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January 21, 2019

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Attn: Pat Carey, PE

Subj: Geotechnical Exploration
Proposed Street & Utility Improvements
Various Locations
Madison, South Dakota
GeoTek #18-H78

This correspondence presents our written report of the geotechnical exploration program for the referenced project. Our work was performed in accordance with the authorization of Gregg Jorgenson with Banner Associates, Inc. We are transmitting an electronic copy of our report for your use.

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.

Brennen Ahlers

Brennen Ahlers, PE
Project Manager

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GEOTECHNICAL EXPLORATION
PROPOSED STREET & UTILITY IMPROVEMENTS
VARIOUS LOCATIONS
MADISON, SOUTH DAKOTA
GEOTEK #18-H78

INTRODUCTION

Project Information

This report presents the results of the recent geotechnical exploration program for the proposed street and utility improvements at various locations in Madison, South Dakota.

Scope of Services

Our work was performed in accordance with the authorization of Gregg Jorgenson with the Banner Associates, Inc. The scope of work as presented in this report is limited to the following:

1. To perform 50 standard penetration test (SPT) borings to gather data on the subsurface conditions at the project areas.

2. To perform laboratory tests that include moisture content, dry density, sieve analysis (#200 sieve wash) and standard Proctor.

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

    - Existing pavement section;
    - Underground utility excavation and backfilling;
    - Subgrade strength and potential corrective measures;
    - Pavement section thicknesses;
    - Special geotechnical conditions that may impact the constructability and final performance of the project;
    - Quality control observation 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 project areas or to characterize the project areas relative to wetlands status.

SITE & SUBSURFACE CONDITIONS

Project Areas & Description

The existing streets are within the northern portion of Madison, South Dakota. The streets are currently asphalt surfaced.

Ground Surface Elevations & Test Boring Locations

We did not determine the ground surface elevations at the test boring locations. Test boring location maps (Figures 1 and 2) are attached showing the relative location of the test borings.

Existing Pavement Conditions

Table 1 summarizes the thickness of the existing asphalt pavement and gravel base encountered at the respective test boring locations. It should be noted that concrete was encountered beneath the asphalt at test borings 3 and 4.

Table 1. Thickness of the Existing Asphalt Pavement

Test Boring & Location	Asphalt Pavement, in	Gravel Base, in.	Test Boring & Location	Asphalt Pavement, in	Gravel Base, in.
1 - 9th St.	4	6	26 - 3rd St.	5 ½	6
2 - 9th St.	4	6	27 - Catherine Ave.	6	1
3 - 8th St.	3	*	28 - Catherine Ave.	6	0
4 - 8th St.	3	*	29 - Catherine Ave.	3 ½	8 ½
5 - 8th St.	3 ½	8	30 - Catherine Ave.	3 ½	6
6 - 7th St.	3	8	31 - Olive Ave.	5	7
7 - Lincoln Ave.	3	8 ½	32 - Olive Ave.	5	5
8 - Lincoln Ave.	3 ½	9	33 - Olive Ave.	4	9
9 - Summit Ave.	3	7	34 - Olive Ave.	4	6
10 - Summit Ave.	3 ½	9	35 - Olive Ave.	4 ½	8
11 - Summit Ave.	3	8 ½	36 - West Ave.	4	4
12 - Prairie Ave.	5	7	37 - West Ave.	4 ½	5
13 - Prairie Ave.	3 ½	6 ½	38 - West Ave.	4 ½	4
14 - Prairie Ave.	3 ½	7	39 - Chicago Ave.	3	7
15 - Prairie Ave.	3 ½	8	40 - Chicago Ave.	3	8
16 - Prairie Ave.	4	8	41 - Chicago Ave.	3	4

*5 inches of concrete was encountered beneath the asphalt with no gravel base beneath the concrete.

Table 1 Cont. Thickness of the Existing Asphalt Pavement

Test Boring & Location	Asphalt Pavement, in	Gravel Base, in.	Test Boring & Location	Asphalt Pavement, in	Gravel Base, in.
17 - 7th St.	5	3	42 - Chicago Ave.	3	4
18 - 6th St.	4	5	43 - Chicago Ave.	3	4
19 - 5th St.	3 ½	24	44 - Liberty Ave.	6	0
20 - 5th St.	3	10	45 - Liberty Ave.	5 ½	3 ½
21 - 5th St.	3	10	46 - Liberty Ave.	3	9
22 - 4th St.	4	5 ½	47 - Liberty Ave.	2	7
23 - 4th St.	3	5	48 - Liberty Ave.	5	6
24 - 4th St.	4 ½	2	49 - Union Ave.	5 ½	0
25 - 3rd St.	5	7	50 - Union Ave.	3 ½	6

*5 inches of concrete was encountered beneath the asphalt with no gravel base beneath the concrete.

Subsurface Conditions

Fifty (50) test borings were performed at the project areas from December 10 to December 13, 2018. The subsurface conditions encountered at the test boring locations are illustrated by means of the boring logs included in Appendix A.

The subsurface soils encountered beneath the pavement and gravel base consisted of the following layers: existing fill materials, fine alluvium soils, mixed alluvium soils, coarse alluvium, glacial outwash soils and glacial till soils. The test borings indicated that frozen soils extended to a depth of approximately 1 ½ feet.

The consistency or 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 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 project areas 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 was measured at a depth of 9 feet at test boring 3. Groundwater did not enter the boreholes at the other test borings 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. A long period of time is generally required for subsurface water to stabilize in the impervious soils encountered at the boring locations. Long term groundwater monitoring was not included in our work scope.

ENGINEERING REVIEW & RECOMMENDATIONS

Project Design Data

We understand that the project will consist of improvements at various locations in Madison, South Dakota. The improvements will likely be performed in 2 phases. The street improvements will consist of reconstructing a new asphalt pavement section. The utility improvements will consist of mainly water main with the potential for some sanitary sewer improvements. Grade changes are expected to be minimal.

The information/assumptions detailed in the project design data section of the report 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.

Utility Excavations

Subgrade Soils

The subgrade soils anticipated at the invert depths for the underground utilities will mostly 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 proposed utilities, provided they are adequately dewatered, and are not disturbed by construction traffic. Localized areas of wet or soft soils may be encountered at the bottom of the trench excavations. These areas will require subexcavation and trench stabilization methods and materials. Appropriate bedding materials should be used for the utility pipes.

Water Control

Water may enter the trench excavations as a result of subsurface water, precipitation or surface run off. Dewatering procedures may be required in order to control and remove water entering the trench excavations. Where clay soils are encountered, it may be possible to remove and control water entering the excavations using normal sump pumping techniques. However, if waterbearing sand soils are encountered, then 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 measured at a depth of 9 feet at test boring 3. Any water that accumulates at the bottom of the excavations should be immediately removed and surface drainage away from the excavations should be provided during construction.

Trench Backfill

In our opinion, the majority of the existing fill materials, fine alluvium soils, mixed alluvium soils, coarse alluvium soils, glacial outwash soils and glacial till soils are suitable for use as trench backfill. Conversely, the topsoil materials and portions of the fine alluvium soils may not be suitable for use as trench backfill. These unsuitable materials consist of organic soils and soils having high moisture content levels (wet soils) such that the specified compaction level cannot be reasonably achieved. The topsoil materials and wet soils were encountered at test borings 2, 11, 13, 14, 16, 20, 23, 25, 29, 32, 33, 36, 38, 40, 45 and 48. The organic soils should be replaced with suitable material available at the project areas 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 project sites or with suitable off-site borrow soils.

