GEOTECHNICAL EXPLORATION
PROPOSED METER BUILDING
SEGMENT 11 – 298TH STREET
LEWIS & CLARK REGIONAL
WATER SYSTEM
NEAR BERESFORD, SOUTH DAKOTA

GEOTEK #10-F07

Prepared By:

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
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January 10, 2011

Banner Associates, Inc.
PO Box 298
Brookings, SD 57006

Attn: Tim Conner, PE

Subj: Geotechnical Exploration
Proposed Meter Building
Segment 11 – 298th Street
Lewis & Clark Regional Water System
Near Beresford, South Dakota
GeoTek #10-F07

This correspondence presents our written report of the geotechnical exploration program for the referenced project. We performed our work in accordance with the authorization from Kristin Bisgard on November 30, 2010. We are transmitting two copies of our report for your use. We are sending an additional copy as noted below.

We thank you for the opportunity of providing our services on this project and look forward to continued participation during the design and construction phases. If you have any questions regarding this report, please contact our office at (605) 335-5512.

Respectfully Submitted,
GeoTek Engineering & Testing Services, Inc.

Jeff Christensen, PE
Geotechnical Manager

Cc: Banner Associates (Brookings), Attn: Kristin Bisgard, P.E.

TABLE OF CONTENTS

GEOTECHNICAL EXPLORATION
PROPOSED METER BUILDING
SEGMENT 11 – 298TH STREET
LEWIS & CLARK REGIONAL WATER SYSTEM
NEAR BERESFORD, SOUTH DAKOTA
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INTRODUCTION

Project Information

This report presents the results of the recent geotechnical exploration program for the proposed meter building for Lewis & Clark Regional Water System near Beresford, South Dakota.

Scope of Services

We performed our work in accordance with the authorization of Kristin Bisgard with Banner Associates. The authorized scope of services included the following:

1. To perform one (1) standard penetration test (SPT) boring to explore the subsurface conditions at the project site.

2. To perform laboratory tests including moisture content, dry density, Atterberg limits (liquid and plastic limits) and unconfined compressive strength.

3. To prepare an engineering report including the results of the field and laboratory tests as well as our geotechnical engineering opinions and recommendations regarding the following:

    - Site preparation and excavation/filling procedures;
    - Foundation types and depths, allowable bearing capacity and estimated potential settlements of foundations;
    - Floor slab support;
    - Foundation backfill;
    - Comments regarding factors that may impact the constructability and final performance of the project;
    - Quality control observations and testing.

The scope of our work was intended for geotechnical purposes only. This scope of work did not include determining the presence or extent of environmental contamination at the site or to characterize the site relative to wetlands status.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The project site is located along the north side of 298th Street and about 1,000 feet east of Interstate 29, one mile south of Beresford, South Dakota. The site is currently in agricultural use for row crops. The location for the test boring was staked by Banner Associates. We were not able to access the staked location due to several soil stockpiles. Therefore, we drilled the test boring about 37 feet north of the staked location. The relative location of the test boring is shown on Figure A1 in the Appendix.

Subsurface Conditions

We performed one (1) test boring at the site on December 28, 2010. The subsurface conditions encountered at the test boring location are illustrated by means of the boring log included in Appendix A. We wish to point out that the subsurface conditions at other times and locations at the site may differ from those found at our test boring location. If different conditions are encountered during construction, it is necessary that you contact us so that our recommendations can be reviewed.

The subsurface conditions encountered at the boring location consist of about 2 feet of topsoil materials at the surface overlying sandy lean clay (glacial till) soils that extended to the termination depth of the boring.

The consistency of the sandy lean clay (glacial till) soils varied from firm to very stiff. The consistency of the soils is indicated by the standard penetration resistance ("N") values as shown on the boring log.

Water Levels

We performed measurements to record the groundwater level at the boring location immediately after completion of the boring. The time and level of the groundwater readings are recorded on the boring log. We did not encounter measurable groundwater at the borehole.

The water levels shown on the boring log may not be an accurate indication of the current level or lack of subsurface groundwater. A long period of time is generally required for subsurface water to stabilize in the impervious soils encountered at the boring location. Long term water level monitoring was not included in our scope of work.

