



**GEOTEK ENGINEERING  
& TESTING SERVICES, INC.**  
909 East 50<sup>th</sup> Street North  
Sioux Falls, South Dakota 57104  
Phone 605-335-5512 Fax 605-335-0773

May 3, 2021

Banner Associates, Inc.  
2307 W. 57<sup>th</sup> Street, Suite 102  
Sioux Falls, South Dakota 57108

Attn: Scott Vander Meulen, PE, LS

Subj: Test Borings & Laboratory Tests  
Proposed Treated Water Pipeline  
Madison Segments 2, 3 & 4  
Lewis & Clark Regional Water System  
Crooks to Madison, South Dakota  
GeoTek #21-464

### **Introduction**

This correspondence presents our reporting of the recent test borings and laboratory tests for the referenced project. Our work was performed in accordance with your authorization.

### **Project Information**

We understand that the project will consist of installing a treated water pipeline (Madison Segments 2, 3 & 4). The project begins at the intersection of 257<sup>th</sup> Street and 469<sup>th</sup> Avenue (about 1 mile west of Crooks, South Dakota) and ends near the intersection of SD Highway 34 and 459<sup>th</sup> Avenue (about 4 miles east of Madison, South Dakota).

### **Test Borings**

We performed 30 test borings on April 14 and April 15, 2021. We were unable to access the location of test boring 4-6A. Table 1 shows the Northings, Eastings and ground surface elevations at the test boring locations (provided by Banner Associates, Inc.). Four (4) test boring location maps (Figures 1 through 4) are attached showing the relative location of the test borings.

**Table 1. Northings, Eastings & Ground Surface Elevations**

<b>Test Boring</b>	<b>Northing</b>	<b>Easting</b>	<b>Ground Surface Elevation, ft</b>
2-1	508161.578	2894772.519	1,567.3
2-2	508935.699	2894703.728	1,545.4
2-3	518670.994	2894222.634	1,594.1

**Table 1 (Continued). Northings, Eastings & Ground Surface Elevations**

<b>Test Boring</b>	<b>Northing</b>	<b>Easting</b>	<b>Ground Surface Elevation, ft</b>
2-4	524742.828	2894029.803	1,565.8
2-5	532289.733	2893714.330	1,599.8
2-6	539922.379	2893441.633	1,604.7
2-7	550516.603	2892821.808	1,608.1
2-8	555550.697	2890103.863	1,571.0
2-9	555589.750	2889352.737	1,565.3
2-10	555538.417	2888217.533	1,557.1
2-11	555573.139	2887232.002	1,551.8
2-12	555451.312	2886462.831	1,557.1
2-13	555419.267	2885975.308	1,558.7
3-1	555126.775	2879152.990	1,610.3
3-2	555069.736	2874938.701	1,623.6
3-3	560141.596	2871586.371	1,654.3
3-4	573406.977	2871521.890	1,665.4
3-5	581717.204	2871158.512	1,586.8
3-6	583740.897	2871067.033	1,582.5
3-7	586469.056	2871013.670	1,588.9
3-8	593955.539	2870581.477	1,620.4
4-1	602504.781	2870146.348	1,688.2
4-2	607586.614	2864680.599	1,691.2
4-3	607477.721	2862585.117	1,699.1
4-4	607222.764	2858594.155	1,676.0
4-4A	607223.068	2857760.609	1,674.9
4-5	607013.020	2854202.163	1,675.4
4-6	617265.339	2851717.363	1,696.3
4-7	617096.003	2848425.211	1,697.1
4-8	616885.932	2843217.210	1,692.1

**Subsurface Conditions**

The subsurface profile at the test boring locations consisted of the following soil types: existing fill materials, topsoil materials, loess soils, fine alluvium soils, mixed alluvium soils, coarse alluvium soils and glacial till soils.

The existing fill materials were encountered at 10 test borings (out of 30 test borings). The topsoil materials were encountered at 23 test borings. The loess soils were encountered at 11 test

borings. The fine alluvium soils were encountered at 13 test borings. The mixed alluvium soils were encountered at 3 test borings. The coarse alluvium soils were encountered at 10 test borings. The glacial till soils were encountered at 18 test borings.

The existing fill materials consisted of lean clay (CL), lean clay with sand (CL) and clayey sand (SC). The topsoil materials consisted of lean clay (CL) and sandy lean clay (CL). The loess soils consisted of lean clay (CL) and lean clay with sand (CL). The fine alluvium soils consisted of lean clay (CL) and lean clay with sand (CL). The mixed alluvium soils consisted of sandy lean clay (CL). The coarse alluvium soils consisted of silty sand (SM), clayey sand (SC), sand with silt (SP-SM) and sand (SP). The glacial till soils consisted of lean clay (CL) and lean clay with sand (CL).

The consistency/relative density of the soils is indicated by the standard penetration resistance (“N”) values as shown on the boring logs. A description of the soil consistency/relative density based on the “N” values can be found on the attached Soil Boring Symbols and Descriptive Terminology data sheet.

We wish to point out that the subsurface conditions at other times and locations along the length of the project may differ from those found at our test boring locations.

### **Water Levels**

Measurements to record the groundwater levels were made at the test boring locations. Delayed groundwater readings were made at the majority of the test borings (not at test borings 2-4, 2-10, 2-12, 2-13 and 4-4A). The time and level of the groundwater readings are recorded on the boring logs. Also, a summary of the groundwater levels is shown in Table 2.

**Table 2. Groundwater Levels**

<b>Test Boring</b>	<b>Ground Surface Elevation, ft</b>	<b>Groundwater Level, ft</b>	<b>Elevation of Groundwater, ft</b>
2-1	1,567.3	14	1,553.3
2-2	1,545.4	11	1,534.4
2-3	1,594.1	7	1,587.1
2-4	1,565.8	7 ½	1,558.3
2-5	1,599.8	11	1,588.8
2-6	1,604.7	9	1,595.7
2-7	1,608.1	3	1,605.1
2-8	1,571.0	Dry to the Cave-In Depth	N/A
2-9	1,565.3	13	1,552.3
2-10	1,557.1	8	1,549.1
2-11	1,551.8	3	1,548.8
2-12	1,557.1	8	1,549.1
2-13	1,558.7	10	1,548.7

**Table 2 (Continued). Groundwater Levels**

<b>Test Boring</b>	<b>Ground Surface Elevation, ft</b>	<b>Groundwater Level, ft</b>	<b>Elevation of Groundwater, ft</b>
3-1	1,610.3	1 ½	1,608.8
3-2	1,623.6	2	1,621.6
3-3	1,654.3	6 ½	1,647.8
3-4	1,665.4	5	1,660.4
3-5	1,586.8	10	1,576.8
3-6	1,582.5	4 ½	1,578.0
3-7	1,588.9	5	1,583.9
3-8	1,620.4	3 ½	1,616.9
4-1	1,688.2	5	1,683.2
4-2	1,691.2	3	1,688.2
4-3	1,699.1	9	1,690.1
4-4	1,676.0	3	1,673.0
4-4A	1,674.9	3 ½	1,671.4
4-5	1,675.4	Dry to the Cave-In Depth	N/A
4-6	1,696.3	3	1,693.3
4-7	1,697.1	3 ½	1,693.6
4-8	1,692.1	4 ½	1,687.6

Note: Delayed groundwater readings were not made at test borings 2-4, 2-10, 2-12, 2-13 and 4-4A.

The water levels may or may not be an accurate indication of the depth or lack of subsurface groundwater. The limited length of observation restricts the accuracy of the measurements. Long term groundwater monitoring was not included in our scope of work.

### **Laboratory Testing**

Select samples from the test borings were submitted to the laboratory for testing. The tests consisted of moisture content, dry density, sieve analysis (#200 sieve wash) and unconfined compressive strength. The results of the laboratory tests are shown on the boring logs adjacent to the samples upon which the tests were performed.

