**CITY OF DULUTH**
PURCHASING DIVISION
Room 100 City Hall
411 West First Street
Duluth, Minnesota 55802-1199
218/730-5340 218/730-5922 FAX
purchasing@duluthmn.gov

**Addendum #1**
**File 16-0533**
**Project: Addition to Building at Tree Farm – Riley Road**

This addendum serves to notify all bidders of the following changes to the solicitation documents:

1) The following question and answer are provided:
Q: Who was the original building made by?
A: The structural reactions report suggests the original building was by Varco-Pruden.

2) The bid form has been revised to include an alternative cost to delay construction start until Spring of 2017 and is attached as Exhibit A.

3) Changes to Drawings:

**Sheet A2.0**

1. Add General Notes:
    1. Provide an Alternative cost to delay construction start until spring of 2017.
2. Door Types / Frame Types. Door Type 'C'. Add the following: Overhead Sectional Door: Energy Series with Intellicore Model 3718 manufactured by Clopay Building Products or equal, color to match existing.
3. Keyed Floor Plan Notes. Note #6. Add the following: Polydrain PDX, Banded Bar Grating #208, manufactured by Advanced Building Technologies or equal.
4. Keyed Floor Plan Notes. Add Keyed note #9:
    9. Paint gypsum board wall.
5. 1/A2.0. Floor Plan. Add Keyed Note #9 at each face of dividing wall on grid 1.
6. Keyed Floor Plan Notes. Add Keyed Note #10:
    10. Reinstall Prefinished Metal Liner Panel over gypsum board wall.
7. 1/A2.0. Floor Plan. Add Keyed Note #10 at south face of dividing wall on grid 1.

8. 2/A2.0. Building Section. Typical Exterior Wall. Provide interior Prefinished Metal Liner Panel wainscoting to match existing – extend 8’-0” minimum above finished floor.

**Sheet A3.0**

9. Add General Notes:
   1. Existing vehicle storage east wall height 14’-10”, west wall height 19’-7” – Contractor to verify – addition to match height and profile of existing.

4) Geotechnical Report is provided and attached as Exhibit B.

Please acknowledge receipt of this Addendum by initialing and dating Addendum #1 below the bid form on the invitation for bids.

Posted: September 16, 2016

EXHIBIT A

# BID FORM (REVISED)

# BID # 16-0533

# ADDITION TO BUILDING AT TREE FARM – RILEY ROAD

| ITEM | PRICE |
|---|---|
| Fall 2016 Construction Start | $ |
| Alternate Spring 2017 Construction Start | $ |
| | $ |
| **TOTAL** | $ |

______________________________________________________________________

TOTAL PRICE IN WRITING

## ACKNOWLEDGMENT OF ADDENDA

ADDENDUM # ________ INITIAL/DATE ________

ADDENDUM # ________ INITIAL/DATE ________

ADDENDUM # ________ INITIAL/DATE ________

ADDENDUM # ________ INITIAL/DATE ________

Signature ____________________________________ Date ________________

Name/Title ____________________________________________

Company Name__________________________________________

Address _______________________________________________

City, State, Zip _________________________________________

Tel.______________________ E-Mail __________________________

If your organization is certified as a Disadvantaged Business Enterprise, please check here: ☐

# EXHIBIT B
Geotechnical Report

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
• ENVIRONMENTAL
• GEOTECHNICAL
• MATERIALS
• FORENSICS

# REPORT OF GEOTECHNICAL EXPLORATION AND REVIEW

## Toolhouse Building Addition

Riley Road and Jean Duluth Road
Duluth, Minnesota

AET Project No. 07-06323

**Date:**
June 2, 2015

**Prepared For:**

City of Duluth
Property & Facilities Management
1532 West Michigan Street
Duluth, Minnesota 55806

www.amengtest.com

**American Engineering Testing, Inc.**

CONSULTANTS
• ENVIRONMENTAL
• GEOTECHNICAL
• MATERIALS
• FORENSICS

June 2, 2015

Ms. Tari L. Rayala, AIA
City of Duluth
Property & Facilities Management
1532 West Michigan Street
Duluth, Minnesota 55806

RE: Report of Geotechnical Exploration and Review
Toolhouse Building Addition
Riley Road and Jean Duluth Road
Duluth, Minnesota
AET Project No. 07-06323

Dear Ms. Rayala:

We are pleased to present the results of our subsurface exploration program and geotechnical review for your building addition project in Duluth, Minnesota. These services were performed following your acceptance of our proposal number 07-06323 dated April 27, 2015.

We are submitting one electronic copy and two hard copies of this report to you. This report is the instrument of service defined in our proposal.

We have enjoyed working with you on this phase of the project. Please contact us if you have questions about this report or require further assistance.