We expect subsurface groundwater levels to fluctuate seasonally and yearly from the groundwater readings recorded at the boring. Fluctuations occur due to varying seasonal and yearly rainfall amounts and snowmelt, as well as other factors. It is possible that the subsurface groundwater levels during or after construction could be significantly different than the time the boring was performed.

ENGINEERING REVIEW AND RECOMMENDATIONS

Project Design Data

We understand that the project will consist of constructing a new meter building for Lewis & Clark Regional Water System near Beresford, South Dakota. The meter building will be a pre-fabricated structure that has approximate dimensions of 15 feet by 30 feet. The building will be heated during the winter. We estimate the floor elevation will be slightly higher than the existing ground surface elevation. We anticipate light foundation loads for the proposed structure.

The above information/assumptions are important factors in our review and recommendations. If there are any corrections or additions to the above-mentioned data, it is necessary that you contact us so that we can review our recommendations with regards to the revised plans.

Discussion

Typically, spread footings are the most cost effective type of foundation system. It is our opinion a spread footing foundation system can be used for support of the proposed meter building after the recommended site preparation has been performed.

Site Preparation

Excavation

We encountered approximately 2 feet of topsoil materials at the test boring. It is our opinion that the topsoil materials are not suitable for support of the footings and floor slab. We recommend site preparation for the spread footings and floor slab consists of removing the topsoil materials in order to expose the sandy lean clay (glacial till) soils. This procedure should be followed by placing compacted granular structural fill up to the design elevations for the footings and floor slab. If structural fill is required beneath the footings, the bottom of the foundation excavations should be laterally oversized one foot beyond the edges of the footing for each vertical foot of structural fill required below the footing (1 horizontal : 1 vertical).

The predominant clayey soils encountered at the boring locations are susceptible to disturbance and can experience strength loss caused by construction traffic and/or additional moisture. Precautions will be required during earthwork activities in order to reduce the risk of soil disturbance. The excavation should be performed with a track-driven excavator (backhoe) having a smooth cutting edge on the bucket to minimize soil disturbance.

The risk of soil disturbance increases significantly with additional moisture and the presence of water. Water may enter the excavation as a result of subsurface water, precipitation and surface run off. It will likely be possible to remove and control water entering the excavation using normal sump pumping techniques due to the low permeable characteristics of the predominant clayey soils encountered at the boring locations. However, lenses and layers of sand may be encountered, requiring more extensive dewatering techniques depending upon the subsurface water levels present during construction and the required excavation depths. Any water that

accumulates in the bottom of the excavation should be immediately removed and surface drainage away from the excavation should be provided during construction.

Filling

We recommend the granular structural fill placed in dry excavations for support of the footings and floor slab should consist of a pit-run or processed sand or gravel having a maximum particle size of 3 inch with less than 15 percent by weight passing the #200 sieve. The on-site clay soils should not be reused for structural fill in the building area.

We recommend that drainage fill be placed in excavations with water or having saturated soils in the bottoms. The drainage fill should consist of either clean crushed rock having a maximum size of 1-inch and no more than 5 percent by weight passing the #4 sieve or free-draining sand with less than 40 percent by weight passing the #40 sieve and less than 5 percent by weight passing the #200 sieve. The initial lift of this material should be placed to a height of approximately 2 feet above the water surface or saturated soils prior to compaction to lessen the risk of disturbing the natural soils.

The fill and backfill materials should be placed and uniformly compacted in thin lifts, using vibratory compactors sized for the individual tasks. For heavy, self-propelled compactors, the fill should be placed in loose lifts of 12 inches or less. For hand-operated compactors, the fill should be placed in loose lifts of 6 inches or less. Table 1 presents a summary of the recommended compaction criteria for the various areas that will likely require fill or backfill. The percentages shown are expressed as minimums of standard Proctor density (ASTM:D698).

Table 1. Recommended Compaction Requirements

Structure	Minimum Compaction, percent
Below Footings and Floor Slabs	95
Exterior Pavements and Sidewalks	95
Exterior Foundation and Retaining Wall Backfill	95
Landscape Areas	90

Foundations

It is our opinion the footings can be designed using a net allowable soil bearing pressure of 2,000 pounds per square foot (psf) if the site has been prepared according to our recommendations in section Site Preparation. The net allowable soil bearing pressure is based on the soil conditions encountered at the test borings, the results of the field and laboratory tests, recommended compaction levels and past experience with similar soil conditions.