OSHA Requirements

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.

Street Improvements

Subgrade Conditions

The upper portions of the subgrade soils encountered at the test boring locations consisted of existing fill materials, fine alluvium soils, mixed alluvium soils and glacial till soils. These subgrade soils have Unified Soils Classification System symbols of CH, CL and SC and AASHTO classifications of A-5, A-6 and A-7.

We have classified the subgrade conditions at each test boring location into 3 categories – favorable, fair and poor. Our opinions of the categories are based on the soils encountered at the test boring locations and the results of the field and laboratory tests and the estimated CBR values. The CBR value is a measure of the supporting value of the subgrade soils. The value can be determined from a soaked test or a unsoaked test. The value from a soaked test is used to simulate the worst conditions (wet periods of the year and the spring thaw), while the value from an unsoaked test is used to simulate normal field conditions (summer and fall). Values from a soaked test are much lower than values from an unsoaked test. The CBR values discussed in this report represent estimated values from soaked tests. The category at each test boring location is summarized in Table 2.

Table 2. Subgrade Conditions

Test Boring	Location	Subgrade Condition	Test Boring	Location	Subgrade Condition
1	9th Street	Fair	26	3rd Street	Poor
2	9th Street	Fair	27	Catherine Avenue	Fair
3	8th Street	Fair	28	Catherine Avenue	Poor
4	8th Street	Fair	29	Catherine Avenue	Poor

Note: The upper 1 ½ feet below the pavement was frozen at the time the test borings were performed.

Table 2 Cont. Subgrade Conditions

Test Boring	Location	Subgrade Condition	Test Boring	Location	Subgrade Condition
5	8th Street	Favorable	30	Catherine Avenue	Fair
6	7th Street	Favorable	31	Olive Avenue	Fair
7	Lincoln Avenue	Fair	32	Olive Avenue	Poor
8	Lincoln Avenue	Fair	33	Olive Avenue	Poor
9	Summit Avenue	Fair	34	Olive Avenue	Fair
10	Summit Avenue	Fair	35	Olive Avenue	Favorable
11	Summit Avenue	Poor	36	West Avenue	Poor
12	Prairie Avenue	Favorable	37	West Avenue	Fair
13	Prairie Avenue	Poor	38	West Avenue	Poor
14	Prairie Avenue	Poor	39	Chicago Avenue	Fair
15	Prairie Avenue	Fair	40	Chicago Avenue	Fair
16	Prairie Avenue	Poor	41	Chicago Avenue	Fair
17	7th Street	Fair	42	Chicago Avenue	Fair
18	6th Street	Fair	43	Chicago Avenue	Fair
19	5th Street	Fair	44	Liberty Avenue	Favorable
20	5th Street	Poor	45	Liberty Avenue	Poor
21	5th Street	Fair	46	Liberty Avenue	Fair
22	4th Street	Fair	47	Liberty Avenue	Fair
23	4th Street	Poor	48	Liberty Avenue	Poor
24	4th Street	Favorable	49	Union Avenue	Fair
25	3rd Street	Poor	50	Union Avenue	Fair

Note: The upper 1 ½ feet below the pavement was frozen at the time the test borings were performed

Poor Category – For a poor category, the subgrade soils within the upper 4 feet to 5 feet of the existing ground surface have high moisture content levels or consist of topsoil materials. We estimate CBR values of 1.0 to 2.0 for the subgrade soils encountered at these test borings. It is our opinion that subgrade reinforcement will likely be needed at and around these test borings. The subgrade reinforcement would consist of a geotextile stabilization fabric. Granular subbase may also be needed above the geotextile stabilization fabric if very poor subgrade conditions are encountered during construction

Fair Category – For a fair category, the subgrade soils within the upper 4 feet to 5 feet of the existing ground surface have moisture content levels that are slightly above a suitable level or consist of fine alluvium soils. We estimate CBR values of 2.0 to 3.0 for the subgrade soils

encountered at these test borings. Modest drying of the subgrade will likely be needed to provide stability at and around these test borings.

Favorable Category – For a favorable category, the subgrade soils within the upper 4 feet to 5 feet of the existing ground surface have moisture content levels that are within a suitable level. We estimate CBR values of 3.0 to 5.0 for the subgrade soils encountered at these test borings. Some localized scarification and drying may be needed at and around these test borings.

Stripping & Removals

We recommend removing the existing pavement section in order to achieve the design elevations. Low-ground-pressure construction equipment or excavators with smooth-edged buckets should be used for the stripping and removals in areas where soft/wet soils are present. In order to limit disturbance of the subgrade soils, it would be beneficial to keep the existing pavement section in place, in the areas outside of the utility trenches, until after the utility installation and backfill procedures have taken place; however, this may be difficult to perform or may not be practical during construction. We expect that the low-ground-pressure equipment will be needed in areas where fair or poor subgrade conditions are encountered.

Filling

If filling is required to achieve the design subgrade elevations, then the fill materials should consist of non-organic lean clay or sandy lean clay soils having a liquid limit less than 45 and a plasticity index between 15 and 35. The moisture content of the fill soils should be 1 percent to 4 percent below the optimum moisture content. The fill soils should be placed in compacted lifts having a maximum thickness of 6 inches. We recommend a minimum compaction specification of 95 percent of standard Proctor (ASTM:D698) for the fill soils.

Scarify & Compact

After the stripping and removals have been completed, we recommend that the exposed subgrade be scarified to a minimum depth of 8 inches and adjusted to a moisture level that is 1 percent to 4 percent below the optimum moisture content as determined by standard Proctor (ASTM:D698). The scarification should be performed by a disc harrow and not a road grader with teeth. The

moisture-conditioned soils should then be compacted. If shallow utilities are present and the scarification cannot be performed, then, at a minimum, we recommend that the exposed subgrade be compacted.

If it is determined during construction that the scarification and compaction will not improve a poor subgrade condition, then the scarification and compaction can be eliminated. This situation may occur in the areas where poor subgrade conditions are encountered (see Table 4). If the poor subgrade condition cannot be improved, then subgrade reinforcement will be needed.

Observations & Testing

Following scarification and compaction process, we recommend that observations and testing be performed to determine if the subgrade soils are unstable and if additional corrections or subgrade reinforcement is needed. A proofroll test should be performed with a truck weighing 20 tons to 30 tons. During the proofroll test, unstable areas in the subgrade should be delineated for stable areas. An unstable area would be considered a location with at least 1 inch of rutting or deflection. This would be considered a poor subgrade condition. If the unstable area has excessive deflection or rutting, then the subgrade may be considered to be in a very poor subgrade condition. Unstable areas will need additional corrections in order to provide a uniform and stable subgrade condition. It should be noted that areas of unstable subgrade may be encountered in areas where favorable or fair subgrade conditions exist. See the section entitled *Unstable Subgrade* for detailed information regarding the additional corrections and subgrade reinforcement.

Unstable Subgrade

Areas of unstable subgrade may be encountered during construction. The soils within the unstable area should be removed, and either moisture-conditioned and recompacted, or replaced with suitable subgrade fill. If the unstable area will not stabilize using this method, then alternative stabilization methods may be used such as a modified cross-section involving a geotextile fabric. The alternative stabilization method should be determined after observing the condition of the subgrade. As previously indicated, we expect that unstable subgrade will be encountered in areas where poor subgrade conditions exist and subgrade reinforcement will

likely be needed. It should be noted that an alternative stabilization method may be needed if very poor subgrade conditions are encountered. For very poor subgrade conditions, granular subbase will likely be needed with the geotextile fabric. The granular subbase should consist of crushed quartzite, recycled concrete or a crushed pit-run material meeting the gradation specifications shown in Table 3.

