AMERICAN
ENGINEERING TESTING

REPORT OF GEOTECHNICAL EXPLORATION

C. Reiss Dock Development
St. Louis Bay
Superior, Wisconsin

AET Project No. P-0014588

Date: August 22, 2022

Prepared for:
Stantec
209 Commerce Parkway
Cottage Grove, Wisconsin 53527

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Forensic • Environmental
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August 22, 2022

Mr. Carl Broberg, P.E.
Stantec
209 Commerce Parkway
Cottage Grove, Wisconsin 53527

RE: Report of Geotechnical Exploration
C. Reiss Dock Development
St. Louis Bay
Superior, Wisconsin
AET Project No. P-0014588

Dear Mr. Broberg:

We are pleased to present the results of our subsurface exploration program for your C. Reiss Dock Development project in Superior, Wisconsin. These services were performed according to the Task Order you issued to AET dated June 24, 2022.

We are submitting an electronic (PDF) version of this geotechnical report to you. Unless you request otherwise, we will not submit any hard copies of the report.

We appreciate the opportunity to work 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.

Benjamin B. Mattson, P.E.
Senior Geotechnical Engineer

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August 22, 2022

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1.0 INTRODUCTION

Stantec is providing planning and engineering services for the proposed C. Reiss Dock development in St. Louis Bay in Superior, Wisconsin. To assist planning and design, Mr. Carl Broberg, P.E., of Stantec 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 provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET's services were performed according to the Task Oder Stantec issued to AET dated June 24, 2022. The authorized scope consists of:

- Ten standard penetration test borings to depths of 20 to 100 feet each
- Visual/manual classification and limited laboratory testing of the recovered soil samples
- Geotechnical engineering review based on the gained data and preparation of this report

These services are intended for geotechnical purposes. The scope is not intended to explore for the presence or extent of environmental contamination.

3.0 PROJECT INFORMATION

The proposed C. Reiss Dock project will develop an existing land dock into a coal shipping facility. The facility will include roads, rail spurs, a passenger vehicle parking lot, an office building, a truck scale, a storage and maintenance building, various conveyor systems, a rail scale, and a stormwater management pond. In general, it appears site grading will consist of cuts of up to about 8 feet and fills of up to about 5 feet. Geotechnical analysis/review of the bulkhead walls is being performed by others and is not part of AET's scope of service. The above-stated information represents our understanding of the project and is an integral part of our engineering review. It is important we be contacted if there are changes from that described so we can evaluate if modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Subsurface Exploration

Our subsurface exploration program consisted of drilling a total of ten borings with standard penetration testing (SPT) and sampling on July 6 through 11, 2022. Stantec selected the number of borings; Stantec and AET mutually agreed on the locations; and AET selected the planned (and final) boring depths. We adjusted the boring depths during drilling based on the encountered subsurface conditions. The boring locations are shown on Figure 1 in Appendix A.

Prior to drilling, we contacted Wisconsin Diggers Hotline to locate public underground utilities at the site. We drilled the borings using 3¼-inch-inside-diameter hollow-stem augers and mud rotary techniques. 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 Laboratory Testing

We performed thirty-five moisture content tests, twenty-five unconfined compressive strength tests (qp, pocket penetrometer), four Atterberg limits tests, and six sieve analysis tests on the recovered soil samples. The moisture content, unconfined compressive strength, and Atterberg limits results are shown on the boring logs, adjacent to the sample on which each test was performed. The sieve analysis results are provided after the boring logs.

Wisconsin Department of Safety and Professional Services (DSPS) form SBD-10793 “Soil Evaluation – Storm” is included in Appendix A. This form includes USDA soil classifications, infiltration rates established by State of Wisconsin code (based on soil texture), and other characteristics of the soils we encountered in boring B-05.

5.0 SITE CONDITIONS

5.1 Surface Observations

The site is primarily occupied by trees and ground vegetation in the south and eastern portions of the site. The ground surface is covered by a concrete surface in most of the remaining area.

5.2 Soils

Below the surficial organic soils or concrete pavement, we encountered fill overlying fine alluvium, coarse alluvium, and mixed alluvium. The fill was highly variable mixtures of sand, gravel, silt, and clay, there were also layers of coal and concrete debris, and layers having organics. At borings B-01 through B-08, the fine alluvium was soft to hard fat clay and medium dense to very dense silt with varying sand content. At B-09 and B-10, the fine alluvium was very loose to loose silt with varying sand and organic contents. At borings B-01 through B-08, the coarse alluvium was medium dense to very dense sand with varying silt content. At B-09 and B-10, the coarse alluvium was very loose to medium dense sand with varying silt contents; several of these layers also had organics and/or pieces of wood. The mixed alluvium (B-02 only) was dense clayey sand.

5.3 Groundwater

We measured groundwater at depths ranging from 2.4 to 22.3 feet in our borings. The groundwater depths generally got shallower from south to north. The installation of piezometers for obtaining additional groundwater level measurements was beyond our scope of service. Groundwater levels will fluctuate due to varying seasonal and annual rainfall and snow melt amounts and other factors, including the level of Lake Superior.

6.0 STRUCTURE RECOMMENDATIONS

6.1 Approach Discussion

Based on the subsurface conditions found in our borings and our understanding of the project, it is our opinion there are several foundation options for the proposed structures (at borings B-04, B-06, B-07, and B-08). These soil correction/foundation options are described in the following sections, in no particular order of geotechnical preference, and include:

- Soil correction by excavation (subcutting) and replacement of unsuitable soils (in conjunction with conventional footings)
- Rammed-aggregate pier ground improvement (in conjunction with conventional footings)
- Helical piles

Soil conditions will vary throughout the project site and it is possible some of these foundation options would not be suitable at other locations. For example, soil correction by subcutting and replacement methods would not be suitable at the locations of borings B-09 and B-10 due to the presence of weak, compressible soils to depths such that excavation is not feasible. Other types of foundations (e.g. driven piles, drilled shafts) could also be suitable but they would probably cost more and are not discussed in this report.

Details of our recommendations are presented below.

6.2 Foundation Option #1: Excavation of Unsuitable Soils

6.2.1 Site Preparation – Excavation

To prepare the structure areas for foundation and floor slab support, we recommend removal of all vegetation, organic soils, existing fill, and other unsuitable soils that are encountered. Our estimated subcut depths are shown in Table 1. An experienced soils technician or geotechnical engineer must perform observations during construction to determine actual required subcut depths, which could be more or less than anticipated.

Table 1: Estimated Subcut Depths

Boring No.	Estimated Subcut Depth (feet)	Planned Structure
B-04	~3.5	Office Building & Truck Scale
B-06	~7	Conveyor Structure
B-07	~7.5	Storage & Maintenance Building
B-08	~9.5	Rail Scale

Where subcutting extends below the proposed foundation grade, the excavation bottom and resultant engineered fill system must be oversized laterally beyond the planned outside edges of the foundation to properly support the loads exerted by that foundation. This engineered fill lateral extension should at least be equal to the vertical depth of fill needed to attain foundation grade at that location (i.e., 1:1 lateral oversize).

After removing all unsuitable materials, and prior to the placement of new fill or concrete, we recommend that the base soils be surface densified to compact loose zones and to correct zones loosened by the excavating process.

It is possible temporary construction dewatering will be needed at some locations. For example, at borings B-06, B-07, and B-08, soil correction is expected to extend about 2 to 4 feet below the water levels we measured in our borings. The selection and design of any dewatering system is not included in our scope of service.