Sincerely,
**American Engineering Testing, Inc.**

Taryn J. Erickson, PE
Geotechnical Engineer



4431 West Michigan Street, Suite 4 | Duluth, MN 55807
Phone 218-628-1518 | Toll Free 800-972-6364 | Fax 218-628-1580 | www.amengtest.com | AA/EEO

## Signature Page

Prepared for:

Ms. Tari L. Rayala, AIA
City of Duluth
Property & Facilities Management
Duluth, Minnesota 55806

Prepared by:

American Engineering Testing, Inc.
4431 West Michigan Street, Suite 4
Duluth, Minnesota 55807
(218) 628-1518/www.amengtest.com

Report Authored By:

Taryn J. Erickson

Taryn J. Erickson, PE
Geotechnical Engineer

Review Conducted By:

M J L Hoppe

Megan J. L. Hoppe, PE
Senior Geotechnical Engineer

**I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota**

**Printed Name:** Taryn J. Erickson

**Signature:** Taryn J. Erickson

**Date:** 6/2/15 **License #:** 51795

TABLE OF CONTENTS

## 1.0 INTRODUCTION

The City of Duluth (City) is planning the construction of an addition to their existing toolhouse building near the intersection of Riley Road and Jean Duluth Road. To assist with planning and design, Ms. Tari Rayala, of the City, authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration program at the site and perform a geotechnical engineering review for the project. This report presents the results of the above services, and it provides our engineering recommendations based on this data.

## 2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal number 07-06323 dated April 27, 2015, and authorized by PO 185675 dated April 28, 2015. The authorized scope consists of the following:

- Arrange for the locating of public underground utilities through Gopher State One Call;
- Drill and sample two standard penetration test borings to depths of 20 feet or auger refusal, whichever comes first;
- Perform visual-manual classification and limited laboratory testing of the recovered soil samples; and
- Perform a geotechnical engineering analysis based on this data and prepare this report.

These services are intended for geotechnical purposes, to evaluate the structural properties of the soil. The scope is not intended to explore for the presence or extent of environmental contamination in the soil or groundwater.

## 3.0 PROJECT INFORMATION

The addition will be constructed off the north side of the existing toolhouse building. We understand that the existing toolhouse building is about 5 years old and is supported on an insulated, thickened-edge slab. The addition will be a metal structure, also planned for support on a thickened-edge slab, and it will consist of three new bays. The addition will cover a footprint of 40 feet by 50 feet and will match the finished floor elevation (FFE) of the existing building. Based on plans provided by the City for the existing building, the FFE of the existing slab is 681.5 feet. We understand the addition will be heated; we assume the structure will have an average monthly indoor air temperature of 64ºF or higher.

This information represents our understanding of the proposed construction and is an integral part of our engineering review. It is important that we be contacted if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

## 4.0 SUBSURFACE EXPLORATION AND TESTING

### 4.1 Field Exploration Program

Our subsurface exploration program for the project consisted of drilling two borings with standard penetration testing (SPT) and sampling on May 7, 2015. The City requested the number of borings; AET recommended the depths and locations based on our understanding of the project. AET staked the boring locations by measuring off the existing walls; we recorded the surface elevations at the locations using the existing slab as our benchmark with an elevation of 681.5 feet. The boring locations and surface elevations are shown on Figure 1 in Appendix A.

Prior to drilling, we contacted Gopher State One Call to locate public underground utilities at the site. We drilled the borings using 3¼-inch inside diameter hollow stem augers. Please refer to

Appendix A for details on the drilling and sampling methods, the classification methods, and the water level measurement details.

The boring logs are found in Appendix A and contain information concerning soil layering, geologic description, moisture condition, and USCS classifications. Relative density or consistency is also noted for the natural soils, which are based on the standard penetration resistance (N-value).

### 4.2 Soil Classification

We performed moisture content and hand penetrometer testing on the cohesive samples from the borings. We visually-manually classified the samples based on texture and plasticity according to the Unified Soil Classification System (USCS) (ASTM D2488). Data sheets describing the USCS System, the descriptive terminology, and the symbols used on the boring logs are included in Appendix A.

## 5.0 SITE CONDITIONS

### 5.1 Surface Features

The proposed area for the addition is to the north of the existing building. Based on our boring elevations, the proposed footprint is relatively flat. The surrounding area is an open field to the north and northeast, and it is occupied by stockpiles to the northwest.

### 5.2 Subsurface Soils/Geology

The generalized soil profile found in our borings consisted of 1 to 2 feet of fill, overlying naturally-occurring till and then coarse alluvium. Based on sample appearance and N-values, the 2 feet of lean clay below the fill in SB-01 may also be fill. The fill consisted of organic silty clay and lean clay with sand. The till consisted of silty clayey sand and sandy silty clay; the coarse alluvium consisted of sand.

### 5.3 Water Level Measurements

We encountered groundwater in boring SB-01 at a depth of 18 feet within a layer of relatively fast draining sand. However, the overlying clayey soils on this site have a relatively low permeability. Therefore, an extended period of time (several days) could be needed for groundwater levels to reach equilibrium in these open boreholes.

The groundwater levels on this site, hydrostatic and perched, will vary in elevation seasonally and annually depending on local precipitation, infiltration, and runoff. The presence or absence of groundwater will depend in part on precipitation or snow melt prior to construction.