Table 3. Granular Subbase Gradation Specifications

Sieve Size	Percent Passing
4-inch	100
3-inch	70 – 90
2-inch	60 – 80
1-inch	40 – 70
#4	10 – 50
#40	5 – 20
#200	0 – 5

The granular subbase should be compacted to a minimum of 97 percent of standard Proctor density (ASTM:D698). It should be noted that compaction testing may not be practical for the granular subbase due to the large aggregate.

Asphalt Pavement Section Thicknesses

Traffic volumes were not provided for the streets; however, we assume low traffic volumes and that the traffic will consist of mostly automobiles with occasional garbage trucks and snow removal equipment.

Table 4 summarizes the recommended asphalt pavement section thicknesses based on the subsurface conditions and assumed traffic loads.

Table 4. Recommended Asphalt Pavement Section Thicknesses

Asphalt Pavement Thickness, in	Aggregate Base Course Thickness, in	Geotextile Fabric	Granular Subbase
4	8*	**	***

*May need to be increased if geotextile fabric is needed (4 inches of asphalt over a minimum of 12 inches of aggregate base course).
**May be needed if an area of unstable subgrade is encountered.
***May be needed if a very poor subgrade condition is encountered. The aggregate thickness base course can be reduced to 4 inches; however, the thickness of the granular subbase will need to be 10 inches or more (4 inches of asphalt, 4 inches of aggregate base course over minimum of 10 inches of granular subbase).

Regarding the geotextile fabric, we recommend using Mirafi HP 370, Propex Geotex 3x3 HF, Huesker Comtrac P 45/45 or an approved alternative that has similar strength properties as the products listed. We recommend that routine maintenance such as crack filling, localized patching and seal coating be performed. The design sections could be reduced if the owner is willing to assume additional maintenance costs or potentially shorter pavement life.

Asphalt & Aggregate Base Course Materials

The asphalt pavement should meet the requirements of sections 320 and 321 for Class G. We recommend that the aggregate base course materials meet the requirements of Sections 260 and 882 of the SDDOT Standard Specifications. The aggregate base course materials should be compacted to a minimum of 97 percent of standard Proctor (ASTM:D698).

Reclaimed Asphalt Materials & Existing Base Course Materials

If it is desired to use a mixture of reclaimed asphalt materials and the existing base course materials for the project, then it is our opinion that this recycled material should be blended with additional crushed aggregate base course material. Due to the varying thicknesses of the existing asphalt and base course, it is difficult to predict how much blending should occur. In addition, the blended material should have 100 percent by weight passing the 1-inch sieve and should meet the requirements of Sections 260 and 882 of the SDDOT Standard Specifications for aggregate base course.

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. Low-ground-pressure construction equipment or excavators with smooth-edged buckets should be used for the stripping and removals in areas where soft/wet soils are present. We expect that low-ground-pressure equipment will be needed.

Cold Weather Precautions

If site preparation and construction is anticipated during cold weather, then we recommend that all subgrades, 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, then 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 and asphalt should not be placed on frozen subgrades. If subgrades freeze, then we recommend that the frozen soils be removed and replaced, or completely thawed. 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 & 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 utilities, 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.

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 backfill placed below slabs and pavements. 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 10,000 square feet of embankment fill placed, at least one (1) test for every 500 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 drilled 50 SPT borings from December 10 to December 13, 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.

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.

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 borings. 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

We performed laboratory tests on select samples to aid in determining the index properties of the soils. The tests consisted of moisture content, dry density, sieve analysis (#200 sieve wash) and standard Proctor. 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 or on the attached data sheets.

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 test 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, then 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.

Brennen Ahlers, PE
Project Manager

REGISTERED PROFESSIONAL ENGINEER
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BRENNEN W. AHLERS
SOUTH DAKOTA
4/21/19

