alpha = 0.0006126 (1 of 2). Comparing 4 points to limit. Seasonality was not detected with 95% confidence.

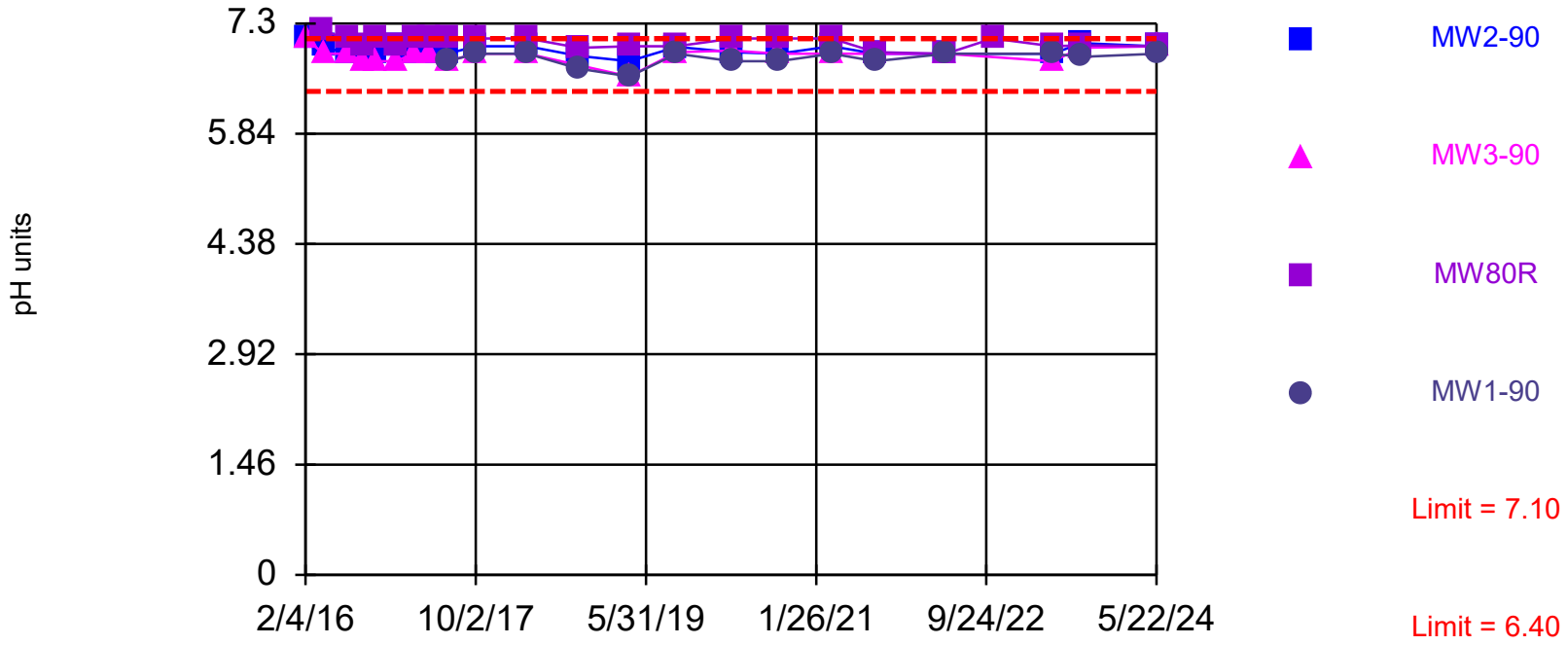
Prediction Limit Analysis Run 8/12/2024 1:52 PM

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

Within Limits

pH, Field

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. Limits are highest and lowest of 56 background values. Annual per-constituent alpha = 0.009781. Individual comparison alpha = 0.001225 (1 of 2). Comparing 4 points to limit. Seasonality was not detected with 95% confidence.

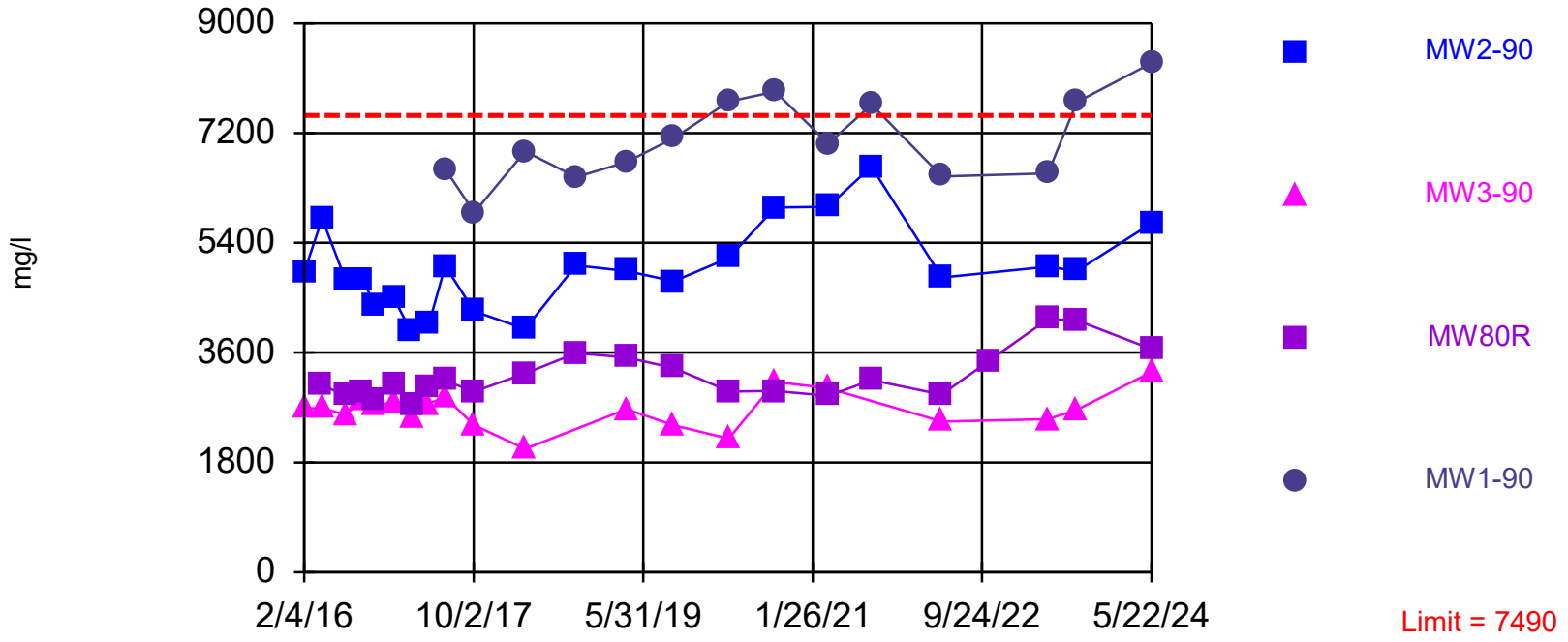
Prediction Limit Analysis Run 8/12/2024 1:52 PM

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

Exceeds Limit: MW1-90

Sulfate, as SO4

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 56 background values. Annual per-constituent alpha = 0.004891. Individual comparison alpha = 0.0006126 (1 of 2). Comparing 4 points to limit. Seasonality was not detected with 95% confidence.

Prediction Limit Analysis Run 8/12/2024 1:52 PM

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

Prediction Limit

R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: Heskett_SanitasAppIII Printed 8/12/2024, 1:54 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	%NDs	Transform	Alpha	Method
Boron, total (mg/l)	MW2-90	0.820	n/a	5/22/2024	0.5ND	No	56	35.71	n/a	0.0006126	NP Inter (normality) 1 of 2
Boron, total (mg/l)	MW3-90	0.820	n/a	5/22/2024	0.5ND	No	56	35.71	n/a	0.0006126	NP Inter (normality) 1 of 2
Boron, total (mg/l)	MW80R	0.820	n/a	5/22/2024	0.5ND	No	56	35.71	n/a	0.0006126	NP Inter (normality) 1 of 2
Boron, total (mg/l)	MW1-90	0.820	n/a	5/22/2024	0.5ND	No	56	35.71	n/a	0.0006126	NP Inter (normality) 1 of 2
Calcium, Total (mg/l)	MW2-90	600	n/a	5/22/2024	514	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Calcium, Total (mg/l)	MW3-90	600	n/a	5/22/2024	522	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Calcium, Total (mg/l)	MW80R	600	n/a	5/22/2024	476	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Calcium, Total (mg/l)	MW1-90	600	n/a	5/22/2024	406	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Chloride (mg/l)	MW2-90	271	n/a	5/22/2024	66.6	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Chloride (mg/l)	MW3-90	271	n/a	5/22/2024	37.1	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Chloride (mg/l)	MW80R	271	n/a	5/22/2024	141	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Chloride (mg/l)	MW1-90	271	n/a	5/22/2024	74.5	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Fluoride (mg/l)	**MW2-90**	**1.01**	**n/a**	**5/22/2024**	**1.05**	**Yes**	**56**	**0**	**n/a**	**0.0006126**	**NP Inter (normality) 1 of 2**
Fluoride (mg/l)	MW3-90	1.01	n/a	5/22/2024	0.14	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Fluoride (mg/l)	MW80R	1.01	n/a	5/22/2024	0.23	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Fluoride (mg/l)	**MW1-90**	**1.01**	**n/a**	**5/22/2024**	**1.11**	**Yes**	**56**	**0**	**n/a**	**0.0006126**	**NP Inter (normality) 1 of 2**
pH, Field (pH units)	MW2-90	7.10	6.40	5/22/2024	7	No	56	0	n/a	0.001225	NP Inter (normality) 1 of 2
pH, Field (pH units)	MW3-90	7.10	6.40	5/22/2024	7	No	56	0	n/a	0.001225	NP Inter (normality) 1 of 2
pH, Field (pH units)	MW80R	7.10	6.40	5/22/2024	7	No	56	0	n/a	0.001225	NP Inter (normality) 1 of 2
pH, Field (pH units)	MW1-90	7.10	6.40	5/22/2024	6.9	No	56	0	n/a	0.001225	NP Inter (normality) 1 of 2
Sulfate, as SO4 (mg/l)	MW2-90	7490	n/a	5/22/2024	5720	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Sulfate, as SO4 (mg/l)	MW3-90	7490	n/a	5/22/2024	3280	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Sulfate, as SO4 (mg/l)	MW80R	7490	n/a	5/22/2024	3660	No	56	0	n/a	0.0006126	NP Inter (normality) 1 of 2
Sulfate, as SO4 (mg/l)	**MW1-90**	**7490**	**n/a**	**5/22/2024**	**8350**	**Yes**	**56**	**0**	**n/a**	**0.0006126**	**NP Inter (normality) 1 of 2**