6.2.2 Fill Placement and Compaction

In general, we do not expect the on-site soils will be suitable for re-use in structure areas. (While there are some sandy soils at the site, it does not appear they are located in planned cut areas.) Fill imported for structural support should be non-organic granular soils having a maximum of 12% by weight passing the No. 200 sieve, and a maximum particle size of 2 inches. Crushed stone (or other rocky materials) could be a suitable alternative, but we should be contacted to review the gradation of any proposed alternative fill material.

Fill placed to attain grade for foundation and/or slab support should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 98% of its maximum standard Proctor dry density (ASTM D698). We anticipate a lift thickness on the order of 6 to 8 inches may be appropriate, although this should be reviewed in the field at the time of construction.

6.2.3 Foundation Design

The proposed office building and truck scale (B-04), conveyor structure (B-06), storage and maintenance building (B-07), and rail scale (B-08) can be supported on conventional shallow foundation systems bearing on competent naturally-occurring soils, or on fill placed and compacted over a suitable subgrade, provided the site has been prepared in accordance with the above recommendations. We recommend that perimeter foundations for heated building spaces bear a minimum of 5 feet below exterior grade for protection from frost penetration. Footings in unheated areas should be extended to a minimum of 7 feet below surrounding grade. We recommend that column footings and continuous wall footings for this project have minimum widths of 3 feet and 15 inches, respectively, even if the contact pressure is less than the allowable bearing pressure.

Based on the subsurface conditions we encountered and provided our recommendations are followed, it is our opinion the foundations for the proposed structures (listed above) can be designed based on a net maximum allowable soil bearing pressure of 4,000 psf. It is our judgment this design pressure will have a factor of safety of at least 3 against the ultimate bearing capacity.

With this design we estimate maximum total settlement of each structure of up to 1 inch, and differential settlements of half this amount over a 30-foot distance, if the bearing soils are not soft, wet, disturbed, or frozen at the time of construction.

We recommend using a coefficient of sliding friction of 0.3 for the interface between cast-in-place concrete and a competent sandy subgrade. It is our opinion this value includes a factor of safety of at least 1.5. If the subgrade soils are clayey and sliding resistance is needed, we recommend placing a 1-foot-thick layer of crushed stone between the clayey subgrade and the concrete foundation.

6.2.4 Floor Slab Design

We recommend the top 6 inches of soil below the floor slabs consist of dense-graded base course or crushed stone. Interior backfill in under slab utility trenches and in footing trenches should be held to the same requirements of Section 6.2.2. Provided our site preparation recommendations are followed, the structural engineer can use a modulus of subgrade reaction of 200 pounds per cubic inch to design the floor slab thickness and reinforcement.

Where a building contains moisture-sensitive equipment, materials, or floor coverings, we recommend 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 contribute to excess humidity and microbial growth in the building. Various methods of vapor retarder construction are described in Part 2, Section 302.2R of the American Concrete Institute Manual of Concrete Practice.

The slab-on-grade should be designed and constructed following the recommendations of the Portland Cement Association and the American Concrete Institute. The slab should have construction joints/control joints at spacings recommended by the Portland Cement Association and the American Concrete Institute to mitigate, but not eliminate, slab curling and cracking. The floor slab should be cast independent of the foundation walls of the building to allow relative movement of the slabs and footings to occur without causing excessive distress to the structure.

6.3 Foundation Option #2: Rammed-Aggregate Pier Ground Improvement

6.3.1 Overview

Rammed-aggregate piers (RAPs, "Geopiers") are an intermediate design-build soil reinforcement system that may be used to support structures (including foundations and floor slabs) as an alternative to soil overexcavation (subcutting) and deep foundations. The system allows the use of conventional spread footings and floor slabs cast on-grade, and typically provides settlement control to within ¾ to 1 inch or less, but lower settlements can be achieved. <u>For this project, RAPs should be used to support the foundations and floor slabs.</u>

RAPs are installed by ramming 1-foot-thick lifts of aggregate into a cavity (shaft) that is created by drilled or displacement methods. The rammed-aggregate lifts form a very stiff, high-density composite aggregate pier. The first lift of aggregate forms a bulb below the bottoms of the piers thereby pre-stressing and pre-straining the soils to a depth equal to at least one pier diameter below the pier.

Ramming takes place with a high-energy beveled tamper or mandrel that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the shaft. This action increases the lateral stress in surrounding soil thereby further stiffening the stabilized composite soil mass. The result of RAP installation is a significant strengthening and stiffening of subsurface soils that can then support floor slabs and spread footings. After installation of the RAPs, the foundations may be constructed as conventional spread footings.

Please contact Mr. Steve Weyda, P.E. of Ground Improvement Engineering at (262) 628-1663 regarding the final system design, including the allowable foundation bearing pressure, RAP shaft lengths and spacing, and a cost estimate.

If a RAP system is selected, Quality Assurance Testing should be performed during installation, including documentation of the shaft lengths, the amount of aggregate used, and tests on the compacted aggregate lifts.

6.3.2 Site Preparation

With an aggregate pier system at this site, vegetation, surficial organic soils, and root clusters would be removed, but existing fill and other non-surficial unsuitable soils could be left in place. New fill below the foundations (where required) should be granular soil having about 5 to 12% by weight passing the No. 200 sieve, and a maximum aggregate size of 1 inch. Fill placed to attain grade for foundation and/or slab support should be compacted in thin lifts, such that the entire lift achieves a compaction level of about 92 to 95% of its maximum standard Proctor dry density. For granular soils, a lift thickness on the order of 8 inches may be appropriate, although this should be reviewed in the field at the time of construction. If the ground improvement design includes differing fill requirements, those requirements should be followed.

6.3.3 Foundation Design

As a preliminary estimate of an allowable bearing pressure that can be used for conventional footing foundation design, we anticipate a value of 4,000 to 5,000 psf (or more) may be achievable using aggregate piers. Ground Improvement Engineering would determine the final values to be used for design. The footing depths should be as described in Section 6.2.3.

6.3.4 Floor Slab Design

Rammed-aggregate piers should also be used to support the floor slabs. See our other recommendations in Section 6.2.4.

6.4 Foundation Option #3: Helical Piles

6.4.1 Overview

Helical piles are a type of deep foundation that have a central shaft with one or more helices near the shaft toe. They are typically screwed into the ground using an excavator; as-built capacities are estimated using correlations with installation torque. The helical pile contractor's engineer will determine the pile details, including estimated pile length; number, size and locations of helices; shaft size; and estimated pile capacities, based on capacity requirements provided by the structural engineer. With a helical pile foundation system, pavements and organic soils would be removed, but existing fill could be left in place. Any buried debris (or other obstructions) would also have to be removed prior to helical pile installation.

6.4.2 Site Preparation

Site preparation for helical pile foundation support should follow the same recommendations as provided in Section 6.3.2.

6.4.3 Foundation Design

The final design of the helical piles would be performed by the pile installer using their own proprietary formulas for relating the amount of torque applied to the pile to allowable axial capacity. However, we anticipate allowable compressive axial capacities could be on the order of 10 to 25 tons. Total settlements of helical piles are typically estimated at about ½ to ¾ inch.

6.4.4 Floor Slab Design

Helical piles should also be used to support the floor slabs. See our other applicable recommendations in Section 6.2.4.

6.5 Seismic Design Considerations

The Seismic Site Class is determined by properties of the top 100 feet of the subsurface profile. Based on our borings and geologic conditions at the site, it is our opinion the project site should be classified as Site Class D to E per Table 1613.5.2 of the IBC.

7.0 RAIL SPUR SUBGRADE RECOMMENDATIONS

Following removal of all organic soils and other unsuitable soils, the top 12 inches of the exposed subgrade should be compacted to a minimum of 95% of its maximum modified Proctor dry density. The project team should anticipate moisture conditioning will be needed to meet this requirement. In addition to the surface compaction, each area should be proof rolled with a fully loaded tandem-axle dump truck and observed for signs of poor performance by a geotechnical engineer or experienced soils technician, just prior to placing new fill. All soft areas should be dug out and corrected.