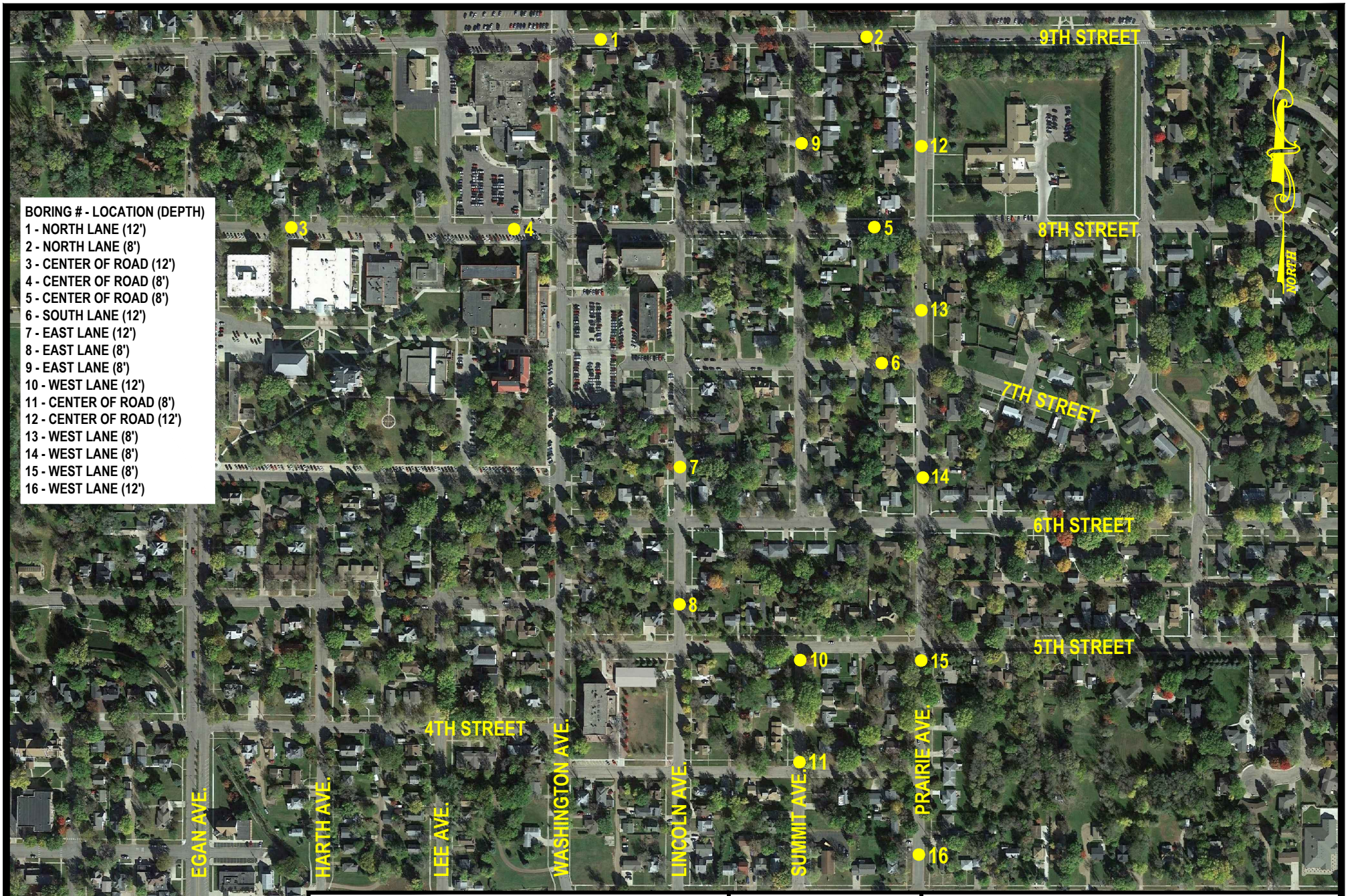

FIGURE 1
TEST BORING LOCATION MAP
TEST BORINGS 1 THROUGH 16
PROPOSED STREET & UTILITY IMPROVEMENTS
MADISON, SD

ACAD/GEOTEK/BRENNEN/18-H78

PROJECT#: 18-H78

DRAWN BY: PLH

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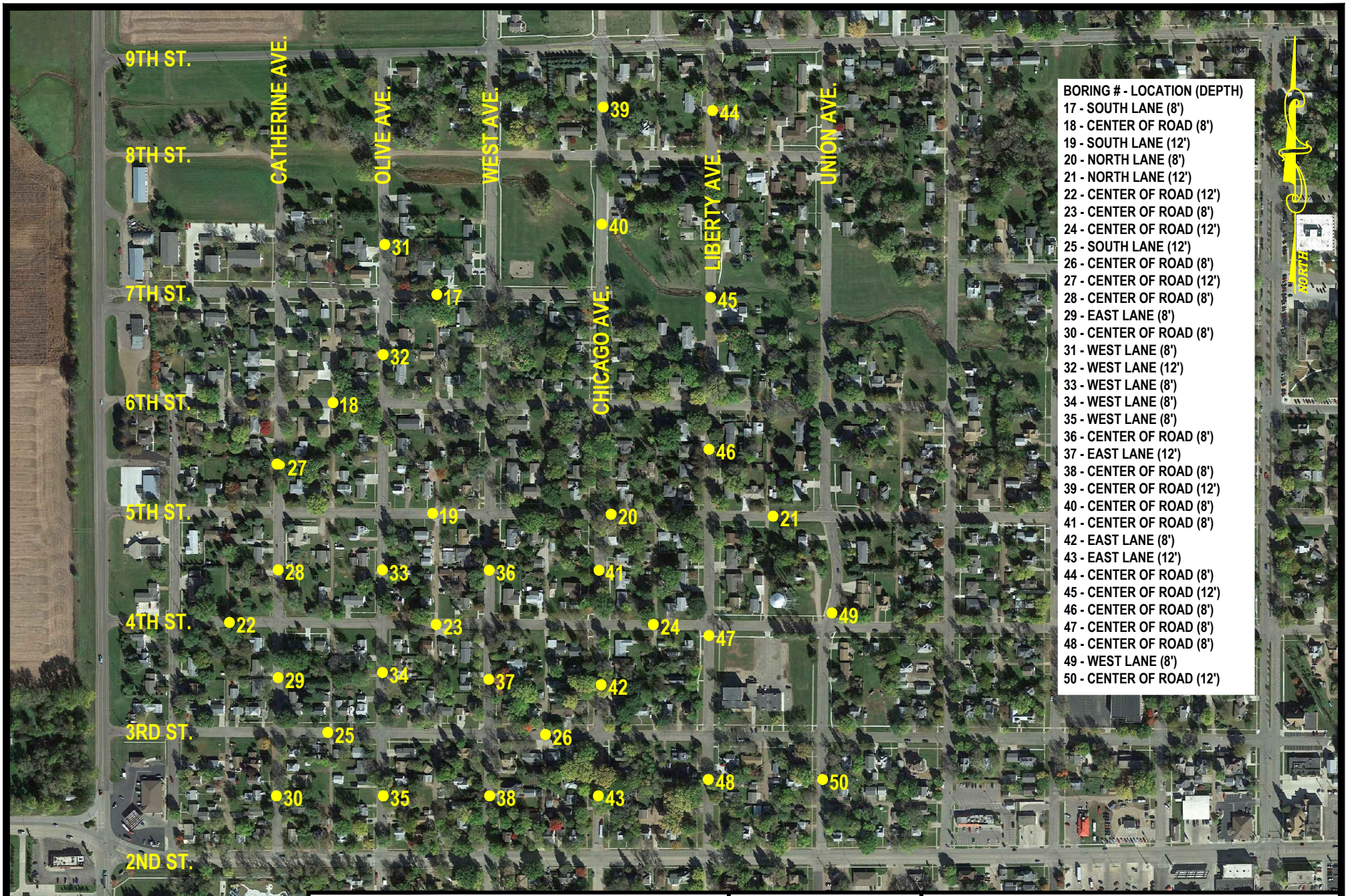

FIGURE 2
TEST BORING LOCATION MAP
TEST BORINGS 17 THROUGH 50
PROPOSED STREET & UTILITY IMPROVEMENTS
MADISON, SD

ACAD/GEOTEK/BRENNEN/18-H78

PROJECT#: 18-H78

DRAWN BY: PLH

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

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **1 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	LEAN CLAY WITH SAND: brown, frozen to 1.5' then moist, firm, 4" of asphalt and 6" of gravel at the surface (CL)	GLACIAL TILL									
			7		1	SPT					
			8		2	SPT	18				
4½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm to stiff, (CL)	GLACIAL TILL									
			6		3	SPT	19				
					6	BAG					
			11		4	SPT	21				
			12		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-10-18	10:25 am	12	--	--	none
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START 12-10-18 COMPLETE 12-10-18 10:25 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **2 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown and dark brown, frozen to 1.5' then moist, 4" of asphalt and 6" of gravel at the surface	FILL									
2	**LEAN CLAY**: brown, moist, stiff, (CL)	FINE ALLUVIUM	10		1	SPT					
3½	**SANDY LEAN CLAY**: brown, moist, firm, (CL)	MIXED ALLUVIUM	9		2	SPT	21				
			8		3	SPT	28	98			
6	**LEAN CLAY WITH SAND**: brown, moist, stiff, (CL)	GLACIAL TILL									
			9		4	SPT					
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-10-18	11:02 am	8.5	--	--	none
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--	--	--	--	--	--