Appendix C

Ash SPLP Laboratory Report (2011)

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

MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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.
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
www.mvtl.com
MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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. Zander

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
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
www.mvtl.com
MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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.
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
www.mvtl.com
MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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: D. Zander

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
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
www.mvtl.com

MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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
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
www.mvtl.com

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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: 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.
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
www.mvtl.com

MEMBER ACIL

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

Duane Leingang
Montana Dakota Utilities
PO Box 40
Mandan ND 58554

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

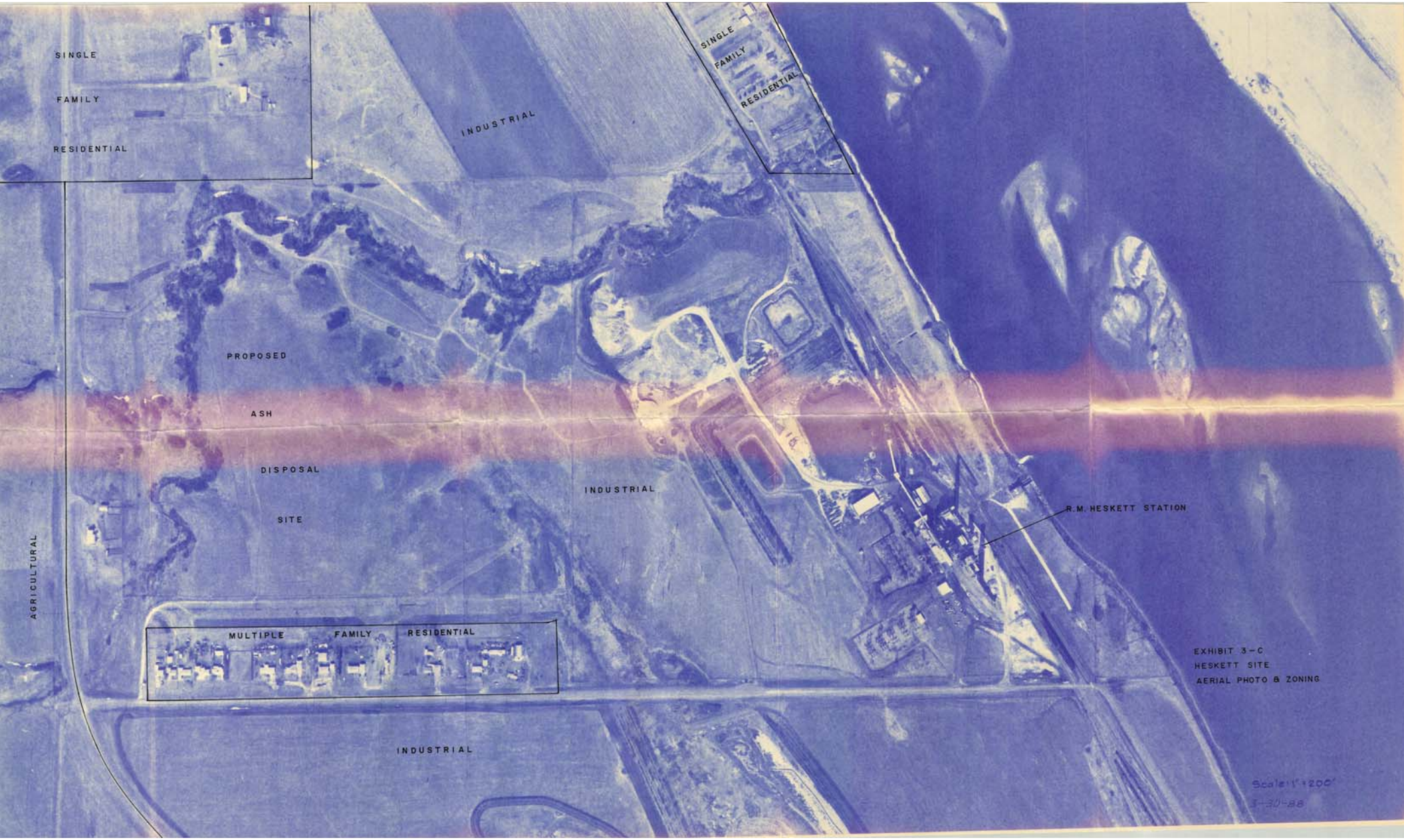
Elevated "Less Than Result" (<): @ = Due to sample matrix
! = Due to sample quantity
= Due to sample concentration
+ = Due to extract volume

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

Appendix D

Aerial Photo (March 30, 1988)

Appendix D Aerial Photo (March 30, 1988)


SINGLE
FAMILY
RESIDENTIAL
INDUSTRIAL
SINGLE
FAMILY
RESIDENTIAL
PROPOSED
ASH
DISPOSAL
SITE
INDUSTRIAL
R.M. HESKETT STATION
AGRICULTURAL
MULTIPLE FAMILY RESIDENTIAL
INDUSTRIAL
EXHIBIT 3-C
HESKETT SITE
AERIAL PHOTO & ZONING
Scale 1"=200'
1-30-88

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 litnologic 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.

WEll 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.

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

LOG OF BORING MW-44 R

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION
0		1	3-3-5-8.	OL/OH		0-1': TOPSOIL (OL/OH): Very Dark Brown (2.5/2 7.5YR); low to medium plasticity; roots, fine to medium grained sand.
						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.
		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.			
20		9	10-10-13-16.			At 20': Interbedded layer of sand.
25		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.

WELL OR PIEZOMETER CONSTRUCTION DETAIL

PRO. CASING
Diameter: 4" by 4"
Type: Steel
Interval: 3' up & 3' down

RISER CASING
Diameter: 2"
Type: Schd 40 PVC
Interval: Stick up to screen (23')

GROUT
Type: Cement
Interval: 0-0.5' BGS

SEAL
Type: Bentonite Chips
Interval: 0.5-21' BGS

SANDPACK
Type: Granusil
Interval: 21-46' BGS

SCREEN
Diameter: 2"
Type: No. 10 Slot
Interval: 23-43' BGS

Elevation, feet

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:

O:\GINT\PROJECTS\34301012.GPJ BARR.LIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-44 R

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.	USCS	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.		
35		12	8-13-16-27.			(CL): At 32': Color change to dark gray (4/1 7.5YR).		
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).		
50								
55								

PRO. CASING
Diameter: **4" by 4"**
Type: **Steel**
Interval: **3' up & 3' down**

RISER CASING
Diameter: **2"**
Type: **Schd 40 PVC**
Interval: **Stick up to screen (23')**

GROUT
Type: **Cement**
Interval: **0-0.5' BGS**

SEAL
Type: **Bentonite**
Interval: **Chips 0.5-21' BGS**

SANDPACK
Type: **Granusil**
Interval: **21-46' BGS**

SCREEN
Diameter: **2"**
Type: **No. 10 Slot**
Interval: **23-43' BGS**

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:

O:\GINT\PROJECTS\34301012.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

State of North Dakota

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58505

MONITORING WELL REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

Name MDU-Heskett Station

Address 2025 38th Street

Mandan, North Dakota

2. WELL LOCATION **(MW-44R)**

Address (if in city) (see attached drawing)

County Morton

SE ¼ SE ¼ SW ¼ Sec. 10 Twp. 139 N. Rge. 81 W.

Lat. 46.86620 Long.: -100.89313

Altitude:

3. METHOD DRILLED

■ Auger Other

4. WELL CONSTRUCTION

Diameter of Hole 8 inches Depth 46 feet

Riser: ■ PVC □ Other

■ Threaded □ Solvent □ Other

Riser rating SDR Schedule 40

Diameter 2.0 inches

From +2 ft. to 23 ft.

Was a well screen installed? ■ Yes □ No

Material Schedule 40 PVC Diameter 2.0 inches

Slot Size #10 set from 23 feet to 43 feet

Sand packed from 21 ft to 46 ft

Depth grouted from 1 ft to 21 ft

Grouting Material

Bentonite x Other

If other explain:

One foot concrete collar at surface

Well head completion:

24" above grade Other x

If other, specify 4" x 4" x 5' steel cover

Was protective casing installed? ■ Yes □ No

Was well disinfected upon completion? □ Yes ■ No

5. WATER LEVEL

Static water level 28.5 feet below surface

If flowing: closed in pressure psi or ft. above land surface

6. WELL LOG

Formation	Depth (Ft.) From	To
Topsoil	0	0.5
Sandy lean clay	0.5	5
Sandy fat clay	5	46

(Use separate sheet if necessary)

7. WAS THE HOLE PLUGGED OR ABANDONED?

□ Yes ■ No

If so, how?

8. REMARKS

3 steel bumpers installed around well head

9. DATE COMPLETED 10-21-14

10. CONTRACTOR CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Midwest Testing Laboratory, Inc. 444

Monitoring Well Contractor Certificate No.

P.O. Box 2084, Bismarck, ND 58502-2084

Address

Signature 10-22-14

Date

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/6in.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0				OL/OH		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.	PRO. CASING Diameter: 4" by 4" Type: Steel Interval: 3' up & 3' down	
		2	4-5-7-9.			At 2': Gravel inclusions. Moist; 10% gravel, 30% sand, 60% fines.		
5		3	4-4-5-8.	CL		Moist; 0% gravel, 20% sand, 80% fines.	RISER CASING Diameter: 2" Type: Schd 40 PVC Interval: Stick up to screen (7')	
		4	4-4-6-6.					
		5	3-4-5-6.	CL		(CL): At 8': Color change to 2.5/1 7.5YR black, no odor.	GROUT Type: Cement Interval: 0-0.5' BGS	
10		6	1-3-3-4.	CL		(CL): At 9': Color change to 2.5/2 7.5YR very dark brown. Moist; 0% gravel, 20% sand, 80% fines.	SEAL Type: Bentonite Interval: Chips 0.5-5' BGS	
		7	1-1-2-1.	CL		(CL): At 11': Color change to 3/3 7.5YR dark brown. Moist; 0% gravel, 20% sand, 80% fines.	SANDPACK Type: Granusil Interval: 5-27' BGS	
15		8	1-2-2-1.			(CL): At 13': Color change to 4/4 7.5YR brown. Wet; 0% gravel, 20% sand, 80% fines.	SCREEN Diameter: 2" Type: No 10 Slot Interval: 7-27' BGS	
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.		