Based on the proposed rail spur grading plan, approximately Station 3+00 to 20+50 will have a cut of up to 8 feet. From approximately Section 20+50 to 49+50 (north terminus), there will be a fill of up to about 5 feet. Borings B-02 and B-03 were located in the cut zone of the rail spur; the soils in this area were mostly fat clay, with lesser amounts of clayey sand and coal. The project team should anticipate moisture conditioning, possibly significant effort, will be needed to properly compact these soils. Further, fat clay soils are relatively low strength and susceptible to frost movements (including softening/weakening during the spring thaw); the project team and owner should understand the constructed rail could have above-average maintenance requirements. If the project team wants to further explore the potential use of the on-site fat clay as fill, we strongly recommend a series of test pits be excavated to allow bulk sampling of the fat clay, to be followed by laboratory moisture-density relationship (Proctor) tests. The primary purpose of these Proctor tests would be to determine the natural (current) moisture content of the fat clay compared to its optimum moisture content.

The project team could consider amendments (e.g. cement, fly ash, etc.) to improve the strength, compressibility, and moisture content characteristics of the clayey subgrade and embankment fill. Mix designs would be needed to determine the type and volume ratio of amendment. If the team wants to consider this option, we recommend having discussions with contractors specializing with soil amendments to discuss potential costs and suitability.

If imported fill will be used as railroad embankment fill, we recommend it be non-organic granular soil having less than 20% by weight passing the No. 200 sieve. Crushed stone (or other rocky materials) could be a suitable alternative, but we should be contacted to review the gradation of any proposed alternative fill material.

Fill placed to attain subgrade elevation for rail spur support should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 95% of its maximum standard Proctor dry density (ASTM D698). Clay fill should be within 2% (+/-) of its optimum moisture content. We anticipate a lift thickness on the order of 4 to 6 inches may be appropriate, although this should be reviewed in the field at the time of construction.

Where clayey soils are present at subgrade elevation, we recommend the placement of geosynthetic separation fabric (e.g. WisDOT 645, Type SAS) at the base of the sub-ballast. The purpose of this fabric is to reduce the risk of migration of fines into the sub-ballast.

8.0 BITUMINOUS PAVEMENT RECOMMENDATIONS

8.1 Pavement Subgrade Preparation

In areas of new pavement, we recommend removal of all existing pavement, organic soils, and other unsuitable soils that are encountered. An experienced soils technician or geotechnical engineer should perform observations during construction to determine actual subcutting requirements.

After removal of these materials and excavation to the required depth, the top 12 inches of the exposed subgrade should be compacted to a minimum of 98% of its maximum standard Proctor dry density. In addition to the surface compaction, each area should be proof rolled with a fully loaded tandem-axle dump truck and observed for signs of poor performance by a geotechnical engineer or experienced soils technician, just prior to placing new fill. All soft areas should be dug out and corrected.

Where the subgrade soils are clays or silts, we recommend the placement of a 12-inch-thick drainage layer. Clayey and silty soils are low-strength, slow-draining, highly-frost-susceptible soils. The placement of a drainage layer will improve the strength and drainage characteristics of the pavement section. The drainage layer should consist of non-organic soil having a maximum of 5% by weight passing the No. 200 sieve, less than 50% by weight passing the No. 40 sieve, and 100% passing the 2-inch sieve. Clean crushed stone would also be a suitable drainage material. Our compaction recommendations are the same as described for subgrade fill. Drain pipes (4-inch-diameter perforated PVC) must be placed at the base of the drainage layer to collect and remove water; other means of subsurface drainage could also be suitable.

Where the subgrade soils are clays or silts, we recommend the placement of a geosynthetic separation fabric between the subgrade and the overlying drainage layer or base course. The separation fabric should meet the requirements of WisDOT 645, Type SAS.

Where new fill (below the base course and drainage layer) is needed in pavement areas, we recommend it consist of non-organic granular soils having less than 12% by weight passing the No. 200 sieve and a maximum aggregate size of 2 inches. Fill placed to attain subgrade elevation in pavement areas should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 98% of its maximum modified Proctor dry density. We anticipate a lift thickness on the order of 4 to 6 inches may be appropriate, although this should be reviewed in the field at the time of construction.

8.2 Bituminous Pavement Design Recommendations

The pavement surface should be sloped to drain water into stormwater collection systems to limit infiltration through the pavement. The design of the pavement slope and the stormwater collection systems is beyond our scope of services. The pavement section we present in Table 2 is based on a design lifetime of 20 years, the soils we encountered in our borings, and subgrade preparation as described in Section 8.1 (including a drainage layer, where needed). The design traffic consists of primarily passenger vehicles. <u>If soil conditions vary from those found in our borings or the anticipated traffic type is different from our assumption, we should be contacted to review and possibly revise our recommendations.</u>

Table 2: Recommended Bituminous Pavement Section

Bituminous Pavement Section Component	Detail
WisDOT upper layer	1.75” (4 LT 58-34 S)
WisDOT 455.2.5 Tack Coat	Yes
WisDOT lower layer	1.75” (4 LT 58-28 S)
WisDOT 455.2.5 Prime Coat	Yes
WisDOT 305, 1¼-inch gradation, base course	12”
Subbase, granular fill (drainage layer)	12” (where needed)
Geosynthetic separation fabric	WisDOT 645, Type SAS
Subgrade Preparation	Per this report

8.3 Pavement Construction

The base course should meet the 1-1/4-inch gradation provided in WisDOT 305, and should be compacted to at least 95% of its maximum standard Proctor dry density. After the base course has been placed, compacted, and tested, it is the contractor's responsibility to maintain the base course in a suitable condition for paving. We recommend each pavement area be proof rolled with a fully-loaded tandem-axle dump truck and observed for signs of poor performance by a geotechnical engineer or experienced soils technician, just prior to placing the pavement. All soft areas should be dug out and corrected.

8.4 Pavement Fatigue and Maintenance

Regardless of the subgrade preparation and design, the owner should expect that cracks will appear in the bituminous pavement within 1 to 3 years due to thermal expansion and contraction, and due to the loss of volatiles from the bituminous cement. These cracks cannot be avoided; they should be cleaned annually and filled with a hot bituminous sealant. Within three to five years after construction, cracks and depressions may appear in heavily traveled areas, such as drive aisles. Such areas should be cut out and repaired expeditiously to extend the pavement life. Periodically during the pavement life, the engineer responsible for maintenance of the facility should determine the need to apply a seal coat of hot bituminous and rock chips.

9.0 CONSTRUCTION CONSIDERATIONS

9.1 Groundwater

Based on the conditions found in our borings, it is our opinion the contractor might encounter groundwater in some excavations at this site; this will depend on excavation depths and water levels at the time of construction. If water is encountered in the excavations, it should be promptly pumped out before compacted fill is placed. The contractor should not be allowed to place fill into standing water, or over softened soils in an attempt to displace these materials. This technique can result in trapping softened soils under foundations, floor slabs, and/or pavements, resulting in excessive post-construction settlement, even if the softened zone is only a few inches thick.

9.2 Disturbance of Soils

The soils at this site are highly moisture sensitive and have the potential to become easily disturbed by construction activity. Even if the contractor uses appropriate methods, it is possible that wet weather during (or in the months leading up to) construction could make earthwork activities difficult. The project team and contractor must understand this risk and take appropriate precautions. If soils become disturbed, they should be subcut to the underlying undisturbed soils, followed by placement of new compacted fill.

9.3 Excavation Slopes

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or running which could require slope maintenance.

9.4 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been met.

