CERTIFIED TESTING SERVICES, INC.

GEOTECHNICAL ENGINEERING REPORT

MIDDLE SCHOOL AND TRANSPORTATION BUILDING
MILFORD, IOWA

CTS PROJECT NO. G5312S

This document was originally issued and sealed by Jed A. McInerney, P.E., License No. 22686 on March 1, 2018.	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa. Signature: Name: Jed A. McInerney, P.E. (date) License Number 22686 My license renewal date is December 31, 2018. Pages or sheets covered by this seal: This report contains 41 pages, including this page. CTS File Number G5312S

Certified Testing Services, Inc.
419 W. 6th Street • P.O. Box 1193 • Sioux City, Iowa 51102 • Phone (712) 252-5132

March 1, 2018

Attn: Mr. Todd Abrahamson
Superintendent
Okoboji Community School District
P. O. Box 147
Milford, Iowa 51351

Re: Geotechnical Engineering Report
Middle School and Transportation Building
Milford, Iowa
CTS Job No. G5312S

Dear Mr. Abrahamson:

Certified Testing Services, Inc. is pleased to transmit our Geotechnical Engineering Report for the referenced project. This report includes the results of field and laboratory testing, and recommendations for foundation design, as well as general site development.

We appreciate the opportunity to perform this Geotechnical Study and look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report or if we may be of further service, please contact our office.

Respectfully submitted,
CERTIFIED TESTING SERVICES, INC.

Jed A. McInerney, P.E. IA 22686
Staff Engineer

James A. Bertsch, P.E. IA 12121
Senior Geotechnical Engineer

JAM/JAB/jb
cc: Beck Engineering, Inc.

GEOTECHNICAL ENGINEERING REPORT

MIDDLE SCHOOL AND TRANSPORTATION BUILDING
MILFORD, IOWA

CTS PROJECT NO. G5312S

PREPARED FOR

ATTN: MR. TODD ABRAHAMSON
SUPERINTENDENT
OKOBOJI COMMUNITY SCHOOL DISTRICT
P. O. BOX 147
MILFORD, IOWA 51351

MARCH 1, 2018

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PROJECT INFORMATION

Project Authorization

Certified Testing Services, Inc. has completed a subsurface exploration for the above referenced project. Mr. Todd Abrahamson, Superintendent of the Okoboji Community School District, authorized our work by signing our proposal on February 13, 2018. This work was performed in accordance with CTS Proposal Number 4387 dated February 13, 2018.

Project Description

Mr. Brad Beck and Mr. Stacy Tegtmeier of Beck Engineering, Inc. provided preliminary project information in emails on January 30 and 31, 2018, February 5, 8, 9, and 28, and March 1, 2018. Mr. Abrahamson also provided additional information on January 31, 2018, and February 5 and 9, 2018. The email from Mr. Abrahamson on February 5, 2018, included Master Plan One and Master Plan Two. The email from Mr. Tegtmeier on February 5, 2018, included a drawing titled, "2018 Okoboji CSD Preliminary Site Plan Layout Option 1" and a drawing titled, "2018 Okoboji CSD Preliminary Site Plan Layout Option 2". The email from Mr. Tegtmeier on February 8, 2018, included a drawing titled, "2018 Okoboji CSD Preliminary Site Plan Layout Option 2" that was revised on February 8, 2018. The emails from Mr. Tegtmeier on February 28, and March 1, 2018, included the drawing titled, "2018 Okoboji CSD Preliminary Site Plan Layout Option 2" and included the boring elevations. The following is our understanding of the school construction:

Middle School

- Single-story building with slab-on-grade
- Masonry wall or steel framed construction is assumed
- Plan dimension of approximately 300 feet by 400 feet
- Report is based on maximum column loads of up to 100 kips and maximum wall loads of up to 6 kips per lineal feet
- Report is also based on less than 3 feet of cut/fill in the building area to bring the site to grade

Transportation Building

- Single-story building with slab-on-grade
- Masonry wall or steel framed construction is assumed
- Plan dimension of approximately 100 feet by 170 feet
- Report is based on maximum column loads of up to 100 kips and maximum wall loads of up to 6 kips per lineal feet
- Report is also based on less than 3 feet of cut/fill in the building area to bring the site to grade

The geotechnical recommendations presented in this report are based on the available project information, building locations, and the subsurface materials described in this report. If the noted information is incorrect or if the locations of the buildings are altered, please

inform CTS in writing so that we may amend the recommendations presented in this report, if appropriate or perform additional borings. CTS will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site to prepare recommendations for foundation systems for the proposed construction. Our original scope of services included drilling eleven soil test borings to depths ranging from 15 feet to 25 feet below existing grade in the proposed building areas and three soil test borings to a depth of 10 feet below the existing grade in the pavement areas; however, auger refusal due to cobbles/possible boulders was encountered in Borings B3, B6, B10, and B16 at depths ranging from 5 feet to 13.5 feet below the existing grade. It should be noted that based on the request of Mr. Abrahamson, three additional borings were performed to depths of 15 feet below the existing grade in open areas; however, as previously stated, Boring B16 encountered auger refusal at 5 feet below the existing grade. The scope of work also included select laboratory testing, and preparation of this geotechnical report. This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and presents recommendations regarding the following:

- Suitability of site for the construction of the proposed project
- Site preparation and grading procedures for project
- Foundation types, depths, allowable bearing capacities and estimate for potential settlement
- Recommendations for pavement subgrade preparation and thickness
- Comments regarding factors that will impact construction and performance of the proposed construction.

The scope of services does not include an environmental assessment of the site.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The site for the proposed project is located northwest of the intersection of 255th Street and H Avenue, southwest of the existing Okoboji High School in Milford, Iowa. The site is bordered by a baseball field to the north, a baseball field and running track to the east, 225th Street to the south, and an abandoned gravel pit to the west.

