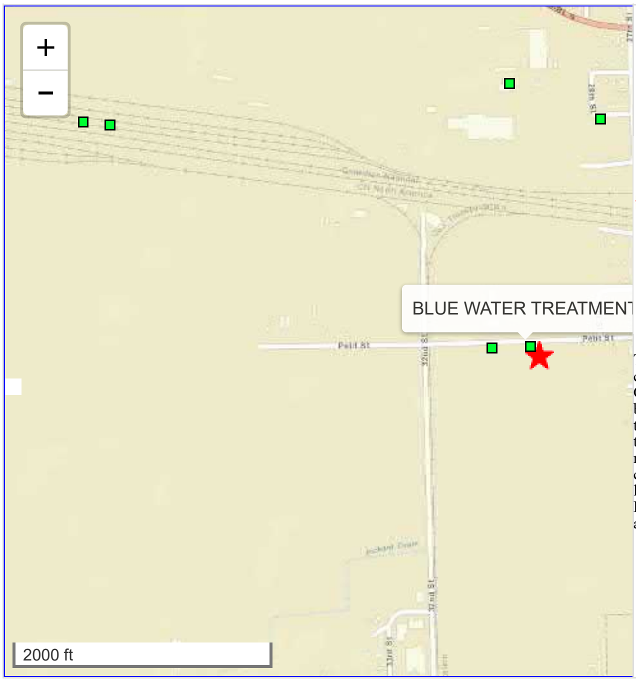
Related Topics: Envirofacts

FRS

FRS Facility Detail Report

BLUE WATER TREATMENT

EPA Registry Id: 110015872938
2931 PETIT ST
PORT HURON, MI 48060



Legend

- ★ Selected Facility
- EPA Facility of Interest
- State/Tribe Facility of Interest

The facility locations displayed come from the FRS Spatial Coordinates tables. They are the best representative locations for the displayed facilities based on the accuracy of the collection method and quality assurance checks performed against each location. The North American Datum of 1983 is used to display all coordinates.

Facility Registry Service Links:

- Facility Registry Service (FRS) Overview
- FRS Facility Query
- FRS Organization Query
- EZ Query
- FRS Physical Data Model
- FRS Geospatial Model

Report an Error

Environmental Interests

Information System	System Facility Name	Information System Id/Report Link	Environmental Interest Type	Data Source	Last Updated Date	Supplemental Environmental Interests:
RESOURCE CONSERVATION AND RECOVERY ACT INFORMATION SYSTEM	BLUE WATER TREATMENT	MIR000103002	UNSPECIFIED UNIVERSE (N)	RCRAINFO		

Additional EPA Reports: MyEnvironment Enforcement and Compliance Site Demographics Facility Coordinates Viewer Environmental Justice Map Viewer Watershed Report

Standard Industrial Classification Codes (SIC)

No SIC Codes returned.

Facility Codes and Flags

EPA Region:	05
Duns Number:	
Congressional District Number:	10
Legislative District Number:	
HUC Code/Watershed:	04090001 / ST. CLAIR
US Mexico Border Indicator:	
Federal Facility:	NO
Tribal Land:	NO

Alternative Names

No Alternative Names returned.

Organizations

Affiliation Type	Name	DUNS Number	Information System	Mailing Address
OPERATOR	BLUE WATER TECHNOLOGIES LLC		RCRAINFO	
OWNER	BLUE WATER TECHNOLOGIES		RCRAINFO	
OPERATOR	BLUE WATER TECHNOLOGIES		RCRAINFO	
OWNER	BLUE WATER TECHNOLOGIES LLC		RCRAINFO	

National Industry Classification System Codes (NAICS)

Data Source	NAICS Code	Description	Primary
RCRAINFO	562219	OTHER NONHAZARDOUS WASTE TREATMENT AND DISPOSAL.	
RCRAINFO	11131	ORANGE GROVES	

Facility Mailing Addresses

Affiliation Type	Delivery Point	City Name	State	Postal Code	Information System
REGULATORY CONTACT	2931 PETIT ST	PORT HURON	MI	48060	RCRAINFO
FACILITY MAILING ADDRESS	PO BOX 610247	PORT HURON	MI	48061	RCRAINFO

Contacts

Affiliation Type	Full Name	Office Phone	Information System	Mailing Address
REGULATORY CONTACT	TED FRANTZ	810-982-3230	RCRAINFO	View
REGULATORY CONTACT	TED FRANTZ	810-982-3230	RCRAINFO	

Last updated on September 24, 2015

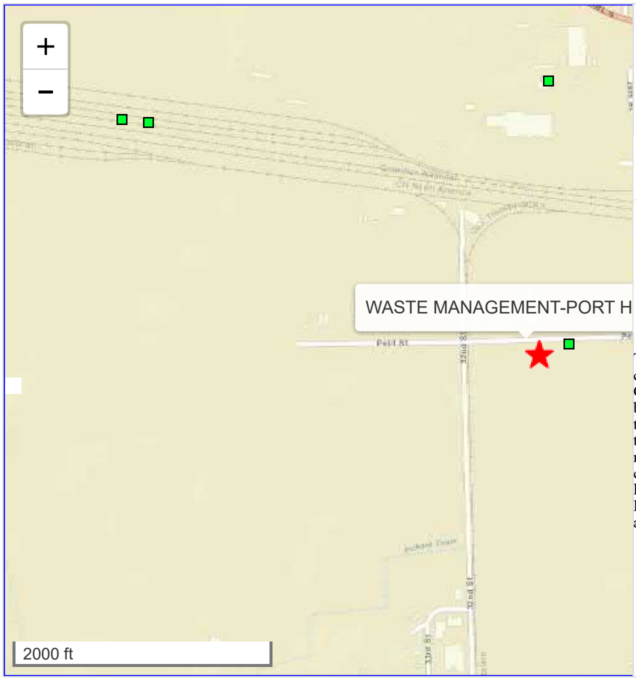
Related Topics: Envirofacts

FRS

FRS Facility Detail Report

WASTE MANAGEMENT-PORT HURON

EPA Registry Id: 110015818873
3005 PETITE
PORT HURON, MI 48060-7486



Legend
- ★ Selected Facility
- EPA Facility of Interest
- State/Tribe Facility of Interest

The facility locations displayed come from the FRS Spatial Coordinates tables. They are the best representative locations for the displayed facilities based on the accuracy of the collection method and quality assurance checks performed against each location. The North American Datum of 1983 is used to display all coordinates.