START 12-10-18 COMPLETE 12-10-18 11:02 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **3 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt over 6" of concrete at the surface	FILL			1	HSA					
2	**LEAN CLAY**: very dark brown, moist, stiff, (CL)	FINE ALLUVIUM	13		2	SPT	22				
5	**LEAN CLAY**: brown, moist, stiff, (CL)	FINE ALLUVIUM	10		3	SPT	22	106			
7	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	11	▼	4	SPT	16				
10	**SAND**: medium to coarse grained, grayish brown, waterbearing, medium dense, (SP)	GLACIAL OUTWASH	15		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-10-18	3:20 pm	12	--	10	▼ 9.0
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START 12-10-18 COMPLETE 12-10-18 3:20 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **4 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown and dark brown, frozen to 1.5' then moist, 3" of asphalt over 6" of concrete at the surface	FILL			1	HSA					
			12		2	SPT	21				
					5	BAG					
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	9		3	SPT	19				
			12		4	SPT	21				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-10-18	2:46 pm	8.5	--	--	none
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START 12-10-18 COMPLETE 12-10-18 2:45 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **5 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3.5" of asphalt and 8" of gravel at the surface	FILL			1	HSA					
			13		2	SPT	14				
4½	**CLAYEY SAND**: a little gravel, brown, moist, medium dense, 41% passing #200 sieve from 4.5' to 6' (SC)	MIXED ALLUVIUM	13		3	SPT	13				
7	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	15		4	SPT	18				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-10-18	12:15 pm	8.5	--	--	none
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START 12-10-18 COMPLETE 12-10-18 12:15 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **6 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 8" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	12		2	SPT	18				
			11		3	SPT	17				
					6	BAG					
			13		4	SPT	19				
			14		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	12:40 pm	12	--	--	none
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START 12-11-18 COMPLETE 12-11-18 12:40 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **7 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 8.5" of gravel at the surface	FILL			1	HSA					
			8		2	SPT	23				
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	11		3	SPT	18				
			13		4	SPT	19				
			13		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	11:48 am	12	--	--	none
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START 12-11-18 COMPLETE 12-11-18 11:48 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **8 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3.5" of asphalt and 9" of gravel at the surface	FILL			1	HSA					
2½	**LEAN CLAY**: brown, moist, stiff, (CL)	FINE ALLUVIUM	9		2	SPT	23				
			11		3	SPT	18				
6	**SAND**: medium grained, brown, moist, medium dense, (SP)	COARSE ALLUVIUM									
			14		4	SPT					
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	11:23 am	8.5	--	--	none
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START 12-11-18 COMPLETE 12-11-18 11:23 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **9 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 7" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: brown, moist, stiff, (CL)	GLACIAL TILL	9		2	SPT	19				
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	11		3	SPT	20				
			15		4	SPT	21				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-10-18	12:47 pm	8.5	--	--	none
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START 12-10-18 COMPLETE 12-10-18 12:47 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **10 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3.5" of asphalt and 9" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: brown, moist, stiff, (CL)	FINE ALLUVIUM	13		2	SPT	15				
			10		3	SPT	15				
6	**SAND**: fine to medium grained, brown, moist, medium dense, (SP)	COARSE ALLUVIUM									
			10		4	SPT					
			13		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	10:50 am	12	--	--	none
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START 12-11-18 COMPLETE 12-11-18 10:50 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **11 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 8.5" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: very dark brown, moist, stiff, (CL)	TOPSOIL	14		2	SPT	25				
3½	**LEAN CLAY**: brown and light brown, moist, firm, (CL)	FINE ALLUVIUM	6		3	SPT	23				
			6		4	SPT	28				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	2:08 pm	8.5	--	--	none
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START 12-11-18 COMPLETE 12-11-18 2:08 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **12 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 5" of asphalt and 7" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm to stiff, (CL)	GLACIAL TILL	7		2	SPT	17				
			9		3	SPT	19	109			
					6	BAG					
			9		4	SPT	21				
			14		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-10-18	11:45 am	12	--	--	none
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START 12-10-18 COMPLETE 12-10-18 11:45 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **13 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3.5" of asphalt and 6.5" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: brown, moist, stiff, (CL)	FINE ALLUVIUM	10		2	SPT	25				
4½	**LEAN CLAY**: brown and light brown, moist, firm to stiff, (CL)	FINE ALLUVIUM	8		3	SPT	24				
			12		4	SPT	27				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	1:07 pm	8.5	--	--	none
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START 12-11-18 COMPLETE 12-11-18 1:06 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **14 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, frozen to 1.5' then moist, 3.5" of asphalt and 7" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: very dark brown, moist, stiff, (CL)	TOPSOIL	11		2	SPT	25	99			
3½	**LEAN CLAY**: brown and light brown, moist, firm, (CL)	FINE ALLUVIUM	8		3	SPT	22				
7	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm, (CL)	GLACIAL TILL	8		4	SPT	21				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	1:35 pm	8.5	--	--	none
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START 12-11-18 COMPLETE 12-11-18 1:34 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **15 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3.5" of asphalt and 8" of gravel at the surface	FILL			1	HSA					
2½	**LEAN CLAY**: mottled brown and gray, moist, stiff, (CL)	FINE ALLUVIUM	12		2	SPT	20				
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	12		3	SPT	20				
			12		4	SPT	19				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	10:22 am	8.5	--	--	none
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START 12-11-18 COMPLETE 12-11-18 10:22 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **16 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 4" of asphalt and 8" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: dark brown, moist, stiff, (CL)	TOPSOIL	11		2	SPT	29				
4½	**LEAN CLAY WITH SAND**: brown, moist, stiff, (CL)	FINE ALLUVIUM	12		3	SPT	20	106			
7	**SAND WITH SILT**: a little clay, medium to coarse grained, brown, moist, loose, (SP-SM)	COARSE ALLUVIUM	6		4	SPT					
9½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm, (CL)	GLACIAL TILL	8		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	9:57 am	12	--	--	none
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START 12-11-18 COMPLETE 12-11-18 9:57 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **17 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 5" of asphalt and 3" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm, (CL)	GLACIAL TILL	7		2	SPT	23				
			7		3	SPT	23				
7	**SANDY LEAN CLAY**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	9		4	SPT					
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	11:03 am	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 11:02 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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

GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **18 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 4" of asphalt and 5" of gravel at the surface	FILL			1	HSA					
			11		2	SPT	19				
3½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL									
			13		3	SPT	13				
			11		4	SPT	21				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	12:19 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 12:19 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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& TESTING SERVICES, INC.
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **19 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3.5" of asphalt and 24" of gravel and geotextile fabric at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	10		2	SPT	21				
					6	BAG					
			12		3	SPT	23				
			9		4	SPT	24				
			11		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	9:37 am	12	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 9:37 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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& TESTING SERVICES, INC.
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **20 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 10" of gravel at the surface	FILL			1	HSA					
3	**FAT CLAY**: very dark brown, moist, firm, (CH)	TOPSOIL	7		2	SPT	24	101			
4½	**FAT CLAY**: very dark brown, moist, firm, (CH)	FINE ALLUVIUM	6		3	SPT	25	103			
			7		4	SPT	26				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	1:47 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 1:45 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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& TESTING SERVICES, INC.
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **21 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 10" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	11		2	SPT	22				
			12		3	SPT	21				
			13		4	SPT					
			15		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	2:14 pm	15	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 2:15 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **22 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 4" of asphalt and 5.5" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm to stiff, (CL)	GLACIAL TILL	7		2	SPT	21				
			9		3	SPT	19				
			11		4	SPT	22				
			11		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	4:13 pm	15	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-11-18 COMPLETE 12-11-18 4:12 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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& TESTING SERVICES, INC.
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **23 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, frozen to 1.5' then moist, 3" of asphalt and 5" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: very dark brown, moist, stiff, (CL)	TOPSOIL	8		2	SPT	27				
3½	**LEAN CLAY**: light brown, moist, firm, (CL)	FINE ALLUVIUM	6		3	SPT	27				
5½	**LEAN CLAY WITH SAND**: a trace of gravel, mottled brown and gray, moist, firm, (CL)	GLACIAL TILL	7		4	SPT	27				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	3:59 pm	8.5	--	--	none
--	--	--	--	--	--
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--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 2:50 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **24 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 4.5" of asphalt and 2" of gravel at the surface	FILL			1	HSA					
2	**CLAYEY SAND**: fine to medium grained, brown, moist, 22% passing #200 sieve from 2' to 3.5' (SC)	MIXED ALLUVIUM	10		2	SPT					
4½	**SANDY LEAN CLAY**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	11		3	SPT	14				
7	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	13		4	SPT					
			12		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	4:04 pm	12	--	--	none
--	--	--	--	--	--
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--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 4:04 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **25 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 5" of asphalt and 7" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: brown and light brown, moist, firm, (CL)	FINE ALLUVIUM	6		2	SPT	25				
			7		3	SPT	22				
7	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	9		4	SPT	25				
			11		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	3:23 pm	12	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-11-18 COMPLETE 12-11-18 3:23 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **26 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 5.5" of asphalt and 6" of gravel at the surface	FILL									
2	**LEAN CLAY**: brown, moist, firm, (CL)	FINE ALLUVIUM	8		2	SPT	24				
					5	BAG					
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	10		3	SPT	21				
			12		4	SPT	23				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	3:40 pm	8.5	--	--	none
--	--	--	--	--	--
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--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 3:40 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **27 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: dark brown and brown, frozen to 1.5' then moist, 6" of asphalt and 1" of gravel at the surface	FILL			1	HSA					
			13		2	SPT	16				
4½	**LEAN CLAY**: light brown, moist, stiff, (CL)	FINE ALLUVIUM	9		3	SPT	13				
7	**LEAN CLAY WITH SAND**: a trace of gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	14		4	SPT	18				
			10		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	12:55 pm	12	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 12:55 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **28 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen, 6" of asphalt and 0" of gravel at the surface	FILL			1	HSA					
1½	**LEAN CLAY**: brown and light brown, moist, firm, (CL)	FINE ALLUVIUM	7		2	SPT	25				
4½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm to stiff, (CL)	GLACIAL TILL	8		3	SPT	22				
			11		4	SPT					
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	4:36 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-11-18 COMPLETE 12-11-18 4:36 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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& TESTING SERVICES, INC.
909 E. 50th Street North
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **29 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3.5" of asphalt and 8.5" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: very dark brown, moist, stiff, (CL)	FINE ALLUVIUM	11		2	SPT	28				
4½	**LEAN CLAY**: brown and light brown, moist, stiff, (CL)	FINE ALLUVIUM	9		3	SPT	26				
6	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL			5	BAG					
			11		4	SPT	24				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	3:45 pm	8.5	--	--	none
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--	--	--	--	--	--