At the time of drilling, the site surface consisted of grass. The site sloped down to the west with approximately 7 feet of elevation change between the boring locations. The site was soft at the time of our site visit and the drill rig did experience difficulty moving around the site.

Subsurface Conditions

The site subsurface conditions were explored with seventeen soil test borings sampled to depths ranging from 5 feet to 25 feet below the existing ground surface in the proposed building areas and pavement areas. CTS personnel chose the boring locations and the boring depths. Beck Engineering, Inc. personnel staked the boring locations in the field. The locations of the borings are indicated on the "Boring Location Plan" included in the Appendix, which is a modified copy of the drawing titled, "2018 Okoboji CSD Preliminary Site Plan Layout Option 2", provided Mr. Tegtmeier in the February 8, 2018 email. The surface elevations at the boring locations were provided by Mr. Tegtmeier in emails on February 28 and March 1, 2018.

The borings were advanced utilizing hollow stem auger drilling methods and soil samples were routinely obtained during the drilling process. Select soil samples were later tested in the laboratory to determine the material's engineering properties for our evaluation. Drilling, soil sampling and the laboratory testing were accomplished generally in accordance with ASTM procedures. The borings were backfilled with on-site material after performing our work; however, it should be noted that some settlement of the backfill material may occur and it is the client's responsibility to backfill the borings once we have left the site.

The subsurface conditions, as identified by the borings, primarily consisted of a 6-inch to 12-inch root zone at the surface that was generally underlain by sandy lean clay fill, clayey sand fill, silty sand fill, poorly graded sand fill, poorly graded sand with silt fill, poorly graded sand with clay fill, lean clay fill, poorly graded sand with silt glacial sand, poorly graded sand glacial sand, lean clay with sand glacial sediment, and clayey sand with gravel glacial sand. It should be noted that the standard penetration test results for the first sample in each boring is not representative of the material's strength due to a 2-foot to 3.5-foot frost layer at the surface.

The boring logs included in the Appendix should be reviewed for specific information at the individual boring locations. The record includes soil/rock descriptions, stratifications, penetration resistances, and locations of the samples and laboratory test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected at locations other than the boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on the boring logs. Samples that were not altered by laboratory testing will be retained for 30 days from the date of this report and then will be discarded.

Water Level Measurements

Free water was not encountered in the borings at the time of drilling. The water level measurements presented in this report are the levels that were measured at the time of our field activities and should be expected to fluctuate with climatic conditions.

EVALUATIONS AND RECOMMENDATIONS

Geotechnical Discussion

The main concern for the site from a geotechnical standpoint is the existing undocumented fill and possible fill materials encountered in the top 4 feet to the depth explored in Borings B2, B3, B10, B11, B12, and B16. The fill and possible fill materials had moisture contents that ranged from 3 percent to 24 percent and standard penetration test results, excluding the results in the first sample due to the depth of frost, ranged from 7 BPF of 63 BPF, which would indicate that the existing fill and possible fill materials were placed with considerable effort; however, based on standard penetration test results of 7 BPF in Boring B12 in a building area and Boring B14 in a pavement area, soft areas may be encountered within the existing fill and possible fill. Based on this, CTS recommends that fill materials be density tested in the bottom of the footing excavations and floor slab and pavement areas to determine if the fill material meets the requirements in the "Site Preparation" section of this report. A minimum of one density test should be performed per column footing, two per footing line, and one per 1,000 square feet of floor slab and pavement area. Fill material that does not meet the requirements of the "Site Preparation" section of this report should be removed and replaced with new structural fill meeting the requirements of the "Site Preparation" section of this report. Unsuitable fill material encountered at bottom of footing grade should be overexcavated a minimum of 10 inches horizontally in each direction for each foot of cut beneath the bottom of the footings. If the owner is willing to accept some movement in the pavement areas, a method that may be used to minimize movement would be to remove the top 12 inches of existing fill material, scarify, moisture condition the second 12 inches of subgrade and compact the subgrade to meet the requirements of the "Site Preparation" section of this report. After the subgrade has been compacted the top 12 inches of removed material should be moisture conditioned and compacted in two 6-inch lifts. If the owner is not willing to assume the risk of movement in the pavement areas, the existing fill would need to be removed and replaced with new structural fill.

The second concern is for total and differential settlement that is anticipated due to the consolidation of the compressible lean clay glacial sediment material encountered in the top 13 feet of Boring B7 and for the compressible glacial sediment material to be encountered in other areas. Our analysis, based on empirical formulas, past experience and available subsurface information, indicates that total settlement due to a column loading of 100 kips will be on the order of 2.5 inches and settlement due to a wall loading of 6 kips per lineal foot will be on the order of 2 inches. In order to minimize settlement to less than 1-inch, CTS recommends that the column footings and continuous footings be placed new structural fill in accordance with the following table. The new structural fill should meet the recommendations in the "Site Preparation" section of this report. The structural fill may exist in most areas based on the existing undocumented fill materials being density tested, as discussed in the previous paragraph. The overexcavations for the footings should extend a minimum of 10 inches horizontally in every direction for each foot of vertical cut beneath the bottom of footings.

Column Loads	Depth of Fill Below Bottom of Footing
Up to 25 Kips	2.0 Feet
25.1 Kips to 75 Kips	3.0 Feet
75.1 Kips to 125 Kips	4.0 Feet

Wall Loads	Depth of Fill Below Bottom of Footing
Up to 3.0 KLF	2.0 Feet
3.1 KLF to 6.0 KLF	3.0 Feet

A third concern is the potential for the granular materials encountered at the site to become disturbed during the excavation process. Disturbed material should be compacted to meet the requirements of the "Site Preparation" section of this report. It should be noted that the sandy soils may slough during the excavation process and based on this, trench footings may not work on this project.