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:

O:\GINT\PROJECTS\34301012.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

State of North Dakota

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58505

MONITORING WELL REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

Name MDU-Heskett Station

Address 2025 38th Street

Mandan, North Dakota

2. WELL LOCATION **(MW-80R)**

Address (if in city) (see attached drawing)

County Morton

NE ¼ SE ¼ SW ¼ Sec. 10 Twp. 139 N. Rge. 81 W.

Lat. 46.86789 Long.: -100.89320

Altitude:

3. METHOD DRILLED

■ Auger Other

4. WELL CONSTRUCTION

Diameter of Hole 8 inches Depth 27 feet

Riser: ■ PVC □ Other

■ Threaded □ Solvent □ Other

Riser rating SDR Schedule 40

Diameter 2.0 inches

From +2.5 ft. to 7 ft.

Was a well screen installed? ■ Yes □ No

Material Schedule 40 PVC Diameter 2.0 inches

Slot Size #10 set from 7 feet to 27 feet

Sand packed from 5 ft to 27 ft

Depth grouted from 1 ft to 5 ft

Grouting Material

Bentonite x Other

If other explain:

One foot concrete collar at surface

Well head completion:

24" above grade Other x

If other, specify 4" x 4" x 5' steel cover

Was protective casing installed? ■ Yes □ No

Was well disinfected upon completion? □ Yes ■ No

5. WATER LEVEL

Static water level 12 feet below surface

If flowing: closed in pressure psi or ft. above land surface

6. WELL LOG

Formation	Depth (Ft.) From	To
Topsoil	0	0.5
Sandy lean clay	0.5	27

(Use separate sheet if necessary)

7. WAS THE HOLE PLUGGED OR ABANDONED?

□ Yes ■ No

If so, how?

8. REMARKS

3 steel bumpers installed around well head

9. DATE COMPLETED 10-21-14

10. CONTRACTOR CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Midwest Testing Laboratory, Inc. 444

Monitoring Well Contractor Certificate No.

P.O. Box 2084, Bismarck, ND 58502-2084

Address

Signature 10-22-14

Date

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

LOG OF BORING MW-101
DRAFT

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

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-101
DRAFT

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

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-101
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
50				CH		FAT CLAY (CH): Black (2.5/1 7.5YR); very stiff; hight plasticity; wet at 43'; [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: **2.98' 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**	1665
55								1660
60						End of boring 58.0 feet		
65								
70								
75								

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-102
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
		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**	
		2	3-2-2-3.					1700
5		3	3-3-4-5.	CL			RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **2.85' ags - 10' bgs**	
		4	3-4-5-7.				GROUT Type: **None** Interval: **None**	
		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
10		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].	SEAL Type: **Bentonite chips** Interval: **0 - 8' bgs**	
		7	3-5-7-9.			LEAN CLAY (CL): Dark Brown (3/2 7.5YR); medium to high plasticity; [Cannonball Formation].	SANDPACK Type: **Silica 40-70** Interval: **8 - 31' bgs**	
15		8	6-8-12-14.				SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **20 - 30' bgs**	1690
		9	6-10-12-16.					
		10	5-9-14-16.	CL				1685
20		11	5-12-15-18.			At 21': Color changes to Black (2.5/1).		
		12	9-15-18-22.					1680
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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-102
DRAFT

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.	USCS	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**	
		14	10-17-18-24.					
		15	6-15-18-26.			At 29': Gypsum.		1675
30		16	7-14-18-22.				RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **2.85' ags - 10' bgs**	
		17	11-16-20-27.			At 33.5' and 34': Gypsum.	GROUT Type: **None** Interval: **None**	1670
35		18	10-14-15-24.	CL			SEAL Type: **Bentonite chips** Interval: **0 - 8' bgs**	
		19	13-19-25-35.				SANDPACK Type: **Silica 40-70** Interval: **8 - 31' bgs**	
		20	8-17-26-31.					1665
40		21	10-20-27-38.				SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **20 - 30' bgs**	
		22	13-20-27-37.					1660
45		23	15-27-27-32.	SM		SILTY SAND (SM): fine to medium grained; Dark Gray (4/1 7.5YR); wet; [Cannonball Formation].		
						End of boring 46.0 feet		
50								

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-103
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0				OL/OH		TOPSOIL (OL/OH): Brown (5/4 7.5YR).		
		1	3-4-5-5.			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**	
		2	5-5-8-8.	CL			RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **2.79' ags - 24' bgs**	1710
5		3	5-8-10-11.				GROUT Type: **Neat cement** Interval: **0 - 19' bgs**	
		4	6-9-15-15.			POORLY GRADED SAND WITH GRAVEL (SP): fine to coarse grained; Brown (5/4 7.5YR); some oxidized staining, some mottling; [Cannonball Formation].	SEAL Type: **Bentonite chips** Interval: **19 - 22' bgs**	
		5	5-6-5-4.	SP			SANDPACK Type: **Silica 40-70** Interval: **22 - 44' bgs**	1705
10		6	4-5-5-7.				SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **24 - 44' bgs**	
		7	2-2-2-3.	SP-SM		POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; Brown (5/4 7.5YR); [Cannonball Formation].		
15		8	3-3-3-3.					1700
						NO RECOVERY (16 - 20').		
20		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].		1695
25								1690

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-103
DRAFT

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.	USCS	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]. *(continued)*	PRO. CASING Diameter: **4"** Type: **Steel pipe** Interval: **3.5' ags - 1.5' bgs**	
30				SM		SILTY SAND WITH GRAVEL (SM): wet; [Cannonball Formation].	RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **2.79' ags - 24' bgs**	1685
		11	10-10-7-9.			LEAN CLAY (CL): Brown (4/4 7.5YR); moist; oxidized staining; medium to high plasticity; [Cannonball Formation].	GROUT Type: **Neat cement** Interval: **0 - 19' bgs**	
		12	8-15-17-22.			At 32.5': Sand lens, color changes to Black (2.5/1 7.5YR).		
35		13	7-19-15-25.			At 33.5': Sand lens. At 34': Interbedded sand with oxidized staining.	SEAL Type: **Bentonite chips** Interval: **19 - 22' bgs**	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.	SANDPACK Type: **Silica 40-70** Interval: **22 - 44' bgs**	
		15	50 for 2"`-.				SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **24 - 44' bgs**	
40		16	12-17-22-30.			At 42-42.5': Silt layer.		1675
		17	9-18-24-50.			At 43.5-44': Silt layer.		
45						End of boring 44.0 feet		
50								

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-104
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
		1	4-5-5-5.	CL		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	3-5-6-8.					
5		3	3-7-9-10.	CL		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	5-7-9-10.				GROUT Type: **None** Interval: **None**	
		5	5-9-9-10.				SEAL Type: **Bentonite chips** Interval: **0 - 7' bgs**	
10		6	5-7-9-10.			At 12': Heavily oxidized.		1670
		7	5-8-8-12.				SANDPACK Type: **Silica 40-70** Interval: **7 - 32' bgs**	
15		8	5-9-11-15.			At 15': Start seeing black staining.	SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **9 - 29' bgs**	
		9	6-9-11-13.			At 17': Heavily oxidized.		1665
		10	4-7-16-19.	SM		SILTY SAND (SM): Strong Brown (5/6 7.5YR); wet; [Cannonball Formation].		
20						At 19.5': Color change to Brown (5/4 7.5YR).		
		11	5-16-22-26.			At 21': Oxidized layer.		1660
		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].		
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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-104
DRAFT

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.	USCS	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)*		1655
		14	8-12-16-21.	CH				
		15	8-12-16-20.					
30		16				Driller notes: sluff.		1650
						End of boring 32.0 feet		
35								
40								
45								
50								

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**

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:

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

LOG OF BORING MW-105
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
0						TOPSOIL: Brown (5/4 7.5YR).		
		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**	1685
		2	5-5-5-6.					
		3	3-2-4-5.	CL			RISER CASING Diameter: **2"** Type: **PVC SCH 80** Interval: **3.16' ags - 10' bgs**	1680
5		4	2-2-2-3.					
		5	2-1-2-2.			LEAN CLAY (CL): Brown (4/2 7.5YR); soft; high plasticity; wet at 16'; [Cannonball Formation].	GROUT Type: **None** Interval: **None**	
10 ▼		6	2-1-2-1.			At 10.5': Color change to Reddish-Yellow (6/6 7.5YR).	SEAL Type: **Bentonite chips** ▼ Interval: **0 - 7' bgs**	1675
		7	2-1-1-3.				SANDPACK Type: **Silica 40-70** Interval: **7 - 30' bgs**	
15		8	4-3-5-5.	CL		At 14.5-15.5': Gravel inclusions. At 15.5': Color change to Brown (4/3 7.5YR).	SCREEN Diameter: **2"; No.6 slot** Type: **PVC SCH 80** Interval: **10 - 30' bgs**	1670
		9	7-9-11-13.					
		10	7-9-11-13.			At 18': Color change to Brown (5/3 7.5YR).		
20		11	7-9-13-15.					1665
		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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

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

LOG OF BORING MW-105
DRAFT

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.	USCS	Graphic Log	LITHOLOGIC DESCRIPTION	WELL OR PIEZOMETER CONSTRUCTION DETAIL	Elevation, feet
25		13	15-25-31-40.					
		14	10-15-18-30.	CL		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
		15	11-16-22-32.					
30						End of boring 30.0 feet		
35								
40								
45								
50								

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**

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:

M:\GINT\PROJECTS\34300014.GPJ BARRLIBRARY.GLB ENVIRO LOG BARR TEMPLATE.GDT

STATE OF NORTH DAKOTA

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58501

WELL DRILLER'S REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

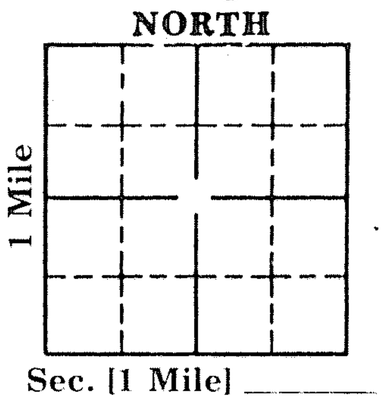
Name Montana Dakota Utilities

Address Bismarck, ND

2. WELL LOCATION

Sketch map location must agree with written location.

Heskett Ash
Dispoal Site
#1-90
139-81-10CAD
Top nof pipe
1675.54
Ground level
1673.6



County Morton

SE ¼ NE ¼ SW ¼ Sec. 10 Twp. 139 N. Rg. 81 W.