### **Resistivity, pH, Chloride Content & Sulfate Content Results**

Thirty (30) soil samples were collected from the test borings and were submitted for resistivity, pH, chloride content and sulfate content testing. The results of the laboratory tests are shown in Table 3.

**Table 3. Laboratory Test Results**

Test Boring	Depth (ft)	Soil Type	Resistivity (ohm-cm) (as-received)	Resistivity (ohm-cm) (saturated)	pH	Chloride (mg/kg)	Sulfate (mg/kg)
2-1	9 ½ to 11	Lean Clay (L)	3,484	3,283	8.5	3	16
2-2	9 ½ to 11	Lean Clay (L)	1,608	1,541	8.3	12	22
2-3	7 to 8 ½	Lean Clay (L)	2,345	2,345	8.4	16	42
2-4	9 ½ to 11	Lean Clay (L)	1,340	1,340	8.0	4	20
2-5	7 to 8 ½	Lean Clay (L)	1,943	1,943	8.3	5	15
2-6	12 to 13 ½	Lean Clay w/ Sand (GT)	1,273	1,273	8.4	20	23
2-7	9 ½ to 11	Sandy Lean Clay (MA)	2,211	2,211	8.1	13	22
2-8	9 ½ to 11	Sand w/ Silt (CA)	25,460	9,380	8.5	8	10
2-9	9 ½ to 11	Sand (CA)	49,580	20,100	8.5	3	10
2-10	9 ½ to 11	Sand (CA)	8,710	7,370	8.3	4	33
2-11	14 ½ to 16	Sand w/ Silt (CA)	44,220	3,886	7.9	8	86
2-12	7 to 8 ½	Sand (CA)	28,810	13,400	8.5	5	14
2-13	7 to 8 ½	Sand w/ Silt (CA)	50,920	14,740	8.4	12	22
3-1	7 to 8 ½	Lean Clay (L)	1,072	1,072	7.8	10	89
3-2	9 ½ to 11	Lean Clay w/ Sand (GT)	1,340	1,340	8.3	4	104
3-3	7 to 8 ½	Lean Clay (L)	1,809	1,809	8.3	24	56
3-4	9 ½ to 11	Lean Clay (L)	1,809	1,809	8.2	9	30
3-5	7 to 8 ½	Sandy Lean Clay (MA)	4,757	4,288	8.4	8	15
3-6	9 ½ to 11	Sand (CA)	7,035	6,700	8.4	11	26
3-7	12 to 13 ½	Sand (CA)	5,092	4,757	8.4	4	49
3-8	12 to 13 ½	Lean Clay (L)	1,474	1,474	8.4	13	108
4-1	12 to 13 ½	Lean Clay w/ Sand (GT)	1,407	1,407	8.4	3	54
4-2	9 ½ to 11	Lean Clay (GT)	1,474	1,407	8.1	6	305
4-3	14 ½ to 16	Lean Clay w/ Sand (GT)	1,608	1,474	8.1	10	230
4-4	9 ½ to 11	Lean Clay w/ Sand (GT)	1,541	1,541	8.2	3	173
4-4A	14 ½ to 16	Lean Clay w/ Sand (GT)	1,139	1,139	7.5	1	4,660
4-5	12 to 13 ½	Lean Clay w/ Sand (GT)	1,608	1,541	7.6	4	1,165
4-6	12 to 13 ½	Lean Clay w/ Sand (GT)	1,340	1,273	8.0	4	306
4-7	7 to 8 ½	Lean Clay w/ Sand (GT)	1,474	1,407	8.2	22	83
4-8	9 ½ to 11	Lean Clay w/ Sand (GT)	1,340	1,273	8.3	13	146

Note: L – loess soils, MA – mixed alluvium soils, CA – coarse alluvium soils and GT – glacial till soils.

## **Discussion**

The subgrade soils anticipated at the invert depths for the pipeline will consist of clay soils and sand soils. Where soils having moderate moisture and density values are encountered at the bottom of the trench excavations, it is our opinion that the soils are considered suitable for support of the pipeline, provided they are adequately dewatered, and are not disturbed by construction traffic. Areas of wet or soft soils will likely be encountered at the bottom of numerous trench excavations. These areas will require subexcavation and trench stabilization methods and materials. Appropriate bedding materials should be used for the pipeline. Subexcavation and trench stabilization methods and materials will likely be needed at and around test borings 2-1, 2-2, 2-3, 2-4, 2-5, 2-7, 3-1, 3-3, 3-4 and 3-8 (areas where soft or wet soils are near the invert depths of the pipeline – mostly wet/soft loess soils).

Water will enter the trench excavations as a result of subsurface water, precipitation or surface run off. Dewatering procedures will be required in order to control and remove water during the excavation for the pipeline. Where clay soils are encountered, it may be possible to remove and control water entering the trench excavations using normal sump pumping techniques. However, where waterbearing sand soils are encountered, extensive dewatering techniques will likely be required due to the potentially large volumes of water. The contractor should provide appropriate dewatering methods and equipment. It should be noted that groundwater was encountered at the majority of the test borings (see Table 2). Also, waterbearing sand soils were encountered at test borings 2-7, 2-9, 2-10, 2-11, 2-12, 2-13, 3-5, 3-6 and 3-7. Any water that accumulates at the bottom of the trench excavations should be immediately removed and surface drainage away from the trench excavations should be provided during construction.

A portion of the soils encountered in the trench excavations may not be suitable or ideal for use as trench backfill. The unsuitable soils would consist of organic soils as well as soils having high moisture content levels such that the specified compaction level cannot be reasonably achieved. The organic soils should be replaced with suitable material available at the site or with suitable off-site borrow soils. The wet soils will require significant drying in order to adjust the moisture content of the soils to a level that will facilitate the specified compaction requirement. Alternatively, the wet soils could be replaced with suitable material available at the site or with suitable off-site borrow soils. Based on the moisture content levels, the majority of the loess soils and fine alluvium soils will require significant drying. Some drying should be expected with the existing fill materials, mixed alluvium soils and glacial till soils. Minimal drying should be expected with the coarse alluvium soils. The topsoil materials should be used a “capping” material at the ground surface.

Pipe jacking will be performed at numerous locations along the length of the pipeline. It is our opinion that the loess soils, fine alluvium soils and mixed alluvium soils generally have low strength levels. We estimate that the loess soils, fine alluvium soils and mixed alluvium soils have unconfined compressive strength values between 0.25 to 0.5 tons per square foot (tsf). Regarding the glacial till soils, it is our opinion that the glacial till soils have moderate to moderately high strength levels. We estimate that the glacial till soils have unconfined compressive strength values between 1.0 to 2.5 tsf. Boulders and cobbles may be encountered within the coarse alluvium soils and glacial till soils. The contractor may experience difficulties if boulders or cobbles are encountered during installation.

All excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, “Excavations and Trenches”. This document states that the excavation safety is the responsibility of the contractor. Reference to this OSHA requirement should be included in the project specifications.

**Standard of Care**

The recommendations submitted in this report represent our professional opinions. Our services for your project were performed in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering profession currently practicing at this time and area.

**Remarks**

We trust this report provides you with the necessary information for the project. If you have any questions or require additional information, please contact our office.

This report was prepared by:  
GeoTek Engineering & Testing Services, Inc.