We recommend all footings be placed at a sufficient depth for frost protection. The perimeter footings for heated buildings should be placed such that the bottom of the footing is a minimum of 4 feet below finished exterior grade. Interior footings in heated buildings can be placed beneath the floor slab. Footings for unheated areas and canopies, or footings that are not protected from frost during freezing temperatures, should be placed at a minimum depth of 5 feet below the lowest adjacent grade.

An important factor in providing a stable foundation condition is to minimize the amount of time the excavation is left open. The clay subgrade should not be exposed to excessive wetting or drying. Footings and backfill should be placed in a timely manner after the excavation has been completed and the footings and foundation walls poured. Any water that accumulates in the excavation should be removed immediately.

As previously mentioned, the clay foundation soils may become wet and as a result will be susceptible to disturbance during construction. Where wet clays are encountered, we recommend over excavating the foundation excavations 4 to 6 inches and backfilling with washed crushed rock having a maximum size of 1-inch and no more than 5 percent by weight passing the #4 sieve. This replacement with crushed rock will provide a more stable and uniform working surface during foundation construction.

It is our opinion the recommended bearing pressure should provide a minimum safety factor of 3.0 against shear or base failure. Total settlement of the structure should be less than 1 inch and differential settlement should be less than ½ inch. Unknown soil conditions at the site that are

different from those depicted at the boring locations could increase the amount of expected settlement.

Floor Slab

We recommend placing a layer of free-draining sand fill directly beneath the floor slab in order to provide a working surface for the placement of concrete and to serve as a capillary barrier. This free-draining granular fill should have less than 40 percent by weight passing the #40 sieve and less than 5 percent by weight passing the #200 sieve. We recommend placing a minimum of 6 inches of free-draining sand fill beneath the floor slab.

Exterior Foundation Backfill

We recommend either granular soils or non-organic clay soils having a liquid limit less than 45 be used as exterior foundation backfill for slab-on-grade structures. If granular soils are used for backfill in areas that will not have asphalt or concrete surfacing, we recommend capping the sand with 1 to 2 feet of clayey soil to minimize infiltration of surface waters. The exterior foundation backfill soils should be placed and compacted according to our previous recommendations in the section entitled Site Preparation - Filling. The foundation walls should be braced prior to backfilling or they should be backfilled evenly on both sides to reduce the risk of damaging the walls.

Site Drainage

Proper site drainage should be provided during and after construction. General site grading should direct all surface waters away from the excavations. Any water that accumulates in the excavations should be removed as soon as possible.

It is important that a positive slope be provided away from the structure for proper drainage. Finished grades should be sloped away from the structure with a minimum slope of 1 inch per foot starting at the foundation and extending to at least 10 feet beyond the excavation line. If pavement will be placed immediately next to the structure, a slope of at least ¼ inch per foot away from the foundation should be used for the pavement, if possible. The joint between the

pavement and the foundation should be properly sealed and maintained. Roof run off water should be controlled with a well-maintained system of gutters and downspouts with extensions to remove the run off water away from the structure.

CONSTRUCTION CONSIDERATIONS

Groundwater and Surface Water

Water may enter the excavations due to subsurface water, precipitation or surface run off. As previously mentioned, the clayey soils encountered at the boring location are relatively poor draining. As a result, water that enters the excavations will likely become trapped or "perched". It will likely be possible to remove and control water entering the excavation using normal sump pumping techniques due to the low permeable characteristics of the predominant clayey soils encountered at the boring location. However, lenses and layers of sand may be encountered, requiring more extensive dewatering techniques depending upon the subsurface water levels present during construction and the required excavation depths. Any water that accumulates in the bottom of the excavation should be immediately removed and surface drainage away from the excavation should be provided during construction.

Disturbance of Soils

The predominant clayey soils encountered at the boring location are susceptible to disturbance and can experience strength loss caused by construction traffic and/or additional moisture. Precautions will be required during earthwork activities in order to reduce the risk of soil disturbance. The excavation should be performed with a track-driven excavator (backhoe) having a smooth cutting edge on the bucket to minimize soil disturbance. If the soils become disturbed, additional excavation and filling will be required.