10.0 ASTM STANDARDS

When we refer to an ASTM Standard in this report, we mean that our services were performed in general accordance with that standard. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

11.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, express 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

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs
Gradation Curves
SBD-10793 – Soil Evaluation-Storm

Appendix A
Geotechnical Field Exploration and Testing
Project No. P-0014588

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling ten geotechnical borings. The locations are shown on Figure 1.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS) - Calibrated to N_{60} Values

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 N60 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 N60 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 (AET rig number 104) we used for this project has a measured energy transfer ratio of 61%. 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 N60 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 logs.

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 logs 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 logs 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 logs are visual-manual judgments. Charts are attached which provide information on the USCS, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include 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 logs. The following information appears under “Water Level Measurements” on the logs:

- 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 locations 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 directly measured in boring
▽:	Estimated water level based solely 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, remolded (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

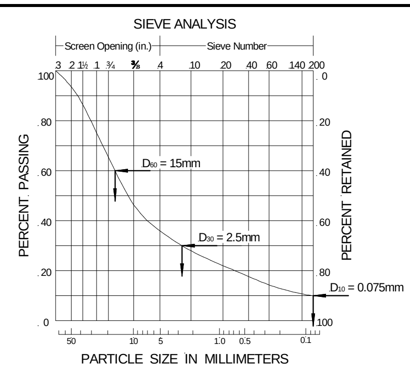
The standard penetration test consists of driving the sampler with a 140 pound hammer and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 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").

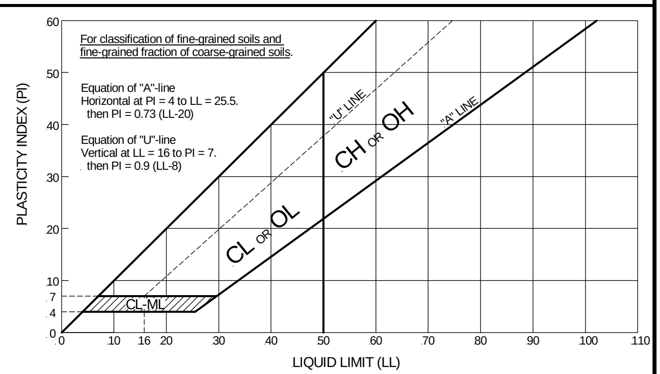
UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

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≥4 and 1≤Cc≤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≥6 and 1≤Cc≤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	$\frac{\text{Liquid limit–oven dried}}{\text{Liquid limit – not dried}}$ <0.75	OL	Organic clay[K.L.M.N] 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	$\frac{\text{Liquid limit–oven dried}}{\text{Liquid limit – not dried}}$ <0.75	OH	Organic clay[K.L.M.P] Organic silt[K.L.M.Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]



$C_u = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{2.5^2}{0.075 \times 15} = 5.6$



Plasticity Chart

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 ≥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 ≥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 ≥30% plus No. 200, predominantly sand, add "sandy" to group name.

[M]If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N]PI≥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.

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.

Peat Description

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

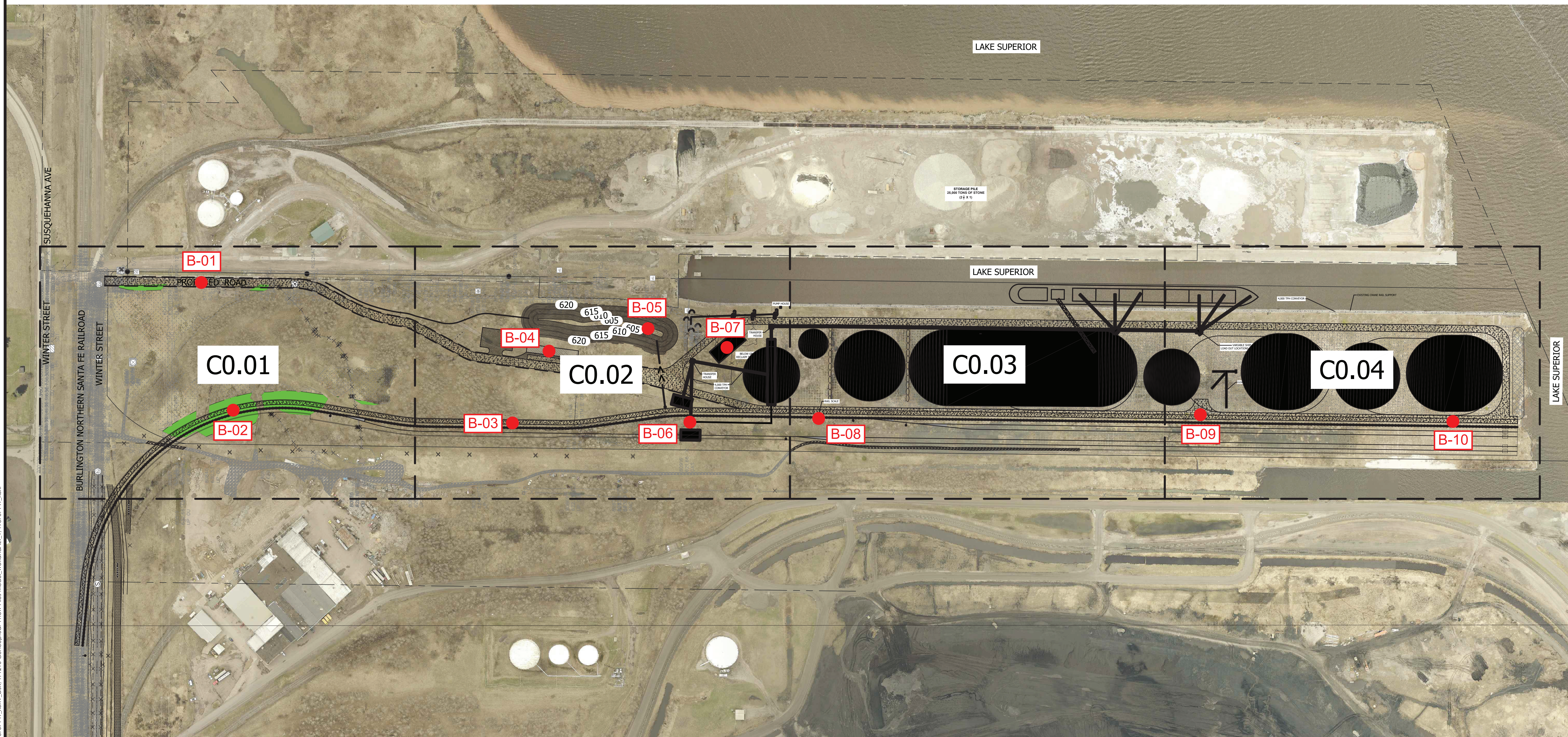
Organic Description (if no lab tests)

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

Root Inclusions

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.