3. PROPOSED USE

☐ Domestic ☐ Geothermal ☒ Monitoring
☐ Stock ☐ Irrigation ☐ Industrial
☐ Municipal ☐ Test Hole

4. METHOD DRILLED

☐ Cable ☐ Reverse Rotary ☐ Bored
☒ Forward Rotary ☐ Jetted ☐ Auger

If other, specify

5. WATER QUALITY

Was a water sample collected for:
Chemical Analysis? ☐ Yes ☐ No
Bacteriological Analysis? ☐ Yes ☐ No
If so, to what laboratory was it sent

6. WELL CONSTRUCTION

Diameter of hole 5 inches. Depth 15 feet.

Casing: ☐ Steel ☒ Plastic ☐ Concrete
☐ Threaded ☐ Welded ☐ Other

If other, specify

Pipe Weight:	Diameter:	From:	To:
SDR-21 lb/ft.	2 inches	±2.0 feet	5 feet
lb/ft.	inches	feet	feet
lb/ft.	inches	feet	feet

Was perforated pipe used? ☐ Yes ☒ No

Perforated pipe set from ft to feet

Was casing left open end? ☐ Yes ☒ No

Was a well screened installed? ☒ Yes ☐ No

Material PVC Diameter 2 inches
(stainless steel, bronze, etc.)

Slot size 10 set from 5 feet to 15 feet

Slot size set from feet to feet

Was a packer or seal used? ☒ Yes ☐ No

If so, what material cse bentonite Depth 3 to 4 Ft.

Type of well: Straight screen ☐ Gravel packed ☒

Depth grouted: From 3 To surface

Grouting Material: Cement X Other

If other explain: w/bentonite

Well head completion: Pitless unit

12" above grade X Other

If other, specify

Was pump installed: ☐ Yes ☒ No

Was well disinfected upon completion? ☐ Yes ☒ No

7. WATER LEVEL

Static water level 12.3 feet below land surface

If flowing: closed-in pressure psi

GPM flow through inch pipe

Controlled by: ☐ Valve ☐ Reducers ☐ Other

If other, specify

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Other

Pumping level below land surface:

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

9. WELL LOG

Formation	Depth (ft.) From	To
Clay, fill	0	3
Sand, fine to medium, yellowish brown	3	6
Clay, silty, yellowish brown, bedrock	6	13
Clay, silty, medium gray	13	15

(Use separate sheet if necessary.)

10. DATE COMPLETED 2/5/90

11. WAS WELL PLUGGED OR ABANDONED?

☐ Yes ☒ No

If so, how

12. REMARKS:

2" PVC cap on bottom of screen
160# of silica sand pack

13. DRILLER'S CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Water Supply, Inc. 46
Driller's or Firm's Name Certificate No

Box 1191 - Bismarck, ND 58502
Address

Lewis Knutson 2/5/90
Signed by Lewis Knutson Date

WHITE—DRILLER'S COPY YELLOW—BOARD'S COPY PINK—CUSTOMER'S COPY

STATE OF NORTH DAKOTA

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58501

WELL DRILLER'S REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

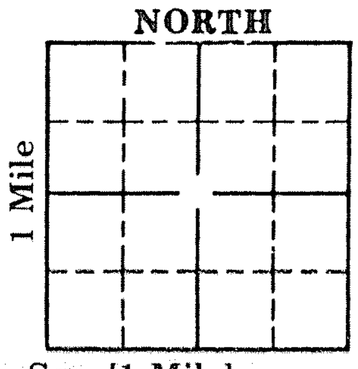
Name Montana Dakota Utilities

Address Bismarck, ND

2. WELL LOCATION

Sketch map location must agree with written location.

Heskett Ash
Disposal Site
#2-90
139--81-10CAB1
Top of pipe
1686.54
Ground level
1684.3



County Morton

SW ¼NE ¼ NW ¼ Sec. 10 Twp. 139 N. Rg. 81 W.

3. PROPOSED USE

☐ Domestic ☐ Geothermal ☒ Monitoring
☐ Stock ☐ Irrigation ☐ Industrial
☐ Municipal ☐ Test Hole

4. METHOD DRILLED

☐ Cable ☐ Reverse Rotary ☐ Bored
☒ Forward Rotary ☐ Jetted ☐ Auger

If other, specify

5. WATER QUALITY

Was a water sample collected for:
Chemical Analysis? ☐ Yes ☐ No
Bacteriological Analysis? ☐ Yes ☐ No
If so, to what laboratory was it sent

6. WELL CONSTRUCTION

Diameter of hole 5 inches. Depth 23 feet.

Casing: ☐ Steel ☒ Plastic ☐ Concrete
☐ Threaded ☐ Welded ☐ Other

If other, specify

Pipe Weight:	Diameter:	From:	To:
SDR-21 ~~lb/ft.~~	2 inches	+2.3 feet	13 feet
lb/ft.	inches	feet	feet
lb/ft.	inches	feet	feet

Was perforated pipe used? ☐ Yes ☒ No

Perforated pipe set from ft to feet

Was casing left open end? ☐ Yes ☒ No

Was a well screened installed? ☒ Yes ☐ No

Material PVC Diameter 2 inches
(stainless steel, bronze, etc.)

Slot size 10 set from 13 feet to 23 feet

Slot size set from feet to feet

Was a packer or seal used? ☒ Yes ☐ No

If so, what material ~~cse~~ bentonite Depth 11 to 12 Ft.

Type of well: Straight screen ☐ Gravel packed ☒

Depth grouted: From 11 To surface

Grouting Material: Cement X Other

If other explain: w/bentonite

Well head completion: Pitless unit

12" above grade X Other

If other, specify

Was pump installed: ☐ Yes ☒ No

Was well disinfected upon completion? ☐ Yes ☒ No

7. WATER LEVEL

Static water level dry feet below land surface

If flowing: closed-in pressure psi

GPM flow through inch pipe

Controlled by: ☐ Valve ☐ Reducers ☐ Other

If other, specify

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Other

Pumping level below land surface:

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

9. WELL LOG

Formation	Depth (ft.) From	To
Topsoil, silty, black	0	1
Sand, fine, yellowish gray	1	6.5
Clay, silty, yellowish brown, till	6.5	11
Clay, silty, medium gray	11	13
Sand	13	15.5
Clay, silty, medium gray, bedrock	15.5	23

(Use separate sheet if necessary.)

10. DATE COMPLETED 2/5/90

11. WAS WELL PLUGGED OR ABANDONED?

☐ Yes ☒ No

If so, how

12. REMARKS:

2" PVC cap on bottom of screen
160# silica sand pack

13. DRILLER'S CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Water Supply, Inc. 46
Driller's or Firm's Name Certificate No.

Box 1191 - Bismarck, ND 58502
Address

Lewis Knutson 2/5/90
Signed by Lewis Knutson Date

WHITE—DRILLER'S COPY YELLOW—BOARD'S COPY PINK—CUSTOMER'S COPY

STATE OF NORTH DAKOTA

BOARD OF WATER WELL CONTRACTORS

900 E. BOULEVARD • BISMARCK, NORTH DAKOTA 58501

WELL DRILLER'S REPORT

State law requires that this report be filed with the State Board of Water Well Contractors within 30 days after completion or abandonment of the well.

1. WELL OWNER

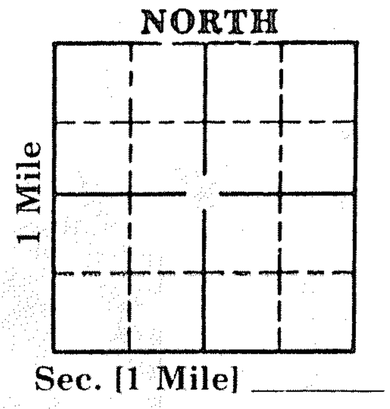
Name Montana Dakota Utilities

Address Bismarck, ND

2. WELL LOCATION

Sketch map location must agree with written location.

Heskett Ash Disposal Site #3-90
139-81-10CAB2
Top of pipe 1685.92
Ground level 1683.6



County Morton

SW ¼ NE ¼ NW ¼ Sec. 10 Twp. 139 N. Rg. 81 W.

3. PROPOSED USE

☐ Domestic ☐ Stock ☐ Geothermal ☐ Irrigation ☐ Municipal ☒ Monitoring ☐ Industrial ☐ Test Hole

4. METHOD DRILLED

☐ Cable ☐ Reverse Rotary ☐ Bored
☒ Forward Rotary ☐ Jetted ☐ Auger

If other, specify

5. WATER QUALITY

Was a water sample collected for:
Chemical Analysis? ☐ Yes ☐ No
Bacteriological Analysis? ☐ Yes ☐ No
If so, to what laboratory was it sent

6. WELL CONSTRUCTION

Diameter of hole 5 inches. Depth 20 feet.

Casing: ☐ Steel ☒ Plastic ☐ Concrete ☐ Threaded ☐ Welded ☐ Other

If other, specify

Pipe Weight:	Diameter:	From:	To:
SDR-21 ~~XXXX~~ lb/ft.	2 inches	+2.3 feet	10 feet
lb/ft.	inches	feet	feet
lb/ft.	inches	feet	feet

Was perforated pipe used? ☐ Yes ☒ No

Perforated pipe set from ft to feet

Was casing left open end? ☐ Yes ☒ No

Was a well screened installed? ☒ Yes ☐ No

Material PVC Diameter 2 inches
(stainless steel, bronze, etc.)

Slot size 10 set from 10 feet to 20 feet

Slot size set from feet to feet

Was a packer or seal used? ☒ Yes ☐ No

If so, what material cse bentonite Depth 7.5 to 9 Ft.

Type of well: Straight screen ☐ Gravel packed ☒

Depth grouted: From 7.5 To surface

Grouting Material: Cement X Other

If other explain: w/bentonite

Well head completion: Pitless unit

12" above grade X Other

If other, specify

Was pump installed: ☐ Yes ☒ No

Was well disinfected upon completion? ☐ Yes ☒ No

7. WATER LEVEL

Static water level dry feet below land surface

If flowing: closed-in pressure psi

GPM flow through inch pipe

Controlled by: ☐ Valve ☐ Reducers ☐ Other

If other, specify

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Other

Pumping level below land surface:

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

ft. after hrs. pumping gpm

9. WELL LOG

Formation	Depth (ft.) From	To
Topsoil, silty, black	0	1
Clay, silty, yellowish brown, till	1	7
Sand, fine, yellowish brown	7	8
Clay, silty, medium gray, till	8	15
Clay, silty to sandy, medium gray, abt 40% sand	15	20

(Use separate sheet if necessary.)

10. DATE COMPLETED 2/5/90

11. WAS WELL PLUGGED OR ABANDONED?

☐ Yes ☒ No

If so, how

12. REMARKS:

2" PVC cap on bottom of screen
160# silica sand pack

13. DRILLER'S CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

Water Supply, Inc. 46
Driller's or Firm's Name Certificate No.