In order to provide for uniform support, CTS recommends that the pavement be supported on a minimum of 2 feet of structural fill meeting the requirements of the "Site Preparation" section of this report, which may exist in most areas based on the existing fill materials being density tested. If there is a delay between subgrade preparation and paving, the moisture content of the pavement subgrade would need to be checked the day before or the day of the pavement placement to determine if the moisture content of the prepared subgrade meets the requirements of the "Site Preparation" section of this report. Material that does not meet the moisture requirement will need to be scarified, moisture conditioned and compacted to meet the requirements of the "Site Preparation" section of this report prior to pavement placement. The chance for frost heave issues to occur goes up greatly if the subgrade soils undergo an increase in moisture content prior to paving. Frost heave can result in the pavement heaving and cracking. If curb and gutters are installed, they should be backfilled as soon as the curb and gutter concrete has achieved adequate strength, usually in 3 days to 7 days. If curb and gutters are not installed, the edge of the pavement should be backfilled within 3 days to 7 days of the pavement being placed. The purpose of backfilling behind the curbs, gutters and edge of pavement as soon as possible is to eliminate areas where water can pond and cause frost heave issues under the pavement due to water migrating under the pavement. The owner should be aware that this procedure will help to minimize frost heave; however, it should be noted that some frost heave may still occur. All work should meet the requirements of SUDAS, if applicable.

The seismic site classification for the site soils, in accordance with ASCE 7, Chapter 20, is a Class D. Due to the low seismic activity in the area, we are not aware of special designs or details for foundation structures due to seismic action.

Site Preparation

CTS recommends that topsoil, soft material, organic material, material containing frost, and unsuitable soils in the construction area be stripped from the site and either wasted

or stockpiled for later use in landscaping. The on-site materials, excluding material that contains cobbles/boulders, are suitable for use as structural fill material. A representative of the geotechnical engineer should determine the depth of removal at the time of construction.

After stripping and excavating to the proposed subgrade level, as required, and prior to density testing the existing undocumented fill, the floor slab and pavement areas should be proofrolled with a loaded tandem axle dump truck or similar piece of heavy rubber tired vehicle (typically with an axial load greater than 9-tons). Soils that are observed to rut or deflect excessively (typically greater than 1-inch) under the moving load should be undercut and replaced with properly compacted fill. If excessive pumping is observed, the proofrolling should stop and the geotechnical engineer should be notified to determine the course of action required to stabilize the site. The proofrolling and undercutting activities should be witnessed by a representative of the geotechnical engineer and should be performed during a period of dry weather.

After subgrade preparation and observation have been completed, fill placement may begin. Fill materials should be lean clay material, granular material in areas where the subgrade consists of granular material, free of organic or other deleterious materials, have a maximum particle size of less than 1.5 inches, and have a liquid limit less than 45 and plasticity index less than 22. Close moisture content control of the lean clay material will be required to achieve the recommended degree of compaction. Structural fill should not contain frost and should not be placed on frozen ground. CTS does not recommend that the structural fill consist of alternating layers of granular and fine-grained material in order to prevent a perched water condition.

Structural fill should be placed in maximum loose lifts of 4 inches for hand compaction equipment and 8 inches for riding compaction equipment and compacted to at least 98 percent of the material's standard Proctor maximum dry density. Backfill for the foundation excavations should be compacted to a minimum of 93 percent around the perimeter of the buildings with the exception of pavement, sidewalks and other structural areas. Lean clay should be compacted to within a minus 3 percent to a plus 3 percent of the optimum moisture content as determined in general accordance with ASTM D 698 procedures. The moisture content of the material should be maintained between the recommended moisture contents until concrete is placed on the material. Materials that undergo increases or decreases in moisture content beyond the recommended moisture content ranges should be scarified, moisture conditioned and compacted to meet these moisture ranges just prior to pavement being placed. Every other lift of compacted-engineered fill should be tested by a representative of the geotechnical engineer prior to placement of subsequent lifts.

Foundation Recommendations

The planned construction can be supported on conventional spread footing foundations bearing on new structural fill material or existing fill material meeting the requirements of the "Site Preparation" section of this report, as discussed in the "Geotechnical Discussion" section of this report. Spread footings for building columns and continuous

footings for bearing walls can be designed for a net allowable soil bearing pressures of 2,000 PSF, based on dead load plus design live load. Minimum dimensions of 24 inches for column footings, 12 inches for trenched footings and 18 inches for continuous footings should be used in foundation design to minimize the possibility of a local bearing capacity failure.

Exterior footings and footings in unheated areas should be located at a depth of 42 inches or deeper below the final exterior grade to provide adequate frost protection. If the buildings are to be constructed during the winter months or if footings will likely be subjected to freezing temperatures after foundation construction, then all footings should be protected from freezing. Otherwise, interior footings can be located at nominal depths compatible with architectural and structural considerations.

The foundation excavations should be observed by a representative of CTS prior to steel or concrete placement to assess that the foundation materials are capable of supporting the design loads and are consistent with the materials discussed in this report. Soft or loose soil zones encountered at the bottom of the footing excavations should be removed to the level of competent naturally deposited soils or properly compacted structural fill as directed by the geotechnical engineer.

After opening, footing excavations should be observed and concrete placed as quickly as possible to avoid exposure of the footing bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. If possible, the foundation concrete should be placed during the same day the excavation is made. If it is required that footing excavations be left open for more than one day, they should be protected to reduce evaporation or entry of moisture.

Consolidation testing was beyond the scope of this exploration. Based on the known subsurface conditions, minimum changes in moisture content of the soils and site geology, laboratory testing, and past experience, we anticipate that properly designed and constructed footings supported on the recommended materials should experience total and differential settlements between adjacent columns of less than 1-inch and ¾-inch, respectively.