  
\_\_\_\_\_  
Jared Haskins, PE  
Geotechnical Manager





FIGURE 1  
 TEST BORING LOCATION MAP (2-1 TO 2-6)  
 PROPOSED TREATED WATER PIPELINE  
 MADISON SEGMENTS 2, 3, & 4  
 LEWIS & CLARK REGIONAL WATER SYSTEM  
 CROOKS TO MADISON, SD ACAD/GEOTEK/JARED/21-464

PROJECT#: 21-464  
 DRAWN BY: MAB



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 East 50th Street North  
 Sioux Falls, South Dakota 57104  
 605-335-5512 Fax 605-335-0773





FIGURE 2  
 TEST BORING LOCATION MAP (2-7 TO 3-3)  
 PROPOSED TREATED WATER PIPELINE  
 MADISON SEGMENTS 2, 3, & 4  
 LEWIS & CLARK REGIONAL WATER SYSTEM  
 CROOKS TO MADISON, SD ACAD/GEOTEK/JARED/21-464

PROJECT#: 21-464

DRAWN BY: MAB



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 East 50th Street North  
 Sioux Falls, South Dakota 57104  
 605-335-5512 Fax 605-335-0773



FIGURE 3  
 TEST BORING LOCATION MAP (3-4 TO 3-8)  
 PROPOSED TREATED WATER PIPELINE  
 MADISON SEGMENTS 2, 3, & 4  
 LEWIS & CLARK REGIONAL WATER SYSTEM  
 CROOKS TO MADISON, SD ACAD/GEOTEK/JARED/21-464

PROJECT#: 21-464

DRAWN BY: MAB



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 East 50th Street North  
 Sioux Falls, South Dakota 57104  
 605-335-5512 Fax 605-335-0773

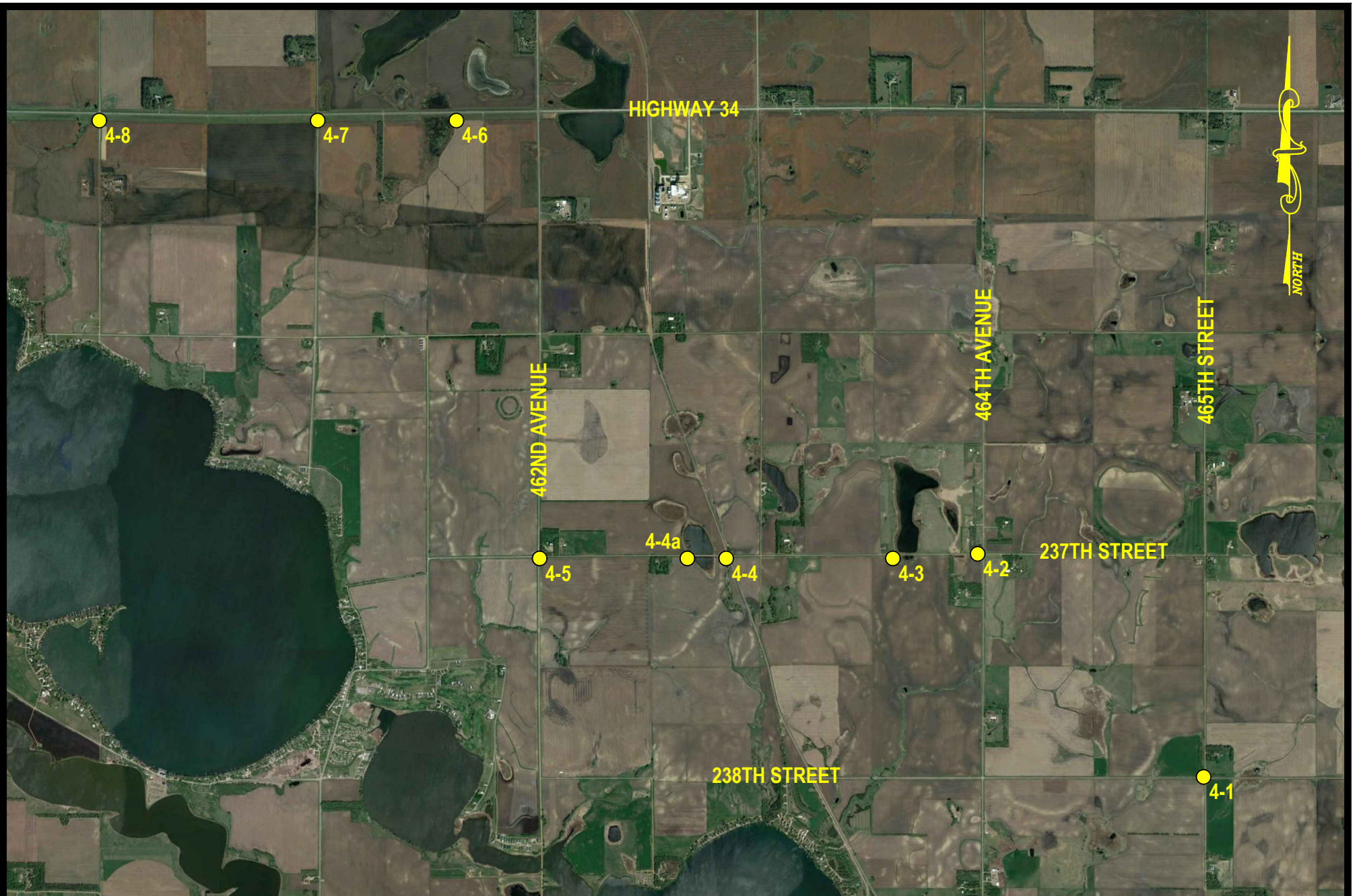


FIGURE 4  
 TEST BORING LOCATION MAP (4-1 TO 4-8)  
 PROPOSED TREATED WATER PIPELINE  
 MADISON SEGMENTS 2, 3, & 4  
 LEWIS & CLARK REGIONAL WATER SYSTEM  
 CROOKS TO MADISON, SD ACAD/GEOTEK/JARED/21-464

PROJECT#: 21-464

DRAWN BY: MAB



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 East 50th Street North  
 Sioux Falls, South Dakota 57104  
 605-335-5512 Fax 605-335-0773



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>2-1 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1567.3 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
2	<u>LEAN CLAY</u> : very dark brown, moist, (CL)					TOPSOIL			1	HSA							
	<u>LEAN CLAY</u> : brown, moist, firm, (CL)					LOESS	5		2	SPT	23	100					
							5		3	SPT	21						
							7		4	SPT	18	102					
9½	<u>LEAN CLAY</u> : brown and gray, moist, firm, (CL)					LOESS	7		5	SPT	24						
12	<u>LEAN CLAY</u> : grayish brown, moist to wet, soft to firm, (CL)					LOESS	5		6	SPT	29	94					
							4		7	SPT							
16	Bottom of borehole at 16 feet.																
WATER LEVEL MEASUREMENTS						START <u>4-14-21</u> COMPLETE <u>4-14-21 10:25 am</u>											
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD <u>3.25" ID Hollow Stem Auger</u>											
4-14-21	10:25 am	16	--	14	none												
4-18-21	4:00 pm	16	--	14	▼ 14												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF <u>Roy Hanson</u>											

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
SURFACE ELEVATION <u>1545.4 ft</u>						NO.	TYPE	WC	D	LL	PL	QU			
2		<b>FILL, MOSTLY CLAYEY SAND:</b> a little gravel, medium grained, brown, dry	FILL			1	HSA								
		<b>FILL, MOSTLY LEAN CLAY:</b> brown and black, moist	FILL	7		2	SPT	28							
4½		<b>LEAN CLAY:</b> brown, moist to wet, soft to firm, (CL)	LOESS	5		3	SPT	24							
				4		4	SPT	27	96					400	
				3		5	SPT	30							
12		<b>LEAN CLAY WITH SAND:</b> a little gravel, brown, moist, firm to stiff, (CL)	GLACIAL TILL	8		6	SPT	22							
16		Bottom of borehole at 16 feet.		9		7	SPT	22	107						
WATER LEVEL MEASUREMENTS					START	4-14-21	COMPLETE	4-14-21 11:10 am							
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD									
4-14-21	11:10 am	16	--	14	none	3.25" ID Hollow Stem Auger									
4-18-21	4:00 pm	16	--	12	11										
--	--	--	--	--	--										
--	--	--	--	--	--	CREW CHIEF Roy Hanson									