Box 1191 - Bismarck, ND 58502
Address

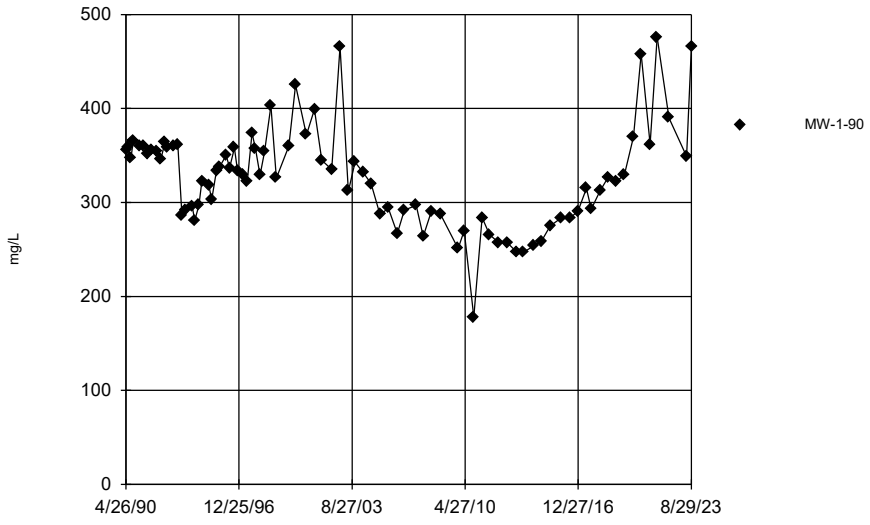
Lewis Knutson 2/5/90
Signed by Lewis Knutson Date

WHITE: DRILLER'S COPY YELLOW: BOARD'S COPY PINK: CUSTOMER'S COPY

Appendix F

MW1-90 Time Series Plots

Alkalinity, bicarbonate

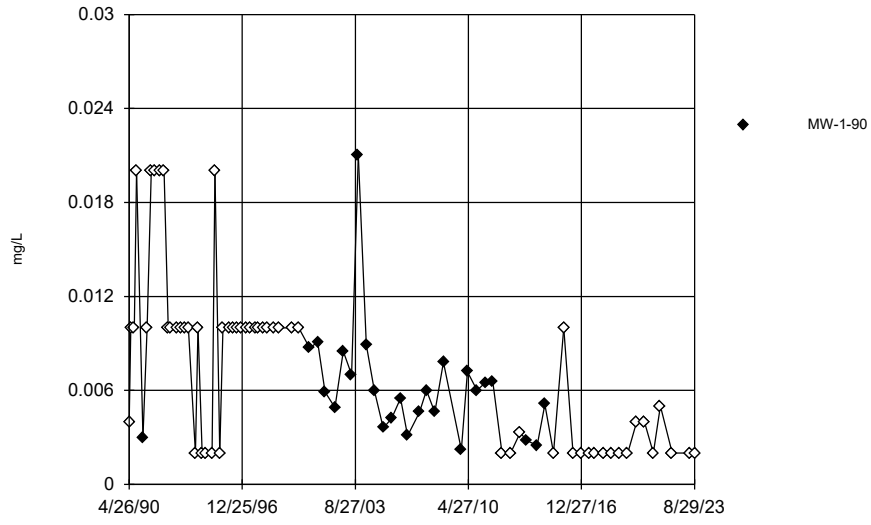


Time Series Analysis Run 11/23/2024 12:08 PM

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

Hollow symbols indicate censored values.

Arsenic

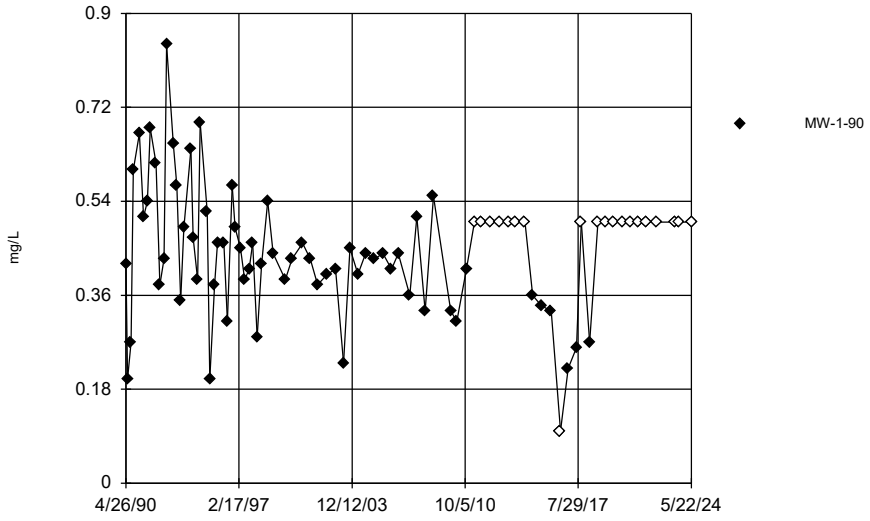


Time Series Analysis Run 11/23/2024 12:08 PM

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

Hollow symbols indicate censored values.

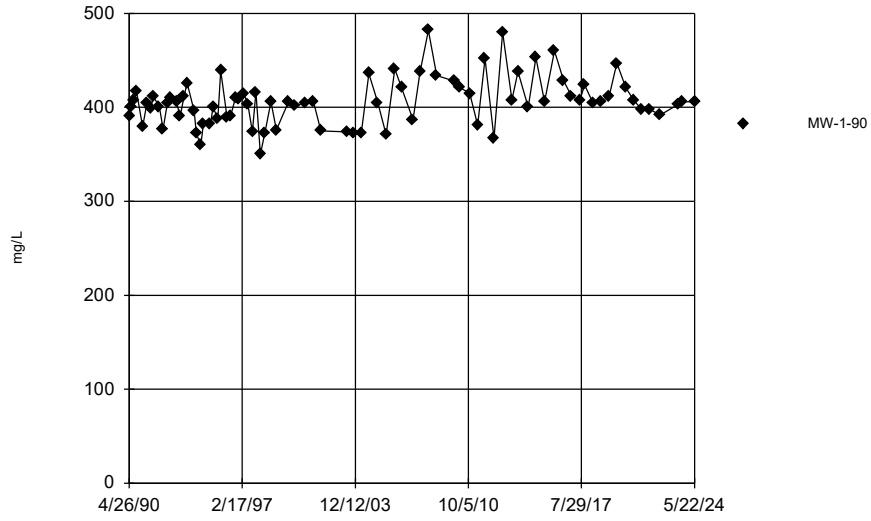
Boron



Time Series Analysis Run 11/23/2024 12:08 PM

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

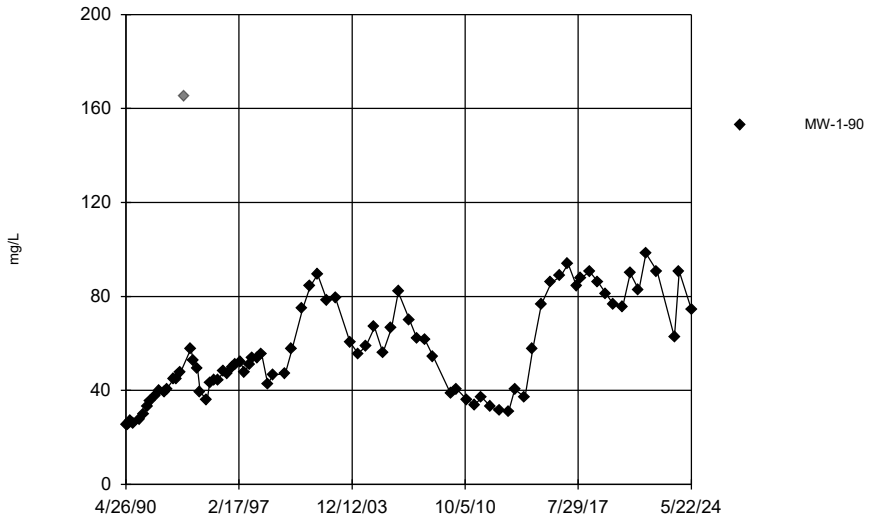
Calcium



Time Series Analysis Run 11/23/2024 12:08 PM

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

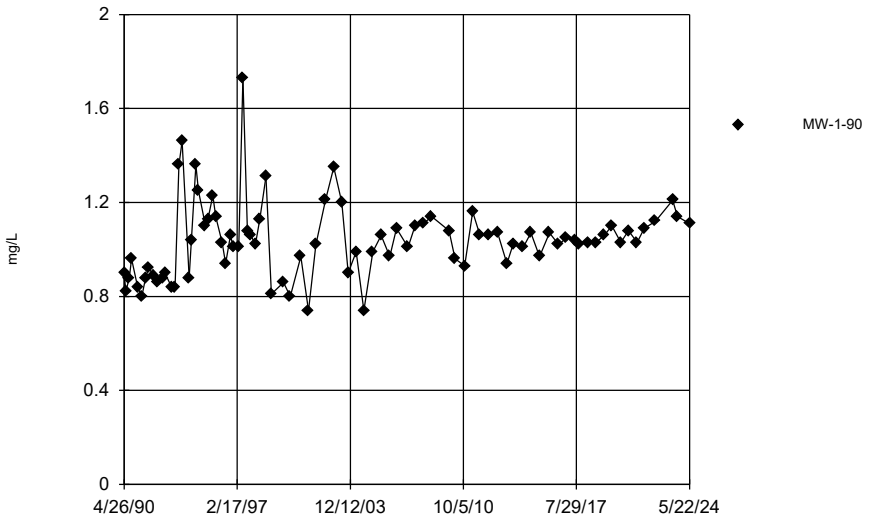
Chloride



Time Series Analysis Run 11/23/2024 12:08 PM
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: MDUHeskett_AMR_MW190

