



## REPORT

# Coal Combustion Residuals Groundwater Monitoring System Certification, Revision 1

*Great River Energy – Stanton Station*

Submitted to:

**Great River Energy**

2875 Third Street SW, Underwood, North Dakota 58576

Submitted by:

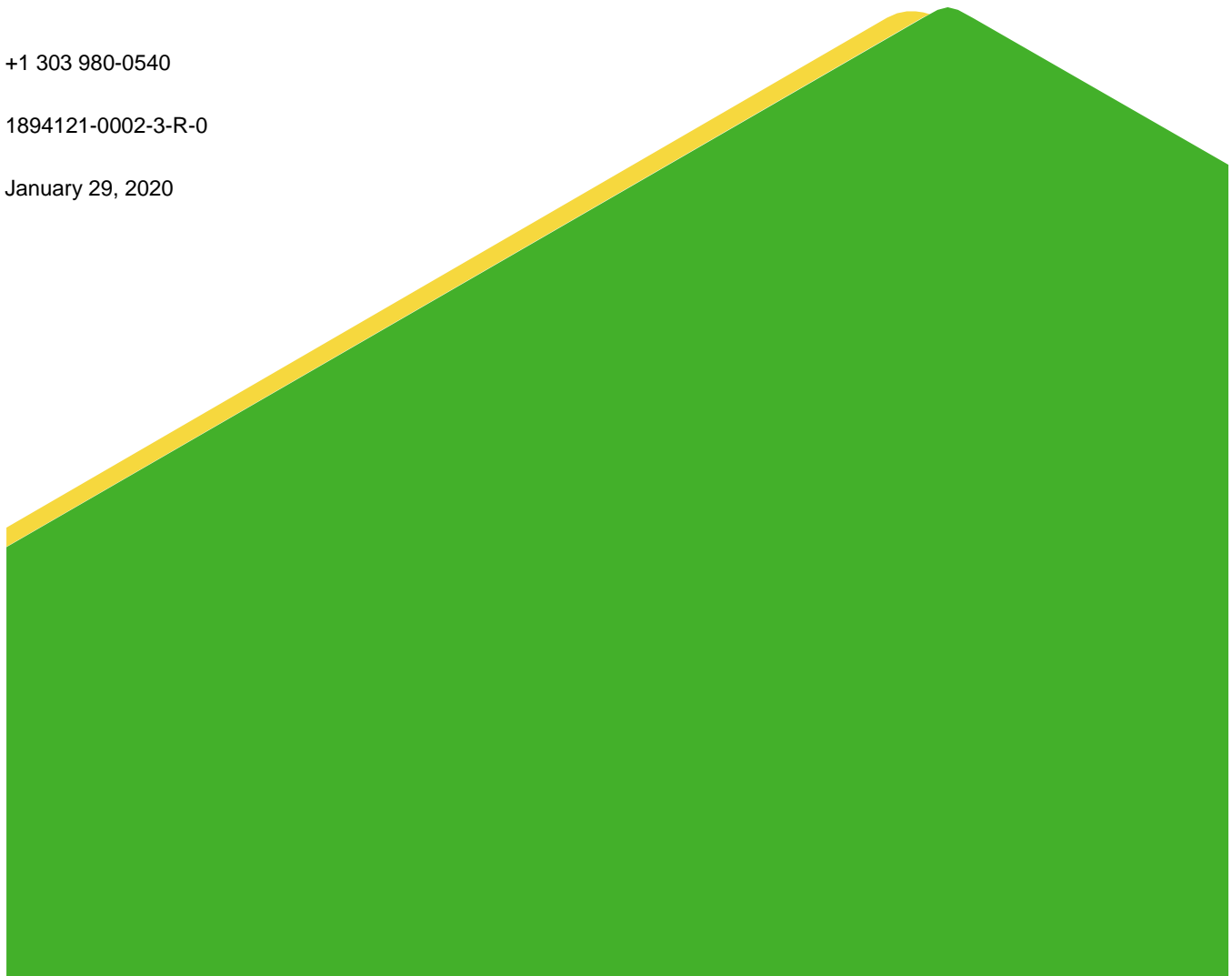
**Golder Associates Inc.**

7245 W Alaska Drive, Suite 200, Lakewood, Colorado 80226

+1 303 980-0540

1894121-0002-3-R-0

January 29, 2020



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## 1.0 INTRODUCTION

Golder Associates Inc. (Golder) has prepared this revision to the Coal Combustion Residual (CCR) Groundwater Monitoring System Certification Report on behalf of Great River Energy (GRE) to certify that the groundwater monitoring system for the CCR facilities at Stanton Station regulated by the United States Environmental Protection Agency's (EPA) CCR rule meets the requirements of 40 CFR 257.91.

## 2.0 SITE BACKGROUND

GRE's Stanton Station was a coal-fired power plant located in Mercer County, North Dakota, approximately three miles southeast of the city of Stanton along the Missouri River (Figure 1). Stanton Station began generating power in 1966, ceased power production in February 2017, and demolition of the industrial site was finished in 2019. CCRs have been managed in composite-lined surface water impoundment cells and dry waste facilities regulated and permitted by the North Dakota Department of Environmental Quality (NDDEQ) in accordance with North Dakota Administrative Code (NDAC) Article 33-20, Solid Waste Management and Land Protection.

Stanton Station has two CCR facilities that are within the purview of the EPA CCR rule (see Figure 1):

- Bottom Ash CCR Landfill (Bottom Ash Landfill) – The Bottom Ash Landfill is located south of the former plant site and west of the Bottom Ash Impoundment.
- Bottom Ash CCR Surface Impoundment (Bottom Ash Impoundment) – The Bottom Ash Impoundment is located south of the former plant site and east of the Bottom Ash Landfill and consisted of three interconnected cells designated the north, center, and south cells.

Closure of the Bottom Ash Landfill and Bottom Ash Impoundment began in 2019 and will be completed in 2020.

### 2.1 Site Setting

Stanton Station is located along the Missouri River, and the general area is primarily characterized by the presence of glacial deposits, with alluvial deposits dominating near-surface geology adjacent to the Missouri River. The following sections detail the regional and site geology and hydrogeology.

#### 2.1.1 Regional and Site Geology

Regional geology of the area surrounding Stanton Station is documented in the *Hydrogeologic Assessment Report, Stanton Station Ash Ponds* (Braun 1993). Physiographically, Stanton Station is located in the Missouri Slope District of the Glaciated Missouri Plateau Section of the Great Plains Province. Subsurface and surficial stratigraphy of Mercer County and the adjacent Oliver County were reviewed in depth by C.G. Carlson for the North Dakota Geological Society (Carlson 1973). Primary near-surface stratigraphic units in the area of Stanton Station include the Tongue River Formation and Cannonball Formation, with named lignite beds prominent near the site.

Near-surface geology at Stanton Station consists of two primary geologic units: the upper alluvial terrace deposits of the Missouri River, and underlying sediments and bedrock belonging to the Bullion Creek Formation, each having variable extents and thicknesses across the site (Braun 1993).



### 2.1.2 Site Hydrogeology

The principal hydrostratigraphic unit and uppermost water-bearing unit near the CCR facilities consists of alluvial deposits, which includes two subunits: an upper silty sand and clay, and an underlying outwash sand and gravel. Individually, these subunits are laterally heterogeneous and geologic conditions within these subunits can be characterized by interbedded layers of gravel, sand, silt, clay, and coal.

Due to variations in subunit thickness throughout the site, groundwater in the uppermost water bearing unit is monitored in both the outwash subunit and the silty sand and clay subunit, with flow generally moving from southwest to northeast towards the Missouri River. Depths from the ground surface to the uppermost water-bearing unit range from 5 to 20 feet in the area around Stanton Station. A map showing recent available groundwater elevations is shown in Figure 1.

The groundwater gradient across the site is influenced by the subsurface units, and ranges from 0.002 to 0.01 (Braun 1993). The geometric mean of hydraulic conductivities measured from wells screened in the upper silty sand subunit is  $3.7 \times 10^{-4}$  cm/sec, or approximately 1.05 ft/day, while the hydraulic conductivity of the lower outwash unit is approximately  $1.4 \times 10^{-2}$  cm/sec or 40 feet/day (Braun 1993).

### 2.1.3 Geologic Cross Sections

Geologic cross sections were compiled based on boring information from current CCR monitoring wells and historic site monitoring wells (Appendix A).

As shown in the cross sections and described previously, site variability results in a range of materials in the near-surface geologic units. Discontinuous seams of coal are located throughout the site, in addition to gravel, sand, silt, and clay.

## 2.2 Release Conceptual Model

At Stanton Station, a hypothetical sub-surface release from either the Bottom Ash Landfill or Bottom Ash Impoundment would be transported downgradient, to the northeast of the site, as demonstrated by the groundwater information presented in Figure 1. The downgradient wells discussed in Section 3.2 are positioned along the northern edge of the CCR facilities to detect a potential release.

## 3.0 GROUNDWATER MONITORING SYSTEM

The CCR groundwater monitoring system at Stanton Station is designed to identify potential impacts resulting from either the Bottom Ash Landfill or Bottom Ash Impoundment.

### 3.1 Information Reviewed

Golder reviewed information from the operating record documenting the design, installation, and development of the monitoring wells and/or describing hydrogeologic conditions at the site to help assess the adequacy of the groundwater monitoring system. The information reviewed included the following:

- Barr Engineering Co. 2015. 2014 Annual Groundwater Monitoring Report – Stanton Station Ash Disposal Facility, NDDH Solid Waste Permit #SP043, Stanton, North Dakota. Prepared for Great River Energy. July 15.
- Braun. 1993. Hydrogeologic Assessment Report, Stanton Station Ash Ponds. Prepared for Great River Energy Stanton Generating Station. Prepared by Braun Intertec Environmental Inc.

- Carlson, C.G. 1973. Geology of Mercer and Oliver Counties, North Dakota. Bulletin 56 – Part I, for the North Dakota Geological Society. County Ground Water Studies 15 – Part I, for the North Dakota State Water Commission.
- McCain and Associates, Inc. 2005. Groundwater Sampling and Analysis Plan – Stanton Station Plant Site, Permitted Ash Disposal Facility, Permit #SP043, Stanton, North Dakota. September.
- Terracon. 2015. Geotechnical Exploration Report – Monitoring Well Installations, GRE – Stanton Station, Mercer County, North Dakota. Terracon Project No. M2155089. Prepared for Golder Associates, Inc. December 3.

### 3.2 Number, Locations, and Depths of Monitoring Wells

40 CFR 257.91 includes the following requirements for the number, locations, and depths of monitoring wells:

- The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the upper most aquifer that:
  - Accurately represent the quality of background groundwater
  - Accurately represent the quality of groundwater passing the waste boundary of the CCR unit
- The number, spacing, and depths of monitoring wells must be based on site-specific technical information that must include thorough characterization of the uppermost aquifer and overlying materials.
- The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards based on the site-specific information. The groundwater monitoring system must contain a minimum of one upgradient monitoring well and three downgradient monitoring wells per unit.

### 3.3 Changes to the Groundwater Monitoring System

The purpose of this revision is to describe changes to the groundwater monitoring network necessitated by the closure of the Bottom Ash Landfill and Bottom Ash Impoundment.

- Closure of the Bottom Ash Landfill includes consolidating the landfill into a smaller footprint, adjusting CCR grades if necessary, installing the final cover system with surface water controls, and establishing vegetation. Consolidation of the landfill footprint was completed in 2019, and final cover construction will occur in 2020.
- Closure of the north and center cells of the Bottom Ash Impoundment includes removal of all waste, liner, and potentially impacted soils from the north and center cell footprints (placed in the south cell and/or Bottom Ash Landfill). Closure of the north and center cells of the Bottom Ash Impoundment was substantially completed in 2019.
- Closure of the south cell of the Bottom Ash Impoundment includes installation of a sump, adjusting CCR grades, installing the final cover system with surface water controls, and establishing vegetation. Closure of the south cell of the Bottom Ash Impoundment was partially completed in 2019 with the remaining final cover components to be installed in 2020.

Due to the closure activities described above, the groundwater monitoring system for the Bottom Ash Landfill and Bottom Ash Impoundment will be transitioned from pre-closure conditions to post-closure conditions between 2019 and 2021 as described in the following sections.

### 3.3.1 Pre-Closure CCR Groundwater Monitoring System

During pre-closure conditions, the CCR groundwater monitoring system consisted of a total of 12 monitoring locations (four upgradient, one side-gradient, and seven downgradient) as shown on Figure 1.

Each CCR unit had a groundwater monitoring system consisting of at least one upgradient and three downgradient monitoring wells, as discussed below:

- The background monitoring wells are located south and west of the CCR units where groundwater is not expected to have been influenced by historic CCR deposition based on groundwater flow trends. There are four upgradient monitoring wells and one side-gradient monitoring well shared between the CCR facilities.
- The Bottom Ash Landfill had four downgradient monitoring wells.
- The Bottom Ash Impoundment had three downgradient monitoring wells.

