GEOTEK ENGINEERING
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October 26, 2018

Lake Area Technical Institute
1201 Arrow Avenue NE
PO Box 730
Watertown, South Dakota 57201

Attn: Shane Ortmeier

Subj: Geotechnical Exploration
Proposed Building Addition
Lake Area Technical Institute
1201 Arrow Avenue NE
Watertown, South Dakota
GeoTek #18-F49

This correspondence presents our written report of the geotechnical exploration program for the referenced project. Our work was performed in accordance with your authorization. We are transmitting an electronic copy of our report for your use. An additional copy of our report is also being sent 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.

Jared Haskins

Jared Haskins, PE
Geotechnical Manager

Cc: CO-OP Architecture, Attn: Josh Blohowiak

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GEOTECHNICAL EXPLORATION
PROPOSED BUILDING ADDITION
LAKE AREA TECHNICAL INSTITUTE
1201 ARROW AVENUE NE
WATERTOWN, SOUTH DAKOTA
GEOTEK #18-F49

INTRODUCTION

Project Information

This report presents the results of the recent geotechnical exploration program for the proposed building addition for Lake Area Technical Institute at 1201 Arrow Avenue NE in Watertown, South Dakota.

Scope of Services

Our work was performed in accordance with the authorization of Shane Ortmeier with Lake Area Technical Institute. The scope of work as presented in this report is limited to the following:

1. To perform six (6) standard penetration test (SPT) borings to gather data on the subsurface conditions within the footprint of the proposed building addition.

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

3. To prepare an engineering report that includes the results of the field and laboratory tests as well as our earthwork and foundation recommendations for design and construction.

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 & SUBSURFACE CONDITIONS

Site Location & Description

The site is located at 1201 Arrow Avenue NE in Watertown, South Dakota. The current site features within and near the area of the proposed building addition include the following: the existing building, a parking lot, sidewalks, vegetated areas and numerous trees. The building addition will be located on the west side of the existing building (west of 100 and 200 Buildings).

Ground Surface Elevations & Test Boring Locations

The ground surface elevations at the test boring locations were determined by using the finished floor of the existing building (door 1B) as a benchmark. An arbitrary elevation of 100.0 feet was used for the benchmark. Based on the benchmark datum, the ground surface elevations at the test boring locations varied from 95.1 feet at test boring 2 to 99.5 feet at test boring 6. A site map is attached at the conclusion of this report showing the relative location of the test borings.

Subsurface Conditions

Six (6) test borings were performed at the site on October 22, 2018. The subsurface conditions encountered at the test boring locations are illustrated by means of the boring logs included in Appendix A.

The subsurface conditions encountered at the test boring locations consisted of 1 ½ feet to 4 ½ feet of existing fill materials overlying glacial till soils. The glacial till soils extended to the termination depth of the test borings. The existing fill materials consisted of lean clay soils. The glacial till soils consisted of lean clay with sand soils and sandy lean clay soils.

The consistency or relative density of the soils is indicated by the standard penetration resistance (“N”) values as shown on the boring log. A description of the soil consistency or 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 at the site may differ from those found at our test boring locations. If different conditions are encountered during construction, then it is important that you contact us so that our recommendations can be reviewed.

Water Levels

Measurements to record the groundwater levels were made at the test boring locations. The time and level of the groundwater readings are recorded on the boring logs. Groundwater did not enter the boreholes at the test boring locations at the time of our measurements.

The water levels indicated on the boring logs 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.

ENGINEERING REVIEW & RECOMMENDATIONS

Project Design Data

We understand that the project will consist of constructing a building addition for Lake Area Technical Institute in Watertown, South Dakota. The building addition will be a single-story slab-on-grade structure with a footprint area of approximately 24,000 square feet. We assume that the finished floor of the building addition will match the finished floor of the existing building. We also assume that foundation support for the building addition will be provided by perimeter footings resting below frost depth and interior footings resting at or slightly below the floor slab. We understand that maximum wall loads will be on the order of 4 kips per lineal foot (klf) and maximum column loads will be on the order of 100 kips. Light floor loads are expected for the building addition.