Sanitas™ v.10.0.23 Software licensed to Barr Engineering Company. UG

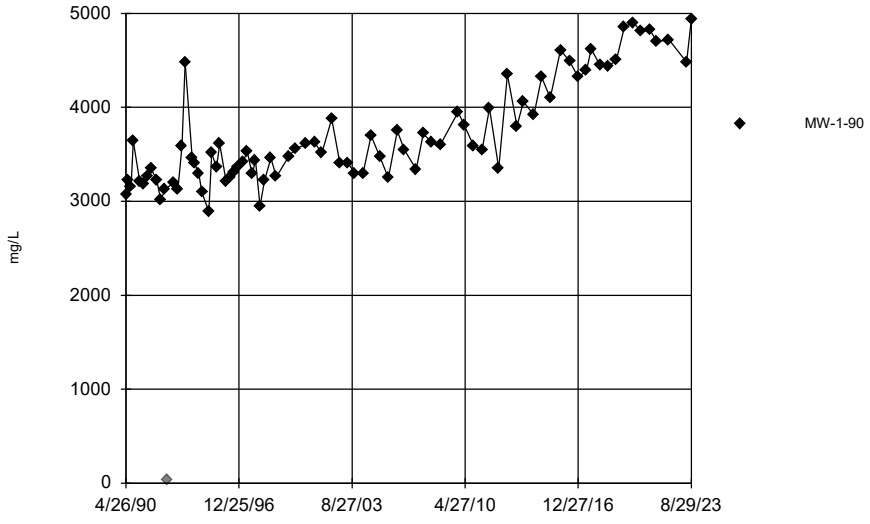
Fluoride



Time Series Analysis Run 11/23/2024 12:08 PM
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: MDUHeskett_AMR_MW190

Sanitas™ v.10.0.23 Software licensed to Barr Engineering Company. UG

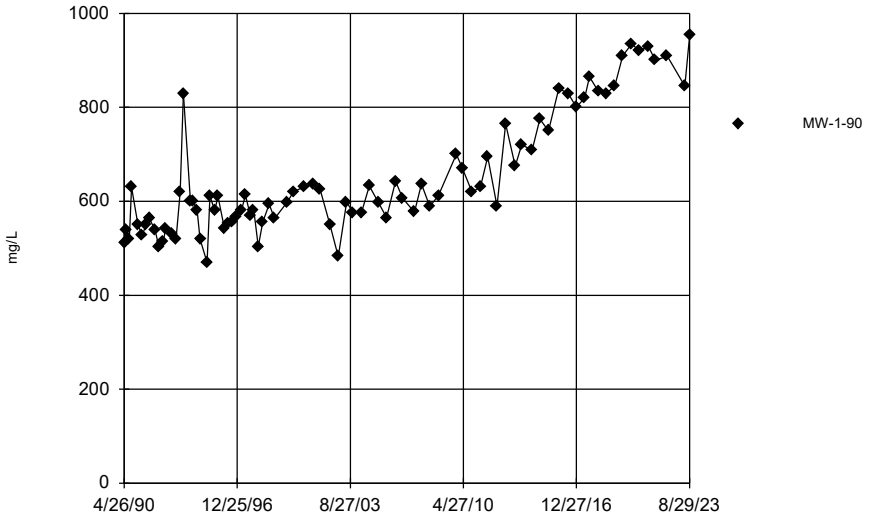
Hardness



Time Series Analysis Run 11/23/2024 12:08 PM
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: MDUHeskett_AMR_MW190

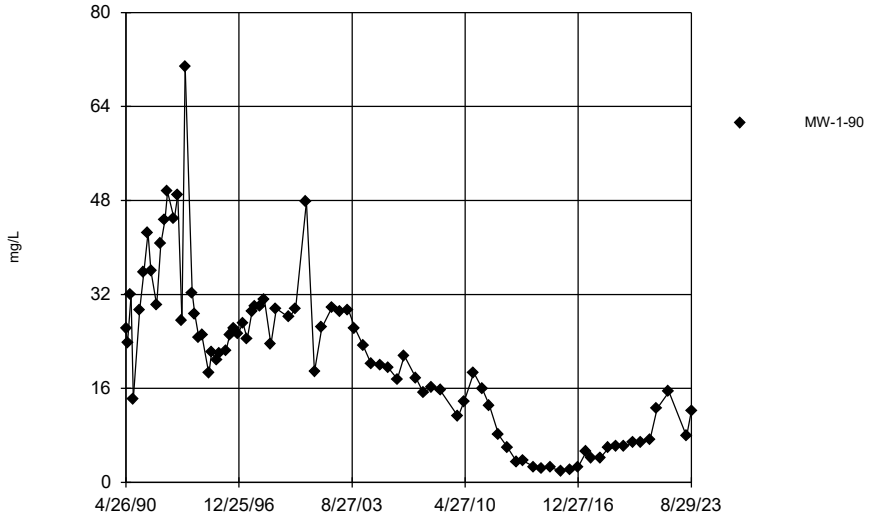
Sanitas™ v.10.0.23 Software licensed to Barr Engineering Company. UG

Magnesium



Time Series Analysis Run 11/23/2024 12:08 PM
R.M. Heskett Station Client: Montana-Dakota Utilities Co. Data: MDUHeskett_AMR_MW190

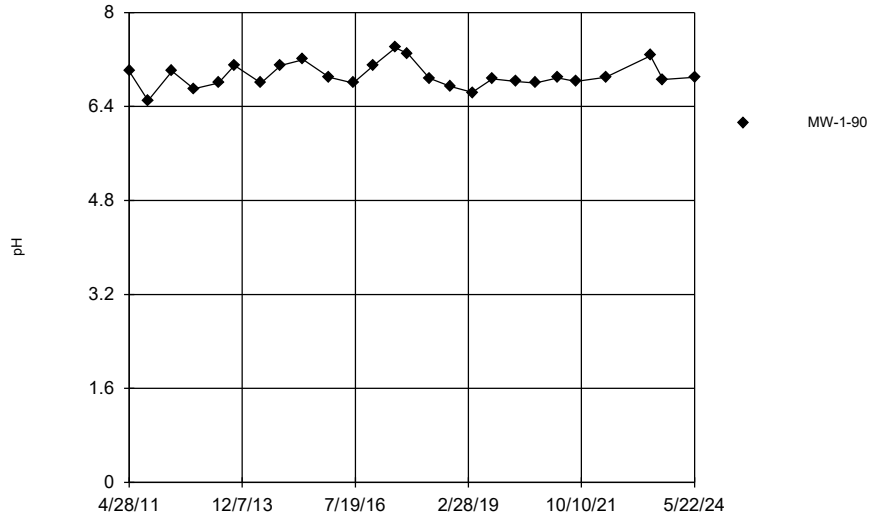
Nitrogen



Time Series Analysis Run 11/23/2024 12:08 PM

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

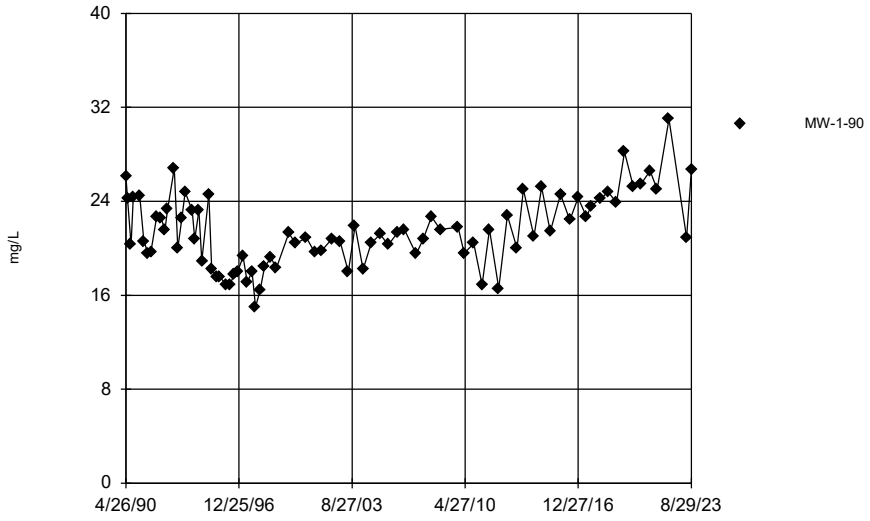
pH



Time Series Analysis Run 11/23/2024 12:08 PM

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

Potassium

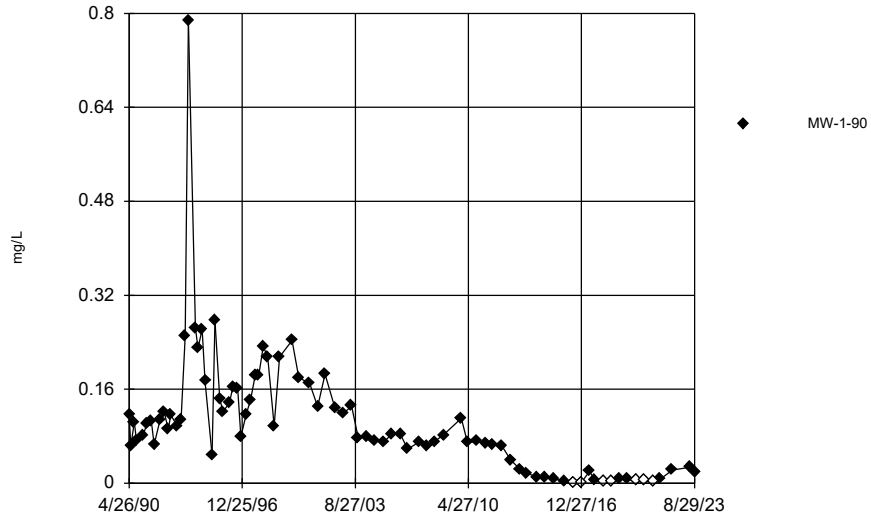


Time Series Analysis Run 11/23/2024 12:08 PM

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

Hollow symbols indicate censored values.