Monitoring well construction details are provided on Table 1 and in Appendix B. The monitoring wells assigned to each facility during pre-closure are summarized on Table 2.

### 3.3.2 Closure Construction CCR Groundwater Monitoring System

During closure construction, the CCR groundwater monitoring system will be reduced to 10 monitoring locations (four upgradient, one side-gradient, and five downgradient) as shown in Figure 2.

Two of the existing monitoring wells were abandoned in October 2019 as part of closure construction (Appendix C). MW-3B and MW-101 are located downgradient of the permitted Bottom Ash Landfill footprint. Due to regrading and closure, the Bottom Ash Landfill has been consolidated into a smaller footprint, and these wells are no longer downgradient of the closed Bottom Ash Landfill. In addition, to accommodate improved site drainage around the Bottom Ash Landfill after closure, the wells and berm on which these wells are installed will be removed.

Based on existing monitoring well locations, general direction of groundwater flow, and removal of the north and center cells of the Bottom Ash Impoundment, MW-103 will now be used as a Bottom Ash Landfill downgradient well.

The Bottom Ash Impoundment south cell will then have two potential downgradient wells (MW-104 and MW-1R) which are far from the new waste boundary developed during closure construction. New monitoring wells closer to the Bottom Ash Impoundment south cell waste boundary cannot be installed until closure construction is completed. Therefore, until new wells can be installed, MW-104 and MW-1R will be used to monitor the Bottom Ash Impoundment south cell during the groundwater monitoring system transition.

- The background monitoring wells are located south and west of the CCR units where groundwater is not expected to have been influenced by historic CCR deposition based on groundwater flow trends. There are four upgradient monitoring wells and one side-gradient monitoring well shared between the CCR facilities.

- The Bottom Ash Landfill has three downgradient monitoring wells.
- The Bottom Ash Impoundment (south cell) has two temporary downgradient monitoring wells.

The monitoring wells assigned to each facility during closure construction are summarized on Table 2.

### 3.3.3 Post-Closure CCR Groundwater Monitoring System

Following closure construction, the CCR groundwater monitoring system will consist of 11 monitoring locations (four upgradient, one side-gradient, and six downgradient) as shown in Figure 3.

Three new monitoring wells (MW-201, MW-202, and MW-203) will be installed around the Bottom Ash Impoundment south cell so that monitoring can be done closer to the waste boundary. These wells are anticipated to be installed in the summer of 2020 and collection of baseline data is anticipated to occur for approximately 16 months (sampling every two months). Once baseline data has been collected, detection monitoring at these wells will begin (second quarter 2022).

Once the new monitoring wells are installed and detection monitoring started at these new wells, monitoring wells MW-104 and MW-1R will be removed from the groundwater monitoring system (for detection monitoring) as they are no longer close to the waste boundary and will be replaced by the new wells.

Each CCR unit will have a groundwater monitoring system consisting of at least one upgradient and three downgradient monitoring wells, as discussed below.

- The background monitoring wells are located south and west of the CCR units where groundwater is not expected to have been influenced by historic CCR deposition based on groundwater flow trends. There are four upgradient monitoring wells and one side-gradient monitoring well shared between the CCR facilities.
- The Bottom Ash Landfill will have three downgradient monitoring wells.
- The Bottom Ash Impoundment will have three downgradient monitoring wells.

The monitoring wells assigned to each facility during post-closure are summarized on Table 2.

**Table 2: CCR Units Monitoring Wells**

Location	Pre-Closure	Closure Construction (temporary)	Post-Closure
Upgradient/Side-gradient	MW-6B	MW-6B	MW-6B
	MW-7A	MW-7A	MW-7A
	MW-7B	MW-7B	MW-7B
	MW-8B	MW-8B	MW-8B
	MW-105	MW-105	MW-105
Bottom Ash Landfill Downgradient	MW-3B	MW-102	MW-102
	MW-9N	MW-9N	MW-9N
	MW-101	MW-103	MW-103
	MW-102	-	-
Bottom Ash Impoundment Downgradient	MW-1R	MW-1R	MW-201
	MW-103	MW-104	MW-202
	MW-104	-	MW-203

The monitoring wells are installed and screened at appropriate locations and depths to obtain groundwater samples from the uppermost water bearing unit. The number and spacing of the downgradient monitoring wells were selected based on the hydrogeologic conditions at the site and the areal extent of the two CCR units, such that impacts to groundwater quality in the uppermost water bearing unit can be detected along potential flow pathways if they were to occur.

### 3.4 Monitoring Well Casing

40 CFR 257.91(e) includes the following requirements for monitoring well construction:

- “Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole.
- The casing must be screened or perforated and packed with sand or gravel to enable collection of groundwater samples.
- The annular space above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

The monitoring wells at SS have polyvinyl chloride (PVC) casings to maintain the integrity of the monitoring well boreholes. The casings are screened within the uppermost water bearing unit and packed with sand to enable collection of groundwater samples within the unit. The annular space above the screened interval in each monitoring well is sealed with a bentonite seal and cement-bentonite grout seal.

## 4.0 REVISION HISTORY

A history of revisions to this document follows:

- 1) Revision 0 – Published October 12, 2017.
- 2) Revision 1 – Revised to reflect: Published January 29, 2020
  - a. Design of pre-closure, closure construction, and post-closure CCR groundwater monitoring systems
    - i. Abandonment of two monitoring system wells as part of closure construction.
    - ii. Proposed locations for three new monitoring system wells for post-closure conditions following closure construction.

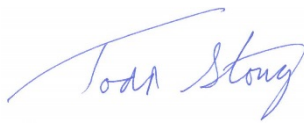
## Closing and Certification

Based upon the review described in this report, the undersigned certifies that the groundwater monitoring system for the Bottom Ash Landfill and Bottom Ash Impoundment at Stanton Station has been designed and constructed to meet the requirements of 40 CFR 257.91.

### Golder Associates Inc.



Erin L. Hunter, PhD  
*Project Engineer*



Todd J. Stong, PE  
*Associate and Senior Consultant*



ELH/TJS/rjg

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## Tables



Table 1: Monitoring Well Summary

Location	Well ID	Date Constructed	TOC Elevation	Ground Surface Elevation	Screen Interval	Top of Screen Elevation	Bottom of Screen Elevation	Sand Pack Interval	Geologic Unit(s) Completed In
			ft amsl	ft amsl	ft bgs	ft amsl	ft amsl	ft bgs	
Upgradient/Side-gradient	MW-6B	9/8/1992	1711.2	1709.3	28.4-38.4	1681	1671	19.0-38.5	Outwash
	MW-7A	8/27/1992	1713.4	1711.0	7.0-17.0	1704	1694	5.0-18.0	Silty Sand/Clay
	MW-7B	9/9/1992	1712.7	1710.9	28.1-38.1	1682	1672	23.0-38.5	Silty Sand/Outwash
	MW-8B	9/3/1992	1749.7	1747.2	54.0-64.0	1694	1684	49.0-64.5	Outwash
	MW-105	11/18/2015	1716.6	1713.5	9.0-19.0	1704	1694	7.0-19.0	Clay/Outwash
Downgradient	MW-3B	6/11/1982	1713.0	1709.4	23.7-28.7	1687	1682	23.2-29.5	Outwash
	MW-101	11/17/2015	1710.8	1707.5	8.0-18.0	1700	1690	6.0-18.0	Silty Sand/Clay
	MW-9N	7/19/2010	1708.1	1705.5	16.0-26.0	1689	1679	14.0 - 26.0	Outwash
	MW-102	11/17/2015	1711.7	1708.5	14.0-24.0	1694	1684	12.0-24.0	Silty Sand/Clay
	MW-103	11/17/2015	1709.1	1705.6	14.0-24.0	1692	1682	12.0-24.0	Outwash
	MW-1R	11/8/1995	1709.2	1706.8	27.0-36.0	1682	1671	25.0-38.0	Outwash/Clay
	MW-104	11/17/2015	1711.7	1708.5	14.0-24.0	1694	1684	12.0-24.0	Outwash
	MW-201								
	MW-202	<i>To Be Installed In 2020 After Closure Construction Completed</i>							
	MW-203								

## Notes:

TOC: top of casing

ft amsl: feet above mean sea level

ft bgs: feet below ground surface

TOC and ground surface elevations surveyed by Interstate Engineering, Inc. in December 2015.

Well construction measurements are from the original bore log, well data sheet or well construction form.

MW-3B and MW-101 were abandoned October 2019 as part of closure construction.

MW-1R and MW-104 will be removed from the groundwater monitoring system (for detection monitoring) once MW-201, MW-202 and MW-203 begin detection monitoring.

## Figures





LEGEND

— 3600 —

EXISTING GROUND TOPOGRAPHY (REFERENCES 3 AND 4)

UPGRADIENT MONITORING WELLS

DOWNGRADIENT MONITORING WELLS - BOTTOM ASH LANDFILL

DOWNGRADIENT MONITORING WELLS - BOTTOM ASH IMPOUNDMENT

(1688)

GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL) (NOTE 1)

GENERAL DIRECTION OF GROUNDWATER FLOW

POTENTIOMETRIC SURFACE CONTOUR (NOTE 2)

NOTE(S)

1.

GROUNDWATER ELEVATIONS WERE MEASURED NOVEMBER 2018.

2.

GROUNDWATER SITE INFORMATION WAS USED IN THE CREATION OF POTENTIOMETRIC SURFACE CONTOURS. CONTOUR INTERVAL IS FIVE (5) FEET.

3.

GROUNDWATER ELEVATION MEASUREMENTS FOR MW-1R DID NOT OCCUR DURING NOVEMBER 2018 AS THE MONITORING WELL WAS INACCESSIBLE DURING PLANT DECONSTRUCTION.

REFERENCE(S)

1.

T144N, R84W, MERCER COUNTY, NORTH DAKOTA.

2.

AERIAL IMAGE IS A COMBINATION OF IMAGERY OBTAINED FROM THE UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AERIAL IMAGE PROGRAM, ACQUIRED IN 2018, AND IMAGERY PROVIDED BY GRE, ACQUIRED IN JUNE 2018.

3.

EXISTING GROUND TOPOGRAPHY IS FROM AN AERIAL SURVEY PERFORMED BY KBM, INC. ON APRIL 27, 2001 (SITE WIDE), A GROUND SURVEY PERFORMED BY INTERSTATE ENGINEERING IN 2014 (BOTTOM ASH IMPOUNDMENT AND LANDFILL AREA), A GROUND SURVEY PERFORMED BY INTERSTATE ENGINEERING IN 2017 (COAL PILE AREA), AND A GROUND SURVEY PERFORMED BY INTERSTATE ENGINEERING IN 2018.

4.

EXISTING GROUND CONTOURS ARE TWO (2) FEET.

Path: \\Denver\\data\\GREAT RIVER ENERGY\\STANTON\\09\_PROJECTS\\1894121\\Network Certification | File Name: 1894121\_Figure 1.dwg