Facility Registry Service Links:

- Facility Registry Service (FRS) Overview
- FRS Facility Query
- FRS Organization Query
- EZ Query
- FRS Physical Data Model
- FRS Geospatial Model

Report an Error

Environmental Interests

Information System	System Facility Name	Information System Id/Report Link	Environmental Interest Type	Data Source	Last Updated Date	Supplemental Environmental Interests:
RESOURCE CONSERVATION AND RECOVERY ACT INFORMATION SYSTEM	WASTE MANAGEMENT	MIK557744547	VSQG (Y)	RCRAINFO		
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (ICIS-NPDES)	WASTE MANAGEMENT-PORT HURON	MIS410662	ICIS-NPDES NON-MAJOR	ICIS		

Additional EPA Reports: MyEnvironment Enforcement and Compliance Site Demographics Facility Coordinates Viewer Environmental Justice Map Viewer Watershed Report

Standard Industrial Classification Codes (SIC)

No SIC Codes returned.

Facility Codes and Flags

EPA Region:	05
Duns Number:	
Congressional District Number:	10
Legislative District Number:	
HUC Code/Watershed:	04090001 / ST. CLAIR
US Mexico Border Indicator:	
Federal Facility:	NO
Tribal Land:	NO

Alternative Names

Alternative Name	Source of Data
WASTE MANAGEMENT	RCRAINFO

Organizations

Affiliation Type	Name	DUNS Number	Information System	Mailing Address
OWNER	WASTE MANAGEMENT OF MICHIGAN		RCRAINFO	
OPERATOR	WASTE MANAGEMENT OF MICHIGAN		RCRAINFO	

National Industry Classification System Codes (NAICS)

Data Source	NAICS Code	Description	Primary
RCRAINFO	562111	SOLID WASTE COLLECTION.	

Facility Mailing Addresses

Affiliation Type	Delivery Point	City Name	State	Postal Code	Information System
FACILITY MAILING ADDRESS	3005 PETIT ST	PORT HURON	MI	48060	RCRAINFO
REGULATORY CONTACT	3005 PETIT ST	PORT HURON	MI	48060	RCRAINFO

Contacts

Affiliation Type	Full Name	Office Phone	Information System	Mailing Address
REGULATORY CONTACT	DARLENE MCLAUGHLIN	810-966-8768	RCRAINFO	
REGULATORY CONTACT	DARLENE MCLAUGHLIN	8109668768	RCRAINFO	View

Last updated on September 24, 2015

Appendix G:

Geotechnical Investigation

Infrastructure Consulting Engineers

4039 40th Street SE • Suite 4 • Grand Rapids • Michigan • 49512

DRAFT REPORT ON PRELIMINARY GEOTECHNICAL INVESTIGATION

AMTRAK FACILITY FEASIBILITY STUDY
PORT HURON, MICHIGAN

Prepared for:

Bergmann
7050 W. Saginaw Hwy., Suite 200
Lansing, Michigan 48917

August 4, 2022
2021116A

Somat Engineering, INCORPORATED

Somat Engineering, INCORPORATED

August 4, 2022
2021116A

Mr. Jeremy Hedden, P.E
Bergmann
7050 West Saginaw Highway, Suite 200
Lansing, Michigan 48917

RE: Report on Preliminary Geotechnical Investigation
Amtrak Facility Feasibility Study
Port Huron, Michigan

Dear Mr. Hedden:

We have completed the preliminary geotechnical investigation report to support the feasibility study for the proposed improvements to the existing Amtrak Station in Port Huron, Michigan. This report presents the results of our observations and results of the geotechnical investigation and general geotechnical recommendations and construction considerations for the proposed improvement concepts.

The soil samples collected during our field investigation will be retained in our laboratory for 90 days from the date of the final report, at which time these samples will be discarded unless otherwise directed by you.

Upon your review, if you should have any questions, please contact us. It is a pleasure working with you on this project.

Sincerely,
Somat Engineering, Inc.

Jane M. Abadir, P.E.
Principal Engineer, Geotechnical Services

Jennifer S. Schmitzer
Project Manager

JSS/JMA/fks

DRAFT GEOTECHNICAL INVESTIGATION REPORT
AMTRAK FACILITY FEASIBILITY STUDY
PORT HURON, MICHIGAN

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APPENDICES

DRAFT GEOTECHNICAL INVESTIGATION REPORT
AMTRAK FACILITY FEASIBILITY STUDY
PORT HURON, MICHIGAN

1.0 INTRODUCTION

1.1 GENERAL

Upon authorization from Bergmann, Somat Engineering, Inc. (Somat) has conducted a geotechnical investigation for the site feasibility study for a new Amtrak facility in Port Huron, Michigan. The geotechnical investigation was performed in accordance with Somat Proposal No. P200048A dated February 11, 2020.

The following sections of this report provide our understanding of the feasibility study, a description of our field investigation, the results of the field and laboratory tests, the logs of test borings, our interpretation of subsoil and groundwater conditions, feasible foundation concepts and general geotechnical and construction considerations for the potential future development.

1.2 PROJECT INFORMATION

The existing Amtrak passenger station was constructed in 1979 and was constructed as a demonstration of a prototype that was being developed at the time (and not based on Amtrak Guidelines). As such, a new station is currently proposed to be improved to better accommodate existing passenger numbers and future growth. A larger facility is needed to improve parking and waiting areas as well as to meet the current Amtrak design requirements.

A specific design has not been completed for this facility so, at this stage, the purpose of the geotechnical investigation was to identify the subsurface conditions at the site and the suitability for supporting a new facility. The new facility will need an access track to the main rail line; adequate parking, adequate lighting, a station building with a waiting room; a level boarding platform; a side track for train parking/storage; and driveways connecting parking areas to roadways and the station building.

1.3 SITE CONDITIONS

The site being considered for the new facility is the current Amtrak passenger station located at 2223 16th Street in the City of Port Huron. The site is a narrow parcel extending from 16th Street west for roughly 1,000 feet. Additionally, the parcel east of 16th Street is being considered, generally extending from 16th Street east to the St. Clair tunnel property. This station is the eastern terminus of the Blue Water passenger line, with only freight train traffic crossing through to the St. Clair Tunnel.

The existing Amtrak station building is located west of 16th Street and on the south side of the passenger rail line. There is an asphalt-paved access drive from 16th Street which leads to the parking lot situated on both the east and west sides of the building. The remainder of both parcels is covered with grass/weeds with sporadic trees. The topography is relatively flat.

2.0 SUBSURFACE INVESTIGATION

2.1 FIELD EXPLORATION

The field exploration program consisted of performing a total of five (5) soil borings spaced within the two parcels for the preliminary geotechnical investigation, designated as TH-01 through TH-05. TH-02 extended to 50 feet below existing grade, while the remainder each extended to 25 feet below existing grades.

Prior to drilling TH-01 and TH-02, the surface was hand augered to a depth of about 6 feet below existing grade to verify the absence of underground utilities, since there was no clear utility marking at the time of the investigation. Standard drilling with soil sampling was resumed to the planned exploration depth after no conflicts were found.

The locations of the soil borings were selected by Somat and approved through Bergmann. Somat staked the boring locations in the field, taking into consideration the locations of the utilities (underground and overhead) as well as physical access for the drill rig (i.e. thick brush, property lines, trees, etc.).