Figure 1 - Boring Locations
AET Project No. P.0014588
August 22, 2022



Stantec
12075 N. Corporate Parkway, Suite 200
Mequon, WI 53092
www.stantec.com

SITE PLAN SHEET INDEX
C. REISS DOCK
C. REISS COMPANY, LLC
ST. LOUIS BAY, SURPERIOR, WI

DATE OF ISSUANCE	
May 25, 2022	

NO	REVISION	DATE

SURVEY	AJR
DRAWN	AJR
DESIGNED	AJR
CHECKED	AJR
APPROVED	AJR
PROJ. NO.	193707141

SHEET NUMBER
C2.00

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-01 (p. 1 of 1)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ___ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
0–2	FILL, mix of silty sand and silt with organics, gray and black, moist, with coal and concrete debris	FILL	51	M	SS	18					
2–4.5	FILL, sandy fat clay, red, with trace roots (CH)		10	M	SS	9	28	2.25			
4.5–7	FAT CLAY, brown and red, soft, with laminations of fine grained silty sand (CH)	FINE ALLUVIUM	4	M	SS	6	34	0.75			
7–14.5	FAT CLAY, red, moist, stiff to hard, with lenses of silt (CH)		9	M	SS	15	37	2.5			
			11	M	SS	24	34	2.5			
			33	M	SS	22	35	0.75			
14.5–17	SILT with sand, reddish brown, moist to waterbearing, dense (ML)		36	M/W ▼	SS	24					
17–18.5	FAT CLAY, red, firm (CH)		7	W	SS	22	67	0.75			
18.5–21.5	SILT with sand, reddish brown, waterbearing, loose to medium dense (ML)		17	W	SS	19					
	End of boring at 21.5 feet										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-19.5'	**3.25" HSA**							
		7/11/22	**1220**	**21.5**	**19.5**	**18.8**	**None**	**18.4**
		7/11/22	**1255**	**21.5**	**19.5**	**17.5**	**None**	**16.4**

(WATER LEVEL MEASUREMENTS)

BORING COMPLETED: **7/11/22**

DR: **JA** LG: **SB** Rig: **104**

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

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

AMERICAN ENGINEERING TESTING

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-02 (p. 1 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
0–1	FILL, clayey sand with organics, fine to medium grained, brown, moist (SC)	TOPSOIL / FILL									
1	FILL, sandy fat clay, brown (CH)	FILL	6	M	SS	10	14				60
2	FILL, fat clay, brown and reddish brown, with trace roots (CH)										
3	FAT CLAY, red, firm to very stiff, with laminations of silty sand from 11 to 11.4 feet and 13 to 13.5 feet and silt from 3 to 14.5 feet (CH)	FINE ALLUVIUM	5	M	SS	7	31	0.5			
5.5			13	M	SS	22	18	2.0	65	21	
8			11	M	SS	24	30	2.0			
10.5			18	M	SS	22	28	1.0			
13			21	M	SS	18	40	0.75			
14.5	SILTY SAND, fine grained, brown, moist, medium dense, with a lens of fat clay near 16.4 feet (SM)	COARSE ALLUVIUM	28	M	SS	20					
17	FAT CLAY, red, firm, with a lens of silty sand near 20.5 feet (CH)	FINE ALLUVIUM	5	M	SS	24	17	1.0			
20.5				M	TW	16					
23		MIXED ALLUVIUM									

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-29.5'	**3.25" HSA**							
		7/11/22	**1020**	**31.5**	**29.5**	**28.6**	**None**	**24.4**
		7/11/22	**1030**	**31.5**	**29.5**	**25.5**	**None**	**22.5**
BORING COMPLETED: **7/11/22**		**7/11/22**	**1100**	**31.5**	**29.5**	**25.5**	**None**	**22.3**
DR: **JA** LG: **SB** Rig: **104**								

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

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AMERICAN ENGINEERING TESTING

AET No: **P-0014588** Log of Boring No. **B-02 (p. 2 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	qp	LL	PL	%-#200
25 26 27	CLAYEY SAND, fine grained, brown, waterbearing, dense, with lenses of silty sand (SC) *(continued)*	MIXED ALLUVIUM *(continued)*	47	W	SS	24					
28 29 30	SILTY SAND, fine grained, brown, waterbearing, dense (SM)	COARSE ALLUVIUM									
31	SILT with sand, brown, waterbearing, dense (ML)	FINE ALLUVIUM	42	W	SS	24					
	End of boring at 31.5 feet										

AMERICAN ENGINEERING TESTING

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-03 (p. 1 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

Surface Elevation ______

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
0–2	FILL, coal, black, with roots from 0 to 3 inches	FILL									
1			5	M	SS	20					
2–6	FILL, fat clay with sand, brown and reddish brown, with trace roots (CH)										
3			12	M	SS	20	22	2.0	60	16	
5.5			7	M	SS	14					
6	FILL, silt with organics, brown and black, moist, with coal debris (OL)	FINE ALLUVIUM					29				
7	SILT with sand, brown, moist (ML)										
8	FAT CLAY, reddish brown, firm to stiff (CH)		10	M	SS	24	33	3.0			
10.5			11	M	SS	24	33	2.25			
13			10	M	SS	24	39	1.75			
15.5			8	M	SS	24	33	1.75			
18			6	M	SS	24	43	1.5			
20.5				M/W	TW	24					

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-29.5'	**3.25" HSA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/8/22	**1440**	**31.5**	**29.5**	**28.9**	**None**	**21.4**	
		7/8/22	**1455**	**31.5**	**29.5**	**28.7**	**None**	**20.3**	
BORING COMPLETED: **7/8/22**									
DR: **JA** LG: **JG** Rig: **104**									

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-03 (p. 2 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS: WC	qp	LL	PL	%-#200
24–25	FAT CLAY, reddish brown, firm to stiff (CH) *(continued)*										
25–31.5	SILT with sand, brown, waterbearing, medium dense to dense, with lenses of clayey sand and sandy silt (ML)		35	W	SS	24					
			26	W	SS	24					
	End of boring at 31.5 feet										

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-04 (p. 1 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
0–2	FILL, mix of coal and brick debris and organics, black and yellow	FILL	8	M	SS	12					
2–3.5	FILL, sandy silt with organics, dark brown and brown, moist, with coal debris (OL)		16	M	SS	14					
3.5–9.5	SILTY SAND, fine grained, brown, moist, medium dense, with lenses of sandy silt (SM)	COARSE ALLUVIUM	23	M	SS	20	18				49
			28	M	SS	18					
9.5–13	FAT CLAY, reddish brown, very stiff (CH)		17	M	SS	24	46	1.5			
13–18	SILTY SAND, fine grained, brown, moist to waterbearing, medium dense, with lenses of fat clay and sandy silt (SM)	COARSE ALLUVIUM	28	M	SS	18					
			27	M/W	SS	20					
18–23	Sandy SILT, brown, waterbearing, dense (ML)	FINE ALLUVIUM	38	W	SS	18					
23–	SAND, fine grained, brown, waterbearing, dense (SP)	COARSE ALLUVIUM									

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-49.5' 3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
	7/6/22	**1030**	**21.5**	**19.5**	**17.9**	**None**	**17.1**	
	7/6/22	**1100**	**21.5**	**19.5**	**15.6**	**None**	**15.6**	
BORING COMPLETED: **7/6/22**	**7/6/22**	**1110**	**21.5**	**19.5**	**17.4**	**None**	**15.4**	
DR: **DG** LG: **JA** Rig: **104**								

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-04 (p. 2 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
25–28	SAND, fine grained, brown, waterbearing, dense (SP) *(continued)*	COARSE ALLUVIUM *(continued)*	39	W	SS	20					
28–51.5	SILT with sand, brown to grayish brown, waterbearing, dense (ML)	FINE ALLUVIUM	32	W	SS	18					
			39	W	SS	16					
			33	W	SS	20					
			40	W	SS	24					
			40	W	SS	21					
	End of boring at 51.5 feet										