Cold Weather Precautions

If site preparation and construction is anticipated during cold weather, we recommend all foundations, slabs and other improvements that may be affected by frost movements be insulated from frost penetration during freezing temperatures. If filling is performed during freezing

temperatures, all frozen soils, snow and ice should be removed from the areas to be filled prior to placing the new fill. The new fill should not be allowed to freeze during transit, placement and compaction. Concrete should not be placed on frozen subgrades. Frost should not be allowed to penetrate below the footings. If floor slab subgrades freeze, we recommend the frozen soils be removed and replaced, or completely thawed, prior to placement of the floor slab. The subgrade soils will likely require reworking and recompacting due to the loss of density caused by the freeze/thaw process.

Excavation Sideslopes

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.

Observations and Testing

This report was prepared using a limited amount of information for the project and a number of assumptions were necessary to help us develop our conclusions and recommendations. It is recommended that our firm be retained to review the geotechnical aspects of the final design plans and specifications to check that our recommendations have been properly incorporated into the design documents.

The recommendations submitted in this report have been made based on the subsurface conditions encountered at the test boring locations. It is possible that there are subsurface conditions at the site that are different from those represented by the borings. As a result, on-site observation during construction is considered integral to the successful implementation of the recommendations. We believe that qualified field personnel need to be on-site at the following times to observe the site conditions and effectiveness of the construction.

Excavation

We recommend that a geotechnical engineer or geotechnical engineering technician working under the direct supervision of a geotechnical engineer observe all excavations for foundations, slabs and pavements. These observations are recommended to determine if the exposed soils are similar to those encountered at the boring locations, if unsuitable soils have been adequately removed and if the exposed soils are suitable for support of the proposed construction. These observations should be performed prior to placement of fill or foundations.

Testing

After the subgrade is observed by a geotechnical engineer/technician and approved, we recommend a representative number of compaction tests be taken during the placement of the structural fill and backfill placed below foundations, slabs and pavements, beside foundation walls and behind retaining walls. The tests should be performed to determine if the required compaction has been achieved. As a general guideline, we recommend at least one test be taken for every 2,000 square feet of structural fill placed in building and paved areas, at least one test for every 75 to 100 feet in trench fill, and for every 2-foot thickness of fill or backfill placed. The actual number of tests should be left to the discretion of the geotechnical engineer. Samples of proposed fill and backfill materials should be submitted to our laboratory for testing to determine their compliance with our recommendations and project specifications.

SUBSURFACE EXPLORATION PROCEDURES

Test Borings

We performed one (1) standard penetration test (SPT) boring on December 28, 2010 with a truck rig equipped with hollow-stem auger. Soil sampling was performed in accordance with the procedures described in ASTM:D1586. Using this procedure, a 2-inch O.D. split barrel sampler is driven into the soil by a 140-pound weight falling 30 inches. After an initial set of 6 inches, the number of blows required to drive the sampler an additional 12 inches is known as the penetration resistance, or "N" value. The "N" value is an index of the relative density of

cohesionless soils and the consistency of cohesive soils. In addition, thin walled tube samples were obtained according to ASTM:D1587, where indicated by the appropriate symbol on the boring log.

The boring was backfilled with on-site materials and some settlement of these materials can be expected to occur. Final closure of the hole is the responsibility of the client or property owner.

The soil samples collected from the boring location will be retained in our office for a period of one month after the date of this report and will then be discarded unless we are notified otherwise.

Soil Classification

As the samples were obtained in the field, they were visually and manually classified by the crew chief according to ASTM:D2488. Representative portions of all samples were then sealed and returned to the laboratory for further examination and for verification of the field classification. In addition, selected samples were then submitted to a program of laboratory tests. Where laboratory classification tests (sieve analysis and Atterberg limits) have been performed, classifications according to ASTM:D2487 are possible. A log of the boring indicating the depth and identification of the various strata, the "N" value, the laboratory test data, water level information and pertinent information regarding the method of maintaining and advancing the drill holes is also attached in Appendix A. Charts illustrating the soil classification procedures, the descriptive terminology and the symbols used on the boring log are also attached in Appendix A.

Water Level Measurements

We performed measurements to record groundwater levels at the boring location at the time the boring was completed. The groundwater level measurements are shown on the bottom of the boring log. The water levels shown on the boring log may not be an accurate indication of the current level or lack of subsurface groundwater. A long period of time is generally required for

subsurface water to stabilize in the impervious soils encountered at the boring location. Long term water level monitoring was not included in our scope of work.