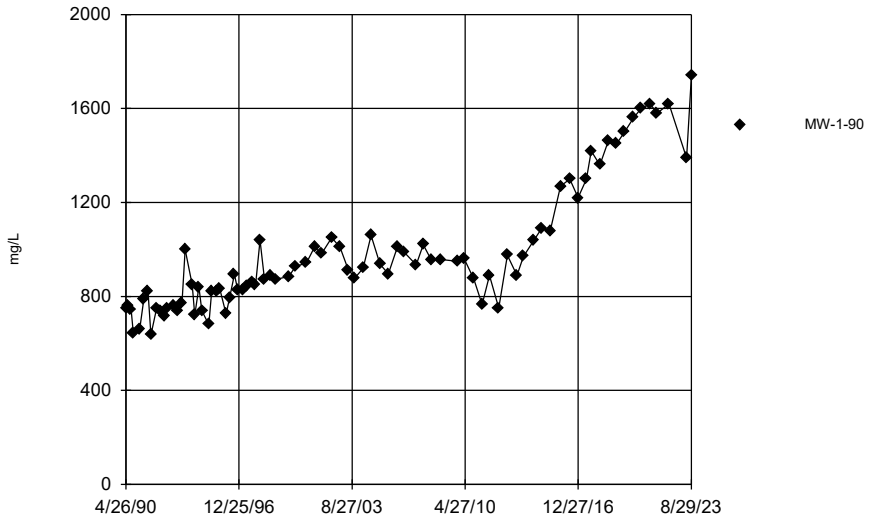
Selenium



Time Series Analysis Run 11/23/2024 12:08 PM

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

Sodium

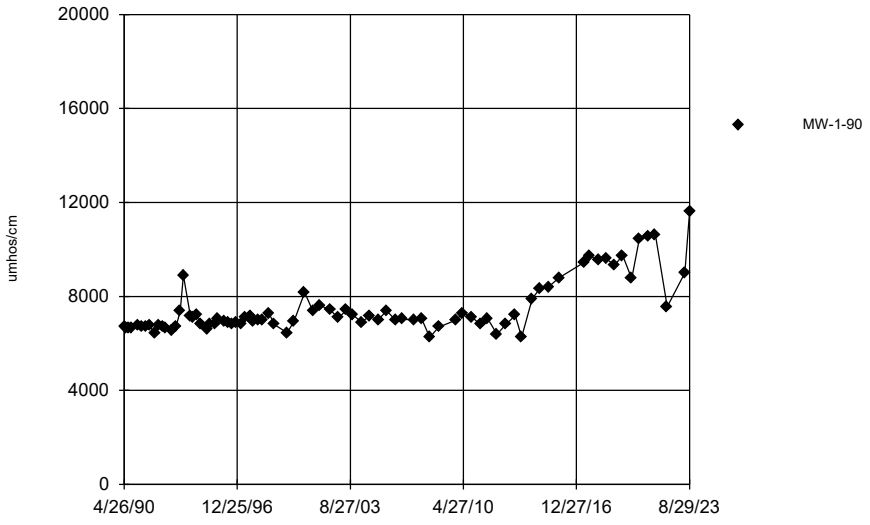


Time Series Analysis Run 11/23/2024 12:08 PM

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

Sanitas™ v.10.0.23 Software licensed to Barr Engineering Company. UG

Specific conductance

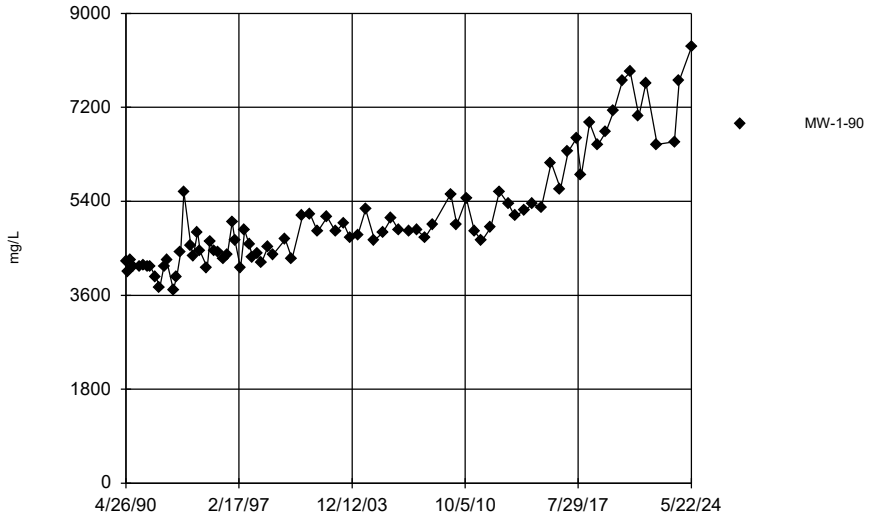


Time Series Analysis Run 11/23/2024 12:08 PM

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

Sanitas™ v.10.0.23 Software licensed to Barr Engineering Company. UG

Sulfate

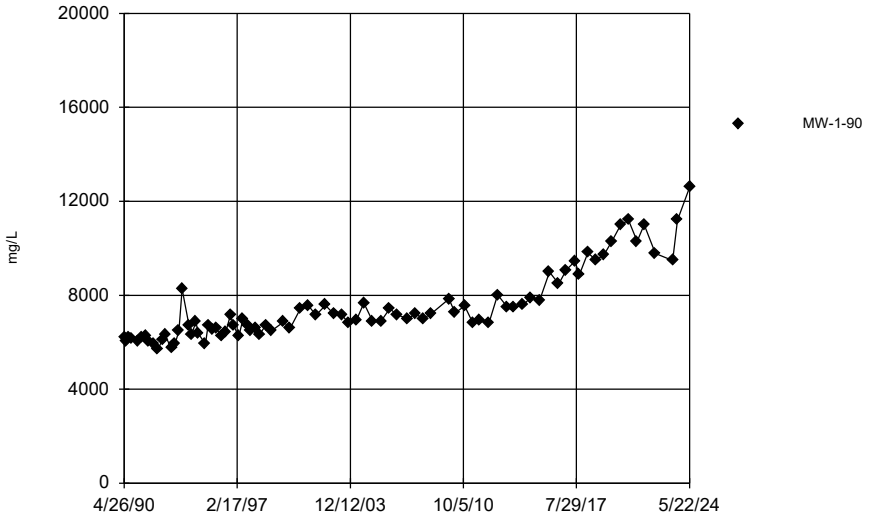


Time Series Analysis Run 11/23/2024 12:08 PM

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

Sanitas™ v.10.0.23 Software licensed to Barr Engineering Company. UG

TDS



Time Series Analysis Run 11/23/2024 12:08 PM

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

Appendix G

Geochemist's Workbench Results

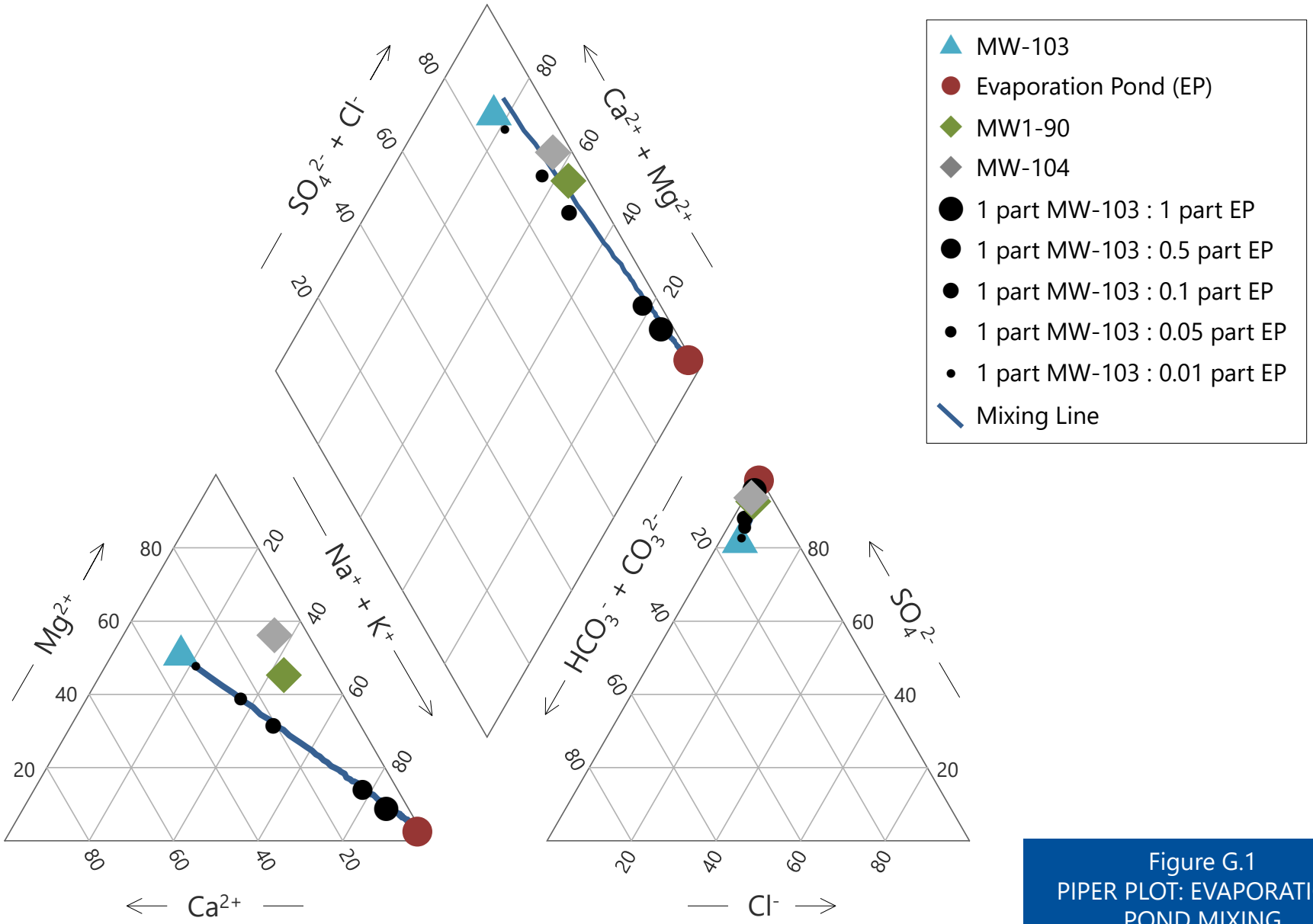
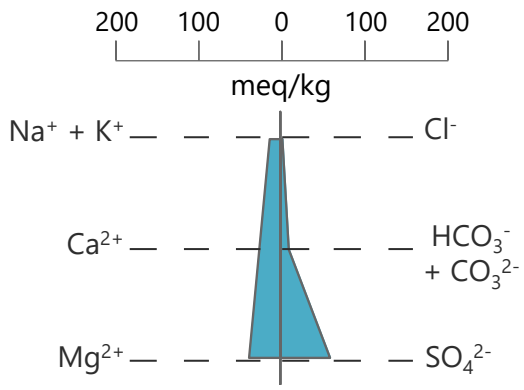
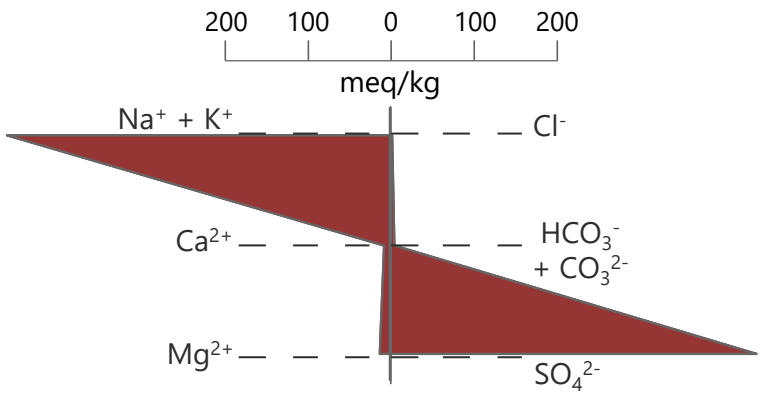