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-05 (p. 1 of 1)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
0	FILL, leaves with roots, dark brown, moist	TOPSOIL / FILL									
1	FILL, mix of concrete and brick debris, roots, and sand, white and yellow, moist	FILL	12	M	SS	13					
3			3	M	SS	6					
4.5	FILL, mix of silt and fat clay, brown and reddish brown, moist										
6			6	M	SS	13		1.25			
7	FAT CLAY, reddish brown, stiff, with trace roots, possible fill (CH)	FINE ALLUVIUM									
8			10	M	SS	16	25	2.5	75	19	
9	FAT CLAY, reddish brown, stiff to very stiff, with laminations of silt (CH)										
10.5			11	M	SS	24	30	3.0			
13			12	M	SS	24	29	3.0			
15.5			11	M	SS	24	30	3.25			
18			17	M/W	SS	24					
18.5	FAT CLAY, reddish brown, very stiff, with lenses of silty sand and sand (CH)										
20	SAND WITH SILT, fine grained, brown, waterbearing, dense (SP-SM)	COARSE ALLUVIUM	47	W	SS	22					
21.5	*End of boring at 21.5 feet*										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-19.5'	**3.25" HSA**	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
		7/8/22	**1015**	**21.5**	**19.5**	**18.9**	**None**	**17.8**	
		7/8/22	**1025**	**21.5**	**19.5**	**18.8**	**None**	**17.4**	
BORING COMPLETED: **7/8/22**									
DR: **JA** LG: **JG** Rig: **104**									

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-06 (p. 1 of 1)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
	FILL, silty sand with organics, fine to medium grained, dark brown, moist (SM)	TOPSOIL / FILL									
1	FILL, coal, black, moist	FILL	2	M	SS	10					
3			2	M	SS	12					
4	FILL, silty sand, fine grained, brown, moist to waterbearing (SM)										
6			15	M/W	SS	22	25				26
7	SILT, brown, waterbearing, medium dense (ML)	FINE ALLUVIUM									
8			26	W	SS	22					
10.5			17	W	SS	20					
13			17	W	SS	18	25				99
15.5			18	W	SS	21					
18			16	W	SS	22					
19.5	SILTY SAND, fine grained, brown, waterbearing, medium dense (SM)	COARSE ALLUVIUM									
20.5			18	W	SS	18					
	End of boring at 21.5 feet										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-9.5'	**3.25" HSA**							
9.5-19.5'	**RD w/DM**	**7/7/22**	**1430**	**11.5**	**9.5**	**8.6**	**None**	**5.5**
		7/7/22	**1440**	**11.5**	**9.5**	**8.1**	**None**	**5.2**
BORING COMPLETED: **7/7/22**								
DR: **JA** LG: **JG** Rig: **104**								

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

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-07 (p. 1 of 1)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ____ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
	FILL, coal with roots, black	FILL									
1	FILL, concrete debris		12	M	SS	10					
2	FILL, mix of sand, clay, and gravel with organics, brown and reddish brown, moist, with lenses of peat from 2.2 to 2.4 feet										
3			9	M	SS	10					
4	FILL, fat clay, brown and reddish brown (CH)										
5											
6			4	M/W	SS	16	30				
7											
8	Sandy SILT, grayish brown, waterbearing, dense, with lenses of silty sand (ML)	FINE ALLUVIUM	40	W	SS	22					
9											
10											
11			39	W	SS	24					
12	SILT with sand, grayish brown with orange mottling, waterbearing, very dense (ML)										
13			56	W	SS	24					
14											
15			57	W	SS	24					
16	SAND WITH SILT, fine grained, brown, waterbearing, dense to very dense (SP-SM)	COARSE ALLUVIUM									
17											
18			59	W	SS	21					
19											
20											
21			49	W	SS	22					
	End of boring at 21.5 feet										

DEPTH:	DRILLING METHOD
0-9.5'	3.25" HSA
9.5-19.5'	RD w/DM

BORING COMPLETED: **7/8/22**

DR: **JA** LG: **JG** Rig: **104**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/8/22	1135	9.0	7.0	6.6	None	6.8
7/8/22	1145	9.0	7.0	6.6	None	5.2

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

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-08 (p. 1 of 1)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ___ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
0–1.5	FILL, mix of coal and sand with roots, black, moist	FILL	6	M	SS	16					
1.5–3.5	FILL, mix of cement grout debris, sand, and clay, reddish gray and blue, moist		19	M	SS	21					
3.5–7	FILL, mix of silty sand and clay, brown and reddish brown		5	M/W	SS	15	38				
7–9.5	FAT CLAY, reddish brown, soft, possible fill (CH)	FINE ALLUVIUM	3	W	SS	16	38	0.75	68	17	
9.5–12	SILTY SAND, fine grained, brown, waterbearing, medium dense, with trace roots, possible fill (SM)	COARSE ALLUVIUM	16	W	SS	20					
12–16.5	SAND, fine grained, brown, waterbearing, medium dense, with laminations of silt with roots (SP)		25	W	SS	15					
			30	W	SS	22					
16.5–21.5	SILT with sand, brown with orange mottling, waterbearing, medium dense to dense (ML)	FINE ALLUVIUM	43	W	SS	24					
			29	W	SS	24					
	End of boring at 21.5 feet										

DEPTH:	DRILLING METHOD
0-12.0'	3.25" HSA
12.0-19.5'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/7/22	1220	14.0	12.0	10.9	None	7.7
7/7/22	1240	14.0	12.0	8.7	None	6.4

BORING COMPLETED: **7/7/22**

DR: **JA** LG: **JG** Rig: **104**

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

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-09 (p. 1 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ______ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
	7.5 inches of concrete	PAVEMENT									
1	FILL, sand with silt, fine to medium grained, brown, moist (SP-SM)	FILL	6	M	SS	18					
2–3	FILL, sand, fine grained, brown, moist to waterbearing, with lenses of silty sand from 8 to 10 feet (SP)		7	M/W	SS	12	24				4
5–6			6	W	SS	20					
8			5	W	SS	17					
10–11	FILL, silty sand, fine grained, brown, waterbearing, with lenses of silt with organics (SM)		2	W	SS	22					
12–13	FILL, silt with sand, dark gray and brown, waterbearing, with lenses of peat (ML)		5	W	SS	21					
15–16			2	W	SS	24					
17–18	SILT, orangish brown and brown, very loose, with trace organics and laminations of peat (ML)	FINE ALLUVIUM	1	W	SS	24	37				
19–20	SILT with organics, dark brown, waterbearing, very loose (OL)		WH	W	SS	24	51				
23		COARSE ALLUVIUM									

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-4.5'	**3.25" HSA**							
4.5-39.5'	**RD w/DM**	**7/7/22**	**0940**	**6.5**	**4.5**	**4.1**	**None**	**3.0**
		7/7/22	**0950**	**6.5**	**4.5**	**3.5**	**None**	**2.5**
BORING COMPLETED:	**7/7/22**	**7/7/22**	**1000**	**6.5**	**4.5**	**3.4**	**None**	**2.4**
DR: **JA** LG: **JG**	Rig: **104**							

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

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-09 (p. 2 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
25–28	SILTY SAND, fine grained, brown, waterbearing, loose, with laminations of peat (SM) *(continued)*	COARSE ALLUVIUM *(continued)*	5	W	SS	24					
28–35	SILT with sand, grayish brown, waterbearing, very loose to loose, with trace organics (ML)	FINE ALLUVIUM	2	W	SS	24					
35–38	SILTY SAND, fine grained, brown, waterbearing, loose (SM)	COARSE ALLUVIUM	8	W	SS	19					
38–41.5	SAND, fine grained, brown, waterbearing, loose (SP)		7	W	SS	16					
	End of boring at 41.5 feet										

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-10 (p. 1 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	Surface Elevation ______ MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
	8.5 inches of concrete	PAVEMENT									
1	FILL, sand, fine grained, brown, moist (SP)	FILL	2	M	SS	12					
2–4	FILL, mix of silty sand and clayey sand, fine grained, brown and grayish brown, moist to waterbearing		10	M/W	SS	10					
5–9	FILL, sand, fine grained, brown, waterbearing (SP)		7	W	SS	24					
			4	W	SS	16					
10–11	SILT with sand, grayish brown, very loose, waterbearing, with trace organics (ML)	FINE ALLUVIUM	4	W	SS	12					
12–14	SILT with organics, dark gray, waterbearing, very loose (OL)		WH	W	SS	24					
15–23	SILT with sand, grayish brown, moist, very loose, with trace organics and laminations of peat (ML)		1	W	SS	24					
			4	W	SS	20					
23	Sandy SILT, grayish brown, waterbearing, very loose to medium dense (ML)										