A schematic including the approximate locations of soil borings within the investigated sites is presented in Appendix A. Soil boring coordinates were recorded with a Trimble Geo7X GPS unit, except for boring TH-01 which was significantly moved from its original location due to trees preventing access to the undeveloped area at the west end of the property. These coordinates were estimated from Google Earth satellite images.

2.1.1 Drilling Operations

The soil borings were performed on July 11 and 12, 2022. The soil borings were drilled using an truck-mounted drill rig advancing 4¼-inch inside diameter, hollow-stem augers to the boring termination depths. Upon completion, all boreholes were backfilled with soil cuttings to the surface.

2.1.2 Standard Penetration Test (SPT)

Soil samples collected during the field portion of the subsoil exploration were labeled with the soil boring designation and a unique sample number. Soil samples were obtained by Standard Penetration Tests in accordance with ASTM D1586 procedures, whereby a conventional 2-inch O.D. split-spoon sampler is driven into the soil with a 140-pound hammer repeatedly dropped through a free-fall distance of 30 inches. The sampler is generally driven three successive 6-inch increments (occasionally four successive increments) with the blows for each 6-inch increment being recorded. The number of blows required to advance the sampler through 12 inches after an initial penetration of 6 inches is termed the Standard Penetration Test resistance (N-value) and is presented graphically on the individual Logs of Test Borings. As added information, the number of blows for each 6-inch increment are also presented on the boring logs.

The N-values reported on the Logs of Test Borings are the direct blow counts from the field and are uncorrected. The efficiency of each specific hammer is dependent on many factors, including type (auto vs. manual), material quality, regularity of maintenance, drill rig mechanics, etc., and can change with time. As such, SPT hammers on each drill rig are required to be calibrated every two years. Certificates are provided to us indicating each hammer's measured energy transfer ratio. For this investigation, DLZ American Drilling used a CME 55 (serial number 404185) drill rig. Based on the current certificate for this drill rig, the energy transfer ratio for the SPT hammer is 91.0%.

2.1.3 Sampling

Soil samples were recovered using split-spoon sampling procedures in accordance with ASTM Standard D1586 ("Standard Method for Penetration Tests and Split Barrel Sampling of Soils"). In general, the samples were obtained every 2.5 feet intervals to a depth of 10 feet and then every 5 feet intervals thereafter to the exploration depths of the borings. The samples were sealed in glass jars in the field to protect the soil and maintain the soil's natural moisture content.

All soil samples for the geotechnical investigation were transported to Somat's laboratory for further analysis and testing and will be retained in our laboratory for a period of 90 days after the date of the final report, after which they will be discarded unless we are notified otherwise.

2.1.4 Groundwater Level Observation Procedures

Whenever possible, groundwater level observations were made during the drilling operations and are shown on the individual Logs of Test Borings. During drilling, the depth at which free water was observed, where drill cuttings became saturated or where saturated samples were collected, was indicated as the groundwater level during drilling. In granular, pervious soils, the indicated water levels are considered relatively reliable when solid or hollow-stem augers are used for drilling. However, in cohesive soils, groundwater observations are not necessarily indicative of the static water table due to the low permeability rates of the soils, and due to the sealing off of natural paths of groundwater flow during drilling operations.

It should be noted that seasonal variations and recent precipitation conditions may influence the level of the groundwater table significantly. Groundwater observation wells are generally used if precise groundwater table information is needed, however the installation of groundwater monitoring wells was not included in the scope of the investigation. Therefore, the discussion and recommendations provided within the report are based on our knowledge of the soil and groundwater conditions in this area, which should provide for a reasonable approximation of the groundwater level.

2.2 LABORATORY TESTING

All soil samples were classified in accordance with the Unified Soil Classification System (USCS). Representative soil samples were subjected to laboratory tests consisting of moisture content determinations, hand penetrometer tests, unconfined compressive strength tests, and Atterberg Limits tests.

The results of all of the laboratory tests are included on the individual Logs of Test Borings in Appendix B and/or graphically in Appendix C. All laboratory tests were performed in accordance with their applicable ASTM procedures. Brief descriptions of the laboratory tests are included in Appendix C after the result sheets.

2.3 LIMITATIONS

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on, below or around this site.

Some soils have been identified on the Logs of Test Borings as “fill” if a soil deposit is suspected to have been placed by human activity, versus having been deposited by natural means. These designations were based on our professional engineering judgment considering factors such as our visual classification, the presence of foreign materials (i.e. bricks, concrete, plastic, etc.), and/or site topography, among many other possibilities. As such, the “fill” descriptions should be considered as secondary information to the standardized soil classification. Due to the large variation of types of fill, methods of fill placement, potential changes of historical use of the site, and soil sample size, it is difficult to discern whether the subject soil sample is native to this site, or fill material based on visual classification alone. As such, the designation of "fill" may not be reliable and hence should be considered as informational only. Conversely, where a soil is not designated as "fill" on the boring logs, it does not necessarily mean it is not a fill soil, only that there were no apparent observations indicating a fill material. Therefore, we cannot guarantee that our description of "fill" soils is accurate, or that we have identified all types of fill material encountered with our sampling on the site.

Further, Somat has made no observations or recommendations with regard to the presence or absence of mold or other biological contaminants (such as spores, fungi, bacteria, viruses and the byproducts of such organisms), now or in the future, on this site or within or on any structures to be constructed on this site. Any consideration with regard to the presence of mold or the possibility of mold growth in or on the structures to be constructed on this site is not within Somat's scope of services on this project.

3.0 SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

Soil conditions encountered at the test boring locations have been evaluated and presented in the form of Logs of Test Borings. The logs include approximate soil stratification with detailed soil descriptions and selected physical properties for each stratum encountered in the test borings. In addition to the observed subsoil stratigraphy, the boring logs present information relating to sample data, Standard Penetration Test results, groundwater level conditions observed in the boring, personnel involved, and other pertinent data. For information, and to aid in understanding the data as presented on the boring logs, General Notes defining nomenclature used in soil descriptions are presented immediately following the Logs of Test Borings. It should be noted that the Logs of Test Borings included with this report have been prepared on the basis of laboratory classifications and testing as well as field logs of the soils encountered.

A generalized description of the soils encountered in the soil borings performed for this project, beginning at the existing ground surface and proceeding downward, is provided below:

Surface Material.

Asphaltic cement concrete (ACC) was encountered at the surface of borings TH-01 and TH-02 in an 8-inch thickness. An apparent base layer was found below the ACC consisting of 2 to 4 inches of gravel/crushed aggregate. Topsoil was encountered at the surface of borings TH-03 and TH-05 in thicknesses of 2 and 18 inches, respectively. TH-04 encountered 18 inches of sand and gravel fill.

Fill Soils.