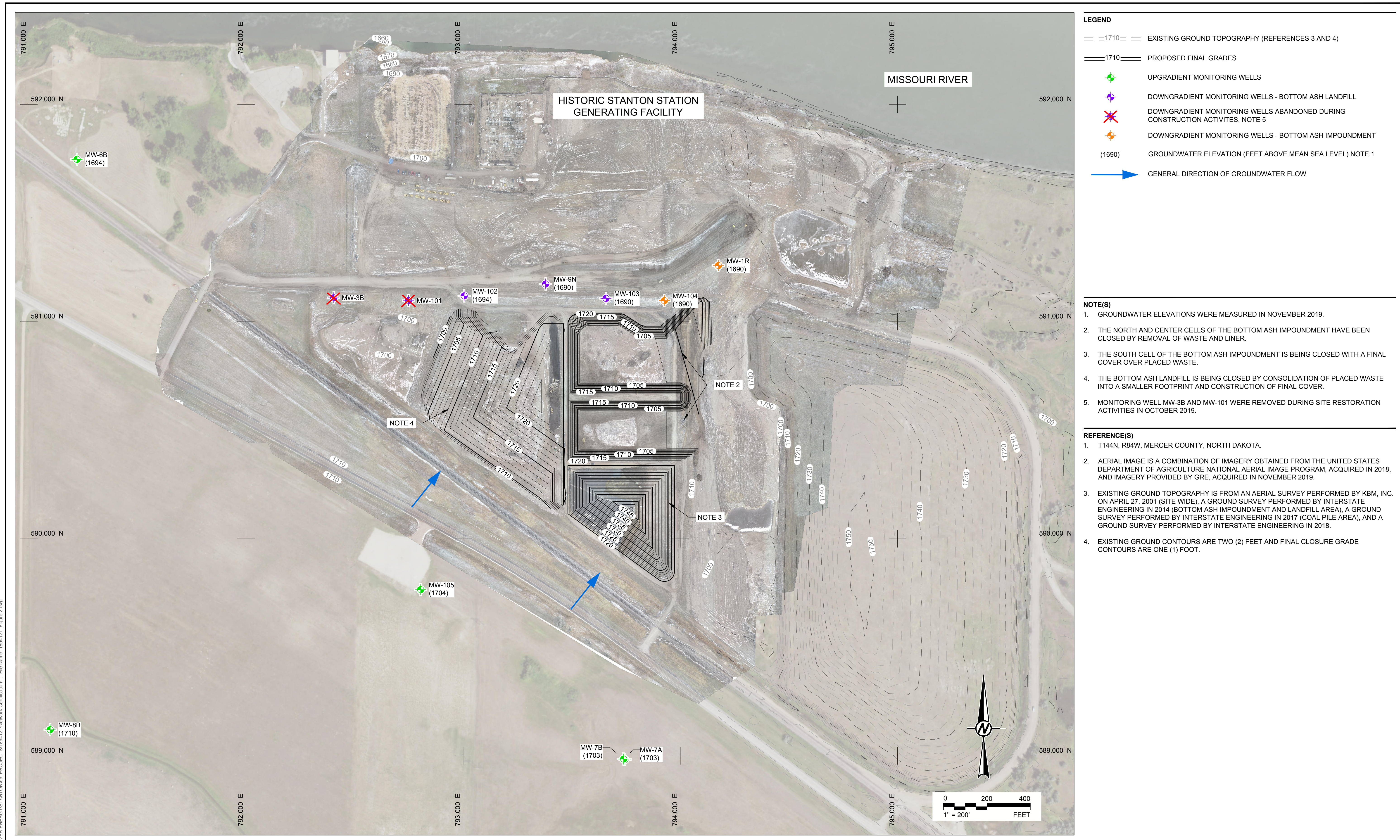
GOLDER

PRE-CLOSURE MONITORING WELL SYSTEM

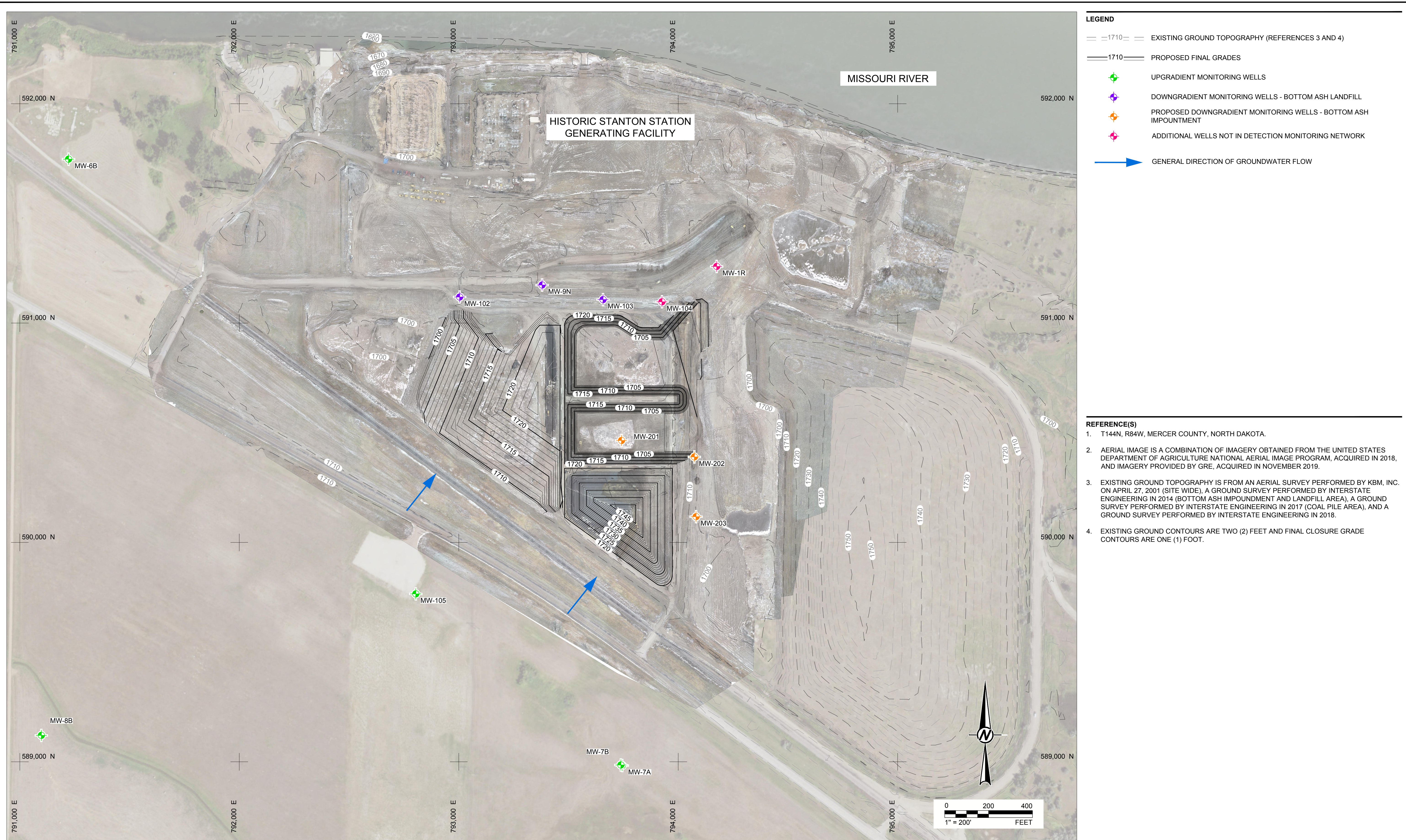
GREAT RIVER ENERGY – STANTON STATION

FIGURE 1











**APPENDIX A**

# Geologic Cross Sections





**LEGEND**

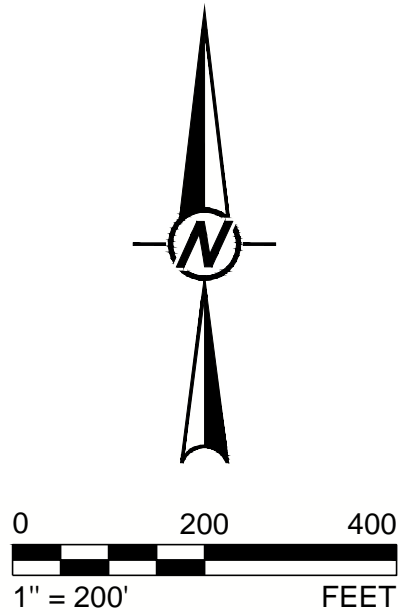
- UPGRADIENT MONITORING WELLS
- DOWNGRADIENT MONITORING WELLS - BOTTOM ASH LANDFILL
- DOWNGRADIENT MONITORING WELLS - BOTTOM ASH IMPOUNDMENT
- HISTORIC BOREHOLE

GENERAL DIRECTION OF GROUNDWATER FLOW

SECTION MARKER WITH FIGURE NUMBER

**NOTE(S)**

- AERIAL IMAGERY OBTAINED FROM UNITED STATES DEPARTMENT OF AGRICULTURE, NATIONAL AERIAL IMAGERY PROGRAM, 2016.
- GROUNDWATER ELEVATIONS WERE MEASURED APRIL 2017.