## 6.0 RECOMMENDATIONS

### 6.1 Approach Discussion

Based on the soil conditions found in our borings and our understanding of the project, the addition may be supported on a thickened-edge slab <u>after</u> proper site preparation. This should include removing the existing fill under the addition footprint and then placing and compacting non-frost susceptible (NFS) fill to design grades. The thickened slab foundation must have proper thermal insulation to protect against frost penetration. Details of our recommendations are presented below.

### 6.2 Site Preparation

#### *6.2.1 Excavation*

The existing fill and any organic soils should be removed from the planned addition footprint. Based on our borings, we estimate subcut depths below existing grade of about 4 feet at Boring SB-01 and about 1 foot at Boring SB-02 to remove the existing fill. However, the actual excavation depths required to remove the existing fill may be shallower or deeper. These depths should be determined by a geotechnical engineer or material technician performing observation of the base soils at the time of excavation. The soils removed should not be reused below the addition area; we recommend non-frost susceptible (NFS) engineered fill be placed to re-establish design grades.

In addition, for proper support and drainage of the insulated thickened-edge slab/foundation system, we recommend the entire thickened-edge slab system be supported on a minimum 6-inch thick layer of non-frost susceptible (NFS) engineered fill. We recommend the non-frost susceptible (NFS) engineered fill layer have a fairly uniform thickness, which will likely require the excavation bottom be sloped to provide a transition between the minimum and maximum subcut depths anticipated at the boring locations. We recommend the excavation bottom be sloped at a grade of 10:1 (H:V) or flatter.

We anticipate naturally-occurring stiff/medium dense till at the bottom of the subcut. Any soils at the bottom of the excavations that are disturbed or loose/soft should be compacted to improve density, or they should be further subcut and replaced. We recommend that the excavator use a backhoe with a smooth-edged bucket (rather than a toothed bucket) to avoid tearing/disturbing the base soils.

We recommend that the zone of subcutting be laterally extended at least 3 feet beyond the outside edge of the new thickened-edge slab or a distance equal to the subcut depth below the thickened edge, whichever is greater. The oversize zone should be measured at the <u>base</u> of the excavation. This recommended oversize zone should provide a minimum 1:1 (H:V) lateral oversizing of the NFS engineered fill below the thickened-edge and the horizontal insulation (which is discussed in subsequent Section 6.4).

The contractor must be careful to avoid damaging or undermining the existing building foundations during excavation and construction of the new addition.

### *6.2.2 Fill Placement and Compaction*

All new fill placed for support of the thickened-edge slab and foundation system should consist of NFS engineered fill. For this site, we recommend the NFS engineered fill consist of a clean, medium grained sand meeting the following gradation requirements.

| Sieve Designation | Percent Passing |
|---|---|
| 3-inch | 100% |
| Ratio No. 40 / 1-inch | 0 - 40% |
| Ratio No. 200 / 1-inch | 0 - 5% |

If the contractor wishes to propose a different gradation of material, they should submit a sample to AET at least three weeks before the start of construction for gradation testing and assessment by a geotechnical engineer. Uniformly-graded fine sand, silty sand, clayey sand, or other fine grained soils will not be suitable.

The NFS engineered fill should be placed in loose lifts about 6 to 8 inches thick, with each lift mechanically compacted to at least 95% of the Standard Proctor maximum dry density (ASTM:D698).

## 6.3 Drainage

We recommend placement of drainage system at the base of the NFS engineered fill zone to remove infiltrating water. The drainage system should consist of perforated or slotted PVC drainage pipes surrounded by properly graded filter rock, and a filter fabric should envelope the filter rock. The drain pipes should be connected to a suitable means of disposal, such as a sump basket or a gravity outfall. A storm sewer gravity outfall would be preferred over exterior daylighting, as the latter may freeze during winter.

## 6.4 Foundation Design

After the site has been prepared as described above, the structure may be supported on a thickened-edge slab properly insulated to eliminate the need to embed the thickened-edge below frost depth. The air-freezing index for Duluth is approximately 3,130 ºF-Days; therefore, for a heated addition, we recommend the thickened edge bear at least 22 inches below exterior grade.

The thickened-edge slab bearing on at least 6 inches of NFS engineered fill placed and compacted over competent native soils can be designed for a maximum net allowable soil bearing pressure of up 2,500 pounds per square foot. It is our judgment this design pressure will provide a factor of safety up to 3 against soil bearing capacity failure.

With this design, we estimate that total settlement of the addition will be ¾ inch or less, with differential settlement less than half this amount provided the bearing soils are not soft, wet, disturbed, or frozen before or after construction. Please note that the total settlement of the addition will be differential to the existing building, which has likely experienced most of its settlement; the structural engineer and architect must consider this when designing connections between the existing building and addition.

We recommend that thermal insulation be placed vertically along the exterior edge of the thickened slab and out horizontally from the building. The insulation should consist of extruded polystyrene (XPS) in accordance with ASTM C578.