Apparent fill soils (beyond the pavement base layer) were encountered in borings TH-03, TH-04, and TH-05 extending to a depth of about 3.5 feet below existing grades. These soils consisted of loose silty sand (mixed with topsoil in TH-03) and medium dense poorly graded sand with silt.

Clay.

Below the surface and fill soil layers, the soils in all of the borings were predominantly lean clay. The consistency of the clay ranged widely from very soft to hard, generally decreasing in strength with depth. Atterberg limits tests performed on the soft clay encountered in boring TH-02 at a depth of 33.5 feet was on the borderline between lean clay and high plasticity clay (fat clay).

Occasional layers of poorly graded sand (with varied amounts of silt), silt, and clayey sand were encountered within the clay strata. The apparent density of these layers ranged from very loose to medium dense.

Please refer to the boring logs for the soil conditions at the specific boring locations. It is emphasized that the stratification lines shown on the Logs of Test Borings are approximate indications of change from one soil type to another at the tested locations. The actual transition from one stratum to the next may be gradual and may vary within the area represented by the test location.

3.2 GROUNDWATER LEVEL OBSERVATIONS

During the drilling process, groundwater was encountered either during drilling or upon completion in all of the soil borings except TH-03. The groundwater levels observed are as follows, with depths referenced from existing ground surface at the time of drilling:

Boring No.	*Groundwater Depth (during drilling)*	*Groundwater Depth (upon completion of drilling)*
TH-01	6 feet	19 feet (borehole collapsed at 19 feet)
TH-02	5.5 feet	none
TH-03	none	none
TH-04	6 feet	none
TH-05	6 feet	none

A lack of groundwater observed does not necessarily indicate that there is no groundwater, due to the sealing off of natural flow paths during the drilling process. In our experience, the depth at which clayey soils change from brown to gray in color (an indication of oxidation) is frequently indicative of the long-term groundwater level. Based on the change of color of the soils encountered in the soil borings, we anticipate the long-term groundwater level at this site is situated at a depth of about 5 to 6 feet below the existing ground surface. However, perched water trapped in the granular layers above the clay should be expected above the long-term groundwater level.

The groundwater levels observed are only accurate for the date and time of drilling. The elevation of the natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation and percolation in the area, as well as the water level in nearby surface water bodies in the vicinity affecting the groundwater flow pattern.

4.0 ANALYSIS AND RECOMMENDATIONS

The purpose of the preliminary geotechnical investigation performed for this project was to provide a general overview of the subsurface soil and groundwater conditions at the site and to provide general subsurface data to be used to assess the feasibility of the potential foundation concepts for the proposed development. Once a final design has been completed, additional soil borings and in-situ geotechnical tests should be performed at specific areas of interest to the design and tailored to provide specific design information for the proposed structures.

4.1 BUILDING FOUNDATION CONSIDERATIONS

4.1.1 Foundation Design Recommendations

We anticipate new buildings for this facility would be a new station building and smaller maintenance or storage-type buildings. These buildings are assumed to be relatively lightly loaded, single story structures with no below grade areas (i.e. no basements). Further, we anticipate that shallow foundations (spread footings, continuous footings, or mat foundations) constructed at conventional frost depths (42 inches below final site grade) would be the desired foundation support.

Based on all of the soil borings drilled for this preliminary geotechnical investigation, at the conventional 3.5-foot depth below the current existing ground surface, bearing soils are anticipated to consist of lean clay and loose to medium dense sand. These soils are considered suitable for support of the anticipated building structures, provided the looser granular soils are improved (compacted or replaced with properly compacted engineered fill) during construction.

The net allowable bearing capacity of the bearing soils anticipated at 3.5 feet depth should be in the range of 2,500 to 5,000 psf, with potentially higher bearing capacity in isolated areas, such as at boring TH-03, where a bearing capacity of 7,000 psf may be achieved. These preliminary estimates of bearing capacity pressures are based on a factor of safety of 3 on the ultimate pressures.

Across the sites, predominantly clay soils were encountered and relatively consistent in strength in all of the borings. Boring TH-02 was drilled to a depth of 50 feet in order to provide deeper soil information. Based on this soil boring (and the bottoms of the other borings), the strength of the clay soils decreases significantly below about 20 to 25 feet in depth. Atterberg limits test performed on the soft clay encountered in boring TH-02 at a depth of 33.5 feet was on the borderline between lean clay and high plasticity clay (fat clay). As such, if below grade structures are considered, then allowable bearing pressures will need to be significantly reduced to prevent significant settlement or bearing failures.

Because the soils are predominantly clay, long term consolidation settlement should be expected. The amount of settlement will ultimately depend on the load and the width of the footings, but in general for loads not exceeding the bearing capacities of 3,000 to 5,000 psf, we would expect settlement to be up to 2 inches over the life of the structure. Bottom heave potential due to the soft and high plasticity clays should also be checked depending on the depth and geometry of the excavations.

For bearing capacity and settlement considerations, isolated spread footing type foundations should be at least 30 inches wide, and continuous strip foundations should be at least 18 inches wide. Foundations along exterior walls, or in any unheated areas, should be situated a minimum of 42 inches below final site grade for protection against frost heave during normal winters.

Light loads are anticipated for the proposed structures, however, depending on the load requirements, shallow pile systems such as geopiers, helical piers, or micropiles piles could also be feasible alternative shallow foundation options, if needed. We anticipate an allowable axial capacity ranging between 15 and 30 feet per pile could be achieved when driven approximately 25 to 30 feet below grade. A more detailed evaluation and analysis will be required to determine the anticipated axial, lateral and uplift capacities based on the type of foundation system and the applied loads.

4.1.2 Groundwater Control Recommendations

With the groundwater table situated at about 5 to 6 feet below existing grade, excavations for conventional footing depths are not anticipated to extend below the groundwater table unless undercuts are necessary. However, perched water could be trapped in sand layers that are situated above less permeable clay layers. There were sand layers encountered from the surface in several of the soil borings, which could be water-bearing depending on weather conditions during the time of construction. In general, it appears that groundwater flow into open excavations may be handled by standard sump pits and pumps. Sheet piles sufficiently toed in the clay layer could also help retain the soils and reduce the flow of groundwater into the excavations.

It should be noted that the elevation of the natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation and percolation in the area, as well as on the water level of surface water bodies in the vicinity affecting the groundwater flow pattern.

4.1.3 Seismic Site Classification Recommendations

Based on our knowledge of the general geotechnical conditions in the vicinity of the project, we classify this site as Site Class D, as per the Michigan 2006 Building Code Table 1615.1.5. Deep soil borings extending to a depth of 100 feet will be required to classify the seismic class specific to this site.