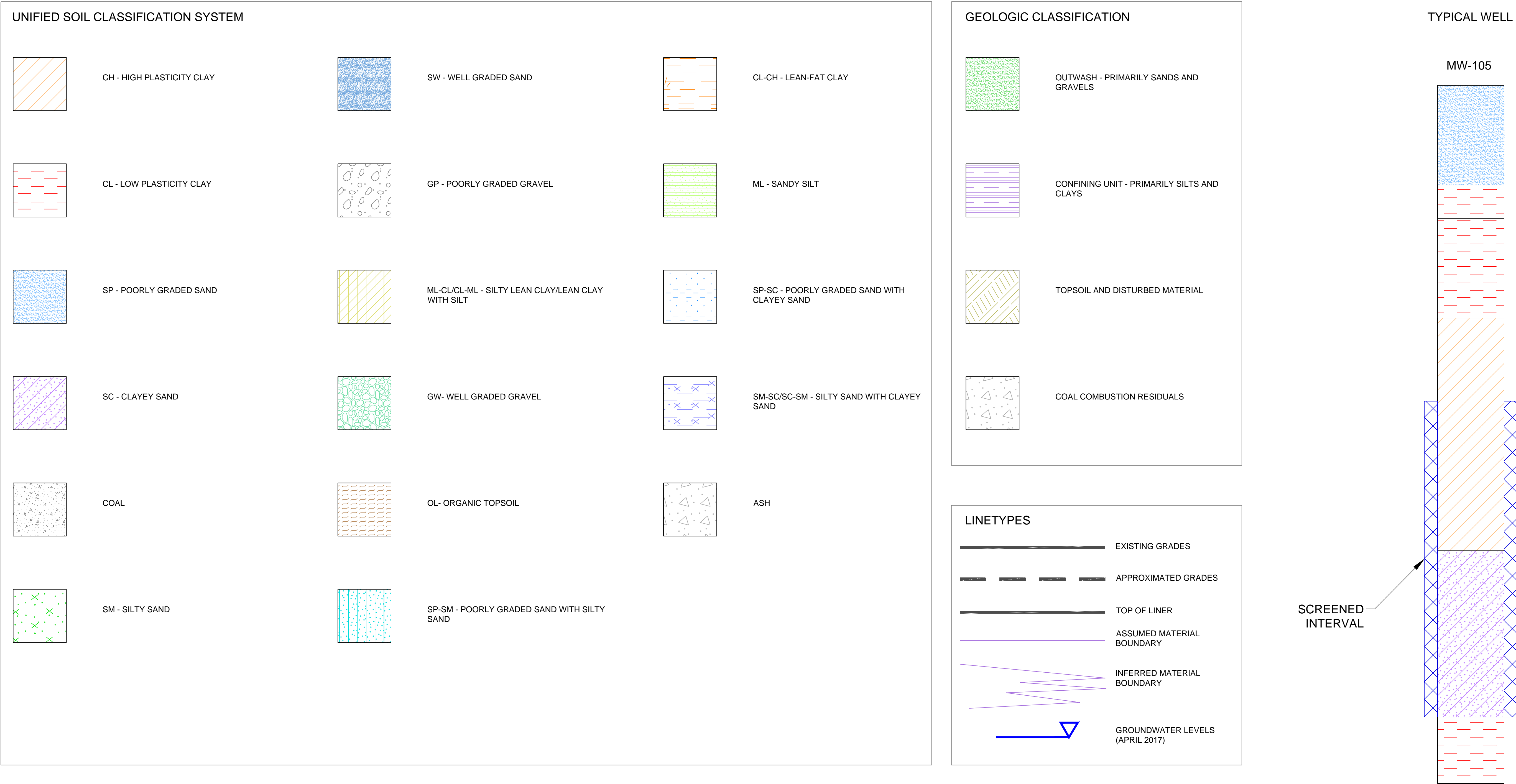


CROSS SECTION LOCATIONS

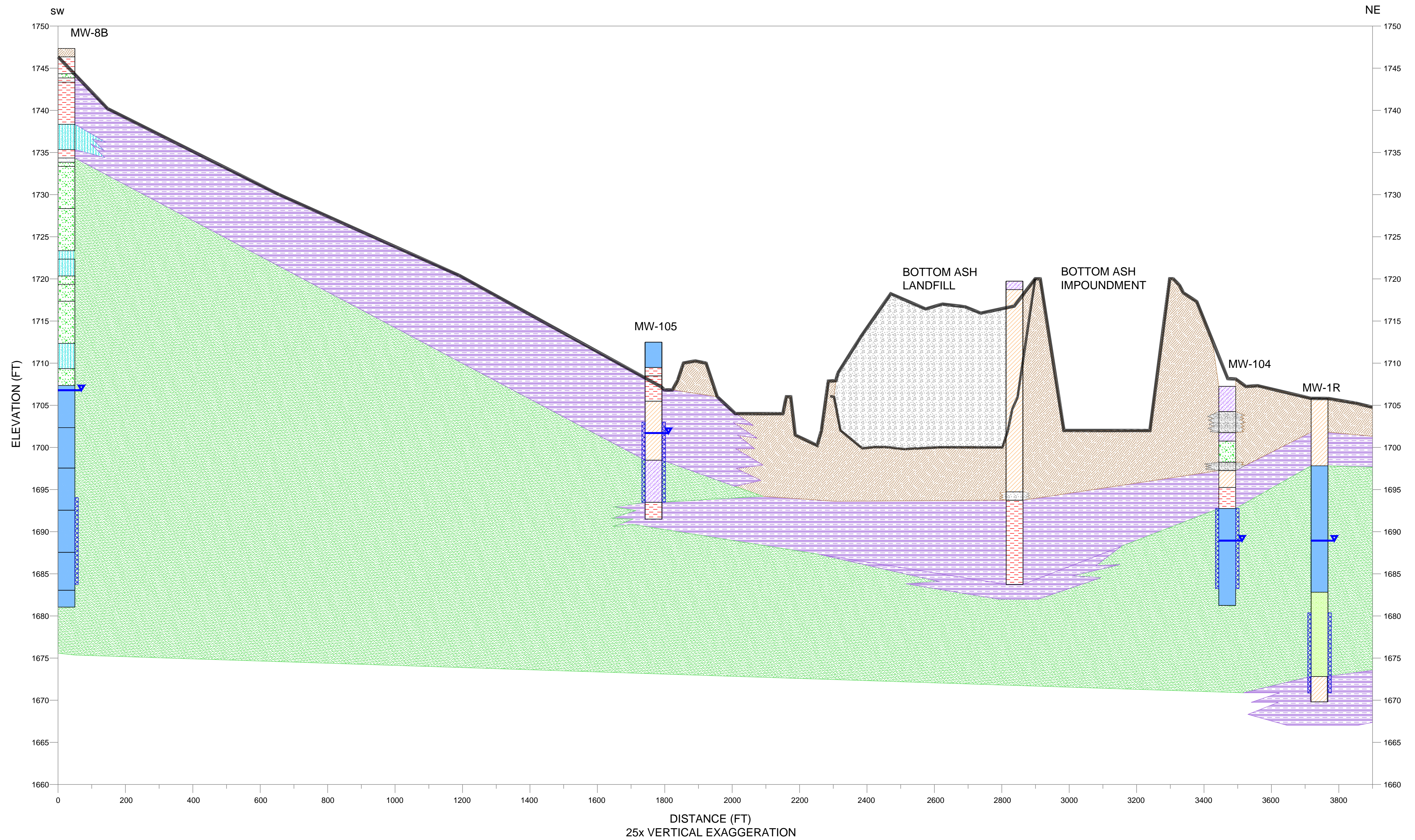
FIGURE 1



Path: \\Denver.golder.com\projects\17\JOBS\1772461 GRE SS\Water Quality\CCR Network Certification\Figures\1 | File Name: 1772461 Cross Sections.dwg



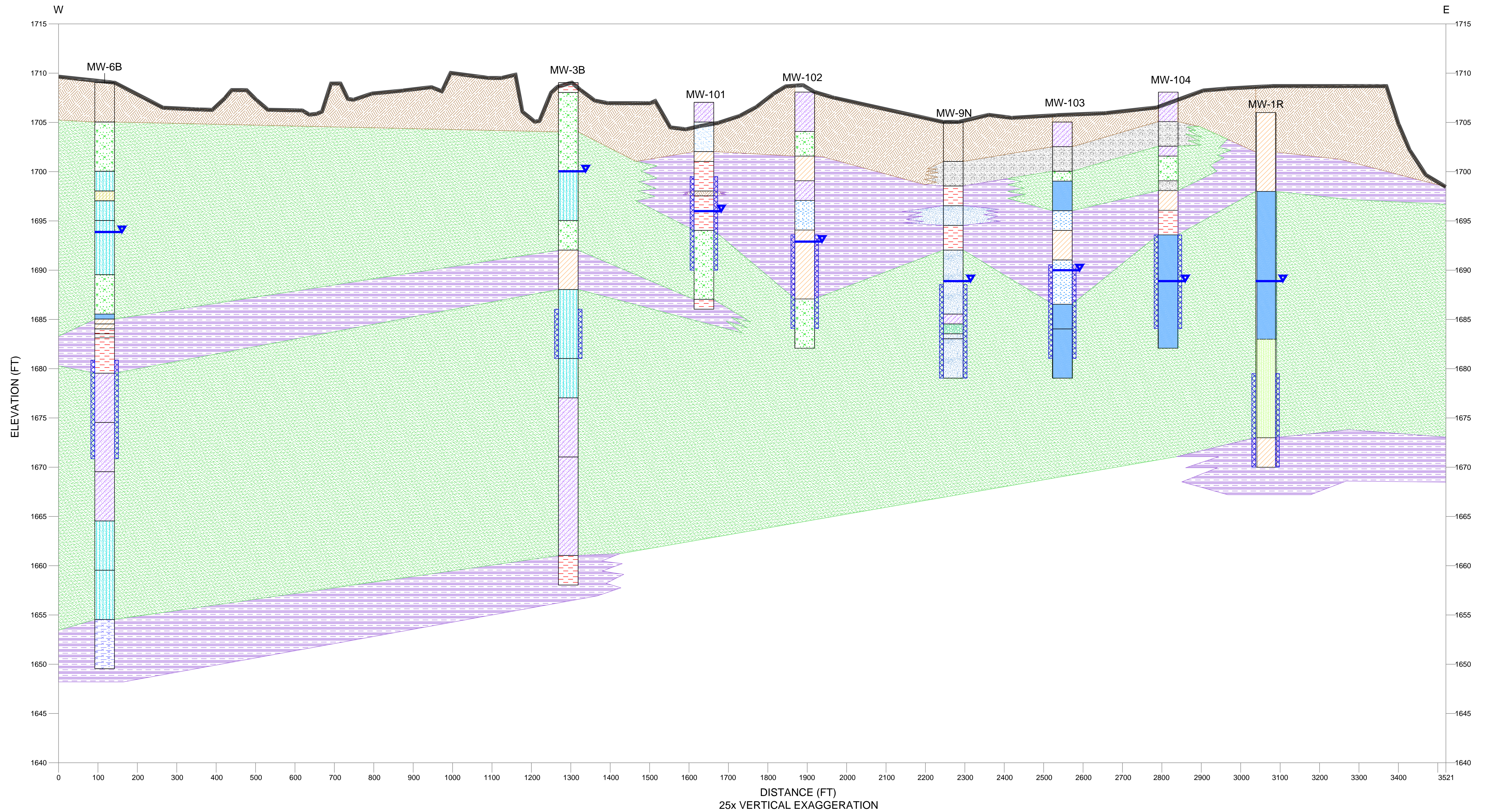




CROSS SECTION A-A'



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CROSS SECTION B-B'



## **APPENDIX B**

# **Monitoring Well Boring Logs and Installation Information**

**LOG OF MONITOR WELL CONSTRUCTION**JOB NO. **4409502219**VERTICAL SCALE **1" = 15'**BORING NO. **SB-1R**WELL NO. **MW-1R**PROJECT **UPA Replacement Wells, Stanton, North Dakota**DEPTH  
IN  
FEET

Description of Material

SURFACE ELEVATION **1707.0**Standpipe Elevation **1709.0****Well Construction**

Standup Steel Casing

Portland Grout

2" SCH 80 PVC Riser Pipe

Bentonite Chips

#16 Silica Sand Pack

2" SCH-80 PVC Screen

Bottom of Pipe

Bottom of Hole

**FILL, FAT CLAY**, brown, soft, inclusions of lignite and silt (CH)**SAND**, with gravel, medium to fine grained, brown, wet to waterbearing, medium dense to loose (SP)**SAND**, medium grained, brown, waterbearing, medium dense (SP)**GRAVEL**, with sand, brown, waterbearing, medium dense (GP)**FAT CLAY**, gray, hard (CH)**END OF BORING**

This monitoring well was installed under the direct supervision of:

Curtis J. Houle

State of North Dakota Board of Water Well Contractors

Certified Monitoring Well Contractor #434

**WATER LEVEL MEASUREMENTS**START **11-8-95**COMPLETE **11-8-95**

13:15

DATE	TIME	BAILED DEPTHS	SCREEN DEPTH	WATER ELEVATION	WATER LEVEL
11-8-95	11:30				13.5'
11-8-95	12:00				13.0'

CREW CHIEF

Houle

**Maxim**  
Technologies Inc.

# LOG OF TEST BORING

MW3A & MW3B

JOB NO. 120-8655 VERTICAL SCALE 1" = 4' BORING NO. 3  
PROJECT GROUND WATER MONITORING PROGRAM-STANTON STATION, STANTON, NORTH DAKOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	N	WL	SAMPLE		LABORATORY TESTS			
				NO.	TYPE	W	D	LL PL	Qu
	↓ SURFACE ELEVATION 1708.0'								
1	SILTY CLAY, dark brown, soft, pieces of roots (topsoil) (CL)	4		1	SB				
	SILTY SAND, fine grained, brown, moist to wet, loose ot medium dense, pieces of lignite (SM)	6		2	SB				
		8		3	SB				
9		9	▼	4	SB				
	SAND, fine grained, brown, waterbearing, loose to medium dense (SP-SM)	5		5	SB				
		9		6	SB				
14	SILTY SAND, fine grained, brown, waterbearing, medium dense (SM)	14		7	SB				
17	FAT CLAY, gray, stiff, lenses of silty sand (CH)								
21		24		8	SB				
	SAND, fine grained, grayish brown, waterbearing, very dense (SP-SM)								
		66		9	SB				
28									
30	SAND, medium to coarse grained, with gravel, gray, waterbearing, dense (SP-SM)								
	Continued on Next Page								



# LOG OF TEST BORING

JOB NO. 120-8655 VERTICAL SCALE 1" = 4' BORING NO. 3 (Cont.)  
 PROJECT GROUND WATER MONITORING PROGRAM-STANTON STATION, STANTON NORTH DAKOTA

DEPTH IN FEET	DESCRIPTION OF MATERIAL	N	WL	SAMPLE		LABORATORY TESTS			
				NO.	TYPE	W	D	$\frac{L.L.}{P.L.}$	Qu
30	SAND (Cont.) (SP-SM)	22		10	SB				
32	CLAYEY SAND, some gravel, gray, stiff (SC)								
		28		11	SB				
38	SANDSTONE, light gray to gray, (T.C: clayey sand, very stiff (SC))								
		$\frac{100}{0.5}$		12	SB				
		46		13	SB				
48	SHALE, gray, (T.C: silty clay, very stiff (CL))								
		57		14	SB				
51	End of Boring  *Unable to obtain accurate water level measurements due to presence of drilling fluid								

## WATER LEVEL MEASUREMENTS

START 5-14-82 COMPLETE 5-14-82

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DEPTHS	WATER LEVEL	METHOD	
5-14	16:05	11'	9½'	8½'	to	8'	HSA 0-20'	@ 18:15
5-14	18:15	51'	20'		to	10'*	JW 17-24½'	
5-14	18:50	51'	None	5'	to	None	DM 24½-49½'	
					to		CREW CHIEF	Jacobson

JOB NO.

120-8655

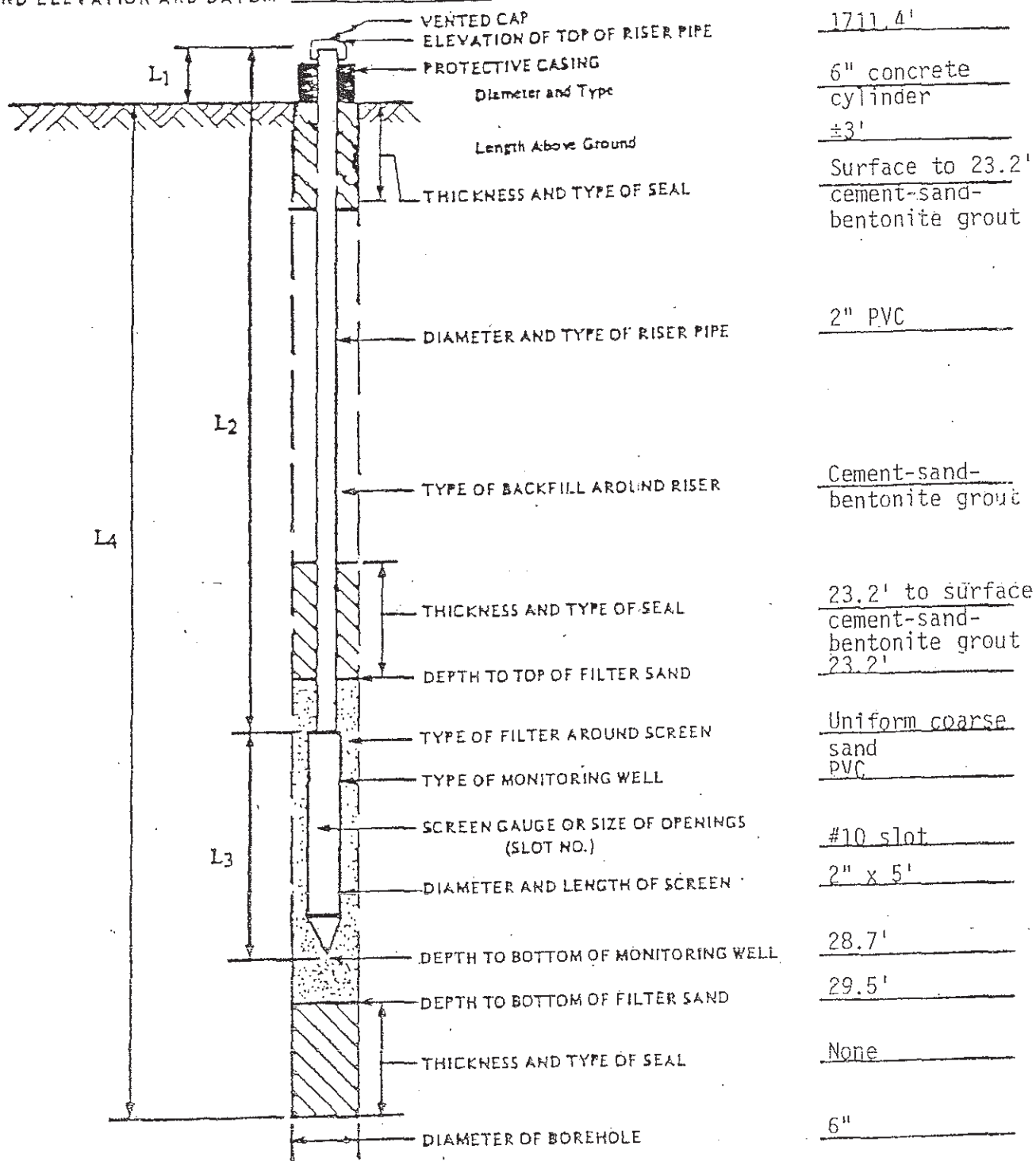
MONITORING WELL NO.