Floor Slab Recommendations

The floor slabs should be supported on a minimum of 2 feet of structural fill, which may exist in some areas, as discussed in the "Geotechnical Discussion" section of this report. CTS recommends that a compacted free draining granular mat with a minimum thickness of 4 inches be placed beneath the floor slab to enhance drainage. The granular mat should consist of coarse sand or well-graded gravel with a maximum size particle of 1-inch and have less than 8 percent passing the #200 sieve. It should be noted that the material passing the #200 sieve should not contain clay. Polyethylene sheeting, if used, should be placed in accordance with the "Manual of Concrete Practice of the American Concrete Institute". The floor slabs should have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage. Floor slabs should not be constructed on frozen ground.

Subgrade prepared as recommended would have a modulus of subgrade reaction, *k* value, of 110 pounds per cubic inch (pci) and friction factor of 0.3 that may be used in the slab-on-grade design for cohesive soils and would have a modulus of subgrade reaction, *k* value, of 250 pounds per cubic inch (pci) and friction factor of 0.4 for cohesionless soils, based on correlations for typical values resulting from a 1-foot by 1-foot plate load test. However, depending on how the slab load is applied, the value will have to be geometrically modified. The value should be adjusted for larger areas using the following expression for cohesive and cohesionless soil:

Modulus of Subgrade Reaction, $k_s = (k/B)$ for cohesive soil and

$$k_s = k\,(B+1/(2B)^2) \text{ for cohesionless soil}$$

Where: k_s = coefficient of vertical subgrade reaction for loaded areas
k = coefficient of vertical subgrade reaction for 1 foot by 1 foot area
B = effective width of area loaded, in feet

Pavement Recommendations

Our scope of services did not include CBR testing of existing subgrade or potential sources of imported fill for the specific purpose of detailed pavement analysis. Instead, we have assumed pavement-related design parameters that are considered to be typical for the area soils types. **If conditions other than those found in our borings are encountered, CTS should be notified to determine if the recommendations presented below are valid.** CTS recommends that the pavement areas be prepared as discussed in the "Geotechnical Discussion" and "Site Preparation" sections of this report.

The recommended pavement thicknesses presented below are considered typical and minimum for the assumed parameters. We understand that given budgetary considerations, it is desirable to place thinner pavement sections than those presented. However, the client, the owner, and the project principals should be aware that thinner pavement sections might result in increased maintenance costs and lower than anticipated pavement life.

The following CTS recommendation is based on the subgrade soils being prepared to achieve a minimum CBR of 2 to 3. Based on our analysis, using the Concrete Pavement Analyst software provided by the National Ready Mixed Concrete Association, the following pavement section was calculated:

PAVEMENT MATERIALS*	PARKING LOT	LIGHT DUTY DRIVE LANES
Portland Cement Concrete	6 Inches	7 Inches

* Pavement materials should conform to local and state guidelines, if applicable.

Rigid concrete pavement is recommended under trash dumpsters or where a

considerable load is transferred from relatively small steel wheels. This should provide better distribution of surface loads to the subgrade without causing deformation of the surface. Trash dumpster pads should be at least 7 inches thick and properly reinforced.

Pavement may be placed after the grade has been prepared as discussed above. The work should be done in accordance with SUDAS or State Department of Transportation guidelines, if applicable.

CONSTRUCTION CONSIDERATIONS

CTS should be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. CTS cannot accept responsibility for conditions that deviate from those described in this report, nor for the performance of the foundation system if not engaged to also provide construction observation and testing for this project.

Moisture Sensitive Soils and Weather Related Concerns

The upper fine-grained soils encountered at this site may be sensitive to disturbances caused by construction activity and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

Drainage and Groundwater Considerations

Water should not be allowed to collect in the foundation excavations, on floor slab areas, or on prepared subgrade of the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Positive site drainage should be provided to reduce infiltration of surface water around the perimeter of the buildings and beneath the floor slabs. The grades should be sloped away from the buildings and surface drainage should be collected and discharged such that water is not permitted to infiltrate the backfill and floor slab areas of the buildings.

Free groundwater was not encountered in the borings at the time of drilling and should not affect construction. It is possible that seasonal variations will cause fluctuations in the water table. Collected water should be removed from excavations by pumping. Should excessive and uncontrolled amounts of seepage occur the geotechnical engineer should be consulted.

Excavations

In Federal Register, Volume 54, Number 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better enhance the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. The clay materials are considered a Class B material and the sand materials considered a Class C material in accordance with OSHA criteria.

We are providing this information solely as a service to our client. CTS does not assume responsibility for construction site safety or the contractor's or other party's compliance with local, state, and federal safety or other regulations.

REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by CTS and design details furnished by Mr. Brad Beck and Mr. Stacy Tegtmeier of Beck Engineering, Inc., and Mr. Abrahamson, Superintendent of the Okoboji Community School District. If deviations from the subsurface conditions noted in this report are encountered during construction, CTS should be notified immediately to determine if changes in the foundation recommendations are required. If CTS is not retained to perform these functions, CTS will not be responsible for the impact of those conditions on the project.