4.2 PAVEMENT & BUILDING SLAB CONSIDERATIONS

4.2.1 Anticipated Subgrade Soils

We expect the new facility will require paved driveways and parking areas. Depending on the final pavement design, we anticipate a pavement section thickness of about 18 inches including pavement and base/subbase layers. In borings TH-01 through TH-05, at the 18-inch depth, the subgrade soils are anticipated to consist of sand/silty sand fill and lean clay. In general, these soils are suitable for support of new pavement, provided the loose sands are improved through compaction. If compaction is not feasible due to saturated subgrade conditions, then it may be necessary to undercut some of these soils and replace with well compacted, and drainable engineered fill. Alternatively, mixing cement or lime into the subgrade soils or using geogrids placed below the base course may help distribute the vertical loading at localized areas where soft and loose areas are identified during proofrolling.

A fill layer in TH-03 was found to be sand mixed with topsoil. We recommend any soils with organics to be completely removed prior to constructing any new pavements.

4.2.2 Drainage Considerations for Pavement and Slab-On-Grade Structures

While structurally these soils are suitable, consideration will need to be given to drainage below the new pavement. Some of the sand was found to contain significant "fines", which reduces the permeability of the subgrade soils and increases their susceptibility to frost action. The clayey/silty soils are considered highly susceptible to frost action and the negative consequences. Any areas where water is not allowed to drain freely either due to subsoil conditions, site grades, or other factors, will have a detrimental effect on the pavement condition over time. As such, new pavement on this site will likely require some undercut of the clay and silty sand soils and replacement with a clean sand or an open graded aggregate to improve drainage.

A provision for edge drains should be considered to enhance drainage conditions in pavement areas and to reduce the effects of frost heave. These drains should consist of corrugated, perforated HDPE pipe in conjunction with a geotextile separator in accordance with MDOT Standards. The spacing will depend on the grade of the new pavement, the locations of the catch basins, and other factors considered by the engineer designing the drainage system. Edge drains should be installed at all catch basin structures in the pavement construction areas within the project limits. In addition, the subgrade should be graded to provide for positive drainage to these structures.

For proposed slabs-on-grade for buildings, we expect similar subgrade soils for support, which will require the same improvements as those noted above for pavement. We anticipate they will be situated above the long-term groundwater level; therefore, we do not believe that an underfloor drainage system would be necessary. However, a properly functioning perimeter foundation drainage system should be constructed; the perimeter drainage systems should drain by gravity to the existing site drainage structures within the project limits. In addition, we believe a vapor barrier beneath the slab would be beneficial in these soil conditions. Though, this should be re-evaluated once structure-specific soil borings are performed for the final design.

4.3 STORMWATER MANAGEMENT CONSIDERATIONS

With constructing new impervious surfaces, we anticipate a stormwater management plan will need to be developed. The plan will likely include a system of storm sewers but could also incorporate other surface drainage structures such as bioswales or retention basins.

Based on the soil borings drilled for this preliminary evaluation, the soils in the upper 10 feet include layers of both sand and lean clay. The clay is not considered permeable (especially in terms of site drainage) with coefficients of permeability (k) values of about 10^{-5} to 10^{-7} cm/s. The sand layers may provide suitable drainage depending on the amount of fines (silt and clay) they contain. Though the thickness of the sand is limited and is saturated starting at about 5 to 6 feet. Coefficients of permeability for the cleaner sand encountered could be about 10^{-2} to 10^{-3} cm/s whereas the "silty" sands would be 10^{-3} to 10^{-5} cm/s.

For final design, we recommend performing in-situ infiltration tests to evaluate the permeability of potential basin locations.

4.4 GEOTECHNICAL INSTRUMENTATION MONITORING

A geotechnical instrumentation program may need to be implemented to monitor any potential settlement or harmful vibrations due to the construction methods used. As required for all construction activity, consideration should be given to the effect of ground vibrations induced from pile driving or other vibratory installations. Generally, the existing soil conditions would not be considered highly susceptible to seismic movement. However, construction activities in close proximity (within 100 feet) to existing structures may cause damage due to vibrations. In addition to above grade structures, consideration should be below grade structures, such as utilities, which may be more susceptible to vibration damage, but may not be readily visible for monitoring. If significant construction vibration is anticipated near existing critical structures, consideration should be given to a proactive monitoring program or the use of non-vibratory techniques.

5.0 GENERAL OBSERVATIONS AND CONSTRUCTION CONSIDERATIONS

While on site for drilling, we observed the surface conditions of the site, and did not find any apparent evidence of contamination, buried debris, or surface debris. Though the old passenger railroad tracks are still present in the parcel east of 16th Street, grown over with weeds and brush. We also did not observe any areas of standing water or wetland/marsh-type areas.

We anticipate excavations in the natural sand soils and site fill soils will be prone to caving and sloughing of the excavation sidewalls, especially in areas where the soil conditions are in a loose condition ('N' value of 9 or less). Appropriate measures will be required to maintain the stability of excavation sidewalls. The required measures will depend on the depth and width of excavation and groundwater conditions at specific locations. In general, excavation walls should be sloped back to a stable angle in accordance with published MI-OSHA guidelines. If sufficient room is not available for sloping the excavation walls, then an earth retention system will be required to maintain the stability of the sidewalls. Construction traffic, stockpiles of soil and construction materials should be kept away from the edges of the excavations for a distance equal to the depth of the excavation. If such clearances cannot be maintained, the resulting surcharge loads should be considered in the design of the shoring system. Likewise, loads from traffic on adjacent road areas also need to be considered in the design. In all cases, MI-OSHA and other regulatory requirements must be followed and adequate protection provided for workers.

6.0 GENERAL QUALIFICATIONS

This report and the attached Logs of Test Borings are instruments of service, which have been prepared in accordance with generally accepted soil and foundation engineering practices. We make no warranties either expressed or implied as to the professional advice included in this report.

The contents of this report have been prepared in order to aid in the evaluation of expected subsoil properties to assist the engineer in verifying the feasibility of developing this site for a future facility. The contents of this report should not be relied upon for other projects or purposes. As this report was intended to provide preliminary subsurface information for consideration of site development, a final geotechnical investigation will need to be performed for design of specific site structures.

Since the information obtained from the soil borings is specific to the exact test locations, soil and water conditions could be different from those occurring at other locations of the site. This report does not reflect variations which may occur between the soil borings. The nature and extent of these variations may not become evident until the time of construction.

This report and the associated Logs of Test Borings should be made available to bidders prior to submitting their proposals and to the successful contractor and subcontractors for their information only, and to supply them with facts relative to the subsurface investigation, laboratory tests, etc.

Somat is not responsible for failure to provide services that other project participants, apart from our client, have assigned to Somat either directly or indirectly. Somat is not responsible for failing to comply with the requirements of design manuals or other documents specified by other project participants that impart responsibilities to the geotechnical engineer without our knowledge and written consent. We are not liable for services related to this project that are not outlined in our scope of services, detailed in our project proposal.