The information/assumptions detailed in the project design data section are important factors in our review and recommendations. If there are any corrections or additions to the information detailed in this section, then it is important that you contact us so that we can review our recommendations with regards to the revised plans.

Discussion

It is our opinion that a spread footing foundation system can be used for support of the proposed building addition after the recommended site preparation has been performed.

In our opinion, the existing fill materials are not suitable for support of the footings of the building addition. With that said, we recommend that the footings of the building addition be supported by the glacial till soils. Regarding the floor slab, it is our opinion that the existing fill materials could be used for indirect support of the floor slab.

Site Preparation – Footing Areas

The site preparation in the footing areas (interior and exterior) of the building addition should consist of removing the existing fill materials in order to expose the glacial till soils. If the excavation required to expose the glacial till soils extends below the bottom-of-footing elevation, then we recommend placing and compacting granular structural fill up to the bottom-of-footing elevation. Please refer to Table 1 for a summary of the anticipated minimum excavation depths to remove the unsuitable soils encountered at the test boring locations. The depth of the excavations will likely vary between the test boring locations.

Table 1. Estimated Excavation Depths – Footing Areas (Interior & Exterior)

Test Boring Number	Ground Surface Elevation, ft	Anticipated Excavation Depth, ft	Approximate Excavation Elevation, ft
1	99.2	4 ½	94.7
2	95.1	2	93.1
3	97.3	2	95.3
4	95.7	2	93.7
5	98.5	2	96.5
6	99.5	1 ½	98.0

Site Preparation – Floor Slab Areas

The site preparation in the floor slab areas of the building addition should consist of removing any vegetation and highly organic soils or excavating to a minimum depth of 12 inches below the bottom-of-floor elevation, whichever is greater. Following the removals, we recommend

compacting the exposed subgrade with a large sheepsfoot roller. The vibrator should be turned off next to the existing building to minimize disturbance to the existing building. We also recommend that observations and testing be performed on the materials exposed at the bottom of the excavation. Unstable areas or areas having low density will likely require further excavation. Some unsuitable materials may be encountered adjacent to the existing building (existing exterior foundation wall backfill). Once the subgrade is approved, granular structural fill should be placed and compacted up to the design grade. Based on the existing surface grades, the thickness of the granular structural fill beneath the floor slab will exceed 12 inches in some areas of the building addition. We recommend that the final 6 inches of granular structural fill beneath the floor slab consist of select granular fill.

Foundation Loads & Settlement

If our recommendations are followed during site preparations, then it is our opinion that the footings of the building addition can be sized for a net allowable soil bearing pressure of up to 4,000 pounds per square foot (psf). With the expected loads, net allowable soil bearing pressure and our site preparation recommendations, total settlement of the footings should be less than 1 inch and differential settlement should be less than ½ inch over 50 feet. Unknown soil conditions at the site that are different from those depicted at the test boring locations could increase the amount of expected settlement. At least a portion of the anticipated total settlement may appear as differential with respect to the existing building. Suitable expansion or control joints should be provided between the existing building and building addition to allow for the expected movement.

Excavation, Temporary Shoring & Helical Piers

All excavations within the footprint of the building addition should be performed with a track backhoe with a smooth edge bucket. The subgrade within the footprint of the building addition should not be exposed to heavy construction traffic from rubber tire vehicles.

If an excavation adjacent to the existing structure is to extend below the existing foundations, then we recommend that the excavation extend 1 foot to 2 feet outside the bottom of the existing foundation and then extend downward and outward at a slope no steeper than 1:1 (horizontal to vertical). This may not apply if caving soils are encountered beneath the existing foundations. In

this case, temporary shoring or underpinning may be needed. Helical piers may be needed if an excavation for a footing cannot be safely performed next to the existing structure. Deeper test borings would likely be needed for the design of the helical piers.