The vertical insulation should have a minimum thickness of 1½ inches. It should be placed on the exterior of the slab and should extend from the top of the slab to the bottom of the thickened edge. The vertical insulation must have a weather-resistant protective covering in order to protect the insulation from degradation, physical damage, or other deterioration. The covering must be compatible with the insulation material, cover all of the exposed insulation, and extend at least 6 inches below the final finished grade.

If the thickened-edge bears at least 22 inches below exterior grade; the horizontal insulation can be limited to the areas extending 4 feet along the wall each way from the two addition corners. This horizontal insulation should have a minimum thickness of 1½ inches and should extend out from the bottom of the vertical insulation at least 2 feet. The horizontal insulation should be sloped downward away from the addition for drainage and should be placed over a smooth, compacted surface consisting of NFS engineered fill.

### 6.5 Floor Slab Design

Interior backfill in underslab utility trenches should consist of NFS fill meeting the gradation and compaction requirements provided in Section 6.2.2 of this report.

Based on a subgrade prepared as discussed in Section 6.2, the structural engineer may use a modulus of subgrade reaction of 200 pounds per cubic inch to design the floor slab thickness and reinforcement.

We recommend that a vapor retarder be placed under the floor slab; the purpose of a vapor retarder is to reduce the potential for the upward migration of water vapor from the soil into and through the concrete slab. Water vapor migrating upward through the slab can damage floor coverings such as the carpeting, wood, or paint/sealers, and it can contribute to excess humidity and microbial growth in the building. Various methods of vapor retarder construction are described in Part 2, Section 302 of the American Concrete Institute *Manual of Concrete Practice*.

### 6.6 Exterior Backfill

Exterior backfill above the NFS fill zone and all of the horizontal insulation should include a surface cap of low permeability material, such as clay, Class 5 aggregate surfacing/base, or pavement. The soil cap should be compacted and should be at least 12 inches thick. The surficial low permeability cap should be sloped down and away from the addition at least 1 inch in 10 feet to promote drainage away from the backfill and insulation.

All exterior backfill should be placed in loose lifts about 6 inches thick, with each lift mechanically compacted using only manually-operated vibratory or impact equipment to at least 95% of the Standard Proctor maximum dry density (ASTM:D698).

## 7.0 CONSTRUCTION CONSIDERATIONS

### 7.1 Groundwater

Although we encountered groundwater in one of our borings, we do not anticipate that the contractor will encounter hydrostatic groundwater in the excavations for the structure. However, surface water can perch over the rather slow draining soils at this site. To allow observation of the excavation bottom and to reduce the potential for soil disturbance or softening, we recommend that all water (groundwater seepage, precipitation, or runoff) be removed from excavations prior to placement of compacted fill or concrete. The contractor should not excavate in standing water or place fill or concrete into standing water in an attempt to displace it. This technique can result in trapping softened soils under the building, causing excess post-construction settlement even if the softened zone is only a few inches thick.

### 7.2 Excavation Sidesloping

The excavations for this project must have side slopes in accordance with OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, “Excavations” (can be found at www.osha.gov). Even with the required OSHA sloping, water could induce side slope erosion which could require slope maintenance. The decision on excavating safe slopes for this project should be made by the excavator’s “competent person.” AET will not accept any liability or responsibility for excavation safety on this project.

### 7.3 Soil Disturbance

The soils found at the site are susceptible to disturbance by construction equipment and workers’ foot traffic. The soils should be protected until a final observation can be made immediately prior to placing new fill or concrete. The responsibility to avoid disturbing the soils by choosing proper equipment and methods lies solely with the contractor.

### 7.4 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our boring locations. We recommend that the base soils be observed and tested by an experienced material technician or a geotechnical engineer. The fill materials should be tested for gradation and Proctor values, and field density tests should be performed as the fill is placed and compacted.

## 8.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to perform our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, expressed or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use."

# Appendix A

AET Project No. 07-06323

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs

## A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by performing two standard penetration test (SPT) borings on May 7, 2015. The locations of the borings appear on Figure 1 preceding the Subsurface Boring Logs in this appendix.

## A.2 SAMPLING METHODS

### A.2.1 Split-Spoon Samples (SS)

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. After an initial set of 6 inches, the number of hammer blows to drive the sampler the next 12 inches is known as the standard penetration resistance or N-value.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in that system. That converted energy provided what is known as an $N_{60}$ blow count.

Most drill rigs today incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional $N_{60}$ values. We use a Pile Driving Analyzer (PDA) and an instrumented rod to measure the actual energy generated by the automatic hammer system. The drill rig we used for this project (AET drill rig number 51) has a measured energy transfer ratio of 80%. The N-values reported on the boring logs and the corresponding relative densities and consistencies are from the field blow counts and have not been adjusted to $N_{60}$ values.