We expect subsurface groundwater levels to fluctuate seasonally and yearly from the groundwater readings recorded at the boring. Fluctuations occur due to varying seasonal and yearly rainfall amounts and snowmelt, as well as other factors. It is possible that the subsurface groundwater levels during or after construction could be significantly different than the time the boring was performed.

Laboratory Tests

We performed laboratory tests on selected samples to aid in determining the index and strength properties of the soils. The index tests consisted of moisture content, dry density and Atterberg limits. The strength tests consisted of unconfined compressive strength. The laboratory tests were performed in accordance with the appropriate ASTM procedures. The results of the laboratory tests are shown on the boring log opposite the samples upon which the tests were performed.

LIMITATIONS

The recommendations and professional opinions submitted in this report were based upon the data obtained through the sampling and testing program at the boring locations. We wish to point out that because no exploration program can totally reveal the exact subsurface conditions for the entire site, conditions between borings and between samples and at other times may differ from those described in our report. Our exploration program identified subsurface conditions only at those points where samples were retrieved or where water was observed. It is not standard engineering practice to continuously retrieve samples for the full depth of the borings. Therefore, strata boundaries and thicknesses must be inferred to some extent. Additionally, some soils layers present in the ground may not be observed between sampling intervals. If the subsurface conditions encountered at the time of construction differ from those represented by our borings, it is necessary to contact us so that our recommendations can be reviewed. The

variations may result in altering our conclusions or recommendations regarding site preparation or construction procedures, thus, potentially affecting construction costs.

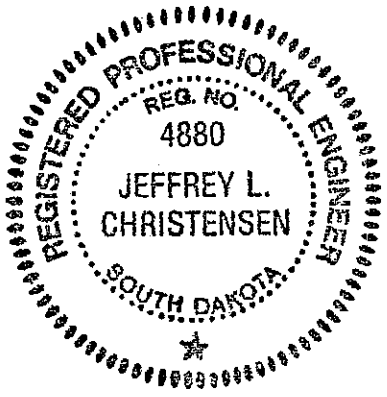
This report is for the exclusive use of the addressee and its representatives for the use in design of the proposed project described herein and preparation of construction documents. Without written approval, we assume no responsibility to other parties regarding this report. Our conclusions, opinions and recommendations may not be appropriate for other parties or projects.

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.