We recommend extreme caution be exercised while excavating adjacent to any existing structure to prevent undermining of the existing foundations. The excavations adjacent to any existing structure should be performed in small sections such that only a limited area of the foundation soils supporting the existing structure is exposed for a short period of time.

Groundwater & Saturated Soils

If groundwater or saturated soils are encountered at the bottom of an excavation, then we recommend placing a layer (6 inches to 12 inches) of drainage rock at the bottom of the excavation prior to the placement of the granular structural fill, select granular fill or footings.

Laterally Oversized Excavations

Where granular structural fill or drainage rock is needed below the footings, the bottom of the excavation should be laterally oversized 1 foot beyond the edges of the footings for each vertical foot of granular structural fill or drainage rock required below the footings (1 horizontal : 1 vertical).

Floor Slabs & Soil Modulus of Subgrade Reaction

If our recommendations are followed during site preparations, then it is our opinion that the floor slab of the building addition can be designed using a soil modulus of subgrade reaction (k value) of 100 psi/inch.

Retaining Walls

We recommend backfilling any retaining walls with free-draining sand. The active lateral earth pressures may be employed only if movement of the walls can be tolerated to reach the active state. A horizontal movement of approximately 1/500 of the height of the wall would be required to develop the active state for granular soils. If the above movement cannot be tolerated, then we recommend using the at-rest lateral earth pressures to design the walls. The zone of the sand

backfill should extend a minimum of 2 feet outside the bottom of the foundation and then extend upward and outward at a slope no steeper than 1:1 (horizontal to vertical). Also, we recommend capping the sand backfill section with 1 foot to 2 feet of clayey soil in areas that will not have asphalt or concrete surfacing to minimize infiltration of surface waters. Table 2 shows the equivalent fluid unit weight values for the various soil types anticipated for this project.

Table 2. Equivalent Fluid Unit Weight Values

Soil Type	At-Rest, pcf		Active, pcf		Passive, pcf	
	Drained	Submerged	Drained	Submerged	Drained	Submerged
Clay	-	-	-	-	220*	115*
Free-Draining Sand (SP)	50	90	35	80	460*	230*

*Value below frost depth – 0 pcf above frost depth.

The passive resistance in front of a retaining wall should not be used in an analysis unless the wall extends well below the depth of frost penetration due to loss of strength upon thawing. In addition, development of passive lateral earth pressure in the soil in front of a wall requires a relatively large rotation or outward displacement of the wall. Therefore, we do not recommend using passive resistance in front of the wall for the analysis.

During backfill operations, bracing and/or shoring of the walls may be needed. Only hand-operated compaction equipment should be used directly adjacent to the walls.

Coefficient of Friction

It is our opinion that a friction factor of 0.35 can be used between the natural clay soils and the bottom of the concrete. A friction factor of 0.45 can be used between the granular structural fill or drainage rock and the bottom of the concrete. The friction values are considered ultimate values. We recommend applying a theoretical safety factor of at least 2.0.

Perimeter Drain Tile Recommendations

Since the building addition will be slab-on-grade, it is our opinion that drain tile is not needed along the perimeter of the building addition. However, if portions of the building addition are below grade, then drain tile should be installed.

Seismic Site Classification

Based on the test borings and the 2012 International Building Code (IBC), it is our opinion that the site, as a whole, corresponds to a Site Class D (stiff soil). Also, the ground acceleration values are as follows: S_S = 0.081 g, S_1 = 0.027 g, S_{MS} = 0.129 g, S_{M1} = 0.065 g, S_{DS} = 0.086 g, S_{D1} = 0.043 g. Therefore, the seismic design category is "A". The ground acceleration values are also based on the 2012 IBC with Risk Category I/II/III. If needed, we can provide ground acceleration values for a different design code.