3B

STANTON STATION, NORTH DAKOTA

GROUND ELEVATION AND DATUM

1708.0'

L<sub>1</sub> = 3.4 FTL<sub>2</sub> = 27.1 FTL<sub>3</sub> = 5.0 FTL<sub>4</sub> = 29.5 FT

INSTALLATION COMPLETED:

Date 6-11-82 Time 7:45

## MONITORING WELL WATER LEVEL MEASUREMENTS

DATE	TIME	BAILED DEPTHS	WATER LEVEL
6-19-82	2:00	None	7.8'



# LOG OF BORING

PROJECT: CFEX-92-0094  
 ASH PONDS HYDROGEOLOGIC STUDY  
 United Power Association  
 Stanton Station  
 Stanton, North Dakota

BORING: **SB-2 / MW-6A & MW-6B**

LOCATION:  
 N91757.00 E91222.15

DATE: 8/27/92

SCALE: 1" = 4'

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev. 100.0	Depth 0.0	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	Tests or Notes
96.0	4.0		TOPSOIL: Sandy Lean Clay, 0 to 1 foot, black, Silty Sand, medium-grained, reacts with HCL, light brown, roots, dry, loose. 1 to 4 feet, Silty Sand, medium-grained, reacts with HCL, light yellowish brown (2.5Y6/4), dry, trace of roots, loose.			
91.0	9.0	SM	FILL: SILTY SAND, medium-grained grading to a medium-grained Poorly Graded Sand with Silt at 7 to 9 feet, damp, light yellowish brown (2.5Y5/6).			
89.0	11.0	SP SM	FILL: Silty Sand, medium-grained grading to a medium-grained Poorly Graded Sand with Silt, damp, light yellowish brown (2.5Y5/6), natural bedding observed.			
88.0	12.0	CL	LEAN CLAY with SILT, moist, olive brown (2.5Y4/3).			
86.0	14.0	SP SM	POORLY GRADED SAND with SILTY SAND, medium-grained, light olive brown (2.5Y5/6), moist to wet at 14 feet.			
80.5	19.5	SP SM	POORLY GRADED SAND with SILTY SAND, fine-grained, waterbearing, light olive brown (2.5Y5/6).			
76.5	23.5	SM	SILTY SAND, grayish brown (2.5Y5/2), waterbearing, cemented sand nodules, slight reaction to HCL.			
76.0	24.0	SP	POORLY GRADED SAND, yellowish brown (10YR5/8), fine- to medium-grained,			
75.5	24.5	CH	waterbearing, cemented sand nodules, slight reaction with HCL.			
75.0	25.0	CH				
74.5	25.5	CL	FAT CLAY, carbonaceous, trace of shell fragments, moist, medium dense, reacts with HCL, black (2.5Y2/0), some Silt and fine-grained Sand.			
70.5	29.5	CL				
		SC	FAT CLAY, carbonaceous, trace of shell fragments, moist, medium dense, reacts with HCL, black (2.5Y2/0) at 24 3/4 feet, 2 inch layer of Silty Sand, olive (5Y5/4).			

Having to jet sand out of auger from 20-24 ft; sand blew up into well at 19.5 ft.



# LOG OF BORING

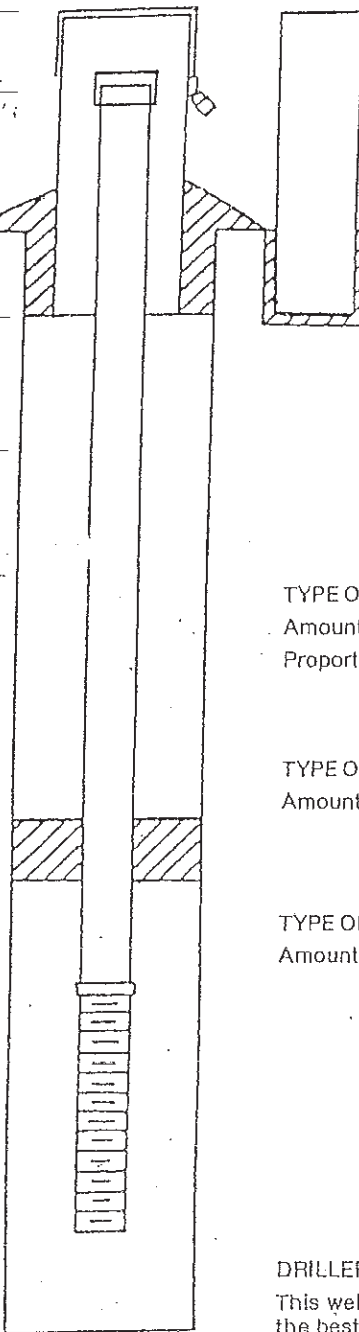
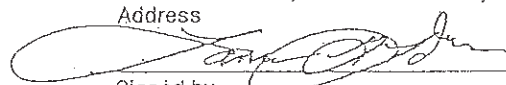
<b>PROJECT: CFEX-92-0094</b> <b>ASH PONDS HYDROGEOLOGIC STUDY</b> United Power Association Stanton Station Stanton, North Dakota	<b>BORING: SB-2 (cont.)</b> <b>LOCATION:</b> N91757.00 E91222.15 <b>DATE:</b> 8/27/92 <b>SCALE:</b> 1" = 4'
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(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	Tests or Notes
65.5	34.5	SC	SANDY LEAN CLAY, fine, gray (2.5Y6/0), trace of shell fragments. LEAN CLAY with GRAVEL, trace of shell fragments, lignite fragments, Clayey Sand gray to blue, blue to gray poorly graded, medium-grained Sand with trace of Clay, dense, bluish gray (5B5/1), homogeneous.			
60.5	39.5	SC	CLAYEY SAND, medium- to coarse-grained, bluish gray (5B5/1), homogeneous, subangular to subrounded. CLAYEY SAND, interbedded with medium- to fine-grained poorly graded sand.			Bedrock-Sandstone Sandstone
55.5	44.5	SP SM	CLAYEY SAND, at 40 feet a 1 inch seam of sand with lignite particles also at 43 feet the same, at 42 to 43 feet a zone of very dense sand interbedded with silts. POORLY GRADED SAND with SILT, olive gray (5Y5/2) with lignite laminations, medium dense.			Sandstone
50.5	49.5	SP SM	POORLY GRADED SAND to SILTY SAND with CLAY, bluish gray (5B5/1), medium dense.			Sandstone
45.5	54.5	SM SC	SILTY SAND with CLAY to CLAYEY SAND, interbedded with lignite laminations, bluish gray (5B5/1), medium dense.			Sandstone
40.5	59.5		END OF BORING.			

# MONITORING WELL FIELD DATA SHEET

Client United Power Association Proj. No. CFEX-92-0094 Location UPA Station, Stanton, ND  
 Well Number MA-6B Well Location SW<sup>1</sup>/<sub>4</sub>, SW<sup>2</sup>/<sub>4</sub>, Sec 16, T144N, R84W Date of Installation 09/08/92  
 Date of Revision \_\_\_\_\_ Crew KD, TC, IL B.M. Location & Elev. ( $\pm 0.01$ ) \_\_\_\_\_

Stick up above ground (to 0.1') <u>1.86</u>  Top of riser pipe (w/o cap) Elev. ( $\pm 0.01$ ) <u>1711.54</u>  Ground surface Elev. ( $\pm 0.1$ ) _____  Depth to bottom of surface seal <u>1'</u>  Approximate water level before installation <u>TPVC 15.09'</u>  Approximate depth of first water encountered in drilling <u>13.5'</u>     Depth to top of seal <u>Flush</u>  Depth to bottom of seal <u>19'</u>  Depth to top of screen <u>28.37'</u>     Depth to bottom of screen <u>38.37'</u>  Depth to bottom of boring <u>38.5'</u>		<div style="display: flex; justify-content: space-between;"> <div>                         GUARD POST:                          Type <u>T-Posts</u>                          Number <u>3</u> </div> <div>                         Protective Cover:                          Type <u>Pro-Top</u>                          Length <u>5'</u>                          Lock # <u>2106</u> </div> </div> <div style="margin-top: 10px;">                         Type of sealing material <u>Concrete</u> </div> <div style="margin-top: 10px;">                         RISER PIPE:                          Type <u>PVC</u>                          Diameter <u>2"</u>                          Total Length <u>30'</u>                          Sections Used <u>3'</u>                          Couplings <u>No</u>                          Cap Yes <u>X</u> No _____                     </div> <div style="margin-top: 10px;">                         TYPE OF GROUT ABOVE SEAL: <u>Bentonite - Portland Cement Grout</u>                          Amount of material used <u>25 lbs Bentonite, 864 lbs Portland Cement</u>                          Proportions <u>40 gallons of water</u> </div> <div style="margin-top: 10px;">                         TYPE OF SEALING MATERIAL: <u>Same as above</u>                          Amount of material used _____                     </div> <div style="margin-top: 10px;">                         TYPE OF FILTER MATERIAL: <u>12 - 30 Silica Sand</u>                          Amount of material used <u>300 lbs</u> </div> <div style="margin-top: 10px;">                         SCREEN:                          Type <u>PVC</u>                          Slot Size <u>0.010</u>                          Length <u>10'</u>                          Diameter <u>2"</u>                          Plug/Point <u>Male Plug</u> </div> <div style="margin-top: 10px;">                         DRILLER'S CERTIFICATION                          This well was drilled under my jurisdiction, and this report is true to the best of my knowledge.  <u>Braun Intertec Environmental, Inc.</u> <span style="float: right;"><u>420</u></span>                          Driller's or Firm's Name <span style="float: right;">Certificate No.</span>  <u>913 S. 18th St., P.O. Box 2379, Bismarck, ND 58502-2379</u>                          Address  <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">                               Signed by                         </div> <div style="text-align: center;"> <u>11-23-92</u>                              Date                         </div> </div> </div>
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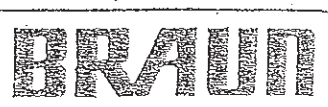
Note: Depths relative to ground surface.

Method of advance:  
 HSA X I.D. 3 3/4"  
 Casing \_\_\_\_\_ I.D. \_\_\_\_\_  
 icone \_\_\_\_\_ O.D. \_\_\_\_\_

Method of development:  
 Air \_\_\_\_\_

Jes \_\_\_\_\_

Approved by: Plant Manager, Stanton Station.  
 Printed copy is not document controlled.  
 For most recent, authorized version, see GRE Intranet site.