If you have any questions regarding this report, please contact us. Please review the important information regarding geotechnical reports included in Appendix D.

APPENDIX A

SOIL BORING LOCATION DIAGRAM

Adapted from GoogleEarth satellite imagery

Drawing Scale as noted

Legend:

Approximate Soil Boring Locations

SOIL BORING LOCATION DIAGRAM

Amtrak Facility Feasibility Study
Port Huron, Michigan

Somat Project No.: *2021116A*

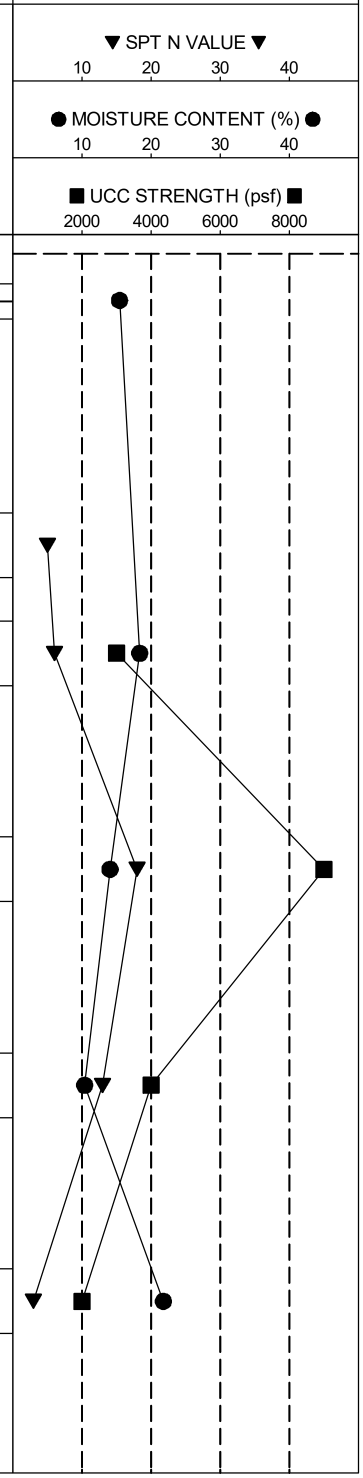
APPENDIX B

LOGS OF TEST BORINGS
AND GENERAL NOTES

LOG OF TEST BORING TH-01

PROJECT NO. 2021116A **DATE STARTED:** 7/12/2022 **DATE COMPLETED:** 7/12/2022

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation	0											
	8 inches of ASPHALTIC CEMENT CONCRETE	0.7											
	FILL - Poorly graded fine gravel/crushed aggregate, trace sand, trace silt (GP)	1.1	BS	3			1.1		15.4				
			HA1	5			1.5	<>					
	LEAN CLAY with sand, trace gravel, gray (CL) (Hand augered to 6 feet to verify no conflict with utilities)	6.0											
	Loose poorly graded FINE SAND with silt, trace gravel, gray-brown, wet (SP-SM)	8.5	SS2	18	2-2-3	5	7.5						
	Stiff to hard LEAN CLAY, few sand, trace gravel, gray (CL)	18.5	SS3	18	2-2-4	6	10.0	3000*	18.3				
			SS4	18	4-7-11	18	15.0	9000*	14.1				
	Very stiff LEAN CLAY with sand, trace gravel, gray (CL)	23.5	SS5	18	3-6-7	13	20.0	4000*	10.4				
	Stiff LEAN CLAY, few sand, trace gravel, gray (CL)	25.0	SS6	18	1-1-2	3	25.0	2000*	21.8				
	End of Boring at 25 feet												



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: 19 feet

BORING LOCATION INFORMATION
Latitude: 42.960506
Longitude: -82.444567

Coordinates/GSE determined by:
Estimated form Google Earth

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:
Wet collapse at 19 ft.

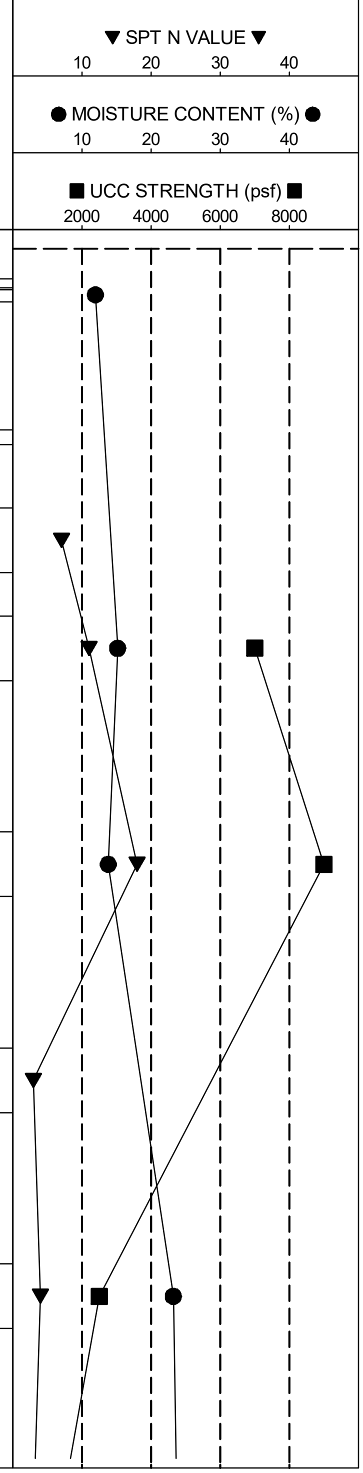
Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

LOG OF TEST BORING TH-02

PROJECT NO. 2021116A **DATE STARTED:** 7/12/2022 **DATE COMPLETED:** 7/12/2022

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation	0											
	8 inches of ASPHALTIC CEMENT CONCRETE	0.7											
	FILL - Poorly graded fine gravel/crushed aggregate, trace sand, trace silt (GP)	0.9	BS	4			1.0	<>	11.9				
			HA1	4			1.2						
	LEAN CLAY with sand, trace gravel, gray (CL) (Hand augered to 6 feet to verify no conflict with utilities)	3.5											
	Poorly graded FINE SAND with silt, trace gravel, brown, moist (SP-SM)	5.5	HA2	4			4.5						
	Loose poorly graded FINE SAND with silt, trace gravel, gray-brown, wet (SP-SM)	8.5	SS3	18	4-5-2	7	7.5						
	Very stiff to hard LEAN CLAY, few sand, trace gravel, gray (CL)		SS4	18	2-4-7	11	10.0	7000*	15.1				
		18.5	SS5	18	4-8-10	18	15.0	9000+*	13.8				
	Very loose CLAYEY FINE SAND, few gravel, gray, wet (SC)	23.5	SS6	18	1-1-2	3	20.0						
	Stiff to medium LEAN CLAY, few sand, trace gravel, gray (CL)		SS7	18	1-2-2	4	25.0	2500*	23.2				