### A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as “DS” or “SU” on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

### A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring log.

Determining the thickness of “topsoil” layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the log should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

## A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring log are based on the Unified Soil Classification System (USCS). The USCS is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil descriptions shown on the boring log are visual-manual judgments. Charts are attached which provide information on the USCS system, the descriptive terminology, and the symbols used on the boring log.

The boring log includes descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

**A.4 WATER LEVEL MEASUREMENTS**

The ground water level measurements are shown at the bottom of the boring log. The following information appears under "Water Level Measurements" on the log:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring location may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

**A.5 TEST STANDARD LIMITATIONS**

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

**A.6 SAMPLE STORAGE**

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

# BORING LOG NOTES

## DRILLING AND SAMPLING SYMBOLS

| Symbol | Definition |
|---|---|
| B,H,N: | Size of flush-joint casing |
| CA: | Crew Assistant (initials) |
| CAS: | Pipe casing, number indicates nominal diameter in inches |
| CC: | Crew Chief (initials) |
| COT: | Clean-out tube |
| DC: | Drive casing; number indicates diameter in inches |
| DM: | Drilling mud or bentonite slurry |
| DR: | Driller (initials) |
| DS: | Disturbed sample from auger flights |
| FA: | Flight auger; number indicates outside diameter in inches |
| HA: | Hand auger; number indicates outside diameter |
| HSA: | Hollow stem auger; number indicates inside diameter in inches |
| LG: | Field logger (initials) |
| MC: | Column used to describe moisture condition of samples and for the ground water level symbols |
| N (BPF): | Standard penetration resistance (N-value) in blows per foot (see notes) |
| NQ: | NQ wireline core barrel |
| PQ: | PQ wireline core barrel |
| RD: | Rotary drilling with fluid and roller or drag bit |
| REC: | In split-spoon (see notes) and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered. |
| REV: | Revert drilling fluid |
| SS: | Standard split-spoon sampler (steel; 1d" is inside diameter; 2" outside diameter); unless indicated otherwise |
| SU | Spin-up sample from hollow stem auger |
| TW: | Thin-walled tube; number indicates inside diameter in inches |
| WASH: | Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid |
| WH: | Sampler advanced by static weight of drill rod and 140-pound hammer |
| WR: | Sampler advanced by static weight of drill rod |
| 94mm: | 94 millimeter wireline core barrel |
| ▼: | Water level measured in borehole prior to abandonment |
| ▽: | Interim water level measurement or estimated water level based on sample appearance |

## TEST SYMBOLS

| Symbol | Definition |
|---|---|
| CONS: | One-dimensional consolidation test |
| DEN: | Dry density, pcf |
| DST: | Direct shear test |
| E: | Pressuremeter Modulus, tsf |
| HYD: | Hydrometer analysis |
| LL: | Liquid Limit, % |
| LP: | Pressuremeter Limit Pressure, tsf |
| OC: | Organic Content, % |
| PERM: | Coefficient of permeability (K) test; F - Field; L - Laboratory |
| PL: | Plastic Limit, % |
| $q_p$: | Pocket Penetrometer strength, tsf (approximate) |
| $q_c$: | Static cone bearing pressure, tsf |
| $q_u$: | Unconfined compressive strength, psf |
| R: | Electrical Resistivity, ohm-cms |
| RQD: | Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run) |
| SA: | Sieve analysis |
| TRX: | Triaxial compression test |
| VSR: | Vane shear strength, remoulded (field), psf |
| VSU: | Vane shear strength, undisturbed (field), psf |
| WC: | Water content, as percent of dry weight |
| %-200: | Percent of material finer than #200 sieve |

## STANDARD PENETRATION TEST NOTES

The standard penetration test consists of driving the sampler with a 140 pound hammer and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM:D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM:D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

# UNIFIED SOIL CLASSIFICATION SYSTEM
# ASTM Designations: D 2487, D2488

**AMERICAN ENGINEERING TESTING, INC.**

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A] | | | | Soil Classification: Group Symbol | Soil Classification: Group Name[B] |
|---|---|---|---|---|---|
| Coarse-Grained Soils More than 50% retained on No. 200 sieve | Gravels More than 50% coarse fraction retained on No. 4 sieve | Clean Gravels Less than 5% fines[C] | $Cu \geq 4$ and $1 \leq Cc \leq 3$[E] | GW | Well graded gravel[F] |
| | | | $Cu<4$ and/or $1>Cc>3$[E] | GP | Poorly graded gravel[F] |
| | | Gravels with Fines more than 12% fines[C] | Fines classify as ML or MH | GM | Silty gravel[F.G.H] |
| | | | Fines classify as CL or CH | GC | Clayey gravel[F.G.H] |
| | Sands 50% or more of coarse fraction passes No. 4 sieve | Clean Sands Less than 5% fines[D] | $Cu \geq 6$ and $1 \leq Cc \leq 3$[E] | SW | Well-graded sand[I] |
| | | | $Cu<6$ and $1>Cc>3$[E] | SP | Poorly-graded sand[I] |
| | | Sands with Fines more than 12% fines[D] | Fines classify as ML or MH | SM | Silty sand[G.H.I] |
| | | | Fines classify as CL or CH | SC | Clayey sand[G.H.I] |
| Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below) | Silts and Clays Liquid limit less than 50 | inorganic | PI>7 and plots on or above “A” line[J] | CL | Lean clay[K.L.M] |
| | | | PI<4 or plots below “A” line[J] | ML | Silt[K.L.M] |
| | | organic | Liquid limit–oven dried / Liquid limit – not dried <0.75 | OL | Organic clay[K.L.M.N]<br>Organic silt[K.L.M.O] |
| | Silts and Clays Liquid limit 50 or more | inorganic | PI plots on or above “A” line | CH | Fat clay[K.L.M] |
| | | | PI plots below “A” line | MH | Elastic silt[K.L.M] |
| | | organic | Liquid limit–oven dried / Liquid limit – not dried <0.75 | OH | Organic clay[K.L.M.P]<br>Organic silt[K.L.M.Q] |
| Highly organic soil | | | Primarily organic matter, dark in color, and organic in odor | PT | Peat[R] |