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>2-3 (1 of 1)</u>												
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																		
DEPTH in FEET	DESCRIPTION OF MATERIAL					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
									NO.	TYPE	WC	D	LL	PL	QU			
	SURFACE ELEVATION <u>1594.1 ft</u>																	
2	<b>LEAN CLAY:</b> black, moist, (CL)					TOPSOIL			1	HSA								
4 1/2	<b>LEAN CLAY:</b> brown, moist, firm, (CL)					LOESS	6		2	SPT	27							
	<b>LEAN CLAY:</b> brown and gray, moist to wet, soft, (CL)					LOESS	4		3	SPT	29	94						
							3		4	SPT	32	89						
							3		5	SPT								
13 1/2	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown, moist, firm, (CL)					GLACIAL TILL	4		6	SPT	36							
16	Bottom of borehole at 16 feet.						8		7	SPT	21	108						2500
WATER LEVEL MEASUREMENTS							START	<u>4-14-21</u>	COMPLETE	<u>4-14-21 11:55 am</u>								
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD												
4-14-21	11:55 am	16	--	14	8.5	3.25" ID Hollow Stem Auger												
4-18-21	4:05 pm	16	--	10	7													
--	--	--	--	--	--													
--	--	--	--	--	--	CREW CHIEF	Roy Hanson											

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
SURFACE ELEVATION <u>1565.8 ft</u>						NO.	TYPE	WC	D	LL	PL	QU			
		<b>FILL, MOSTLY LEAN CLAY:</b> brown and black, moist, 7" of gravel at the surface	FILL			1	HSA								
				4		2	SPT								
				7		3	SPT	30							
7		<b>LEAN CLAY:</b> black, moist, firm, (CL)	TOPSOIL	5	▼	4	SPT	37	84						
9½		<b>LEAN CLAY:</b> brown and dark gray, moist to wet, soft, (CL)	LOESS	4		5	SPT	31	93						
12		<b>LEAN CLAY:</b> brown and gray, wet, soft, (CL)	LOESS	4		6	SPT								
16½				4		7	SPT	34							
		<b>LEAN CLAY WITH SAND:</b> a trace of gravel, brown and gray, moist, firm, (CL)	GLACIAL TILL			8	SPT	26	102					2600	
21		Bottom of borehole at 21 feet.													
WATER LEVEL MEASUREMENTS						START	4-14-21	COMPLETE	4-14-21 12:55 pm						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD									
4-14-21	12:55 pm	21	--	19	▼ 7.5	3.25" ID Hollow Stem Auger									
--	--	--	--	--	--										
--	--	--	--	--	--										
--	--	--	--	--	--	CREW CHIEF Roy Hanson									

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 2-5 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1599.8 ft</u>														
2	<b>FILL, MOSTLY LEAN CLAY:</b> brown and black, moist, 4" of gravel at the surface	FILL			1	HSA									
3½	<b>LEAN CLAY:</b> very dark brown, moist, (CL)	TOPSOIL	5		2	SPT	29	92							
	<b>LEAN CLAY:</b> brown and gray, moist to wet, soft, (CL)	LOESS	4		3	SPT	25	97							
			4		4	SPT	29	94							
11	<b>LEAN CLAY:</b> grayish brown, wet, soft, (CL)	LOESS	3	▼	5	SPT	29								
			4		6	SPT	30								
14½	<b>LEAN CLAY:</b> brown, wet, soft, (CL)	LOESS	4		7	SPT	31	88							
16	Bottom of borehole at 16 feet.														

WATER LEVEL MEASUREMENTS

START 4-14-21 COMPLETE 4-14-21 1:46 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-14-21	1:45 pm	16	--	14	13.5	3.25" ID Hollow Stem Auger
4-18-21	4:05 pm	16	--	11	▼ 11	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Roy Hanson

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21





**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>2-6 (1 of 1)</u>												
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																		
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1604.7 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
									NO.	TYPE	WC	D	LL	PL	QU			
3	<b>LEAN CLAY:</b> very dark brown, moist, firm, (CL)					TOPSOIL	6		1	HSA								
	<b>LEAN CLAY:</b> dark brown, moist, firm, (CL)					LOESS	6		2	SPT	31							
	<b>LEAN CLAY:</b> dark brown, moist, firm, (CL)					LOESS	6		3	SPT								
7	<b>LEAN CLAY:</b> brown, moist, soft, (CL)					LOESS	4		4	SPT	28	97						
9½	<b>LEAN CLAY:</b> brown and gray, moist to wet, soft, (CL)					LOESS	2	▼	5	SPT	30							
12	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown, moist, stiff, (CL)					GLACIAL TILL	9		6	SPT	17	116						
	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown, moist, stiff, (CL)					GLACIAL TILL	9		7	SPT	18	114						2800
21	Bottom of borehole at 21 feet.						14		8	SPT	18	115						
WATER LEVEL MEASUREMENTS						START <u>4-14-21</u> COMPLETE <u>4-14-21 2:35 pm</u>												
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD 3.25" ID Hollow Stem Auger												
4-14-21	2:35 pm	21	--	19	none													
4-18-21	4:10 pm	21	--	10	▼ 9													
--	--	--	--	--	--													
--	--	--	--	--	--	CREW CHIEF Roy Hanson												

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 2-7 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1608.1 ft</u>														
	<b>LEAN CLAY:</b> black, moist, firm, (CL)	TOPSOIL			1	HSA									
4 1/2			6	▼	2	SPT	25	99							
7	<b>LEAN CLAY WITH SAND:</b> grayish brown, wet, soft, (CL)	FINE ALLUVIUM	3		3	SPT									
9 1/2	<b>SILTY SAND:</b> fine grained, brown, waterbearing, very loose, (SM)	COARSE ALLUVIUM	2		4	SPT	23								
	<b>SANDY LEAN CLAY:</b> brown and gray, wet, soft, with lenses of sand (CL)	MIXED ALLUVIUM	2		5	SPT									
			3		6	SPT	24								
			4		7	SPT	28								
18	<b>LEAN CLAY WITH SAND:</b> a little gravel, grayish brown, moist, stiff, (CL)	GLACIAL TILL	9		8	SPT	20	111							
21	Bottom of borehole at 21 feet.														

WATER LEVEL MEASUREMENTS

START 4-14-21 COMPLETE 4-14-21 3:30 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-14-21	3:30 pm	21	--	18	3.5	3.25" ID Hollow Stem Auger
4-18-21	4:10 pm	21	--	6.5	▼ 3	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Roy Hanson

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 2-8 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1571.0 ft</u>														
2	<b>LEAN CLAY:</b> very dark brown, moist, (CL)	TOPSOIL			1	HSA									
3½	<b>LEAN CLAY:</b> dark brown, moist, firm, (CL)	FINE ALLUVIUM	8		2	SPT	27								
	<b>CLAYEY SAND:</b> fine grained, brown, dry, very loose to medium dense, percent passing the #200 sieve = 20% (at 8') (SC)	COARSE ALLUVIUM	4		3	SPT									
			9		4	SPT	6								
9½				17		5	SPT	6							
	<b>SAND WITH SILT:</b> fine grained, brown, moist, dense, (SP-SM)	COARSE ALLUVIUM	16		6	SPT	6								
16				17		7	SPT								
	Bottom of borehole at 16 feet.														