# LOG OF BORING

PROJECT: CFEX-92-0094  
 ASH PONDS HYDROGEOLOGIC STUDY  
 United Power Association  
 Stanton Station  
 Stanton, North Dakota

BORING: **SB-3 / MW-7A & MW-7i**

LOCATION:  
 N88990.05 E93743.52

DATE: 8/27/92

SCALE: 1" = 4'

Elev. 100.0	Depth 0.0	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	Tests	or	Notes
			TOPSOIL: Dark brown to light brownish gray, silty clay, friable, roots, dry, strong reaction to HCL.					
97.0	3.0							
96.0	4.0	SM	SILTY SAND, dry, olive yellow (2.5Y6/6).					
		CL CH	LEAN-FAT CLAY, stiff, moist. From 5 to 7 feet, a vertical sand stringer through half of core (dry), olive brown (2.5Y4/4), mottled, stiff, inclusions of calcite, reacts with HCL.					
90.0	10.0							
89.5	10.5	SM	SILTY SAND, wet, light olive brown (2.5Y5/4).					
88.5	11.5	CL						
88.0	12.0	CH	LEAN-FAT CLAY, soft, light olive brown (2.5Y5/4)					
87.0	13.0	SM						
86.5	13.5	ML	SILTY SAND, waterbearing, light olive brown (2.5Y5/4).					
86.0	14.0	CL						
		CL CH SM CL CH	SILTY LEAN CLAY, wet, soft, light olive brown (2.5Y5/4). LEAN-FAT CLAY, wet, stiff, light olive brown (2.5Y5/4). SILTY SAND, waterbearing, light olive brown (2.5Y5/4).					
82.0	18.0							
		CH	LEAN-FAT CLAY, stiff, varying fine-grained sand content throughout, light olive brown (2.5Y5/4). FAT CLAY, moist, olive gray (5Y4/2), mild reaction to HCL, very dense, slightly sticky, plastic, very small shell fragments, fine roots noted at about 23 feet, starting at about 23 feet were small distinct, dark yellow brown (10YR3/4) mottles.					
74.5	25.5							
73.5	26.5	CL	LEAN CLAY with SAND, moist to waterbearing, dark grayish brown (2.5Y4/2), mild reaction to HCL, firm, slightly sticky, slightly plastic.					
		CH	FAT CLAY, moist, dry, color was light olive gray (5Y6/2), moist color was olive gray (5Y4/2), moist color grades to dark gray (2.5YN4/0) at about 30.5 feet. Strong reaction to HCL to 31 feet. Soil was hard,					
69.0	31.0							
		CL						

(See Report and Standard Plates for evaluation and descriptive terminology.)

## LOG OF BORING

PROJECT: CFEX-92-0094 ASH PONDS HYDROGEOLOGIC STUDY United Power Association Stanton Station Stanton, North Dakota	BORING: <b>SB-3 (cont.)</b>	
	LOCATION: N88990.05 E93743.52	
	DATE: 8/27/92	SCALE: 1" = 4'

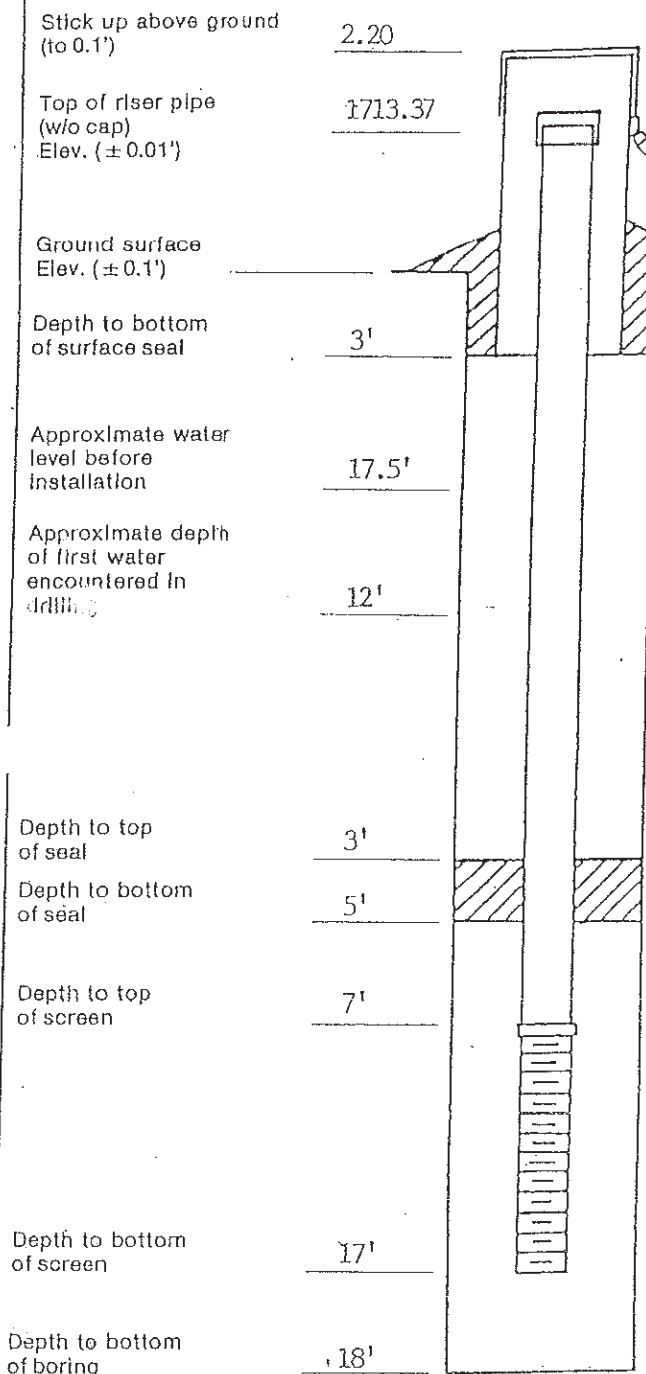
(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	Tests or Notes
67.0	33.0	SP	friable with subangular blocky structure and slightly sticky to 30.5 feet. From 30.5 feet to 31 feet soil was dense, hard, slightly sticky and plastic. Calcareous nodules from 28.5 feet to 29.5 feet, light gray (5Y7/2) in color. One root channel noted, some small detrital coal, stringers of medium sand noted, a 3 inch layer of dark yellowish brown (10YR4/6), lean clay at about 30.5 feet noted. Many small snail shells from 30.5 feet to 31 feet.			Boring jetted following drilling. Many coal pieces washed out in jetting. Note that no coal pieces were found in barrel sampler in final formation. Coal pieces must be from lower in formation.
62.0	38.0		LEAN CLAY, moist, olive brown (2.5Y4/3) grading to very dark gray (5Y3/1). Strong reaction to HCL, slightly sticky, slightly plastic, hard, some detrital coal, some sand, some wood fragments, some roots, many small snail shells and fragments.			
			POORLY GRADED SAND with some CLAY, medium textured sand, waterbearing, black (5Y2.5/1), slight reaction to HCL, massive structure, soft, nonplastic. Lean Clay seam with cobbles from 37.2 feet to 37.3 feet. Medium sand from 37.3 to 37.5 feet. Coarse sand from 37.5 feet to 37.6 feet, dark olive gray (5Y3/2). Silty clay with sand from 37.6 feet to end of boring. Laminae visible. Sand of fine texture. Very dark gray (5Y3/1) with a slight reaction to HCL.			
			END OF BORING.			



# MONITORING WELL FIELD DATA SHEET

Client United Power Association Proj. No. CPEX-92-0094 Location UPS Station, Stanton, ND  
 Well Number MM-7A Well Location SW 1/4, NE 1/4, Sec 21, T144N, R84W Date of Installation 08/27/92  
 Date of Revision \_\_\_\_\_ Crew KD, TC, LM B.M. Location & Elev. (± 0.01) \_\_\_\_\_



GUARD POST:  
 Type T-Posts  
 Number 3

Protective Cover:  
 Type Pro-Top  
 Length 5'  
 Lock # 2106

Type of sealing material Concrete

**RISER PIPE:**

Type PVC  
 Diameter 2"  
 Total Length 7'  
 Sections Used 1'  
 Couplings No  
 Cap Yes X No \_\_\_\_\_

TYPE OF GROUT ABOVE SEAL: Concrete

Amount of material used \_\_\_\_\_

Proportions \_\_\_\_\_

TYPE OF SEALING MATERIAL: 1/4" Bentonite Pellet

Amount of material used 25 lbs.

TYPE OF FILTER MATERIAL: 12 - 30 Silica Sand

Amount of material used 240 lbs.

**SCREEN:**

Type PVC  
 Slot Size 0.010  
 Length 10'  
 Diameter 2"  
 Plug/Point Male Plug

**DRILLER'S CERTIFICATION**

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

Braun Intertec Environmental, Inc.

421

Driller's or Firm's Name

Certificate No.

913 S. 18th St., P.O. Box 2379, Bismarck, ND 58502-2379

Address

Signed by

Date

*[Signature]* 11-23-92

Note: Depths relative to ground surface.

**Method of advance:**

HSA X I.D. 3 1/4"

Casing \_\_\_\_\_ I.D. \_\_\_\_\_

zone \_\_\_\_\_ O.D. \_\_\_\_\_

**Method of development:**

Jet \_\_\_\_\_ Air \_\_\_\_\_

Surge X Ball \_\_\_\_\_

Approved by: Plant Manager, Stanton Station.

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For most recent, authorized version, see GRE Intranet site.

**BRAUN**

# MONITORING WELL FIELD DATA SHEET

Client United Power Association Proj. No. CFEX-92-0094 Location UPA Station, Stanton, ND  
 Well Number M1-7B Well Location SW 1/4, NE 1/4, Sec 21, T144N, R84W Date of Installation 09/09/92  
 Date of \_\_\_\_\_ Revision \_\_\_\_\_ Crew KD, TC, LL B.M. Location & Elev. ( $\pm 0.01$ ) \_\_\_\_\_

Stick up above ground (to 0.1')	1.53		GUARD POST: Type <u>T-Posts</u> Number <u>3</u>	Protective Cover: Type <u>Pro-Top</u> Length <u>5'</u> Lock # <u>2106</u>
Top of riser pipe (w/o cap) Elev. ( $\pm 0.01'$ )	1712.55		Type of sealing material <u>Concrete</u>	
Ground surface Elev. ( $\pm 0.1'$ )				
Depth to bottom of surface seal	1'			
Approximate water level before installation	TPVC 15.05'			
Approximate depth of first water encountered in drilling	12'			
Depth to top of seal	Flush			
Depth to bottom of seal	23'			
Depth to top of screen	28.13'			
Depth to bottom of screen	38.13'			
Depth to bottom of boring	38.5'			

TYPE OF GROUT ABOVE SEAL: Bentonite - Portland Cement Grout  
 Amount of material used 15 lbs. Bentonite, 480 lbs Portland Cement  
 Proportions 15 gallons of water.

TYPE OF SEALING MATERIAL: Bentonite - Portland Cement Grout  
 Amount of material used 15 lbs. Bentonite, 480 lbs. Portland Cement  
15 gallons of water.

TYPE OF FILTER MATERIAL: 12 - 30 Silica Sand  
 Amount of material used 350 lbs.

SCREEN: PVC  
 Type Timco  
 Slot Size 0.010  
 Length 10'  
 Diameter 2"  
 Plug/Point Male Plug

## DRILLER'S CERTIFICATION

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

Braun Intertec Environmental, Inc. 420  
 Driller's or Firm's Name Certificate No.  
913 S. 18th St., P.O. Box 2379, Bismarck, ND 58502-2379  
 Address

Signed by

Date

BRAUN

Note: Depths relative to ground surface.

Method of advance:  
 -SA X I.D. 3 3/4"  
 casing \_\_\_\_\_ I.D. \_\_\_\_\_  
 cone \_\_\_\_\_ O.D. \_\_\_\_\_

Method of development:

Approved by: Air Plant Manager, Stanton Station.  
 at \_\_\_\_\_ Surg Printed copy is for document controlled.  
 For most recent, authorized version, see GRE Intranet site.



# LOG OF BORING

**PROJECT: CFEX-92-0094**  
**ASH PONDS HYDROGEOLOGIC STUDY**  
 United Power Association  
 Stanton Station  
 Stanton, North Dakota

**BORING: SB-9 / MW-8A & MW-8**

**LOCATION:**  
 N89124.66 E91102.89

**DATE: 9/1/92**      **SCALE: 1" = 4'**

(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	Tests or Notes
100.0	0.0					
99.0	1.0		TOPSOIL: Grayish brown, many roots, silt, dry.			
		CL	LEAN CLAY, roots, blocky structures, calcite rich, strong reaction to HCL, dry, light brown to gray.			
97.0	3.0					
96.5	3.5	SM	SILTY SAND, loose, dry.			
96.0	4.0	CL	SANDY LEAN CLAY, dry, dense, strong reaction to HCL, trace of roots.			
		CL	SANDY LEAN CLAY, dry, reacts strongly with HCL, dry, light olive brown (2.5Y5/4).			
91.0	9.0					
		SP	SILTY SAND, interbedded with silts and lean clay, damp, trace of lignite and calcite inclusions, light olive brown (2.5Y5/4).			
		SM				
88.0	12.0					
		CL	SANDY LEAN CLAY, fine, moist, calcite stringers, trace of lignite, light olive brown (2.5Y5/4).			
87.0	13.0					
86.5	13.5	SP	POORLY GRADED SAND, fine- to medium-grained sand, moist.			
86.0	14.0	SM	SILTY SAND with trace of CLAY, moist, light olive brown (2.5Y5/4).			
		SM	SILTY SAND, damp, grayish brown (2.5Y5/2). At approximately 18 feet, a 4 inch layer of sandy lean clay, moist, trace of lignite, light olive brown (2.5Y5/2).			
81.0	19.0		SILTY SAND with CLAY, waterbearing, few lignite laminae, from 22 to 24 feet, interbedded medium to coarse laminations of poorly graded sand, olive brown (2.5Y4/3).			
		SM				
76.0	24.0					
		SP	SILTY SAND, waterbearing, olive brown (2.5Y4/3).			
		SM				
73.0	27.0					
		SM	SILTY SAND, waterbearing. At 29.5 feet, a 4 inch layer of the same with clay, olive (5Y5/4), few lignite particles, subrounded.			
70.0	30.0					
		SM	SAND to SILTY SAND, assumed saturated.			