Frost Protection – Footings

We recommend that 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 the finished exterior grade. Interior footings in heated buildings can be placed beneath the floor slab. Footings for unheated structures should be placed such that the bottom of the footing is a minimum of 5 feet below the finished exterior grade.

Frost Protection – Surface Improvements

It is our opinion that the on-site clay soils have a moderate frost susceptibility. Surface improvements, such as pavements and sidewalks, constructed on these clay soils are potentially subject to both cosmetic and structural damage caused by frost heaving. We anticipate the heave for the on-site clay soils to potentially be on the order of 0.1 inch to 0.2 inch for each foot of frost penetration within the soil, which would translate to ½ inch to 1 inch of total movement. The heave could be even greater if free water is available, resulting in a buildup of ice lenses. The surface improvements should be designed to accommodate the potential frost movements, or non-frost susceptible drainage fill should be placed beneath the surface improvements. If movement cannot be tolerated, then we recommend placing non-frost susceptible drainage fill beneath the surface improvements. The non-frost susceptible drainage fill should extend to a depth of 4 feet below the finished exterior grade. If it is desired to reduce (but not eliminate) the amount of potential frost heave, we recommend consideration be given to placing approximately 2 feet of non-frost susceptible drainage fill beneath the surface improvements.

Material Types & Compaction Levels

Granular Structural Fill – The granular structural fill should consist of a pit-run or processed sand or gravel having a maximum particle size of 3 inches with less than 15 percent by weight passing the #200 sieve. The granular structural fill should be placed in lifts of up to 1 foot in thickness.

Select Granular Fill – The select granular fill should consist of a medium to coarse grained, free-draining sand or rock having a maximum particle size of 1 inch with less than 5 percent by weight passing the #200 sieve. The select granular fill should be placed in lifts of up to 1 foot in thickness.

Drainage Rock – The drainage rock should be crushed, washed and meet the gradation specifications shown in Table 3.

Table 3. Drainage Rock Gradation Specifications

Sieve Size	Percent Passing
1 ½-inch	100
1-inch	70 – 90
¾-inch	25 – 50
3/8-inch	0 – 5

Free-Draining Sand – The free-draining sand should have a maximum particle size of 1 inch with less than 5 percent by weight passing the #200 sieve. The free-draining sand should be placed in lifts of up to 1 foot in thickness.

Non-Frost Susceptible Drainage Fill – The non-frost susceptible drainage fill should have a maximum particle size of 1 inch, less than 40 percent by weight passing the #40 sieve and less than 5 percent by weight passing the #200 sieve. The non-frost susceptible drainage fill should be placed in lifts of up to 1 foot in thickness.

Exterior Foundation Wall Backfill for Slab-on-Grade Structures – We recommend that either clay or granular soils be used. Debris, organic material or over-sized material should not be used as backfill. If granular soils are used in areas that will not have asphalt or concrete surfacing, then

we recommend capping the granular soils with approximately 1 foot of clay soils to minimize infiltration of surface water. The exterior backfill should be placed in lifts of up to 1 foot in thickness. The majority of the on-site soils can be used as backfill.

Recommended Compaction Levels – The recommended compaction levels listed in Table 4 are based on a material's maximum dry density value, as determined by a standard Proctor (ASTM: D698) test.

Table 4. Recommended Compaction Levels

Placement Location	Compaction Specifications
Below Footings	98%
Below Floor Slabs	95%
Exterior Foundation Wall Backfill for Slab-on-Grade Structures	95%
Behind Retaining Walls	95% - 98%
Non-Structural Areas	90%

Notes: Compaction specifications are not applicable with the drainage rock.

Recommended Moisture Levels – The moisture content of the clay backfill materials, when used as backfill around the exterior of a foundation should be maintained within a range of plus 1 percent to minus 4 percent of the materials' optimum moisture content. When the clay backfill materials are used below a vehicle area, or as site grading, the materials' moisture content should be maintained within a range of minus 1 percent to minus 4 percent of the materials' optimum moisture content. The optimum moisture content should be determined using a standard Proctor (ASTM: D698) test.