GROUNDWATER READINGS
First Encountered: 5.5 feet
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.960459
Longitude: -82.44332

Coordinates/GSE determined by: Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

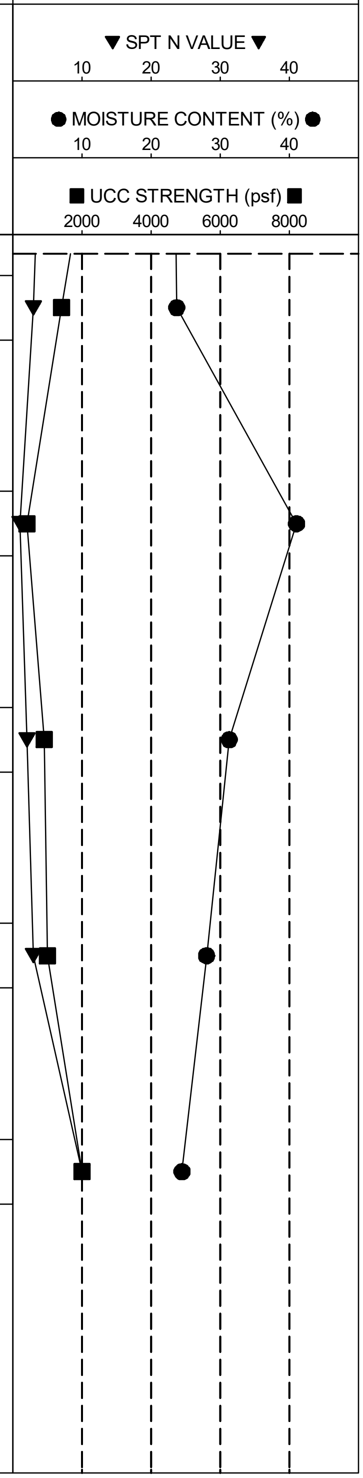
Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

LOG OF TEST BORING TH-02

PROJECT NO. 2021116A **DATE STARTED:** 7/12/2022 **DATE COMPLETED:** 7/12/2022

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation												
	Stiff to medium LEAN CLAY, few sand, trace gravel, gray (CL)		SS8	18	1-1-2	3	30.0	1400#	23.7				
	33.5												
	Very soft to medium LEAN CLAY, trace sand, trace gravel, gray (CL)		SS9	18	0-0-1	1	35.0	400#	41.0		49	28	
			SS10	18	0-1-1	2	40.0	900	31.3	95			
			SS11	18	1-1-2	3	45.0	1000#	28.0				
	48.5												
	Stiff LEAN CLAY, few sand, trace gravel, gray (CL)		SS12	18	2-4-6	10	50.0	2000#	24.5				
	50.0	50											
	End of Boring at 50 feet	55											



GROUNDWATER READINGS
First Encountered: 5.5 feet
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.960459
Longitude: -82.44332

Coordinates/GSE determined by:
Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

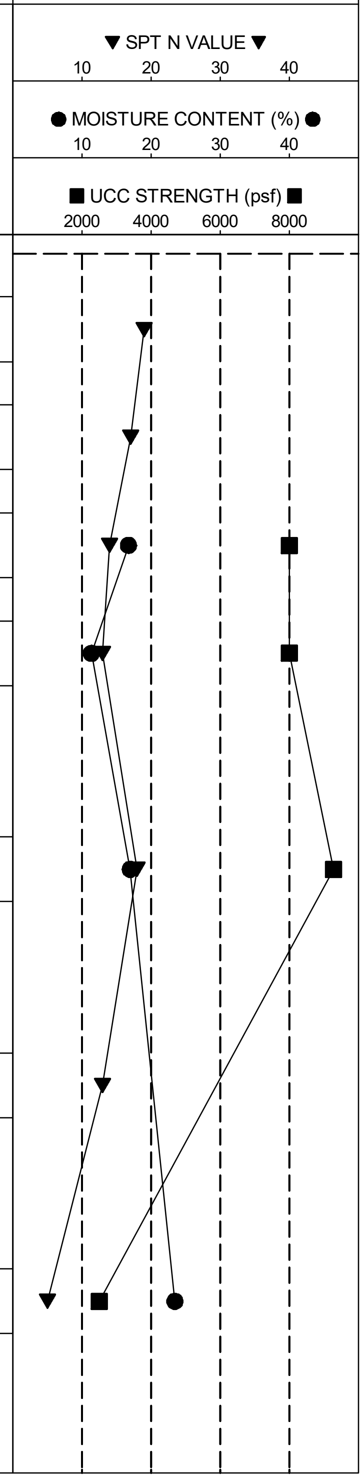
Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

PROJECT NO. 2021116A **DATE STARTED:** 7/11/2022 **DATE COMPLETED:** 7/11/2022

LOG OF TEST BORING TH-03

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation												
	2 inches of TOPSOIL	0.2											
	FILL - Mixed medium dense silty fine sand and topsoil, trace gravel, occasional clay pockets, brown and black, moist (SM)	3.5	SS1	11	6-9-10	19	2.5						
	Medium dense poorly graded FINE SAND, trace silt, trace gravel, brown with pockets of black, moist (SP)	6.0	SS2	13	5-8-9	17	5.0						
	Hard LEAN CLAY, few sand, trace gravel, gray (CL)	18.5	SS3	8	4-6-8	14	7.5	8000*	16.7				
			SS4	18	4-6-7	13	10.0	8000*	11.4				
			SS5	18	6-8-10	18	15.0	9270	17.0	118			
	Medium dense SILT, trace sand, occasional clay seams, gray, moist (ML)	23.5	SS6	16	6-7-6	13	20.0						
	Stiff LEAN CLAY, few sand, trace gravel, gray (CL)	25.0	SS7	18	2-3-2	5	25.0	2500*	23.4				
	End of Boring at 25 feet												



GROUNDWATER READINGS
First Encountered: none
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.960293
Longitude: -82.44243

Coordinates/GSE determined by:
Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