Figure G.1
PIPER PLOT: EVAPORATION POND MIXING
R.M. Heskett Station
Mandan, North Dakota

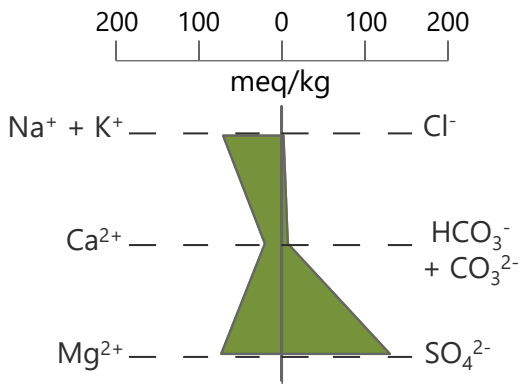
BARR



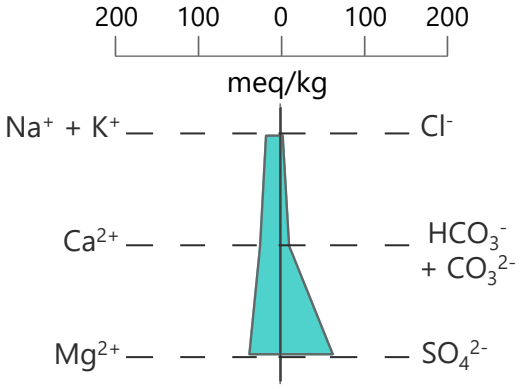
MW103



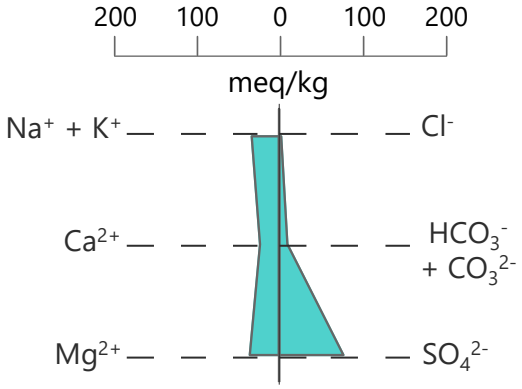
Evaporation Pond (EP)



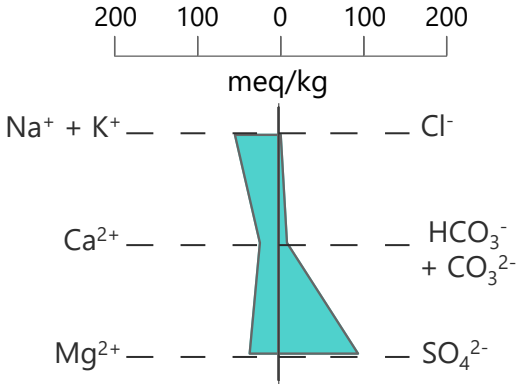
MW1-90



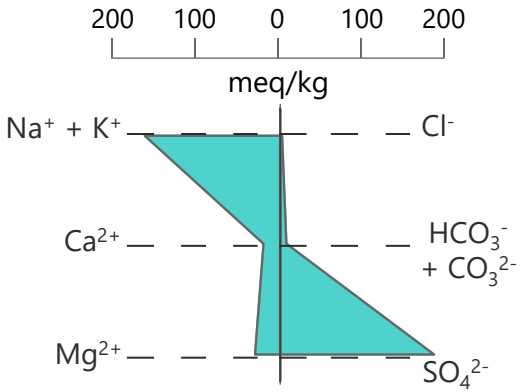
1 part MW-103 : 0.01 part EP



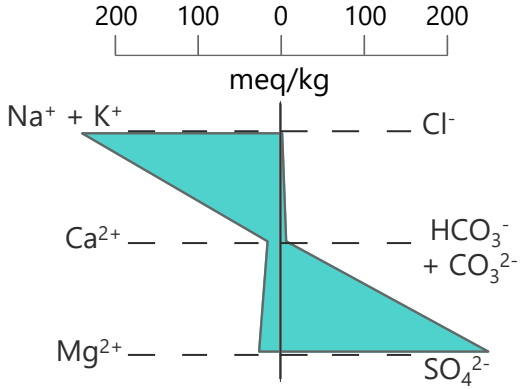
1 part MW-103 : 0.05 part EP



1 part MW-103 : 0.1 part EP



1 part MW-103 : 0.5 part EP



1 part MW-103 : 1 part EP

BARR

Figure G.2
STIFF PLOT: EVAPORATION POND MIXING
R.M. Heskett Station
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		MW-103	Evap Pond	1 : 0.01	1 : 0.05	1 : 0.1	1 : 0.5	1 : 1	MW1-90	MW-104
Sample Date		8/23/2021	9/16/2014	n/a					8/28/2023	8/24/2021
HCO3-	mg/l	645	340	642	630	617	543	492	568	820
Ca++	mg/l	500	125	496	482	466	375	313	406	422
Cl-	mg/l	119	79.8	119	117	115	106	99	90.7	94.1
F-	mg/l	0.30	0.1	0.30	0.29	0.28	0.23	0.20	1.14	0.54
Mg++	mg/l	464	165	461	450	437	364	315	953	1,640
K+	mg/l	20.0	734	27.1	54.0	84.9	258	377	26.7	34
Na+	mg/l	266	10,600	368	758	1,210	3,710	5,430	1,740	1,940
SO4--	mg/l	3,000	22,100	3,190	3,910	4,740	9,370	12,500	7,710	11,600
pH	SU	6.6	10.7	6.6	6.7	6.7	7.4	8.9	6.9	6.9
TDS	mg/kg	4,950	34,100	5,240	6,350	7,610	14,700	19,600	13,100	16,500

Appendix C Groundwater Elevation and Flow Rate

Appendix C
Groundwater Elevations
2024 Annual Monitoring Report
Heskett CCR Groundwater Compliance

Location	Date	Top of Riser Elevation ft amsl	Depth to Water ft	Water Level Elevation ft amsl
MW-13	5/22/2024	1724.27	28.76	1695.51
MW-13	8/28/2024	1724.27	29.45	1694.82
MW-13	11/26/2024	1724.27	30.29	1693.98
MW1-90	5/22/2024	1675.86	10.54	1665.32
MW1-90	8/28/2024	1675.86	11.12	1664.74
MW1-90	11/26/2024	1675.86	11.35	1664.51
MW2-90	5/22/2024	1687.08	20.27	1666.81
MW2-90	8/28/2024	1687.08	20.38	1666.70
MW2-90	11/26/2024	1687.08	21	1666.08
MW-33	5/22/2024	1717.95	39.27	1678.68
MW-33	8/28/2024	1717.95	39.94	1678.01
MW3-90	5/22/2024	1686.46	17.46	1669.00
MW3-90	8/28/2024	1686.46	18.42	1668.04
MW3-90	11/26/2024	1686.46	19.25	1667.21
MW-44R	5/22/2024	1711.57	24.7	1686.87
MW-44R	8/28/2024	1711.57	26.15	1685.42
MW-44R	11/26/2024	1711.57	27.51	1684.06
MW-70	5/22/2024	1706.34	18.9	1687.44
MW-70	8/28/2024	1706.34	19.43	1686.91
MW-80R	5/22/2024	1686.78	13.27	1673.51
MW-80R	8/28/2024	1686.78	13.5	1673.28
MW-80R	11/26/2024	1686.78	13.85	1672.93
MW-101	5/22/2024	1719.53	34.94	1684.59
MW-101	8/28/2024	1719.53	35.05	1684.48
MW-102	5/22/2024	1706.64	14.39	1692.25
MW-102	8/28/2024	1706.64	15.55	1691.09
MW-103	5/22/2024	1717.53	30.13	1687.40
MW-103	8/28/2024	1717.53	29.19	1688.34
MW-103	11/26/2024	1717.53	30.04	1687.49
MW-104	5/22/2024	1684.51	12.51	1672.00
MW-104	8/28/2024	1684.51	13.08	1671.43
MW-105	5/22/2024	1689.14	12.06	1677.08
MW-105	8/28/2024	1689.14	12.4	1676.74

Appendix C
Groundwater Flow Rate
2024 Annual Monitoring Report
Heskett CCR Groundwater Compliance

Heskett Groundwater Velocity Calculation

Sampling Date	5/22/2024

Upgradient: MW13

Top of Casing Elevation	1724.27	ft amsl	*Groundwater Monitoring System Report (Barr, 2016)*
Depth to Water	28.76	ft below TOC	
Water Level Elevation	1695.51	ft amsl	

Downgradient: MW1-90

Top of Casing Elevation	1675.86	ft amsl	*Groundwater Monitoring System Report (Barr, 2016)*
Depth to Water	10.54	ft below TOC	
Water Level Elevation	1665.32	ft amsl	

horizontal hydraulic	1.00E-04	cm/s	*Groundwater Monitoring System Documentation (Barr, 2017*
conductivity (Kh)	2.83E-01	ft/day	
porosity (n)	0.25		*Groundwater Monitoring System Documentation (Barr, 2017*
horizontal distance	1850	ft	
WL elevation difference	30.19	ft	
gradient (i)	0.016	ft/ft	
linear velocity (V)	0.0185033	ft/day	
V	**6.8**	ft/yr	

Appendix C
Groundwater Flow Rate
2024 Annual Monitoring Report
Heskett CCR Groundwater Compliance

Heskett Groundwater Velocity Calculation

Sampling Date	8/28/2024

Upgradient: MW13

Top of Casing Elevation	1724.27	ft amsl	*Groundwater Monitoring System Report (Barr, 2016)*
Depth to Water	29.45	ft below TOC	
Water Level Elevation	1694.82	ft amsl	

Downgradient: MW1-90

Top of Casing Elevation	1675.86	ft amsl	*Groundwater Monitoring System Report (Barr, 2016)*
Depth to Water	11.12	ft below TOC	
Water Level Elevation	1664.74	ft amsl	

horizontal hydraulic	1.00E-04	cm/s	*Groundwater Monitoring System Documentation (Barr, 2017)*
conductivity (Kh)	2.83E-01	ft/day	
porosity (n)	0.25		*Groundwater Monitoring System Documentation (Barr, 2017)*
horizontal distance	1850	ft	
WL elevation difference	30.08	ft	
gradient (i)	0.016	ft/ft	
linear velocity (V)	0.0184359	ft/day	
V	**6.7**	ft/yr	