The moisture content of the granular backfill materials should be maintained at a level that will be conducive for vibratory compaction.

Drainage

Proper drainage should be maintained during and after construction. The general site grading should direct surface run-off waters away from the excavations. Water which accumulates in the excavations should be removed in a timely manner.

Finished grades around the perimeter of the structure should be sloped such that positive drainage away from the structure is provided. Also, a system to collect and channel roof run-off waters away from the structure is suggested.

CONSTRUCTION CONSIDERATIONS

Groundwater & Surface Water

Water may enter the excavations due to subsurface water, precipitation or surface run off. Any water that accumulates in the bottom of the excavations should be immediately removed and surface drainage away from the excavations should be provided during construction.

Disturbance of Soils

The soils encountered at the test 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.

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

The 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 & 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 test 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 test 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 (1) test be taken for every 2,000 square feet of structural fill placed in building and pavement areas, at least one (1) test for every 75 feet 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 six (6) standard penetration test (SPT) borings on October 22, 2018 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 logs. In addition, we also performed one (1) test boring using hand-operated equipment.

The test borings were backfilled with on-site materials and some settlement of these materials can be expected to occur. Final closure of the holes is the responsibility of the client or property owner.

The soil samples collected from the test boring locations will be retained in our office for a period of one (1) 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, select 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. Logs of the test borings 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 are also attached in Appendix A. Charts illustrating the soil classification procedures, the descriptive terminology and the symbols used on the boring logs are also attached in Appendix A.

Water Level Measurements

Subsurface groundwater levels should be expected to fluctuate seasonally and yearly from the groundwater readings recorded at the test boring locations. 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 test borings were performed.

Laboratory Tests

Laboratory tests were performed on select 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 (liquid and plastic 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 logs opposite the samples upon which the tests were performed or on the data sheets included in the Appendix.

LIMITATIONS

The recommendations and professional opinions submitted in this report were based upon the data obtained through the sampling and testing program at the test 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 test 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 test 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.

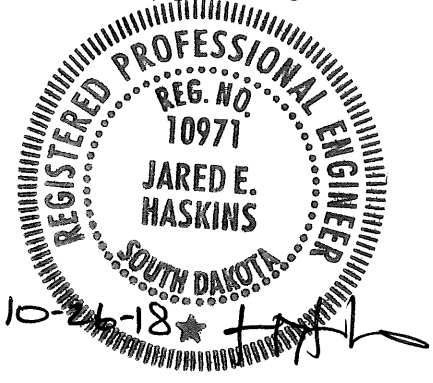
This report is for the exclusive use of the addressee and its representatives for use in design of the proposed project described herein and preparation of construction documents. Without written approval, we assume no responsibility to other parties regarding this report. Our conclusions, opinions and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