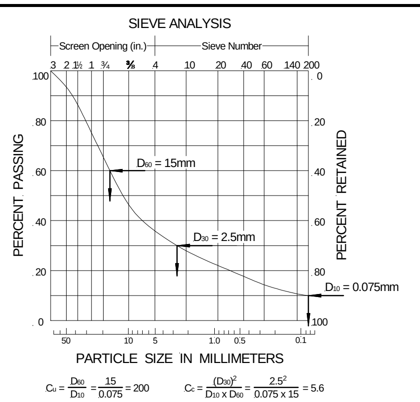
## Notes

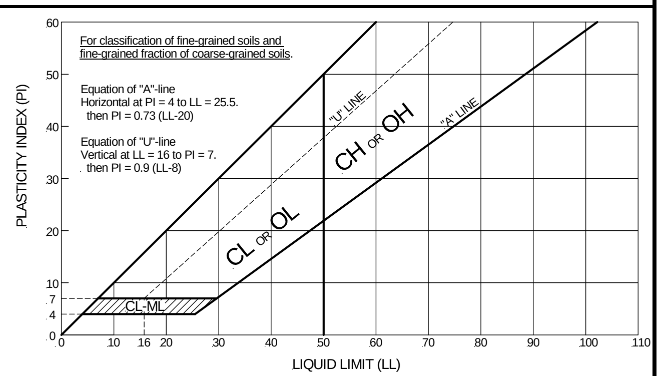
[A]Based on the material passing the 3-in (75-mm) sieve.
[B]If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.
[C]Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains $\geq$15% sand, add “with sand” to group name.
[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H]If fines are organic, add “with organic fines” to group name.
[I]If soil contains $\geq$15% gravel, add “with gravel” to group name.
[J]If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.
[K]If soil contains 15 to 29% plus No. 200 add “with sand” or “with gravel”, whichever is predominant.
[L]If soil contains $\geq$30% plus No. 200, predominantly sand, add “sandy” to group name.
[M]If soil contains $\geq$30% plus No. 200, predominantly gravel, add “gravelly” to group name.
[N]PI$\geq$4 and plots on or above “A” line.
[O]PI<4 or plots below “A” line.
[P]PI plots on or above “A” line.
[Q]PI plots below “A” line.
[R]Fiber Content description shown below.



Plasticity Chart

## ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

**Grain Size**

| Term | Particle Size |
|---|---|
| Boulders | Over 12" |
| Cobbles | 3" to 12" |
| Gravel | #4 sieve to 3" |
| Sand | #200 to #4 sieve |
| Fines (silt & clay) | Pass #200 sieve |

**Gravel Percentages**

| Term | Percent |
|---|---|
| A Little Gravel | 3% - 14% |
| With Gravel | 15% - 29% |
| Gravelly | 30% - 50% |

**Consistency of Plastic Soils**

| Term | N-Value, BPF |
|---|---|
| Very Soft | less than 2 |
| Soft | 2 - 4 |
| Firm | 5 - 8 |
| Stiff | 9 - 15 |
| Very Stiff | 16 - 30 |
| Hard | Greater than 30 |

**Relative Density of Non-Plastic Soils**

| Term | N-Value, BPF |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 5 - 10 |
| Medium Dense | 11 - 30 |
| Dense | 31 - 50 |
| Very Dense | Greater than 50 |

**Moisture/Frost Condition** (MC Column)

| | |
|---|---|
| D (Dry): | Absense of moisture, dusty, dry to touch. |
| M (Moist): | Damp, although free water not visible. Soil may still have a high water content (over “optimum”). |
| W (Wet/ Waterbearing): | Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt. |
| F (Frozen): | Soil frozen |

**Layering Notes**

| | |
|---|---|
| Laminations: | Layers less than ½" thick of differing material or color. |
| Lenses: | Pockets or layers greater than ½" thick of differing material or color. |