WATER LEVEL MEASUREMENTS

START 4-14-21 COMPLETE 4-14-21 4:40 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-14-21	4:40 pm	16	--	11.5	none	3.25" ID Hollow Stem Auger
4-18-21	4:15 pm	16	--	8	none	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Roy Hanson

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 2-9 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1565.3 ft</u>														
2	<b>FILL, MOSTLY LEAN CLAY WITH SAND:</b> brown and black, moist	FILL			1	HSA									
4 1/2	<b>SANDY LEAN CLAY:</b> brown, moist, soft, (CL)	MIXED ALLUVIUM	3		2	SPT	10	115							
9 1/2	<b>CLAYEY SAND:</b> fine grained, brown, dry, loose to medium dense, (SC)	COARSE ALLUVIUM	6		3	SPT	9								
			9		4	SPT									
14 1/2	<b>SAND:</b> fine grained, brown, moist to wet, medium dense, (SP)	COARSE ALLUVIUM	12		5	SPT	6								
16	<b>SAND:</b> a trace of gravel, fine to medium grained, brown, waterbearing, medium dense, (SP)	COARSE ALLUVIUM	13		6	SPT									
16	Bottom of borehole at 16 feet.		13		7	SPT	13								

WATER LEVEL MEASUREMENTS

START 4-15-21 COMPLETE 4-15-21 9:10 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-15-21	9:10 am	16	--	13	13	3.25" ID Hollow Stem Auger
4-18-21	4:15 pm	16	--	13	13	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Roy Hanson

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 2-10 (1 of 1)

PROJECT **Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1557.1 ft</u>														
2	<b>FILL, MOSTLY CLAYEY SAND:</b> fine to medium grained, dark brown, dry	FILL			1	HSA									
4 1/2	<b>CLAYEY SAND:</b> a trace of gravel, fine to medium grained, brown, dry, medium dense, (SC)	COARSE ALLUVIUM	9		2	SPT	9								
	<b>SAND:</b> a trace of gravel, fine to medium grained, brown, dry to waterbearing, loose to medium dense, percent passing the #200 sieve = 4% (at 13') (SP)	COARSE ALLUVIUM	11		3	SPT									
			10	▼	4	SPT	15								
			8		5	SPT									
			10		6	SPT	19								
14 1/2	<b>SAND:</b> a little gravel, medium grained, brown, waterbearing, dense, (SP)	COARSE ALLUVIUM	16		7	SPT									
19	<b>SAND:</b> a trace of gravel, medium grained, grayish brown, waterbearing, medium dense, (SP)	COARSE ALLUVIUM	13		8	SPT	14								
			14		9	SPT	20								
			13		10	SPT									
31	Bottom of borehole at 31 feet.														

**WATER LEVEL MEASUREMENTS**

START 4-15-21 COMPLETE 4-15-21 10:30 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-15-21	10:30 am	31	--	8	▼ 8	3.25" ID Hollow Stem Auger
--	--	--	--	--	--	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Roy Hanson

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 2-11 (1 of 1)

PROJECT **Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1551.8 ft</u>														
2	<b>LEAN CLAY:</b> black, moist, (CL)	TOPSOIL			1	HSA									
4 1/2	<b>LEAN CLAY:</b> very dark gray, wet, soft, (CL)	FINE ALLUVIUM	2	▼	2	SPT	34	88							
7	<b>LEAN CLAY WITH SAND:</b> very dark gray, wet, soft, (CL)	FINE ALLUVIUM	4		3	SPT	21	109							
	<b>SAND WITH SILT:</b> a little gravel, medium grained, gray, waterbearing, very loose to medium dense, (SP-SM)	COARSE ALLUVIUM	4		4	SPT									
			9		5	SPT	12								
			10		6	SPT									
			11		7	SPT									
19	<b>SAND:</b> a trace of gravel, fine grained, gray, waterbearing, medium dense, (SP)	COARSE ALLUVIUM	10		8	SPT	22								
26	Bottom of borehole at 26 feet.		10		9	SPT									

**WATER LEVEL MEASUREMENTS**

START 4-15-21 COMPLETE 4-15-21 11:35 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-15-21	11:35 am	26	--	7.5	▼ 3	3.25" ID Hollow Stem Auger
4-18-21	4:20 pm	26	--	4	▼ 3	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Roy Hanson

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 2-12 (1 of 1)

PROJECT **Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1557.1 ft</u>														
3	<b>FILL, MOSTLY LEAN CLAY:</b> a trace of gravel, brown and black, moist, 5" of gravel at the surface	FILL	8		1	HSA									
4½	<b>LEAN CLAY:</b> dark grayish brown, moist, firm, (CL)	FINE ALLUVIUM			2	SPT	25	96							
	<b>SAND:</b> a trace of gravel, fine to medium grained, brown, dry to waterbearing, medium dense, percent passing the #200 sieve = 5% (at 8') (SP)	COARSE ALLUVIUM	15		3	SPT	6								
			10	▼	4	SPT	8								
9½	<b>SAND:</b> fine to medium grained, brown, waterbearing, loose to medium dense, (SP)	COARSE ALLUVIUM	8		5	SPT	23								
			9		6	SPT									
14½	<b>SAND:</b> a little gravel, medium grained, grayish brown, waterbearing, medium dense, (SP)	COARSE ALLUVIUM	10		7	SPT	19								
16	<b>SAND:</b> a little gravel, medium grained, gray, waterbearing, medium dense, (SP)	COARSE ALLUVIUM													
21	Bottom of borehole at 21 feet.		9		8	SPT									

WATER LEVEL MEASUREMENTS

START 4-15-21 COMPLETE 4-15-21 12:30 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-15-21	12:30 pm	21	--	8	▼ 8	3.25" ID Hollow Stem Auger
--	--	--	--	--	--	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Roy Hanson

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>2-13 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL				GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
								NO.	TYPE	WC	D	LL	PL	QU			
	SURFACE ELEVATION <u>1558.7 ft</u>																
2	<u>LEAN CLAY</u> : black, moist, (CL)				TOPSOIL			1	HSA	28							
4 1/2	<u>LEAN CLAY</u> : brown, moist, firm, (CL)				FINE ALLUVIUM	7		2	SPT	27							
	<u>SAND WITH SILT</u> : a trace of gravel, fine to medium grained, brown, dry to waterbearing, medium dense, (SP-SM)				COARSE ALLUVIUM	10		3	SPT	8							
						11		4	SPT								
						9	▼	5	SPT								
						10		6	SPT	25							
16						15		7	SPT								
	Bottom of borehole at 16 feet.																
WATER LEVEL MEASUREMENTS						START	<u>4-15-21</u>	COMPLETE	<u>4-15-21 1:20 pm</u>								
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD											
4-15-21	1:20 pm	16	--	10	▼ 10	3.25" ID Hollow Stem Auger											
--	--	--	--	--	--												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF Roy Hanson											

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21





**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>3-1 (1 of 1)</u>										
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																
DEPTH in FEET	DESCRIPTION OF MATERIAL					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS					
									NO.	TYPE	WC	D	LL	PL	QU	
	SURFACE ELEVATION <u>1610.3 ft</u>															
4 1/2     12     16	LEAN CLAY: black to very dark brown, moist to wet, firm, (CL)					TOPSOIL		▼	1	HSA						
							5		2	SPT	27	101				
	LEAN CLAY: brown and gray, wet, soft to firm, (CL)					LOESS	8		3	SPT	28	98				
							3		4	SPT	36					
							2		5	SPT	33					
	LEAN CLAY: grayish brown, wet, soft to firm, (CL)					LOESS	4		6	SPT						
							5		7	SPT	32	93				
Bottom of borehole at 16 feet.																
WATER LEVEL MEASUREMENTS						START	<u>4-14-21</u>	COMPLETE	<u>4-14-21 9:46 am</u>							
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD										
4-14-21	9:52 am	16	--	14	2.5	3.25" ID Hollow Stem Auger										
4-18-21	4:25 pm	16	--	7	▼ 1.5											
--	--	--	--	--	--											
--	--	--	--	--	--	CREW CHIEF Mike Wagner										