No recovery-no sample

# LOG OF BORING

<b>PROJECT: CFEX-92-0094</b> <b>ASH PONDS HYDROGEOLOGIC STUDY</b> United Power Association Stanton Station Stanton, North Dakota	<b>BORING: SB-9 (cont.)</b> <b>LOCATION:</b> N89124.66 E91102.89 <b>DATE: 9/1/92</b> <b>SCALE: 1" = 4'</b>
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(See Report and Standard Plates for evaluation and descriptive terminology.)

Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	Tests or Notes
65.0	35.0					
		SP	POORLY GRADED SAND, waterbearing, trace of gravel, coarse grained.			
62.0	38.0	SM				
		SM	SILTY SAND, trace of Gravel (shale), trace of coarse sand, olive (5Y4/3).			
60.0	40.0					
		SP	POORLY GRADED SAND, fine- to medium-grained, waterbearing, trace of gravel, few coarse sand stringers (vertical), trace of lignite, iron oxide nodules, olive (5Y4/3).			
55.0	45.0					
		SP	POORLY GRADED SAND, less gravel and iron oxide nodules. At 49.5 feet, a 3 inch layer of sandy lean clay. Sampler sent back down to the 45 to 50 foot depth. Upon retrieval of sampler, poorly graded fine- to medium-grained sand with cemented silica nodules (resembling a coral structure), mild to reacts strongly with HCL, olive (5Y4/3).			Sand forced up in auger approx. 8 ft. Problems getting hexrod and sampler down to starting depth to advance.  Having to wash bore hole.  Still blowing up 6 to 8 ft in auger.
50.2	49.8		No recovery, assume fine- to medium-grained sand.			
		SP				
		SP	No recovery.			
40.2	59.8					
		SP	Same as 45 to 50 feet with cemented silica nodules.			



# LOG OF BORING

<b>PROJECT: CFEX-92-0094</b> <b>ASH PONDS HYDROGEOLOGIC STUDY</b> <b>United Power Association</b> <b>Stanton Station</b> <b>Stanton, North Dakota</b>					<b>BORING: SB-9 (cont.)</b>		
					<b>LOCATION:</b> <b>N89124.66 E91102.89</b>		
					<b>DATE: 9/1/92</b>	<b>SCALE: 1" = 4'</b>	
(See Report and Standard Plates for evaluation and descriptive terminology.)	Elev.	Depth	ASTM Symbol	Description of Materials (ASTM D 2488)	BPF	WL	Tests or Notes
	35.7	64.3	SP	POORLY GRADED SAND, coarse grained with Gravel, waterbearing.			Switched to split spoon.
	33.7	66.3					
				END OF BORING.			

# MONITORING WELL FIELD DATA SHEET

Client United Power Association Proj. No. CEEX-92-0094 Location UPA Station, Stanton, ND  
 Well Number MW-8B Well Location SW 1/4, NW 1/4, Sec 21, T144N, R84W Date of Installation 09/03/92  
 Date of \_\_\_\_\_  
 Revision \_\_\_\_\_ Crew KD, TC, IM B.M. Location & Elev. ( $\pm 0.01$ ) \_\_\_\_\_

Stick up above ground  
(to 0.1')

3.00

Top of riser pipe  
(w/o cap)  
Elev. ( $\pm 0.01$ )

1749.37

GUARD POST:

Type T-Posts

Number 3

Protective Cover:

Type Pro-Top

Length 5'

Lock # 2106

Ground surface  
Elev. ( $\pm 0.1$ )

Type of sealing material Concrete

Depth to bottom  
of surface seal

1.5'

RISER PIPE:

Type

PVC

Diameter

2"

Total Length

60'

Sections Used

6'

Couplings

No

Cap

Yes X

No \_\_\_\_\_

Approximate water  
level before  
installation

22'

Approximate depth  
of first water  
encountered in  
drilling

22.7'

TYPE OF GROUT ABOVE SEAL: Neat Cement Grout

Amount of material used \_\_\_\_\_

Proportions 11 bags Portland (1034#), 35 lbs. Bentonite, 60 gal water

Depth to top  
of seal

1.5'

TYPE OF SEALING MATERIAL: Neat Cement Grout

Amount of material used \_\_\_\_\_

See grout above

Depth to bottom  
of seal

49'

TYPE OF FILTER MATERIAL: 12 - 30 Silica Sand and Natural

Amount of material used \_\_\_\_\_

100 lbs. and Natural

Depth to top  
of screen

54'

SCREEN:

Type

PVC

Slot Size

0.010

Length

10'

Diameter

2"

Plug/Point

Male Plug

Depth to bottom  
of screen

64'

Depth to bottom  
of boring

64.5'

DRILLER'S CERTIFICATION

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

Braun Intertec Environmental, Inc.

421

Driller's or Firm's Name

Certificate No.

913 S. 18th St., P.O. Box 2379, Bismarck, ND 58502-2379

Address

*David D. Montgomery*

Signed by

11-23-92

Date

Note: Depths relative to ground surface.

Method of advance:

HSA X I.D. 3 3/4"

Casing \_\_\_\_\_ I.D. \_\_\_\_\_

cone \_\_\_\_\_ O.D. \_\_\_\_\_

Method of development:

Air \_\_\_\_\_

Jet \_\_\_\_\_ Surge X Ball \_\_\_\_\_

Approved by: Plant Manager, Stanton Station.

Printed copy is not document controlled.

For most recent, authorized version, see GRE Intranet site.

**BRAUN**



Barr Engineering Company

MW9N

**LOG OF PIEZOMETER**  
(Reference Boring No. MW9)

Sheet 1 of 1

			Location: Stanton Station		Client: Great River Energy	
Barr Project Number: 34291006			Surface Elevation: 1705.52		Top of Casing Elevation: 1708.18	
STRATA		PIEZOMETER DETAILS	DEPTH (ft.)		ELEVATION (ft.)	
DESCRIPTION	SYMBOL					
			0.0	GS	1705.52	
			2.0		1703.52	
COAL: black, dry.			5.0		1700.52	
SANDY LEAN CLAY (CL): brown, dry, interbedded with coal.						
WELL GRADED SAND (SW): fine to medium grained, brown, dry.						
LEAN CLAY (CL): brown, moist, interbedded with medium sand, high plasticity.			14.0		1691.52	
WELL GRADED SAND (SW): fine to medium grained, brown, moist, trace clay.			16.0		1689.52	
CLAYEY SAND (SC): medium grained, brown, wet.						
WELL GRADED GRAVEL (GW): brown, wet, some clay.						
WELL GRADED SAND (SW): medium grained, brown, wet.						
WELL GRADED SAND (SW): medium grained, dark brown, wet, some gravel.			26.0		1679.52	
Completion Depth: 26.0 Date Started: 7/19/10 Date Completed: 7/19/10 Logged By: JLS4 Drilling Contractor: BRAUN Drilling Method: HSA Coordinates North: East:			<b>LEGEND</b> FILTER PACK BENTONITE CEMENT GROUT CUTTINGS / BACKFILL			
			<b>WATER LEVELS</b> WATER LEVEL: 17.0 ft DATE: 07-19-2010 TIME: 11:30 am			

M:\GINT\PROJECTS\34291006\_STANTON.GPJ BARR ENGINEERING.GLB LOG OF BORING WELL REPORT BARR ENGINEERING.GDT

The stratification lines represent approximate boundaries. The transition may be gradual.

# BORING LOG NO. B-101

Page 1 of 1

**PROJECT:** Monitoring Well Installations

**CLIENT:** Golder Associates, Inc.  
Lakewood, Colorado

**SITE:** GRE - Stanton Station  
Mercer County, North Dakota

GRAPHIC LOG	LOCATION: See Exhibit A-2  Latitude: 47.28447° Longitude: -101.33546°		INSTALLATION DETAILS		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
	DEPTH	ELEVATION (Ft.)	Steel Casing	PVC Riser				
	<b>FILL - CLAYEY SAND</b> , brown, very loose, fine-grained	1704					X	2-1-2 N=3
	<b>FILL - POORLY GRADED SAND</b> , light brown, loose, fine-grained	1701	Bentonite				X	4-4-4 N=8
	<b>FILL - FAT CLAY</b> , brown, stiff, silt laminations	1700			5		X	4-5-4 N=9
	<b>FILL - SANDY LEAN CLAY</b> , grayish-brown, stiff, silt laminations						X	4-4-4 N=8
	<b>TOPSOIL (OL)</b> , dark brown	1697					X	
	<b>LEAN CLAY (CL)</b> , dark grayish-brown to grayish-brown, medium stiff to soft, silt laminations, waterbearing sand seam at 12.5 feet	1696.5			10	▽	X	2-3-3 N=6
			Silica Sand			▽	X	1-2-2 N=4
	<b>SILTY SAND (SM)</b> , brown, medium dense, fine-grained, waterbearing	1693			15		X	2-5-7 N=12
			PVC Screen				X	
	<b>LEAN CLAY (CL)</b> , brown, soft	1686	Sluff		20		X	2-1-2 N=3
	<b>Boring Terminated at 21 Feet</b>	1685						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3 1/4" ID HSA 0-19 1/2"

See Exhibit A-3 for description of field procedures.

Notes:

Abandonment Method:  
Boring converted to monitoring well installation.

See Appendix B for explanation of symbols and abbreviations.

## WATER LEVEL OBSERVATIONS

While drilling  
On 11/20/2015

**Terracon**  
1805 Hancock Drive  
Bismarck, North Dakota

Boring Started: 11/17/2015

Drill Rig: D-90

Project No.: M2155089

Boring Completed: 11/17/2015

Driller: MR

Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2155089 GPJ TERRACON2012.GDT 12/2/15

# BORING LOG NO. B-102

Page 1 of 1

**PROJECT:** Monitoring Well Installations

**CLIENT:** Golder Associates, Inc.  
Lakewood, Colorado

**SITE:** GRE - Stanton Station  
Mercer County, North Dakota

GRAPHIC LOG	LOCATION: See Exhibit A-2  Latitude: 47.28453° Longitude: -101.33443°		INSTALLATION DETAILS		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	
	DEPTH	ELEVATION (Ft.)	<div><div>Steel Casing</div><div>PVC Riser</div><div>Surface Elev.: 1706 (Ft.)</div></div>						
<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div>	FILL - CLAYEY SAND, dark brown, very loose to loose, fine to medium-grained, coal inclusions		<div><div></div><div>Bentonite</div><div></div><div>PVC Screen</div><div>Silica Sand</div><div>Sluff</div></div>		4.0	1702			1-1-1 N=2
									2-3-3 N=6
	6.5	1699.5			FILL - SILTY SAND, dark brown, medium dense, fine to coarse-grained, coal inclusions	5		3-5-11 N=16	
	9.0	1697			FILL - FAT CLAY, brown, very stiff, boulder around 8 feet			9-15-15 N=30	
	11.0	1695			CLAYEY SAND (SC), brown, medium dense, fine-grained	10		6-7-6 N=13	
	14.0	1692			POORLY GRADED SAND WITH CLAY (SP-SC), brown, medium dense, fine-grained, sand lenses			2-5-5 N=10	
					FAT CLAY (CH), grayish-brown, very stiff to stiff	15		5-8-10 N=18	
					waterbearing sand seam at 19 feet				
	21.0	1685			SILTY SAND (SM), grayish-brown, dense, fine-grained, waterbearing	20		3-3-6 N=9	
	26.0	1680				25		9-15-16 N=31	
Boring Terminated at 26 Feet									
Stratification lines are approximate. In-situ, the transition may be gradual.			Hammer Type: Automatic						
Advancement Method: 3 3/4" ID HSA 0-24 1/2"		See Exhibit A-3 for description of field procedures.	Notes:						
Abandonment Method: Boring converted to monitoring well installation.		See Appendix B for explanation of symbols and abbreviations.							
WATER LEVEL OBSERVATIONS		<div><div>Terracon</div><div>1805 Hancock Drive Bismarck, North Dakota</div></div>	Boring Started: 11/17/2015		Boring Completed: 11/17/2015				
While drilling			Drill Rig: D-90		Driller: MR				
On 11/20/2015			Project No.: M2155089		Exhibit: A-5				

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2155089 GPJ TERRACON2012.GDT 12/2/15

# BORING LOG NO. B-103

Page 1 of 1

**PROJECT:** Monitoring Well Installations

**CLIENT:** Golder Associates, Inc.  
Lakewood, Colorado

**SITE:** GRE - Stanton Station  
Mercer County, North Dakota

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2155089.GPJ TERRACON2012.GDT 12/2/15

GRAPHIC LOG

LOCATION: See Exhibit A-2

Latitude: 47.2845° Longitude: -101.33185°

DEPTH

ELEVATION (Ft.)