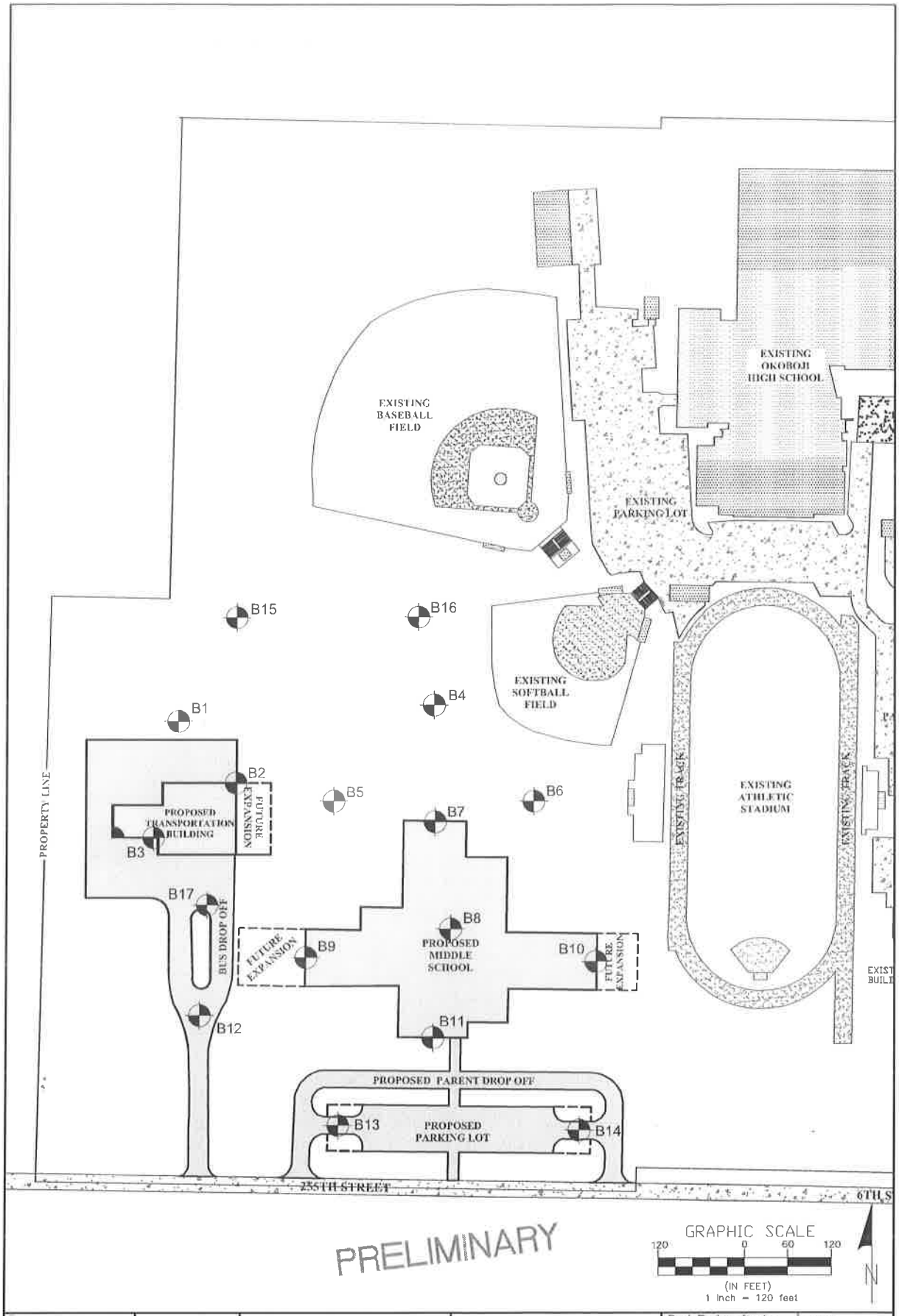
The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are complete, the geotechnical engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of the Okoboji Community School District and

their consultants for the specific application to the proposed Middle School and Transportation Building project in Milford, Iowa.

APPENDIX

BORING LOCATION PLAN



Drawn 2-1-18 By ARH	Checked by	2018 Okoboji CSD Preliminary Site Layout Option 2	BEI Beck Engineering, Inc.	Beck Engineering, Inc. 3301 Zenith Avenue P.O. Box 238 Spirit Lake, Iowa 51360 (712) 336-3596	Client: Okoboji CSD P.O. Box 147 Milford, IA 51351
Revised 2-8-18 By SDT	SDT				
	BEI Project No.				
SHEET 1	E18009				

BORING LOGS

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/23/18
Date Completed: 2/23/18

Boring No.: B-1
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1421.4

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			12-Inch Root Zone, 2.5-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Dark Brown, Moist		10-30-28 N= 58	18								
			FILL, Silty Sand, Medium Yellow Brown, Moist to Dry		11-20-43 N= 63	10								
5			(With Gravel)		5-8-11 N= 19	4								
			(Cobbles)		2-8-8 N= 16	6								
10														
			POORLY GRADED SAND WITH SILT, Grayish Yellow Brown, Moist, Medium Dense, Glacial Sand	SP-SM	13-7-9 N= 16	5								
15			END OF BORING AT 15 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/23/18
Date Completed: 2/23/18

Boring No.: B-2
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1424.3

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			12-Inch Root Zone, 2-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Medium Brown, Moist		14-16-8 N= 24	11								
			(Dark Brown and Yellow Brown)		3-4-6 N= 10	24								
5			(With Gravel)		8-8-10 N= 18	18								
			FILL, Silty Sand, Medium Yellow Brown, Moist		8-25-26 N= 51	8								
10														
			FILL, Sandy Lean Clay, Dark Brown, Dry		8-21-21 N= 42	10								
15			END OF BORING AT 15 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/23/18
Date Completed: 2/23/18

Boring No.: B-3
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1422.3

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			12-Inch Root Zone, 2.5-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Dark Brown and Yellow Brown, Moist		10-10-7 N= 17	14								
			(Medium Brown, Sand Layers)		4-6-8 N= 14	12								
5			(With Gravel)		39-100-100 N= 200	15								
			FILL, Clayey Sand with Gravel, Medium Yellow Brown, Moist		10-25-19 N= 44	6								
10			(Cobble/Possible Boulders)											
			FILL, Silty Sand with Gravel/Cobbles, Grayish Yellow Brown, Moist		15-18-16 N= 34	7								
			END OF BORING AT 13.5 FEET DUE TO AUGER REFUSAL ON COBBLES/POSSIBLE BOULDERS FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/22/18
Date Completed: 2/22/18