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
		SURFACE ELEVATION <u>1623.6 ft</u>				NO.	TYPE	WC	D	LL	PL	QU
2		<b>LEAN CLAY:</b> very dark brown to black, moist, (CL)	TOPSOIL			1	HSA					
3 1/2		<b>LEAN CLAY:</b> dark brown, moist to wet, soft, (CL)	LOESS	4		2	SPT	32	91			
		<b>LEAN CLAY:</b> brown and gray, wet, firm, (CL)	LOESS	5		3	SPT	29	97			
7		<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	14		4	SPT	24				
				19		5	SPT	18	115			3200
12		<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and dark brown, moist, stiff, (CL)	GLACIAL TILL	13		6	SPT	21				
16		Bottom of borehole at 16 feet.		11		7	SPT					
WATER LEVEL MEASUREMENTS					START	4-14-21		COMPLETE	4-14-21 10:39 am			
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD						
4-14-21	10:47 am	16	--	14	3	3.25" ID Hollow Stem Auger						
4-18-21	4:30 pm	16	--	4	2							
--	--	--	--	--	--							
--	--	--	--	--	--	CREW CHIEF Mike Wagner						

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>3-3 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL				GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
								NO.	TYPE	WC	D	LL	PL	QU			
	SURFACE ELEVATION <u>1654.3 ft</u>																
3	<b>FILL, MOSTLY LEAN CLAY:</b> dark brown and brown, moist				FILL			1	HSA								
	<b>LEAN CLAY:</b> brown and gray, moist to wet, firm, (CL)				LOESS	6		2	SPT	29							
						7		3	SPT	30	92						
						5		4	SPT	29	94						
						6		5	SPT	28	98					900	
						7		6	SPT	31							
16	Bottom of borehole at 16 feet.					8		7	SPT								
WATER LEVEL MEASUREMENTS						START	<u>4-15-21</u>		COMPLETE	<u>4-15-21 8:59 am</u>							
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD											
4-15-21	9:03 am	16	--	14	7.5	3.25" ID Hollow Stem Auger											
4-18-21	4:40 pm	16	--	13	▼ 6.5												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF Mike Wagner											

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 3-4 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1665.4 ft</u>														
1	<b>FILL, MOSTLY LEAN CLAY:</b> dark brown, moist	FILL				1	HSA								
	<b>LEAN CLAY:</b> black, moist, stiff, (CL)	TOPSOIL				2	SPT	34	79						
3½	<b>LEAN CLAY:</b> brown and gray, moist to wet, firm, (CL)	LOESS	9			3	SPT	32	88						
			7			4	SPT	28							
			5			5	SPT	28							
			6			6	SPT	27	97						
12	<b>LEAN CLAY:</b> grayish brown, wet, firm, (CL)	LOESS	6			7	SPT	20							
16	Bottom of borehole at 16 feet.		8												

WATER LEVEL MEASUREMENTS

START 4-14-21 COMPLETE 4-14-21 11:44 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-14-21	11:51 am	16	--	13.5	5	3.25" ID Hollow Stem Auger
4-18-21	4:40 pm	16	--	7	5	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 3-5 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1586.8 ft</u>														
2	<b>LEAN CLAY:</b> very dark brown to black, moist, (CL)	TOPSOIL			1	HSA									
4 1/2	<b>LEAN CLAY WITH SAND:</b> brown and gray, moist, firm, (CL)	FINE ALLUVIUM	6		2	SPT	13								
9 1/2	<b>SANDY LEAN CLAY:</b> dark brown, moist, soft to firm, (CL)	MIXED ALLUVIUM	6		3	SPT									
12	<b>CLAYEY SAND:</b> fine to medium grained, dark brown, waterbearing, very loose, (SC)	COARSE ALLUVIUM	3		4	SPT	13								
14 1/2	<b>LEAN CLAY WITH SAND:</b> very dark brown, wet, soft, (CL)	FINE ALLUVIUM	4	▼	5	SPT									
19 1/2	<b>SAND:</b> a little gravel, medium to coarse grained, brown, waterbearing, dense, (SP)	COARSE ALLUVIUM	4		6	SPT	29	94							
26	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, very stiff, (CL)	GLACIAL TILL	17		7	SPT	14								
			18		8	SPT	22	104						4000	
			19		9	SPT									
	Bottom of borehole at 26 feet.														

WATER LEVEL MEASUREMENTS

START 4-14-21 COMPLETE 4-14-21 1:18 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-14-21	1:18 pm	26	--	11	11	3.25" ID Hollow Stem Auger
4-18-21	4:45 pm	26	--	10	▼ 10	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 3-6 (1 of 1)

PROJECT **Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1582.5 ft</u>														
	<b>LEAN CLAY:</b> very dark brown, moist, firm, (CL)	TOPSOIL			1	HSA	20								
5			7		2	SPT	13	114							
	<b>SAND WITH SILT:</b> a little gravel, fine to medium grained, brown, moist to waterbearing, medium dense to dense, (SP-SM)	COARSE ALLUVIUM	9		3	SPT									
9½			28		4	SPT	13								
	<b>SAND:</b> a little gravel, medium to coarse grained, brown, waterbearing, dense to very dense, (SP)	COARSE ALLUVIUM	34		5	SPT									
			36		6	SPT	8								
			19		7	SPT									
19½															
21	<b>SAND:</b> a trace of gravel, medium grained, gray, waterbearing, dense, (SP)	COARSE ALLUVIUM	19		8	SPT	13								
	Bottom of borehole at 21 feet.														

WATER LEVEL MEASUREMENTS

START 4-14-21 COMPLETE 4-14-21 2:29 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-14-21	2:34 pm	21	--	7	6	3.25" ID Hollow Stem Auger
4-18-21	4:50 pm	21	--	5	4.5	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 3-7 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1588.9 ft</u>														
2	<b>SANDY LEAN CLAY:</b> very dark brown, moist, (CL)	TOPSOIL			1	HSA	14								
	<b>SAND:</b> a little gravel, fine to coarse grained, brown, moist to waterbearing, dense, (SP)	COARSE ALLUVIUM	21		2	SPT	5								
			25	▼	3	SPT									
7	<b>SAND:</b> a little gravel, fine to medium grained, brown and dark brown, waterbearing, loose to medium dense, (SP)	COARSE ALLUVIUM	15		4	SPT	22								
			6		5	SPT									
			6		6	SPT									
14½	<b>LEAN CLAY:</b> a trace of gravel, gray, moist, firm to stiff, (CL)	GLACIAL TILL	13		7	SPT	20	109							
			6		8	SPT	19	108							
21	Bottom of borehole at 21 feet.														

WATER LEVEL MEASUREMENTS

START 4-14-21 COMPLETE 4-14-21 3:26 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-14-21	3:30 pm	21	--	6	5.5	3.25" ID Hollow Stem Auger
4-18-21	5:00 pm	21	--	6	▼ 5	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 3-8 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1620.4 ft</u>														
2	<b>LEAN CLAY:</b> black, moist, (CL)	TOPSOIL			1	HSA									
3½	<b>LEAN CLAY WITH SAND:</b> dark grayish brown, moist, firm, (CL)	LOESS	8	▼	2	SPT	27	96							
	<b>LEAN CLAY:</b> brown and gray, moist to wet, soft to firm, (CL)	LOESS	5		3	SPT									
			5		4	SPT	33	87							
			3		5	SPT	31								
			7		6	SPT	30	91							
14½	<b>LEAN CLAY:</b> gray, wet, stiff, (CL)	LOESS	9		7	SPT	24	103							
19½	<b>LEAN CLAY WITH SAND:</b> a trace of gravel, gray, moist, firm, (CL)	GLACIAL TILL	6		8	SPT	27	101							
21	Bottom of borehole at 21 feet.														