INSTALLATION DETAILS

Steel Casing

PVC Riser

Surface Elev.: 1707 (Ft.)

Bentonite

PVC Screen

Silica Sand

Sluff

DEPTH (Ft.)

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

FIELD TEST RESULTS

	<b>FILL - CLAYEY SAND</b> , dark brown, medium dense to loose, fine-grained, coal inclusions	1704.5				X	3-5-11 N=16
2.5	<b>FILL - COAL</b>					X	6-4-5 N=9
5.0		1702					
6.0	<b>SILTY SAND (SM)</b> , brown, medium dense, fine-grained	1701				X	5-11-13 N=24
	<b>POORLY GRADED SAND (SP)</b> , light brown, medium dense, fine-grained						
9.0		1698				X	5-6-5 N=11
	<b>POORLY GRADED SAND WITH CLAY (SP-SC)</b> , brown, loose, fine-grained						
11.0		1696				X	3-3-6 N=9
	<b>FAT CLAY (CH)</b> , brown, stiff, sand lenses						
14.0		1693				X	4-6-5 N=11
	<b>POORLY GRADED SAND WITH CLAY (SP-SC)</b> , brown, medium dense, fine-grained						
18.5		1688.5				X	5-9-9 N=18
	<b>POORLY GRADED SAND (SP)</b> , brown, loose, fine to coarse-grained, waterbearing						
21.0		1686				X	3-2-2 N=4
	<b>POORLY GRADED SAND WITH SILT AND GRAVEL (SP)</b> , grayish-brown, medium dense, fine to coarse-grained, waterbearing						
26.0		1681				X	5-7-9 N=16
	<b>Boring Terminated at 26 Feet</b>						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
3 3/4" ID HSA 0-24 1/2"

Abandonment Method:  
Boring converted to monitoring well installation.

See Exhibit A-3 for description of field procedures.

See Appendix B for explanation of symbols and abbreviations.

Notes:

Boring Started: 11/17/2015

Drill Rig: D-90

Project No.: M2155089

Boring Completed: 11/17/2015

Driller: MR

Exhibit: A-6

WATER LEVEL OBSERVATIONS

While drilling

On 11/20/2015

Terracon

1805 Hancock Drive  
Bismarck, North Dakota

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2155089 GPJ TERRACON2012.GDT 12/2/15

## Page 1 of 1

**CLIENT: Golder Associates, Inc.**  
**Lakewood, Colorado**

GRAPHIC LOG	LOCATION: See Exhibit A-2		INSTALLATION DETAILS		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
	Latitude: 47.2845° Longitude: -101.33072°	Surface Elev.: 1708 (Ft.)	Steel Casing	PVC Riser				
DEPTH	ELEVATION (Ft.)							
	<b>FILL - CLAYEY SAND</b> , dark brown, medium dense, fine-grained, coal inclusions							2-5-6 N=11
	3.0	1705						5-7-11 N=18
	<b>FILL - COAL</b> , black							
	5.5	1702.5			5			5-4-5 N=9
	<b>FILL - CLAYEY SAND</b> , brown, loose, fine-grained, coal inclusions							
	6.5	1701.5	Bentonite					4-5-6 N=11
	<b>FILL - SILTY SAND</b> , brown, medium dense, fine-grained							
	9.0	1699						
	<b>FILL - COAL</b> , black							
	10.0	1698			10			4-5-4 N=9
	<b>FILL - FAT CLAY</b> , gray, stiff, silt laminations							
	12.0	1696						
	<b>SANDY LEAN CLAY (CL)</b> , brownish-gray, soft to medium stiff							2-1-2 N=3
	14.5	1693.5			15			7-9-11 N=20
	<b>POORLY GRADED SAND WITH SILT AND GRAVEL (SP)</b> , grayish-brown, medium dense to loose, fine to coarse-grained							

Hammer Type: Automatic







Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2155089.GPJ TERRACON2012.GDT 12/2/15



## Page 1 of 1

**CLIENT: Golder Associates, Inc.**  
**Lakewood, Colorado**

GRAPHIC LOG	LOCATION: See Exhibit A-2		INSTALLATION DETAILS		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
	Latitude: 47.28083° Longitude: -101.33521°	Surface Elev.: 1708 (Ft.)	Steel Casing	PVC Riser				
DEPTH	ELEVATION (Ft.)							
	<b>FILL - POORLY GRADED SAND</b> , light brown, medium dense, fine-grained						X	3-4-6 N=10
	3.0	1705					X	3-2-3 N=5
	<b>FILL - SANDY LEAN CLAY</b> , brown, medium stiff						X	
	4.0	1704	Bentonite					
	<b>LEAN CLAY (CL)</b> , brownish-gray, medium stiff, silt laminations				5		X	3-2-3 N=5
	7.0	1701						
	<b>FAT CLAY (CH)</b> , brown, medium stiff, sand lenses and silt laminations						X	3-3-5 N=8
							X	3-3-3 N=6
							X	3-3-1 N=4
	14.0	1694	Silica Sand					
	<b>CLAYEY SAND (SC)</b> , brown, loose, fine to medium-grained						X	2-2-2 N=4
			PVC Screen		15			
	<b>SANDY LEAN CLAY (CL)</b> , brown, stiff, silt laminations						X	2-4-4 N=8
	21.0	1687	Sluff		20			
<b>Boring Terminated at 21 Feet</b>								

Hammer Type: Automatic

Notes:

See Appendix B for explanation of symbols and abbreviations.

Boring Completed: 11/18/2015

Driller: MR

Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2155089.GPJ TERRACON2012.GDT 12/2/15



**APPENDIX C**

# Monitoring Well Abandonment Reports

## MONITORING WELL ABANDONMENT REPORT

Monitoring well MW-3B located at 47.2845° N, 101.3370° W (see attached map) was abandoned October 24, 2019, by Terracon Consultants, Inc. with assistance from Baranko Brothers.

### PROCEDURE:

1. The monitoring well was backfilled with bentonite chips, which were hydrated as they were put into the monitoring well.
2. The steel protective cover was pulled out of the ground.
3. The ground around the monitoring well was excavated to approximately 5 feet below the ground surface.
4. The 2" PVC was trimmed to approximately 5 feet below the ground surface.
5. The 5-foot deep hole was backfilled with soil, and the surface was graded to direct surface water away from abandoned well.

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

Kate Kelly, Terracon Consultants, Inc

465

Driller's or Firm's Name

Certificate No.

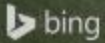
1805 Hancock Drive, PO Box 2084, Bismarck, North Dakota 58502

Address

  
Signed By

10/29/2019

Date



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MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY,  
AND IS NOT INTENDED FOR CONSTRUCTION  
PURPOSES

Project Manager:	KK	Project No.	M2195085
Drawn by:	KK	Scale:	AS SHOWN
Checked by:	CC	File Name:	MW-3B
Approved by:	CC	Date:	10/29/2019

**Terracon**  
1805 Hancock Dr, PO Box 2084  
Bismarck, ND 58501

## WELL LOCATION PLAN

Monitoring Well Decommissioning  
GRE Stanton Station  
Stanton, ND

## MONITORING WELL ABANDONMENT REPORT

Monitoring well MW-101 located at 47.2845° N, 101.3356° W (see attached map) was abandoned October 24, 2019, by Terracon Consultants, Inc. with assistance from Baranko Brothers.

### PROCEDURE:

1. The monitoring well was backfilled with bentonite chips, which were hydrated as they were put into the monitoring well.
2. The steel protective cover was pulled out of the ground.
3. The ground around the monitoring well was excavated to approximately 5 feet below the ground surface.
4. The 2" PVC was trimmed to approximately 5 feet below the ground surface.
5. The 5-foot deep hole was backfilled with soil, and the surface was graded to direct surface water away from abandoned well.

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

Kate Kelly, Terracon Consultants, Inc

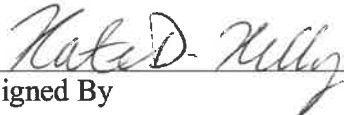
465

Driller's or Firm's Name

Certificate No.

1805 Hancock Drive, PO Box 2084, Bismarck, North Dakota 58502

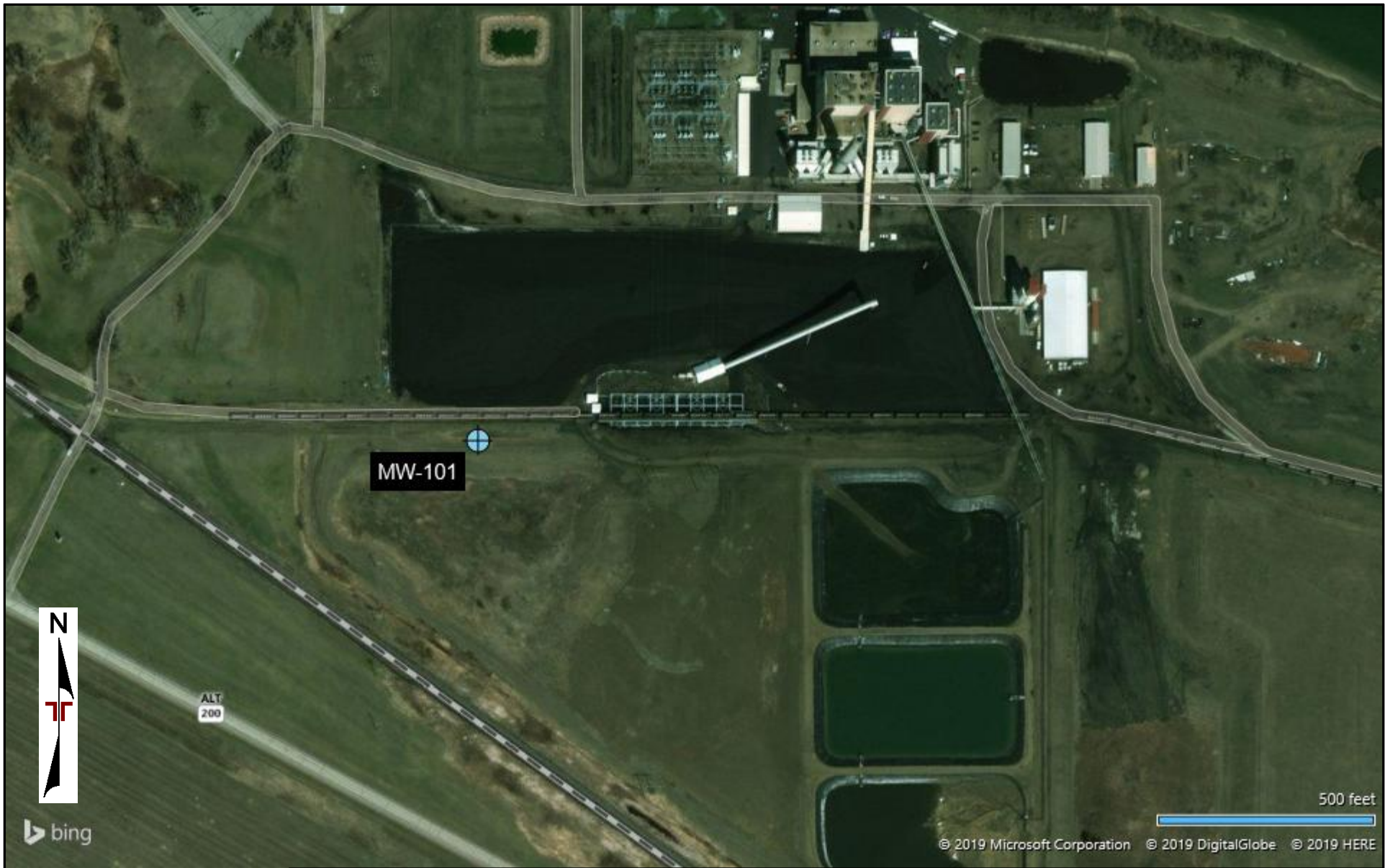
Address

  
Signed By

10/29/2019

Date





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MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY,  
AND IS NOT INTENDED FOR CONSTRUCTION  
PURPOSES

Project Manager:	KK	Project No.	M2195085
Drawn by:	KK	Scale:	AS SHOWN
Checked by:	CC	File Name:	MW-101
Approved by:	CC	Date:	10/29/2019

**Terracon**  
1805 Hancock Dr, PO Box 2084  
Bismarck, ND 58501

## WELL LOCATION PLAN

Monitoring Well Decommissioning  
GRE Stanton Station  
Stanton, ND





**[golder.com](http://golder.com)**