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

Jeff Christensen, PE
Geotechnical Manager



Appendices

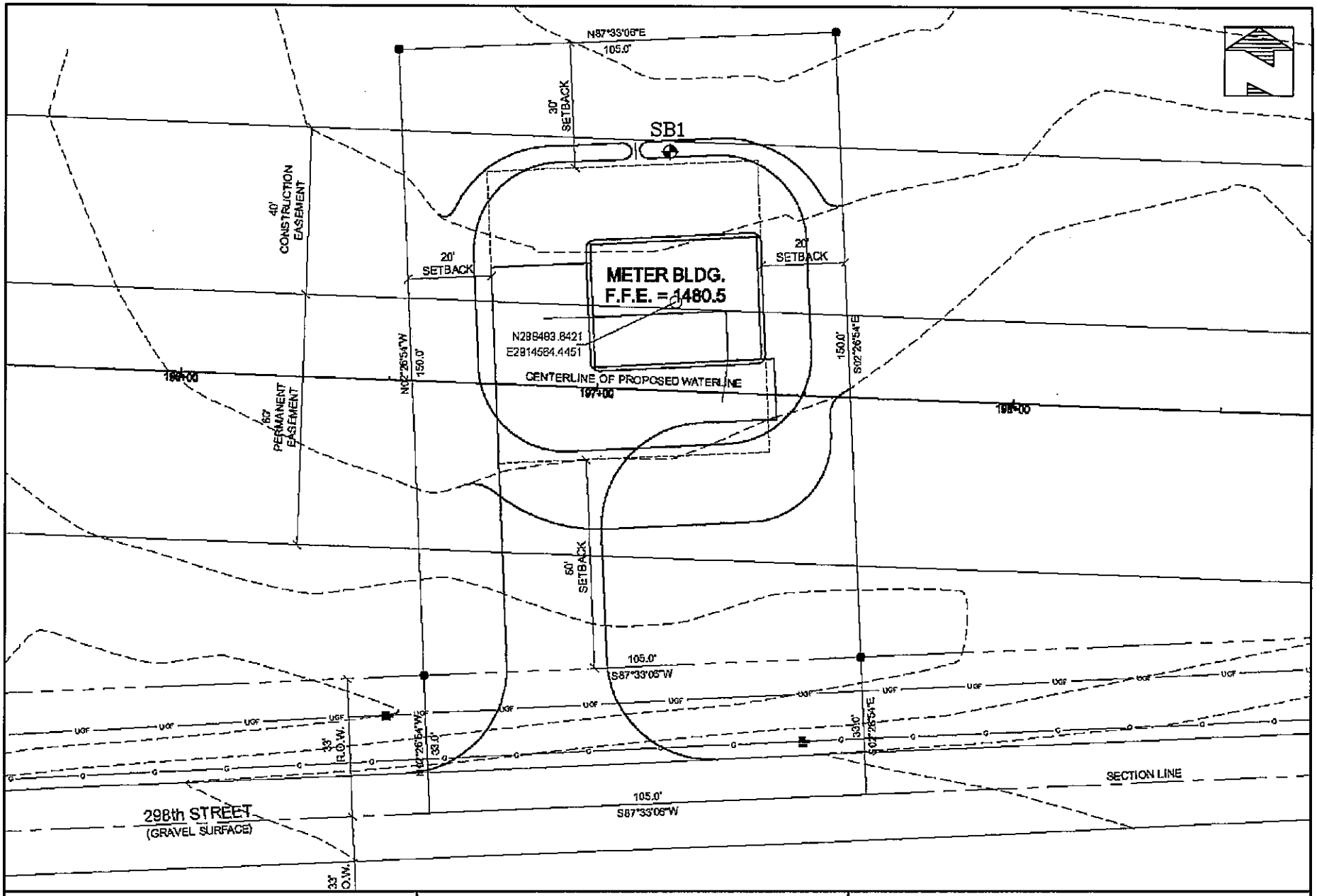


FIGURE 1
PROPOSED METER BUILDING
SEGMENT 11
LEWIS & CLARK REGIONAL WATER SYSTEM
NEAR BERESFORD, SD.

ACAD\GEOTEK\JEFF\10-F07

PROJECT#: 10-F07

DRAWN BY: SCS CHECKED BY: JC

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **10-F07** BORING NO. **1 (1 of 1)**

PROJECT **Proposed Meter Building, Segment 11, Lewis & Clark Regional Water System, Near Beresford, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	LEAN CLAY: dark brown, frozen to moist, (CL)	TOPSOIL			1	HSA					
2	**SANDY LEAN CLAY**: a trace of gravel, brown, moist, firm to very stiff, (CL)	GLACIAL TILL	8		2	SPT	19	106			
			9		3	SPT	23	102			
			14		4	SPT	27	98	46	18	3700
			16		5	SPT					
			18		6	SPT					
			22		7	SPT					
			19		8	SPT					
21	Bottom of borehole at 21 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-28-10	11:45 am	21	--	16	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

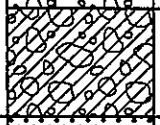
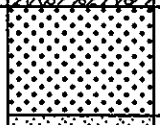
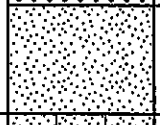
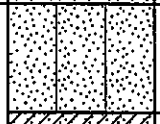
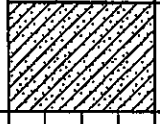
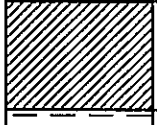
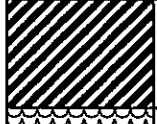
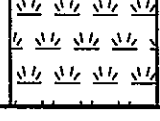
START 12-28-10 COMPLETE 12-28-10 11:30 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Gordy Hawkey

GEOTECHNICAL TEST BORING 10-F07.GPJ GEOTEKENG.GDT 1/10/11

SOIL CLASSIFICATION CHART

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

Symbol	Definition
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

Symbol	Definition
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

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

DESCRIPTIVE TERMINOLOGY

Term	Definition
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

PARTICLE SIZES

Term	Particle Size
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

GRAVEL PERCENTAGES

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