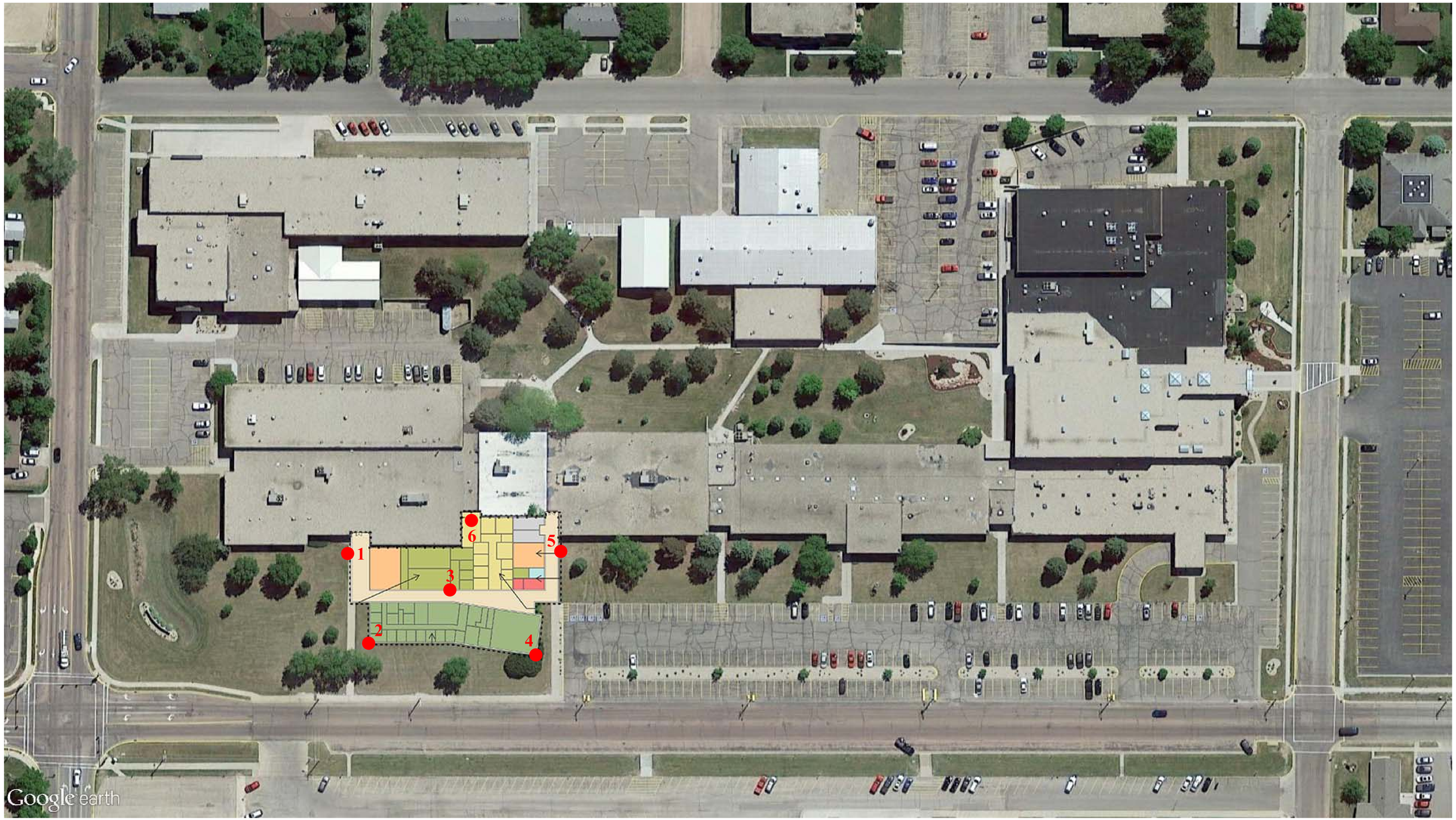
STANDARD OF CARE

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.

Jared Haskins, PE
Geotechnical Manager





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SOIL BORING LOCATIONS
10.11.2018

HEALTH SCIENCES
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-F49** BORING NO. **1 (1 of 1)**

PROJECT **Proposed Building Addition, Lake Area Technical Institute, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 99.2 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a little gravel, dark brown and brown, moist	FILL			1	HSA					
			17		2	SPT	13	112			
4½	**SANDY LEAN CLAY**: a little gravel, mottled brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	18		3	SPT					
			13		4	SPT	14	120			
			16		5	SPT					
			18		6	SPT					
			15		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

START 10-22-18 COMPLETE 10-22-18 1:13 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
10-22-18	1:13 pm	16	--	14	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 18-F49.GPJ GEOTEKENG.GDT 10/26/18

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-F49** BORING NO. **2 (1 of 1)**