WATER LEVEL MEASUREMENTS

START 4-14-21 COMPLETE 4-14-21 4:22 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-14-21	4:26 pm	21	--	17	6	3.25" ID Hollow Stem Auger
4-18-21	5:00 pm	21	--	11	▼ 3.5	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21





**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
SURFACE ELEVATION <u>1688.2 ft</u>						NO.	TYPE	WC	D	LL	PL	QU		
		<b>LEAN CLAY:</b> very dark brown, moist, stiff, (CL)	TOPSOIL			1	HSA	28						
3½		<b>LEAN CLAY:</b> dark brown, moist, stiff, (CL)	FINE ALLUVIUM	9		2	SPT	25	93					
			FINE ALLUVIUM	11	▼	3	SPT	20	101					
7		<b>LEAN CLAY:</b> brown and gray, moist, firm, (CL)	FINE ALLUVIUM	7		4	SPT	31	90					
9½		<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, firm to stiff, (CL)	GLACIAL TILL	9		5	SPT	21	105					
			GLACIAL TILL	8		6	SPT	22	106					
16		Bottom of borehole at 16 feet.		10		7	SPT							
WATER LEVEL MEASUREMENTS						START	<u>4-15-21</u>	COMPLETE	<u>4-15-21 9:58 am</u>					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD								
4-15-21	10:59 am	16	--	15	none	3.25" ID Hollow Stem Auger								
4-18-21	5:00 pm	16	--	7	▼ 5									
--	--	--	--	--	--									
--	--	--	--	--	--	CREW CHIEF Mike Wagner								

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
SURFACE ELEVATION <u>1691.2 ft</u>						NO.	TYPE	WC	D	LL	PL	QU		
3		<b>LEAN CLAY:</b> very dark brown to black, moist, firm, (CL)	TOPSOIL	8		1	HSA							
		<b>LEAN CLAY:</b> brown and gray, moist, firm, (CL)	FINE ALLUVIUM	6		2	SPT	32						
				7		3	SPT	29	92					
				8		4	SPT	26						
9½		<b>LEAN CLAY:</b> a little gravel, brown and gray, moist to wet, firm to stiff, (CL)	GLACIAL TILL	8		5	SPT	27	102					
				10		6	SPT	25	113					
14½		<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	13		7	SPT							
16		Bottom of borehole at 16 feet.												
WATER LEVEL MEASUREMENTS					START	4-15-21		COMPLETE	4-15-21 10:58 am					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD								
4-15-21	11:02 am	16	--	13	5	3.25" ID Hollow Stem Auger								
4-18-21	5:00 pm	16	--	6	3									
--	--	--	--	--	--									
--	--	--	--	--	--	CREW CHIEF Mike Wagner								

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 4-3 (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS								
					NO.	TYPE	WC	D	LL	PL	QU				
	↓ SURFACE ELEVATION <u>1699.1 ft</u>														
2	<b>FILL, MOSTLY LEAN CLAY:</b> dark brown, moist	FILL			1	HSA									
	<b>LEAN CLAY:</b> very dark brown to black, moist, stiff, (CL)	TOPSOIL	9		2	SPT	24	95							
4½	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	12		3	SPT									
			13		4	SPT	18	111							
			11		5	SPT									
			11		6	SPT	19	109							
			11		7	SPT									
21	<b>LEAN CLAY WITH SAND:</b> a little gravel, gray, moist, stiff, (CL)	GLACIAL TILL	13		8	SPT	15	118							
26	Bottom of borehole at 26 feet.		14		9	SPT									

WATER LEVEL MEASUREMENTS

START 4-15-21 COMPLETE 4-15-21 12:16 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-15-21	12:16 pm	26	--	24	none	3.25" ID Hollow Stem Auger
4-18-21	5:05 pm	26	--	16	9	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 21-464.GPJ - GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>4-4 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1676.0 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
	<b>LEAN CLAY:</b> black, moist, firm, (CL)					TOPSOIL			1	HSA							
3	<b>LEAN CLAY:</b> dark brown, moist, firm, (CL)					FINE ALLUVIUM	6	▼	2	SPT	29	91					
4½	<b>LEAN CLAY:</b> brown and gray, moist, firm, (CL)					FINE ALLUVIUM	6		3	SPT	26	98					
6	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, stiff, (CL)					GLACIAL TILL	9		4	SPT	21						
							9		5	SPT	20	110					
12	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and dark brown, moist, stiff, (CL)					GLACIAL TILL	11		6	SPT	21						
							14		7	SPT	18	112					
19½	<b>LEAN CLAY WITH SAND:</b> a little gravel, gray, moist, very stiff, (CL)					GLACIAL TILL	16		8	SPT							
21	Bottom of borehole at 21 feet.																
WATER LEVEL MEASUREMENTS							START	<u>4-15-21</u>	COMPLETE	<u>4-15-21 1:55 pm</u>							
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD											
4-15-21	1:55 pm	21	--	19	17	3.25" ID Hollow Stem Auger											
4-18-21	5:10 pm	21	--	7.5	▼ 3												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF	Mike Wagner										

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # 21-464

BORING NO. 4-4A (1 of 1)

PROJECT Proposed Treated Water Pipeline, Madison Segments 2, 3 & 4, Lewis & Clark Regional Water System, Crooks to Madison, SD

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS									
					NO.	TYPE	WC	D	LL	PL	QU					
	↓ SURFACE ELEVATION <u>1674.9 ft</u>															
3	<b>FILL, MOSTLY LEAN CLAY WITH SAND:</b> with gravel, brown, moist	FILL	11		1	HSA										
	<b>LEAN CLAY:</b> gray, moist to wet, stiff, (CL)	FINE ALLUVIUM	10		2	SPT	9									
					3	SPT	27	96								
7	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, stiff, (CL)	GLACIAL TILL	13		4	SPT	19	110								
					5	SPT										
					6	SPT	22									
14½	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and dark brown, moist, stiff, (CL)	GLACIAL TILL	14		7	SPT	24	104								3100
					8	SPT										
19½	<b>LEAN CLAY WITH SAND:</b> a little gravel, gray, moist, firm, (CL)	GLACIAL TILL	7													
21	Bottom of borehole at 21 feet.															

WATER LEVEL MEASUREMENTS

START 4-15-21 COMPLETE 4-15-21 2:46 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD
4-15-21	2:50 pm	21	--	12	3.5	3.25" ID Hollow Stem Auger
--	--	--	--	--	--	
--	--	--	--	--	--	
--	--	--	--	--	--	CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 21-464.GPJ - GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>4-5 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1675.4 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
2	<b>LEAN CLAY:</b> very dark brown, moist, (CL)					TOPSOIL			1	HSA							
	<b>LEAN CLAY:</b> brown and gray, moist, firm, (CL)					FINE ALLUVIUM	8		2	SPT	23						
							8		3	SPT	27	95					
7	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, stiff to very stiff, (CL)					GLACIAL TILL	10		4	SPT							
							13		5	SPT	19	108					
							14		6	SPT	18	112					
16	Bottom of borehole at 16 feet.						19		7	SPT							
WATER LEVEL MEASUREMENTS						START <u>4-15-21</u> COMPLETE <u>4-15-21 3:32 pm</u>											
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD <u>3.25" ID Hollow Stem Auger</u>											
4-15-21	3:32 pm	16	--	14	none												
4-18-21	5:10 pm	16	--	14	none												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF <u>Mike Wagner</u>											

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS							
SURFACE ELEVATION <u>1696.3 ft</u>						NO.	TYPE	WC	D	LL	PL	QU			
3		<b>LEAN CLAY:</b> very dark brown to black, moist, soft, (CL)	TOPSOIL			1	HSA								
		<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, firm to stiff, (CL)	GLACIAL TILL	4	▼	2	SPT	42	74						
				11		3	SPT	24							
				8		4	SPT								
				14		5	SPT	21	107						
13½		<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and dark brown, moist, stiff, (CL)	GLACIAL TILL	13		6	SPT	21							
				13		7	SPT	24	96						
19½		<b>LEAN CLAY WITH SAND:</b> a little gravel, gray, moist, stiff, (CL)	GLACIAL TILL	10		8	SPT								
21		Bottom of borehole at 21 feet.													
WATER LEVEL MEASUREMENTS					START	<u>4-15-21</u>		COMPLETE	<u>4-15-21 4:26 pm</u>						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD									
4-15-21	4:30 pm	21	--	18	8	3.25" ID Hollow Stem Auger									
4-18-21	5:10 pm	21	--	10	▼ 3										
--	--	--	--	--	--										
--	--	--	--	--	--	CREW CHIEF Mike Wagner									