DEPTH:	DRILLING METHOD
0-4.5'	3.25" HSA
4.5-39.5'	RD w/DM

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
7/6/22	1430	6.5	4.5	3.3	None	3.2
7/6/22	1440	6.5	4.5	3.3	None	2.9
7/6/22	1450	6.5	4.5	3.3	None	2.8

BORING COMPLETED: **7/6/22**

DR: **JA** LG: **DG** Rig: **104**

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

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22

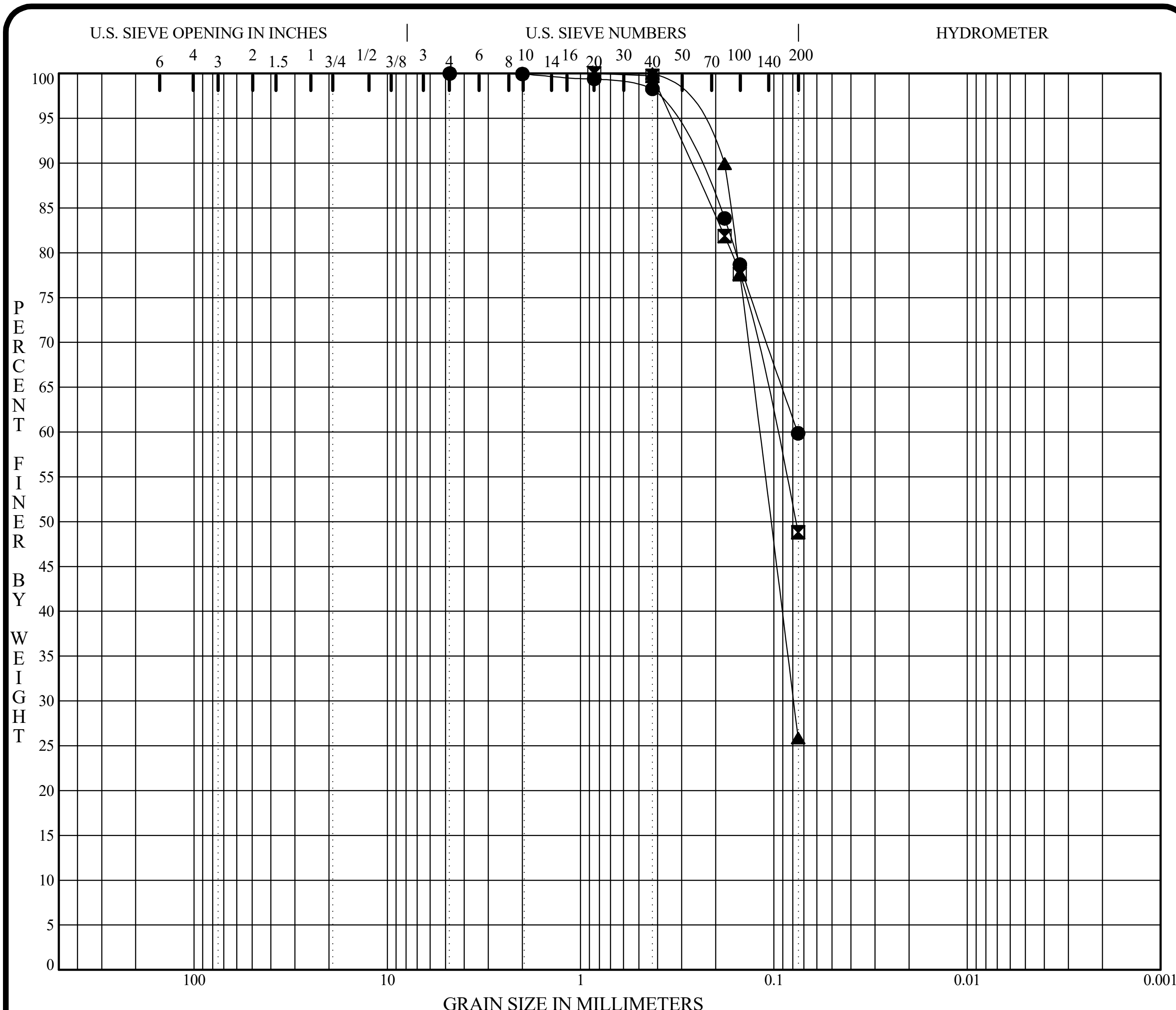
SUBSURFACE BORING LOG

AET No: **P-0014588** Log of Boring No. **B-10 (p. 2 of 2)**

Project: **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	qp	LL	PL	%-#200
24–33	Sandy SILT, grayish brown, waterbearing, very loose to medium dense (ML) *(continued)*										
25–26			11	W	SS	17					
30–31			1	W	SS	24	35				61
33–41.5	SILTY SAND, fine grained, grayish brown, waterbearing, very loose, with trace roots and wood pieces near 40 feet (SM)	COARSE ALLUVIUM									
35–36			WH	W	SS	24					
40–41.5			2	W	SS	24					
	End of boring at 41.5 feet										

AET_CORP P-0014588 - C. REISS DOCK.GPJ AET+CPT+WELL.GDT 8/22/22



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-02**	**1.2'**	**Sandy fat clay (CH)**	**14**					
⧗	**B-04**	**5.5'**	**Silty sand, fine grained (SM)**	**18**					
▲	**B-06**	**5.5'**	**Silty sand, fine grained (SM)**	**25**					