Boring No.: B-4
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1426.9

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			12-Inch Root Zone, 2.3-Foot Frost Layer at Surface											
			FILL, Clayey Sand, Light Brown, Moist		38-36-20 N= 56	9								
5			POORLY GRADED SAND WITH SILT, Grayish Yellow Brown, Dry to Moist, Medium Dense, Glacial Sand	SP-SM	9-9-19 N= 28	3								
			(Gravel)		6-10-12 N= 22	3								
10			(With Gravel)		4-12-13 N= 25	3								
			(Cobbles)		4-12-13 N= 25	5								
15			END OF BORING AT 15 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/26/18
Date Completed: 2/22/18

Boring No.: B-5
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1425.0

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			12-Inch Root Zone, 2-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Dark Brown, Moist		10-25-39 N= 64	15								
			FILL, Silty Sand, Medium Yellow Brown, Moist		9-9-9 N= 18	6								
5			(With Gravel)		5-9-9 N= 18	5								
					5-9-10 N= 19	4								
10			POORLY GRADED SAND WITH SILT AND GRAVEL, Grayish Yellow Brown, Moist, Medium Dense, Glacial Sand	SP-SM	9-11-11 N= 22	6								
15			END OF BORING AT 15 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/22/18
Date Completed: 2/22/18

Boring No.: B-6
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1426.0

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2-Foot Frost Layer at Surface											
			FILL, Silty Sand with Gravel and Clay Layers, Medium Brown and Yellow Brown, Moist		15-21-26 N= 47	5								
					7-11-11 N= 22	6								
5			POORLY GRADED SAND, Grayish Yellow Brown, Moist to Dry, Medium Dense, Fine Grained, Glacial Sand	SP-SM	8-9-8 N= 17	6								
					8-9-12 N= 21	2								
10			END OF BORING AT 10 FEET DUE TO AUGER REFUSAL ON COBBLES/POSSIBLE BOULDERS FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/22/18
Date Completed: 2/22/18

Boring No.: B-7
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1425.6

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2.7-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Dark Brown and Medium Yellow Brown, Moist		18-19-19 N= 38	18								
			LEAN CLAY WITH SAND, Dark Brown, Very Moist, Stiff, Glacial Sediment	CL	4-4-5 N= 9	26								
5			(Medium Brown)		3-4-4 N= 8	25								
			(Medium Yellow Brown)		4-5-5 N= 10	19								
10			(Gravel)											
			CLAYEY SAND WITH GRAVEL, Grayish Yellow Brown, Moist, Medium Dense, Glacial Sand	SC	7-10-8 N= 18	13								
15			END OF BORING AT 15 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/22/18
Date Completed: 2/22/18

Boring No.: B-8
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1427.2

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2-Foot Frost Layer at Surface											
			POORLY GRADED SAND WITH SILT, Grayish Yellow Brown, Moist to Dry, Medium Dense to Dense, Glacial Sand/Possible Fill	SP-SM	22-18-18 N= 36	6								
					7-14-12 N= 26	4								
5					9-12-13 N= 25	4								
			(With Gravel)		7-15-14 N= 29	3								
10														
					9-18-17 N= 35	4								
15														
20			POORLY GRADED SAND, Grayish Yellow Brown, Moist, Medium Dense to Dense, Fine Grained, Glacial Sand	SP	8-13-13 N= 26	6								
			(With Gravel and Silt)		10-15-18 N= 33	4								
25			END OF BORING AT 25 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF BORING G5312S.GPJ CERTIFIED TESTING.GDT 2/26/18

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/22/18
Date Completed: 2/22/18

Boring No.: B-9
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1426.6

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2.3-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Medium Brown, Moist		31-39-34 N= 73	11								
			FILL, Poorly Graded Sand, Grayish Yellow Brown, Moist, Fine Grained		5-14-18 N= 32	4								
5			FILL, Lean Clay with Sand, Medium Brown, Moist, Possible Glacial Sediment		3-3-4 N= 7	20								
			POORLY GRADED SAND WITH SILT, Grayish Yellow Brown, Moist, Loose to Medium Dense, Glacial Sand	SP-SM	4-4-4 N= 8	5								
10			(With Gravel)		6-10-9 N= 19	8								
15														
20			POORLY GRADED SAND, Grayish Yellow Brown, Moist, Medium Dense to Dense, Fine Grained, Glacial Sand	SP	5-5-6 N= 11	4								
					6-16-19 N= 35	9								
25			END OF BORING AT 25 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/22/18
Date Completed: 2/22/18

Boring No.: B-10
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1427.6

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Dark Brown and Medium Yellow Brown, Moist		9-9-8 N= 17	12								
5			FILL, Poorly Graded Sand with Silt and Gravel, Grayish Yellow Brown, Moist, Possible Glacial Sand		5-11-10 N= 21	4								
					5-11-10 N= 21	6								
					8-31-32 N= 63	7								
10			END OF BORING AT 10 FEET DUE TO AUGER REFUSAL ON COBBLES/POSSIBLE BOULDERS FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/26/18
Date Completed: 2/26/18

Boring No.: B-11
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1426.6

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2.5-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Dark Brown, Moist		17-33-30 N= 63	9								
			FILL, Silty Sand, Medium Yellow Brown, Moist		9-10-9 N= 19	5								
5			FILL, Poorly Graded Sand with Silt, Grayish Yellow Brown, Dry to Moist		6-12-11 N= 23	3								
			(With Gravel)		6-8-8 N= 16	4								
10			(Clay Lumps)		6-10-9 N= 19	4								
15			END OF BORING AT 15 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/23/18
Date Completed: 2/23/18

Boring No.: B-12
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1426.6

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			12-Inch Root Zone, 3.5-Foot Frost Layer at Surface											
			FILL, Sandy Lean Clay, Dark Brown, Moist		21-26-20 N= 46	14								
			(Olive Gray and Medium Yellow Brown)		4-3-4 N= 7	16								
5					4-4-4 N= 8	14								
			(With Gravel)		5-8-10 N= 18	14								
10			END OF BORING AT 10 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/26/18
Date Completed: 2/26/18