PROJECT **Proposed Building Addition, Lake Area Technical Institute, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 95.1 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a little gravel, dark brown and brown, moist	FILL			1	HSA					
2	**SANDY LEAN CLAY**: a little gravel, mottled brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	14		2	SPT	10	123	36	15	
			18		3	SPT	13	121			8300
			15		4	SPT					
			19		5	SPT					
			18		6	SPT					
			17		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

START 10-22-18 COMPLETE 10-22-18 2:12 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
10-22-18	2:12 pm	16	--	14	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 18-F49.GPJ GEOTEKENG.GDT 10/26/18

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-F49** BORING NO. **3 (1 of 1)**

PROJECT **Proposed Building Addition, Lake Area Technical Institute, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 97.3 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a little gravel, dark brown and brown, moist	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	16		2	SPT	11				
			17		3	SPT					
			16		4	SPT					
			14		5	SPT					
			13		6	SPT					
			15		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
10-22-18	3:00 pm	16	--	14	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 10-22-18 COMPLETE 10-22-18 3:00 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 18-F49.GPJ GEOTEKENG.GDT 10/26/18

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
www@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-F49** BORING NO. **4 (1 of 1)**

PROJECT **Proposed Building Addition, Lake Area Technical Institute, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 95.7 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a little gravel, dark brown, moist	FILL			1	HSA					
2	**SANDY LEAN CLAY**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	13		2	SPT					
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	16		3	SPT	15	120			
			14		4	SPT	15	118			
			17		5	SPT					
			16		6	SPT					
			16		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
10-22-18	3:43 pm	16	--	14	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 10-22-18 COMPLETE 10-22-18 3:43 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 18-F49.GPJ GEOTEKENG.GDT 10/26/18

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-F49** BORING NO. **5 (1 of 1)**

PROJECT **Proposed Building Addition, Lake Area Technical Institute, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 98.5 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a little gravel, dark brown, moist	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	13		2	SPT					
			15		3	SPT	16				
			16		4	SPT	17	115	36	14	
			17		5	SPT					
			17		6	SPT					
			17		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

START 10-22-18 COMPLETE 10-22-18 4:22 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
10-22-18	4:21 pm	16	--	14	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 18-F49.GPJ GEOTEKENG.GDT 10/26/18

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-F49** BORING NO. **6 (1 of 1)**

PROJECT **Proposed Building Addition, Lake Area Technical Institute, Watertown, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 99.5 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a little gravel, dark brown, moist	FILL			1	HSA					
1½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	15		2	SPT	14				
			13		3	SPT					
			13		4	SPT					
			17		5	SPT					
			17		6	SPT					
			17		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
10-22-18	5:12 pm	16	--	14	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

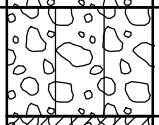
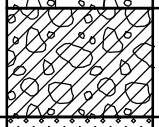
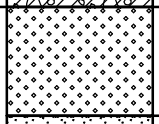
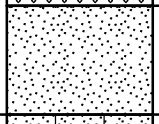
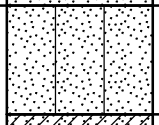
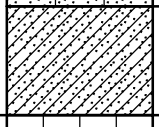
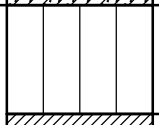
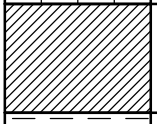
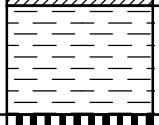
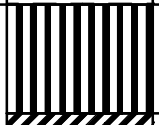
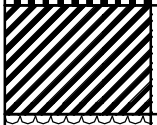
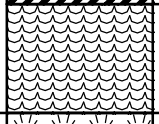
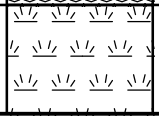
START 10-22-18 COMPLETE 10-22-18 5:13 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 18-F49.GPJ GEOTEKENG.GDT 10/26/18

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
	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		Consistency
Term	N-Value	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

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

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

GRAVEL PERCENTAGES

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