START 12-11-18 COMPLETE 12-11-18 3:45 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **30 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3.5" of asphalt and 6" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm to stiff, (CL)	GLACIAL TILL	7		2	SPT	20				
			13		3	SPT	21				
			10		4	SPT	22				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-11-18	2:59 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-11-18 COMPLETE 12-11-18 2:59 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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909 E. 50th Street North
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **31 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 5" of asphalt and 7" of gravel at the surface	FILL			1	HSA					
2½	**LEAN CLAY**: brown, moist, (CL)	FINE ALLUVIUM	9		2	SPT	15				
4½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm, (CL)	GLACIAL TILL	5		3	SPT	20				
			7		4	SPT	24				
8½	Bottom of borehole at 8½ feet.										

LABORATORY TESTS

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	10:29 am	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 10:29 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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909 E. 50th Street North
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **32 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, frozen to 1.5' then moist, 5" of asphalt and 5" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: very dark brown, moist, stiff, (CL)	TOPSOIL	9		2	SPT	35	83			
3½	**LEAN CLAY**: brown, moist, stiff, (CL)	FINE ALLUVIUM	9		3	SPT	16				
7	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	15		4	SPT	18				
			11		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	11:45 am	12	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 11:45 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **33 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, frozen to 1.5' then moist, 4" of asphalt and 9" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: very dark brown, moist, stiff, (CL)	FINE ALLUVIUM	12		2	SPT	26	98			
4	**LEAN CLAY**: light brown, moist, firm, (CL)	FINE ALLUVIUM	7		3	SPT	29				
6	**LEAN CLAY WITH SAND**: a trace of gravel, mottled and gray, moist, stiff, (CL)	GLACIAL TILL	12		4	SPT	22				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	1:30 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 1:30 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **34 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, frozen to 1.5' then moist, 4" of asphalt and 6" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: light brown, moist, stiff, (CL)	FINE ALLUVIUM	7		2	SPT	22				
4½	**LEAN CLAY WITH SAND**: a trace of gravel, mottled and gray, moist, stiff, (CL)	GLACIAL TILL	7		3	SPT	22				
			8		4	SPT					
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	1:55 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 2:55 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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

GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **35 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, frozen to 1.5' then moist, 4.5" of asphalt and 8" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a trace of gravel, mottled and gray, moist, stiff to very stiff, (CL)	GLACIAL TILL	16		2	SPT	16				
			15		3	SPT	17				
			15		4	SPT	17				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-12-18	2:25 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-12-18 COMPLETE 12-12-18 2:25 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **36 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 4" of asphalt and 4" of gravel at the surface	FILL			1	HSA					
3	**LEAN CLAY**: very dark brown, moist, stiff, (OL)	TOPSOIL	9		2	SPT	23	103			
4½	**LEAN CLAY**: very dark brown, moist, stiff, (CL)	FINE ALLUVIUM	11		3	SPT	27	97			
6	**LEAN CLAY**: brown, moist, soft, (CL)	FINE ALLUVIUM	4		4	SPT	33				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	6:19 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 9:10 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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Sioux Falls, South Dakota 57104
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **37 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 4.5" of asphalt and 5" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: dark brown, moist, firm, (CL)	FINE ALLUVIUM	6		2	SPT	20				
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, a few sand lens below 10' (CL)	GLACIAL TILL	9		3	SPT	20				
			9		4	SPT	22				
			10		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	6:15 pm	12	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 8:55 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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909 E. 50th Street North
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **38 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, frozen to 1.5' then moist, 4.5" of asphalt and 4" of gravel at the surface	FILL			1	HSA					
2½	**LEAN CLAY**: dark brown, moist, stiff to firm, (CL)	FINE ALLUVIUM	9		2	SPT	25				
			7		3	SPT	23				
7	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	12		4	SPT	23				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	8:41 am	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 8:40 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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& TESTING SERVICES, INC.
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **39 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, very loose, 3" of asphalt and 7" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm to stiff, (CL)	GLACIAL TILL	9		2	SPT	20				
			7		3	SPT	27				
			8		4	SPT	23				
			7		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	9:57 am	12	--	--	none
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--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 9:54 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **40 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 8" of gravel at the surface	FILL			1	HSA					
			9		2	SPT	16				
					5	BAG					
5	**LEAN CLAY**: very dark brown, moist, soft, (CL)	FINE ALLUVIUM	4		3	SPT	24				
7	**LEAN CLAY**: mottled brown and gray, moist, firm, (CL)	FINE ALLUVIUM	6		4	SPT	25				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	10:16 am	8.5	--	--	none
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--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 10:15 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **41 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 4" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: mottled brown and gray, moist, stiff, (CL)	FINE ALLUVIUM	9		2	SPT	23				
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm to stiff, (CL)	GLACIAL TILL	8		3	SPT	23				
			10		4	SPT	25				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	10:38 am	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 10:35 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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909 E. 50th Street North
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **42 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 4" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: brown, dry, stiff, (CL)	FINE ALLUVIUM	10		2	SPT	12				
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	14		3	SPT	16				
			13		4	SPT					
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	10:55 am	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 10:55 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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909 E. 50th Street North
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **43 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: dark brown, frozen to 1.5' then moist, 3" of asphalt and 4" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: brown, moist, stiff, (CL)	FINE ALLUVIUM	11		2	SPT	14				
					6	BAG					
4½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	GLACIAL TILL	14		3	SPT	6				
			15		4	SPT	16				
			14		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	11:25 am	12	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 11:25 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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& TESTING SERVICES, INC.
909 E. 50th Street North
Sioux Falls, South Dakota 57104
605-335-5512 Fax 605-335-0773
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **44 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 6" of asphalt and 0" of gravel at the surface	FILL			1	HSA					
2	**SANDY LEAN CLAY**: dark brown, moist, firm, (CL)	MIXED ALLUVIUM	7		2	SPT	11				
					5	BAG					
5½	**SAND**: fine to medium grained, brown, moist, medium dense, (SP)	COARSE ALLUVIUM	9		3	SPT					
			11		4	SPT					
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	1:25 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 1:25 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th Street North
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605-335-5512 Fax 605-335-0773
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **45 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 5.5" of asphalt and 3.5" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY**: very dark brown, moist, firm, (CL)	TOPSOIL	7		2	SPT	23	104			
4½	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm, (CL)	GLACIAL TILL	6		3	SPT	26	101			
			7		4	SPT	23				
			7		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	1:00 pm	12	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 1:00 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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& TESTING SERVICES, INC.
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605-335-5512 Fax 605-335-0773
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **46 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 3" of asphalt and 9" of gravel at the surface	FILL			1	HSA					
3	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm to stiff, (CL)	GLACIAL TILL	7		2	SPT	20				
			11		3	SPT	13				
			11		4	SPT					
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS					
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	12:35 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 12:34 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th Street North
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **47 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 2" of asphalt and 7" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm to stiff, (CL)	GLACIAL TILL	8		2	SPT	19				
					5	BAG					
			11		3	SPT	22				
			12		4	SPT	24				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	12:02 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 12:02 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **48 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: brown, frozen to 1.5' then moist, 5" of asphalt and 6" of gravel at the surface	FILL			1	HSA					
3	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, sand lens at 8' (CL)	GLACIAL TILL	5		2	SPT	25				
			9		3	SPT	18				
			11		4	SPT	25				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	11:46 am	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 11:45 am