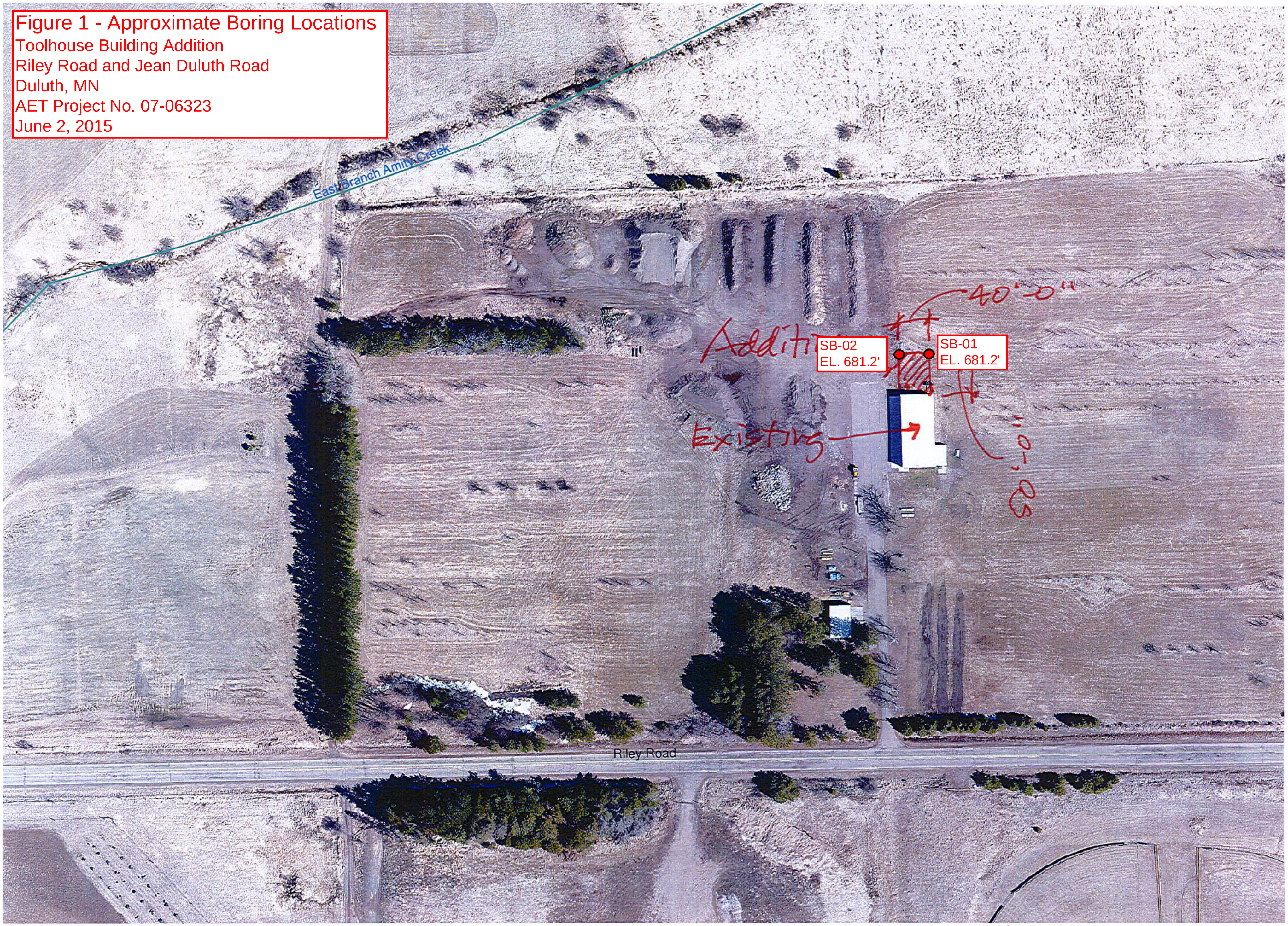
**Fiber Content of Peat**

| Term | Fiber Content (Visual Estimate) |
|---|---|
| Fibric Peat: | Greater than 67% |
| Hemic Peat: | 33 – 67% |
| Sapric Peat: | Less than 33% |

**Organic/Roots Description (if no lab tests)**

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the soil properties. *Slightly organic* used for borderline cases.

| | |
|---|---|
| With roots: | Judged to have sufficient quantity of roots to influence the soil properties. |
| Trace roots: | Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties. |




Toolhouse @ Tree Farm; Jean Duluth + Riley Roads
City of Duluth

AMERICAN ENGINEERING TESTING, INC.