Boring No.: B-13
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1426.0

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2-Foot Frost Layer at Surface FILL, Poorly Graded Sand with Silt and Gravel, Grayish Yellow Brown, Moist		38-32-22 N= 54	4								
5			POORLY GRADED SAND WITH SILT AND GRAVEL, Grayish Yellow Brown, Dry to Moist, Medium Dense, Glacial Sand	SP-SM	6-14-12 N= 26	4								
					5-13-14 N= 27	3								
					8-12-11 N= 23	4								
10			END OF BORING AT 10 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/22/18
Date Completed: 2/22/18

Boring No.: B-14
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1426.8

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2-Foot Frost Layer at Surface											
			FILL, Lean Clay with Sand Layers, Dark Brown and Medium Yellow Brown, Moist		5-4-4 N= 8	22								
			FILL, Poorly Graded Sand with Clay, Medium Yellow Brown, Moist		3-3-4 N= 7	4								
5			POORLY GRADED SAND WITH SILT, Grayish Yellow Brown, Moist, Medium Dense, Glacial Sand	SP-SM	6-10-11 N= 21	4								
			(With Gravel)		9-7-6 N= 13	7								
10			END OF BORING AT 10 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/26/18
Date Completed: 2/26/18

Boring No.: B-15
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1425.7

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			6-Inch Root Zone, 2-Foot Frost Layer at Surface											
			FILL, Silty Sand, Dark Brown and Medium Yellow Brown, Moist		5-8-8 N= 16	7								
			(Medium Yellow Brown)		8-6-8 N= 14	5								
5			POORLY GRADED SAND WITH SILT, Grayish Yellow Brown, Dry to Moist, Medium Dense, Glacial Sand	SP-SM	10-11-12 N= 23	3								
			(With Gravel)		7-9-9 N= 18	4								
10														
					9-9-8 N= 17	5								
15			END OF BORING AT 15 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

Job Number: **G5312S**
Project: **Middle School and Transportation Building**
Date Started: **2/23/18**
Date Completed: **2/23/18**

Boring No.: **B-16**
Boring Location: **Milford, IA**
Drill Type: **Hollow Stem**
Ground Elev.: **1428.0**

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			12-Inch Root Zone, 3.5-Foot Frost Layer at Surface											
			FILL, Clayey Sand with Gravel, Dark Brown and Light Brown, Moist		9-40-42 N= 82	16								
					8-23-23 N= 46	9								
5			END OF BORING AT 5 FEET DUE TO AUGER REFUSAL ON COBBLES/POSSIBLE BOULDERS FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

LOG OF EXPLORATORY BORING

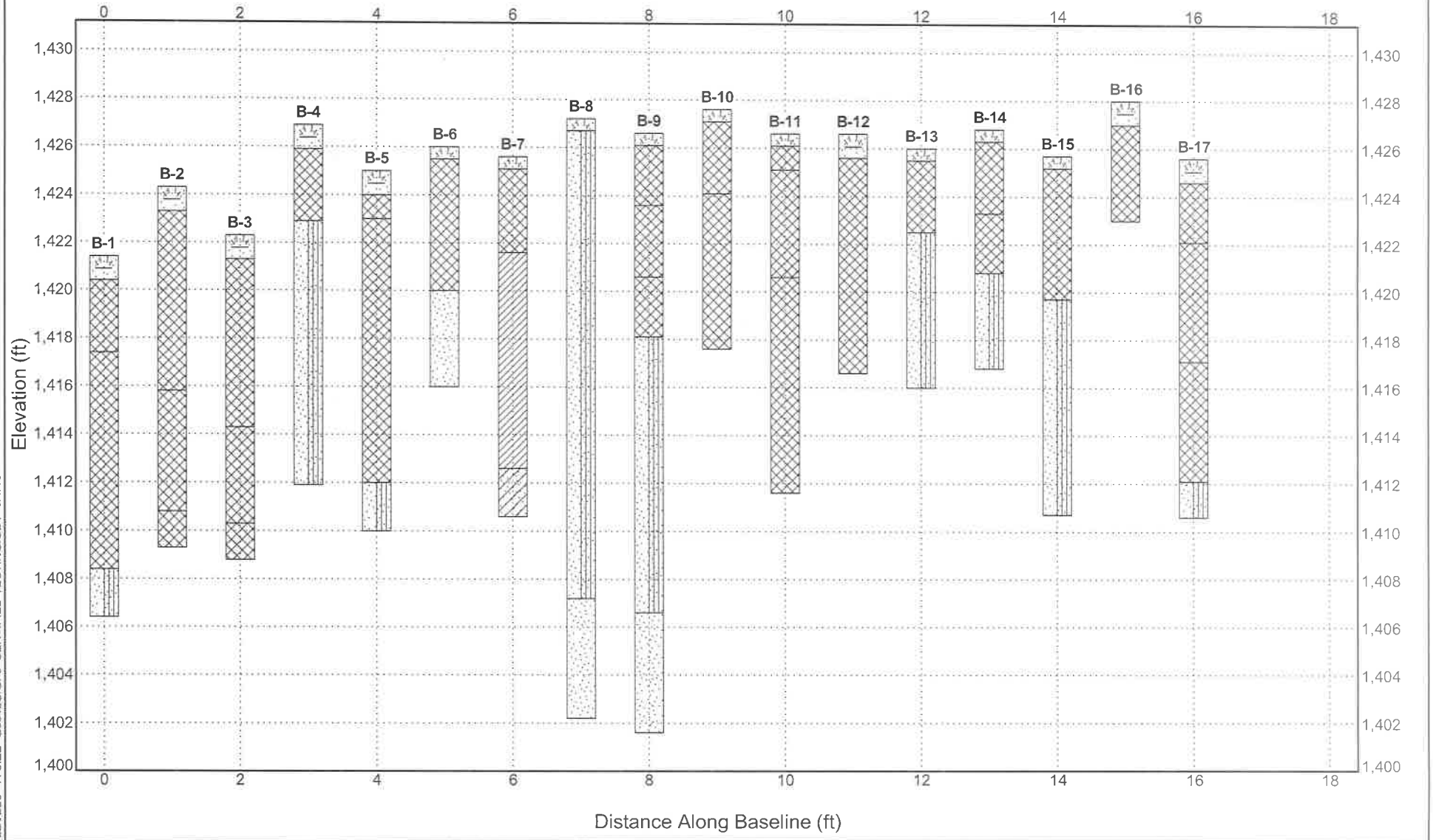
Job Number: G5312S
Project: Middle School and Transportation Building
Date Started: 2/23/18
Date Completed: 2/23/18