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th Street North
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605-335-5512 Fax 605-335-0773
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **49 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	LEAN CLAY WITH SAND: a little gravel, mottled brown and gray, frozen to 1.5' then moist, firm to stiff, 5.5" of asphalt and 0" of gravel at the surface (CL)	GLACIAL TILL			1	HSA					
			8		2	SPT	24				
					5	BAG					
			12		3	SPT	24				
			12		4	SPT	24				
8½	Bottom of borehole at 8½ feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	2:40 pm	8.5	--	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 2:40 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th Street North
Sioux Falls, South Dakota 57104
605-335-5512 Fax 605-335-0773
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GEOTECHNICAL TEST BORING LOG

GEOTEK # **18-H78** BORING NO. **50 (1 of 1)**

PROJECT **Proposed Street & Utility Improvements, Various Locations, Madison, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: black and brown, frozen to 1.5' then moist, 3.5" of asphalt and 6" of gravel at the surface	FILL			1	HSA					
2	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, stiff, (CL)	GLACIAL TILL	10		2	SPT	18				
			10		3	SPT	22				
			10		4	SPT	22				
			12		5	SPT					
12	Bottom of borehole at 12 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
12-13-18	3:00 pm	12	--	--	none
--	--	--	--	--	--
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--	--	--	--	--	--

START 12-13-18 COMPLETE 12-13-18 3:00 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
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 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%

GEOTEK ENGINEERING
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909 East 50th Street North
Sioux Falls, SD 57104
605-335-5512 Fax 605-335-0773
www.geotekeng.com

MOISTURE - DENSITY TEST REPORT

REPORTED TO:

Banner Associates, Inc. (Brookings)
Gregg Jorgenson
409 22nd Avenue South
PO Box 298
Brookings, SD 57006

PROJECT: 18-H78

Proposed Street & Utility
Improvements
Various Locations
Madison, SD

COPIES TO:

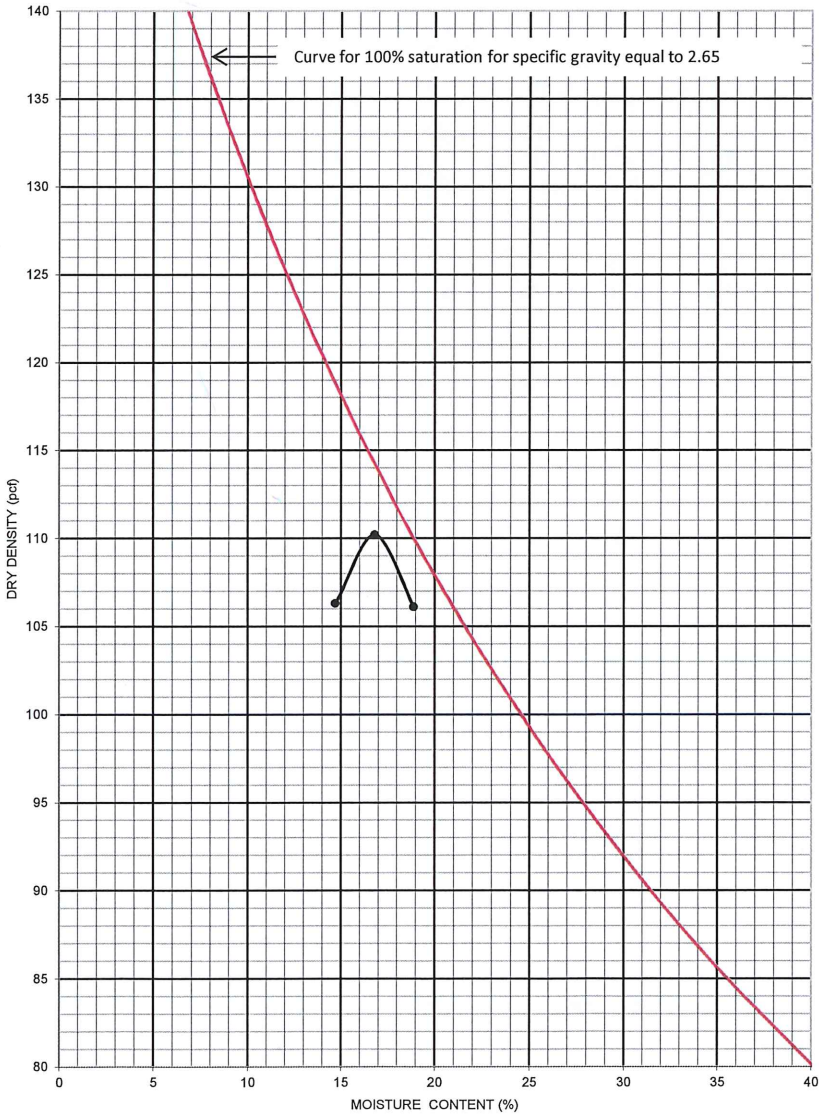
DATE REPORTED: 1/14/2019

SAMPLE DATA

Sample No.: 1
ASTM Test Method: D698B Manual
Soil Classification: Lean Clay with Sand and a trace of Gravel, Brown (CL) - 1
Remarks: SB1 (4 1/2 to 12')

Date Received: 12/10/2018
Date Tested: 1/2/2019

TEST DATA



Maximum Density, pcf: 110.2

Optimum Moisture, %: 16.8

Percent Passing, %:

3/4":	100
3/8":	100
#4:	97
#200:	72

Atterberg Limits (ASTM: D4318):
Liquid Limit:
Plastic Limit:
Plasticity Index:

Paul Miles, Construction Materials Lab Supervis

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Madison, SD

COPIES TO:

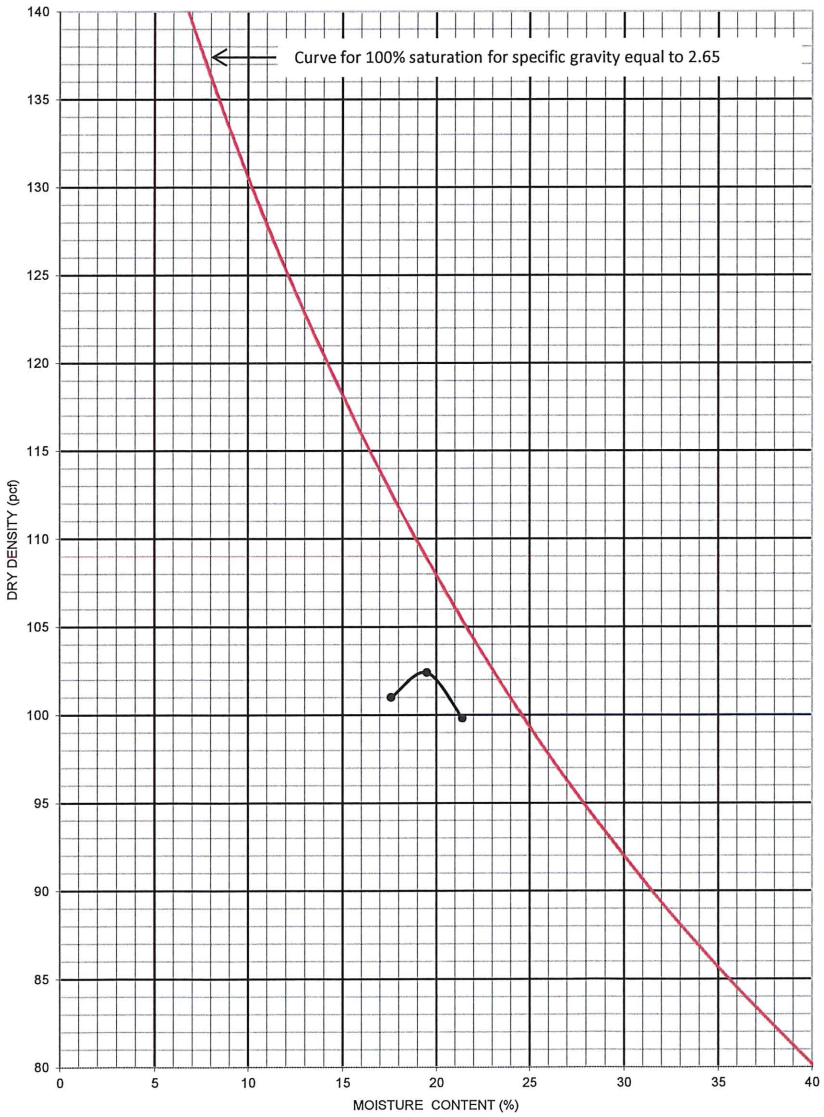
DATE REPORTED: 1/14/2019

SAMPLE DATA

Sample No.: 2
ASTM Test Method: D698B Manual
Soil Classification: Lean Clay, Brown (CL) - 2
Remarks: SB 26 (2 to 4/1/2')

Date Received: 12/13/2018
Date Tested: 1/2/2019

TEST DATA



Maximum Density, pcf: 102.4

Optimum Moisture, %: 19.5

Percent Passing, %:

3/4":	100
3/8":	100
#4:	100
#200:	86

Atterberg Limits (ASTM: D4318):
Liquid Limit:
Plastic Limit:
Plasticity Index:

Paul Miles, Construction Materials Lab Supervis

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Madison, SD

COPIES TO:

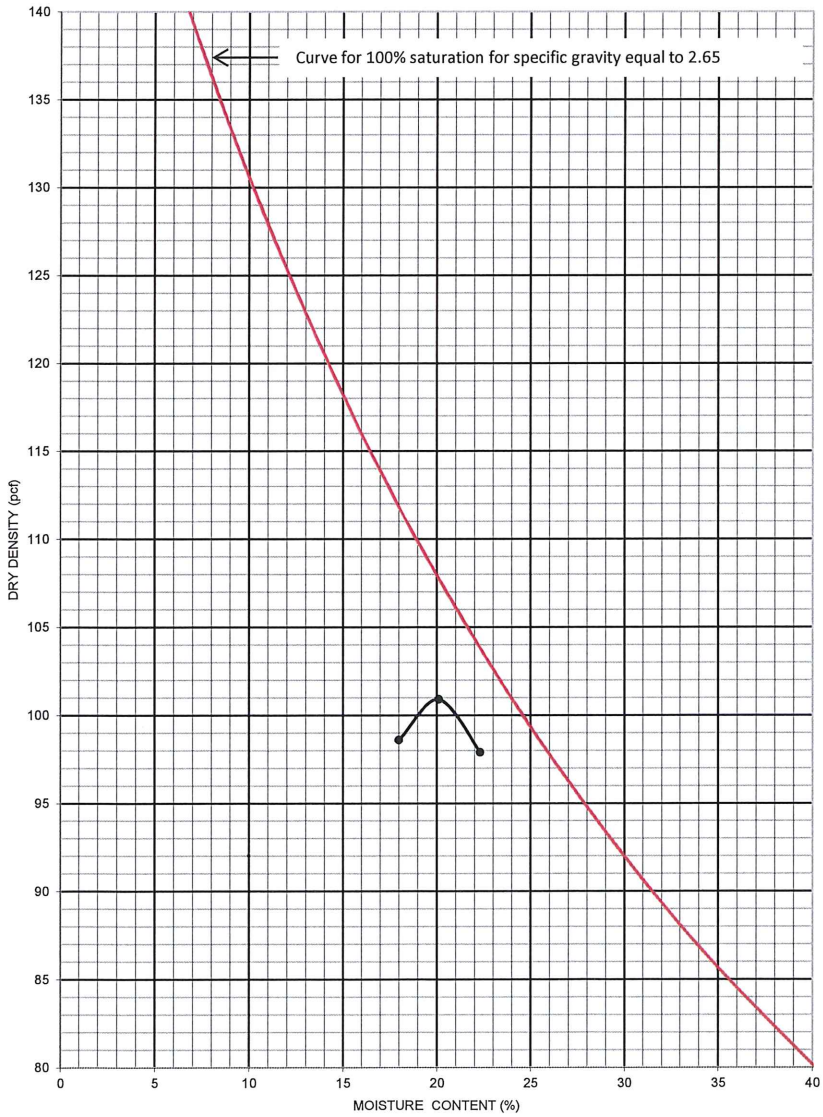
DATE REPORTED: 1/14/2019

SAMPLE DATA

Sample No.: 3
ASTM Test Method: D698B Manual
Soil Classification: Lean Clay, Very Dark Brown (CL) - 3
Remarks: SB 38 (1 to 2 1/2')

Date Received: 12/13/2018
Date Tested: 1/3/2019

TEST DATA



Maximum Density, pcf: 100.9

Optimum Moisture, %: 20.1

Percent Passing, %:

3/4":	100
3/8":	100
#4:	100
#200:	96

Atterberg Limits (ASTM: D4318):
Liquid Limit:
Plastic Limit:
Plasticity Index:

Paul Miles, Construction Materials Lab Supervis