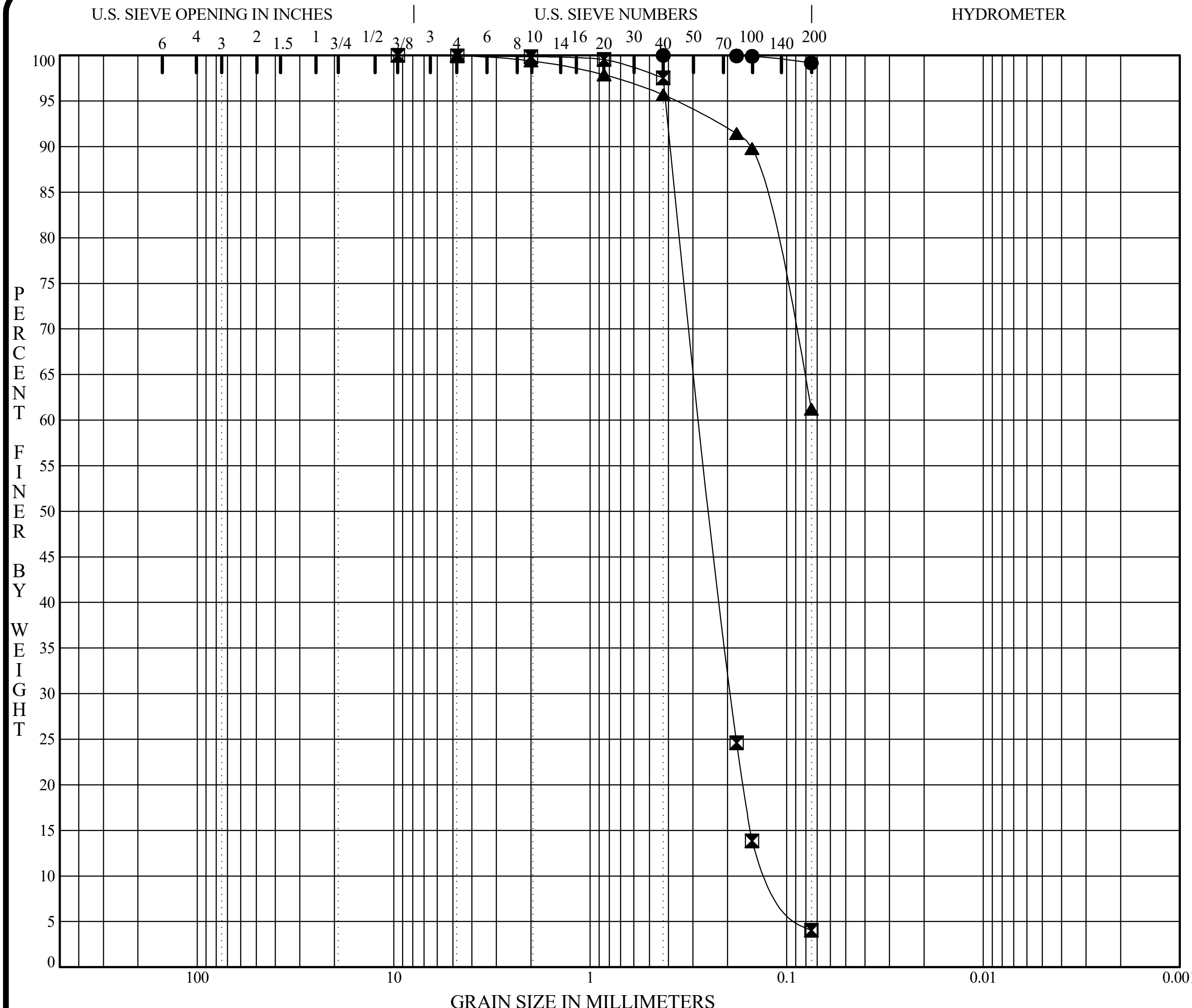
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-02**	**1.2'**	**4.75**	**0.08**			**0.0**	**40.1**	**59.9**	
⧗	**B-04**	**5.5'**	**0.85**	**0.10**			**0.0**	**51.2**	**48.8**	
▲	**B-06**	**5.5'**	**0.43**	**0.12**	**0.079**		**0.0**	**74.1**	**25.9**	

PROJECT **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

AET JOB NO. **P-0014588**
DATE **7/7/22**

AMERICAN ENGINEERING TESTING

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**B-06**	**13.0'**	**Silt (ML)**	**25**					
⧗	**B-09**	**3.0'**	**Sand, fine grained (SP)**	**24**				**1.18**	**2.4**
▲	**B-10**	**30.5'**	**Sandy silt (ML)**	**35**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-06**	**13.0'**	**0.43**				**0.0**	**0.8**	**99.2**	
⧗	**B-09**	**3.0'**	**9.50**	**0.27**	**0.192**	**0.1142**	**0.1**	**95.9**	**4.0**	
▲	**B-10**	**30.5'**	**4.75**				**0.0**	**38.8**	**61.2**	

PROJECT **C. Reiss Dock Development; St. Louis Bay; Superior, Wisconsin**

AET JOB NO. **P-0014588**
DATE **7/6/22**

AMERICAN ENGINEERING TESTING

GRADATION CURVES

Wis. Dept. of Safety and Professional Services
Division of Safety and Buildings

SOIL EVALUATION - STORM

in accordance with SPS 382.365 and 385, Wis. Adm. Code

County: Douglas

Parcel I.D.

Reviewed by | Date

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s. 15.04 (1) (m)).

Property Owner: c/o Stantec	Property Location: Govt. Lot NE 1/4 NE 1/4 S 16 T 49 N R 14W E (or) W
Property Owner's Mailing Address: 209 Commerce Parkway	Lot # / Block # / Subd. Name or CSM#
City: Cottage Grove / State: WI / Zip Code: 53527 / Phone Number: (608) 839-1998	☒ City ☐ Village ☐ Town: Superior / Nearest Road: Winter Street

Drainage area ______ ☐ sq. ft. ☐ acres

Optional:
Test Site Suitable for (check all that apply)

☐ Irrigation ☐ Bioretention trench ☐ Trench(es)
☐ Rain garden ☐ Grassed swale ☐ Reuse
☐ Infiltration trench ☐ SDS (> 15' wide) ☐ Other ______

Hydraulic Application Test Method:

☒ Morphological Evaluation
☐ Double-Ring Infiltrometer
☐ Other (specify) ______

B-05 Obs. # ☒ Boring ☐ Pit Ground surface elev. ______ ft. Depth to limiting factor 209 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr
1	0-1		organic debris				a,w		---
2	2-54		concrete & brick debris	w/ sand			a,w		---
3	54-84	7.5YR 4/4	---	c/si*	0,m	m,fr	a,w	<5	0.07/0.13*
4	84-108	5YR 4/4	---	c	0,m	m,fi	g,w	<5	0.07
5	108-240	5YR 4/4	---	c	0,m	m,vfi	a,w	<5	0.07
6	240-258	7.5YR 4/4	---	s**	0,sg	m,lo	---	<5	0.50**
			groundwater at 17.4 feet						

Obs. # ☐ Boring ☐ Pit Ground surface elev. ______ ft. Depth to limiting factor ______ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

CST/PSS Name (Please Print): Blake E. Snyder	Signature: Blake Snyder	CST/PSS Number: 1323667
Address: 1837 CTH OO; Chippewa Falls, Wisconsin 54729	Date Evaluation Conducted: July 8, 2022	Telephone Number: (715) 861-5045

Property Owner c/o Stantec Parcel ID # ______ Page 2 of 2

Obs. # ☐ Boring ☐ Pit Ground surface elev. ______ ft. Depth to limiting factor ______ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

Obs. # ☐ Boring ☐ Pit Ground surface elev. ______ ft. Depth to limiting factor ______ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

Test Results and/or Summary Comments

The installation of monitoring wells for obtaining additional groundwater measurements was beyond our scope of services.

* Layer 3 was a mix of lean clay and silt

** Per Wisconsin DSPS, the sandy loam infiltration rate is used for fine sand and loamy fine sand soil textures. These layers are marked by an asterisk in the texture and hydraulic app rate columns.

The Dept. of Safety and Professional is an equal opportunity service provider and employer. If you need assistance to access services or need material in an alternate format, contact the department at 608-266-3151 or TTY through Relay.

AMERICAN ENGINEERING TESTING

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Project No. P-0014588

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 GBA[1], of which we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Understand the Geotechnical Engineering Services Provided for this Report

Geotechnical engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical engineering services is typically a geotechnical engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

B.2.2 Geotechnical Services are Performed for Specific Purposes, Persons, & Projects, & at Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client.

Likewise, geotechnical engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

1 Geoprofessional Business Association, 15800 Crabbs Branch Way, Suite 300, Rockville, MD 20855
Telephone: 301/565-2733: www.geoprofessional.org

B.2.3 Read the Full Report
Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. Read and refer to the report in full.

B.2.4 You Need to Inform Your Geotechnical Engineer About Change
Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, always inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

B.2.5 Most of the "Findings" Related in This Report Are Professional Opinions
Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

B.2.6 This Report's Recommendations Are Confirmation-Dependent
The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.

B.2.7 This Report Could Be Misinterpreted
Other design professionals' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

B.2.8 Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical engineering report, along with any attachments or appendices, with your contract documents, but be certain to note conspicuously that you've included the material for information purposes only. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and be sure to allow enough time to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

B.2.9 Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. 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.2.10 Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical engineering study. For that reason, a geotechnical engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated subsurface environmental problems have led to project failures. If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

B.2.11 Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. Geotechnical engineers are not building-envelope or mold specialists.