# SUBSURFACE BORING LOG

AET JOB NO: **07-06323**  LOG OF BORING NO. **SB-01 (p. 1 of 1)**

PROJECT: **Toolhouse Building Addition; Riley Road and Jean Duluth Road; Duluth, MN**

SURFACE ELEVATION: **681.2**

| DEPTH IN FEET | MATERIAL DESCRIPTION | GEOLOGY | N | MC | SAMPLE TYPE | REC IN. | WC | DD | LL | PL | %-#200 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–2 | FILL, lean clay with sand, a little gravel, trace roots, brown | FILL | 9 | M | SS | 12 | 15 | | | | |
| 2–4 | LEAN CLAY WITH SAND, a little gravel, brown, may be fill (CL) | TILL OR FILL | 13 | M | SS | 8 | 11 | | | | |
| 4–15 | SILTY CLAYEY SAND, a little gravel, brown, moist, medium dense (SC-SM) | TILL | 20 | M | SS | 6 | 13 | | | | |
| | | | 22 | M | SS | 12 | | | | | |
| | | | 19 | M | SS | 14 | | | | | |
| | | | 18 | M | SS | 3 | | | | | |
| 15–18 | SANDY SILTY CLAY, a little gravel, brown, stiff (CL-ML) | | 14 | M | SS | 12 | 20 | | | | |
| 18–21 | SAND, fine to medium grained, brown, wet, loose (SP) | COARSE ALLUVIUM | 4 | W | SS | 8 | | | | | |

**END OF BORING AT 21.0 FEET**
*Boring backfilled with auger cuttings*

| DEPTH: | DRILLING METHOD |
|---|---|
| 0-19½' | 3.25" HSA |

WATER LEVEL MEASUREMENTS

| DATE | TIME | SAMPLED DEPTH | CASING DEPTH | CAVE-IN DEPTH | DRILLING FLUID LEVEL | WATER LEVEL |
|---|---|---|---|---|---|---|
| 5/7/15 | | 21.0 | 19.5 | 19.0 | -- | 18.0 |

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

BORING COMPLETED: **5/7/15**

DR: **LA** LG: **KH** Rig: **51**

06/06

AMERICAN ENGINEERING TESTING, INC.

# SUBSURFACE BORING LOG

AET JOB NO: **07-06323**  LOG OF BORING NO. **SB-02 (p. 1 of 1)**

PROJECT: **Toolhouse Building Addition; Riley Road and Jean Duluth Road; Duluth, MN**

SURFACE ELEVATION: **681.2**

| DEPTH IN FEET | MATERIAL DESCRIPTION | GEOLOGY | N | MC | SAMPLE TYPE | REC IN. | WC | DD | LL | PL | %-#200 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–1 | FILL, organic silty clay, trace roots, dark brown | FILL | 5 | M | SS | 12 | 21 | | | | |
| 1–4 | SILTY CLAYEY SAND, trace roots, brown, moist, medium dense (SC-SM) | TILL | 12 | M | SS | 6 | 12 | | | | |
| 4–8.5 | SANDY SILTY CLAY, a little gravel, brown, stiff (CL-ML) | | 15 | M | SS | 12 | 13 | | | | |
| | | | 15 | M | SS | 12 | 16 | | | | |
| 8.5–11.5 | SILTY CLAYEY SAND WITH GRAVEL, brown, moist, dense (SC-SM) | | 36 | M | SS | 12 | | | | | |
| 11.5–21 | SANDY SILTY CLAY, a little gravel, dark brown, stiff to hard (CL-ML) | | 13 | M | SS | 12 | 15 | | | | |
| | | | 21 | M | SS | 0 | | | | | |
| | | | 40 | M | SS | 3 | | | | | |
| 21 | **END OF BORING AT 21.0 FEET**<br>*Boring backfilled with auger cuttings* | | | | | | | | | | |

| DEPTH: | DRILLING METHOD |
|---|---|
| 0-19½' | 3.25" HSA |

WATER LEVEL MEASUREMENTS

| DATE | TIME | SAMPLED DEPTH | CASING DEPTH | CAVE-IN DEPTH | DRILLING FLUID LEVEL | WATER LEVEL |
|---|---|---|---|---|---|---|
| 5/7/15 | | 21.0 | 19.5 | 19.0 | -- | None |

BORING COMPLETED: **5/7/15**

DR: **LA** LG: **KH** Rig: **51**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

# Appendix B

AET Project No. 07-06323

## Geotechnical Report Limitations and Guidelines for Use

# Geotechnical Report Limitations and Guidelines for Use
# AET Project No. 07-06323

## B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by ASFE[1], of which, we are a member firm.

## B.2 RISK MANAGEMENT INFORMATION

### B.2.1 Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

### B.2.2 Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

### B.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typically factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, always inform your geotechnical engineer of project changes, even minor ones, and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

### B.2.4 Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

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1 ASFE, 8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 : www.asfe.org

**B.2.5 Most Geotechnical Findings Are Professional Opinions**
Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

**B.2.6 A Report's Recommendations Are Not Final**
Do not overrely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

**B.2.7 A Geotechnical Engineering Report Is Subject to Misinterpretation**
Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

**B.2.8 Do Not Redraw the Engineer's Logs**
Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

**B.2.9 Give Contractors a Complete Report and Guidance**
Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need to prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

**B.2.10 Read Responsibility Provisions Closely**
Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their report. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

**B.2.11 Geoenvironmental Concerns Are Not Covered**
The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.