Boring No.: B-17
Boring Location: Milford, IA
Drill Type: Hollow Stem
Ground Elev.: 1425.6

Shelby Tube | Standard Split Spoon | Water Level ATD
Modified California | Grab Sample | Water Level After 24 Hours

Depth in Feet	Graphic Log	Sample Type	SOIL DESCRIPTION	USCS	Blow Counts SPT (N) Blows/Foot	Moisture Content, %	Dry Density (PCF)	% Saturation	Hand Penetrometer (TSF)	Unconfined Comp. Strength (TSF)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Cone Penetrometer (Blows per 1-3/4")
			12-Inch Root Zone, 3-Foot Frost Layer at Surface											
			FILL, Clayey Sand with Gravel, Light Brown and Medium Brown, Moist		12-35-25 N= 60	10								
			FILL, Sandy Lean Clay with Gravel, Medium Brown, Moist		8-11-10 N= 21	12								
5			(Sand Layers, Medium Brown and Medium Yellow Brown)		17-23-20 N= 43	12								
			FILL, Clayey Sand, Light Brown, Moist		10-25-21 N= 46	13								
10														
			POORLY GRADED SAND WITH SILT AND GRAVEL, Grayish Yellow Brown, Moist, Dense, Glacial Sand	SP-SM	10-18-15 N= 33	4								
15			END OF BORING AT 15 FEET FREE WATER WAS NOT ENCOUNTERED AT TIME OF DRILLING											

BORING PROFILES



Certified Testing Services, Inc.
419 W. 6th Street, PO Box 1193
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Telephone: 712-252-5132
Fax: 712-252-0110

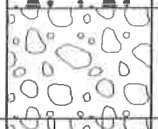
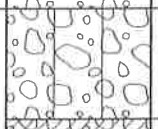
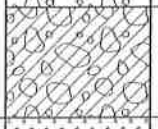
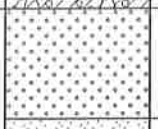
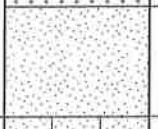
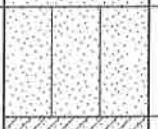
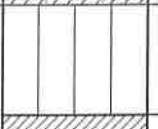
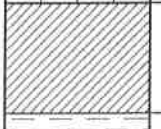
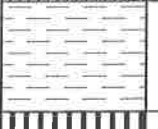
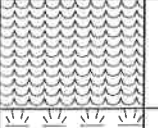
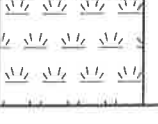
Middle School and Transportation Building
Milford, IA

Project Number: G5312S

LITHOLOGY AND WATER LEVELS - A SIZE G5312S.GPJ CERTIFIED TESTING.GDT 3/1/18

SOIL CLASSIFICATION CHART AND GENERAL NOTES

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

GENERAL NOTES

SAMPLING SYMBOLS:

	STANDARD PENETRATION TEST – 1 3/8: I.D., 2" O.D.
	SHELBY THIN-WALLED TUBE – 3" O.D. UNDISTURBED SAMPLE
	GRAB SAMPLE
	ROCK CORE
	AUGER SAMPLE
	NO RECOVERY

WATER LEVEL MEASUREMENT SYMBOLS:

▽	WATER LEVEL AT TIME OF DRILLING
▼	WATER LEVEL AFTER 7 DAYS

CONSISTENCY OF FINE-GRAINED SOILS	
UNCONFINED COMPRESSIVE STRENGTH, QU, PSF	CONSISTENCY
< 500	VERY SOFT
500 - 1,000	SOFT
1,001 - 2,000	MEDIUM
2,001 - 4,000	STIFF
4,001 - 8,000	VERY STIFF
8,001 - 16,000	HARD
> 16,000	VERY HARD

RELATIVE DENSITY OF COARSE GRAINED SOILS	
N-BLOWS/FT.	RELATIVE DENSITY
0 - 3	VERY LOOSE
4 - 9	LOOSE
10 - 29	MEDIUM DENSE
30 - 49	DENSE
50 - 80	VERY DENSE
80 +	EXTREMELY DENSE

RELATIVE PROPORTIONS OF SAND AND GRAVEL	
DESCRIPTIVE TERM(S) (OF COMPONENTS ALSO PRESENT IN SAMPLE)	PERCENT OF DRY WEIGHT
WITH	15 - 29
MODIFIER	> 30

GRAIN SIZE TERMINOLOGY	
MAJOR COMPONENT OF SAMPLE	SIZE RANGE
BOULDERS	OVER 12 IN. (300MM)
COBBLES	12 IN. TO 3 IN. (300 MM TO 75 MM)
GRAVEL	3 IN. TO #4 SIEVE (75MM TO 4.75MM)
SAND	#4 TO #200 SIEVE (4.75MM TO 0.075 MM)
SILT OR CLAY	PASSING #200 SIEVE (0.075MM)

RELATIVE PROPORTIONS OF FINES	
DESCRIPTIVE TERM(S) (OF COMPONENTS ALSO PRESENT IN SAMPLE)	PERCENT OF DRY WEIGHT
WITH	15 - 29
MODIFIER	> 30