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21



**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

DEPTH in FEET		DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS				
SURFACE ELEVATION <u>1697.1 ft</u>						NO.	TYPE	WC	D	LL	PL	QU
2		<b>LEAN CLAY:</b> black, moist, (CL)	TOPSOIL			1	HSA					
3½		<b>LEAN CLAY:</b> dark brown, moist, soft, (CL)	FINE ALLUVIUM	4	▼	2	SPT	27	93			
		<b>LEAN CLAY:</b> brown and gray, moist, firm, (CL)	FINE ALLUVIUM	5		3	SPT	27	97			
7		<b>LEAN CLAY WITH SAND:</b> a little gravel, brown, moist, firm to stiff, a few lenses of sand at 8' (CL)	GLACIAL TILL	7		4	SPT	23				
				9		5	SPT	31	91			
				9		6	SPT	21	107			
16		Bottom of borehole at 16 feet.		9		7	SPT					
WATER LEVEL MEASUREMENTS					START	<u>4-15-21</u>	COMPLETE	<u>4-15-21 3:30 pm</u>				
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD						
4-15-21	3:30 pm	16	--	13	▼ 3.5	3.25" ID Hollow Stem Auger						
4-18-21	5:15 pm	16	--	6.5	▼ 3.5							
--	--	--	--	--	--							
--	--	--	--	--	--	CREW CHIEF Roy Hanson						

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21





**GEOTEK ENGINEERING & TESTING SERVICES, INC.**  
 909 E 50th St N  
 Sioux Falls, South Dakota, 57104  
 605-335-5512 Fax  
 jhaskins@geotekeng.com

**GEOTECHNICAL TEST BORING LOG**

GEOTEK # <u>21-464</u>						BORING NO. <u>4-8 (1 of 1)</u>											
PROJECT <u>Proposed Treated Water Pipeline, Madison Segments 2, 3 &amp; 4, Lewis &amp; Clark Regional Water System, Crooks to Madison, SD</u>																	
DEPTH in FEET	DESCRIPTION OF MATERIAL SURFACE ELEVATION <u>1692.1 ft</u>					GEOLOGIC ORIGIN	N	WL	SAMPLE		LABORATORY TESTS						
									NO.	TYPE	WC	D	LL	PL	QU		
2	<b>LEAN CLAY:</b> black, moist, (CL)					TOPSOIL			1	HSA							
4 1/2	<b>LEAN CLAY:</b> very dark brown, moist, firm, (CL)					FINE ALLUVIUM	6		2	SPT	25	99					
9 1/2	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and gray, moist, stiff, (CL)					GLACIAL TILL	9	▼	3	SPT	18	110					
12	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown, moist, stiff, (CL)					GLACIAL TILL	12		4	SPT	19						
16	<b>LEAN CLAY WITH SAND:</b> a little gravel, brown and dark gray, moist, stiff, (CL)					GLACIAL TILL	9		5	SPT	20	109					
	Bottom of borehole at 16 feet.						9		6	SPT	20	108					
									7	SPT							
WATER LEVEL MEASUREMENTS						START <u>4-15-21</u> COMPLETE <u>4-15-21 2:50 pm</u>											
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL	METHOD											
4-15-21	2:50 pm	16	--	14	none	3.25" ID Hollow Stem Auger											
4-18-21	5:15 pm	16	--	6.5	▼ 4.5												
--	--	--	--	--	--												
--	--	--	--	--	--	CREW CHIEF Roy Hanson											

GEOTECHNICAL TEST BORING 21-464.GPJ GEOTEKENG.GDT 4/28/21

# SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS	
			GRAPH	LETTER		
<p><b>COARSE GRAINED SOILS</b></p> <p>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</p>	<p><b>GRAVEL AND GRAVELLY SOILS</b></p> <p>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE</p>	<p>CLEAN GRAVELS</p> <p>(LITTLE OR NO FINES)</p>		<b>GW</b>	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		<b>GP</b>	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		<b>GM</b>	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES	
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		<b>GC</b>	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES	
	<p><b>SAND AND SANDY SOILS</b></p> <p>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE</p>	<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		<b>SW</b>	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
		<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		<b>SP</b>	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES	
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		<b>SM</b>	SILTY SANDS, SAND - SILT MIXTURES	
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		<b>SC</b>	CLAYEY SANDS, SAND - CLAY MIXTURES	
		<p><b>FINE GRAINED SOILS</b></p> <p>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</p>	<p><b>SILTS AND CLAYS</b></p> <p>LIQUID LIMIT LESS THAN 50</p>		<b>ML</b>	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
					<b>CL</b>	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	<b>OL</b>			ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
<p><b>SILTS AND CLAYS</b></p> <p>LIQUID LIMIT GREATER THAN 50</p>			<b>MH</b>	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS		
			<b>CH</b>	INORGANIC CLAYS OF HIGH PLASTICITY		
<p><b>HIGHLY ORGANIC SOILS</b></p>				<b>OH</b>	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
				<b>PT</b>	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

# BORING LOG SYMBOLS AND DESCRIPTIVE TERMINOLOGY

## SYMBOLS FOR DRILLING AND SAMPLING

<u>Symbol</u>	<u>Definition</u>
Bag	Bag sample
CS	Continuous split-spoon sampling
DM	Drilling mud
FA	Flight auger; number indicates outside diameter in inches
HA	Hand auger; number indicates outside diameter in inches
HSA	Hollow stem auger; number indicates inside diameter in inches
LS	Liner sample; number indicates outside diameter of liner sample
N	Standard penetration resistance (N-value) in blows per foot
NMR	No water level measurement recorded, primarily due to presence of drilling fluid
NSR	No sample retrieved; classification is based on action of drilling equipment and/or material noted in drilling fluid or on sampling bit
SH	Shelby tube sample; 3-inch outside diameter
SPT	Standard penetration test (N-value) using standard split-spoon sampler
SS	Split-spoon sample; 2-inch outside diameter unless otherwise noted
WL	Water level directly measured in boring
▼	Water level symbol

## SYMBOLS FOR LABORATORY TESTS

<u>Symbol</u>	<u>Definition</u>
WC	Water content, percent of dry weight; ASTM:D2216
D	Dry density, pounds per cubic foot
LL	Liquid limit; ASTM:D4318
PL	Plastic limit; ASTM:D4318
QU	Unconfined compressive strength, pounds per square foot; ASTM:D2166

### DENSITY/CONSISTENCY TERMINOLOGY

<u>Density</u>	<u>Consistency</u>	
<u>Term</u>	<u>N-Value</u>	<u>Term</u>
Very Loose	0-4	Soft
Loose	5-8	Firm
Medium Dense	9-15	Stiff
Dense	16-30	Very Stiff
Very Dense	Over 30	Hard

### PARTICLE SIZES

<u>Term</u>	<u>Particle Size</u>
Boulder	Over 12"
Cobble	3" – 12"
Gravel	#4 – 3"
Coarse Sand	#10 – #4
Medium Sand	#40 – #10
Fine Sand	#200 – #40
Silt and Clay	passes #200 sieve

### DESCRIPTIVE TERMINOLOGY

<u>Term</u>	<u>Definition</u>
Dry	Absence of moisture, powdery
Frozen	Frozen soil
Moist	Damp, below saturation
Waterbearing	Pervious soil below water
Wet	Saturated, above liquid limit
Lamination	Up to ½" thick stratum
Layer	½" to 6" thick stratum
Lens	½" to 6" discontinuous stratum

### GRAVEL PERCENTAGES

<u>Term</u>	<u>Range</u>
A trace of gravel	2-4%
A little gravel	5-15%
With gravel	16-50%