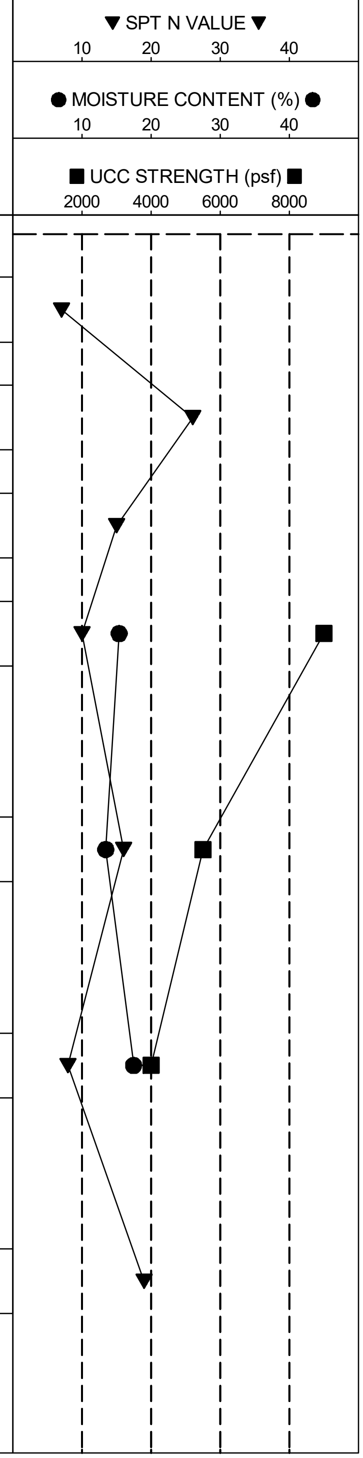
Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

PROJECT NO. 2021116A **DATE STARTED:** 7/11/2022 **DATE COMPLETED:** 7/11/2022

LOG OF TEST BORING TH-04

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation	0											
	18 inches of sand and gravel FILL (1.5)												
	FILL - Loose silty fine sand, trace gravel, orange-brown, moist (SM) (3.5)		SS1	18	3-3-4	7	2.5						
	Medium dense poorly graded FINE SAND with silt, brown, moist to wet (SP-SM) (8.5)	5	SS2	18	5-12-14	26	5.0						
			SS3	18	5-7-8	15	7.5						5
	Hard to very stiff LEAN CLAY, few sand, trace gravel, gray (CL) (23.5)	10	SS4	18	2-4-6	10	10.0	9000+*	15.4				
		15	SS5	18	3-7-9	16	15.0	5500*	13.4				
		20	SS6	18	2-3-5	8	20.0	4000*	17.5				
	Medium dense SILT, trace sand, occasional clay seams, gray, moist (ML) (25.0)		SS7	18	3-7-12	19	25.0						
	End of Boring at 25 feet	25											



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.960314
Longitude: -82.441239

Coordinates/GSE determined by: Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

LOG OF TEST BORING TH-05

PROJECT NO. 2021116A **DATE STARTED:** 7/11/2022 **DATE COMPLETED:** 7/11/2022

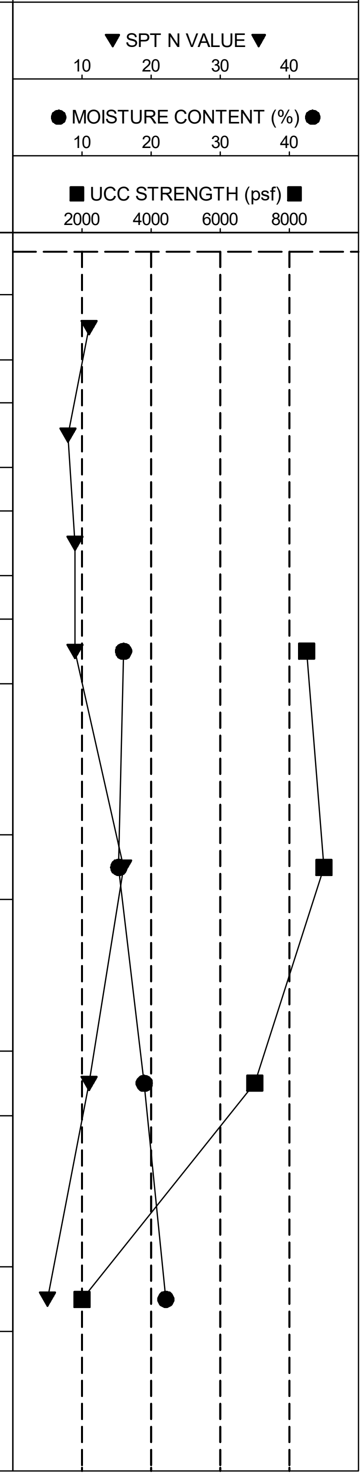
LOG OF SOIL PROFILE

Ground Surface Elevation

Depth to bottom of layer (ft)	Description
1.5	18 inches of TOPSOIL
3.5	FILL - Medium dense poorly graded fine sand, trace silt, trace gravel, orange-brown with pockets of black, moist (SP)
8.5	Loose poorly graded FINE SAND, trace silt, brown, moist to wet (SP)
25.0	Hard to stiff LEAN CLAY, few sand, trace gravel, gray (CL)
	End of Boring at 25 feet

FIELD DATA / LABORATORY DATA

SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
SS1	15	4-5-6	11	2.5						
SS2	18	2-3-5	8	5.0						
SS3	18	2-4-5	9	7.5						
SS4	18	3-4-5	9	10.0	8500*	16.0				
SS5	18	4-7-9	16	15.0	9000+*	15.3				
SS6	18	3-4-7	11	20.0	5060	19.0	113			
SS7	18	2-2-3	5	25.0	2000*	22.1				



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.95997
Longitude: -82.438518

Coordinates/GSE determined by:
Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

GENERAL NOTES

Unified Soil Classification System (USCS)
ASTM D2488 (Modified)

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1 3/8" I.D., 2" O.D. (standard)	BS:	Bulk Sample	RC:	Rock Core with diamond bit, NX size, (unless otherwise noted)
S:	Split Spoon – non-standard size, as noted	HSA:	Hollow Stem Auger		
ST:	Thin-Walled Tube – 3" O.D., (unless otherwise noted)	DP:	Direct Push	RB:	Rock Bit/Roller Bit
LS:	Liner Sample	PS:	Piston Sample	WR:	Wash Rotary
PA:	Power Auger	PT:	Pitcher Sample	NR:	No Recovery
HA:	Hand Auger	WS:	Wash Sample	VS:	Vane Shear Test
AU:	Auger Sample			ER:	Hammer Energy Ratio

Standard Penetration Test Resistance, N-Value: Sum of 2nd and 3rd 6-inch increments, in blows per foot of a 140-pound hammer falling 30 inches and driving an 18-inch to 30-inch long, 2-inch OD split spoon.

WATER LEVEL MEASUREMENT:
Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of a groundwater table. In low permeability soils (clays and silts), the accurate determination of groundwater levels may not be possible with only short-term observations. Groundwater levels at times and locations other than when and where individual borings were performed could vary.

DESCRIPTIVE SOIL CLASSIFICATION:
Soil classification is based on the Unified Soil Classification (USC) System and ASTM Standards D-2487 and D-2488. Coarse-grained soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are generally described as: clays, if they are plastic, and silts, if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their apparent in-place density and fine-grained soils on the basis of their apparent in-place density (silty soils) or consistency (clayey soils).

CONSISTENCIES OF COHESIVE SOILS:
The pocket penetrometer, pocket torvane, and in-situ vane shear tests are converted into an estimated unconfined compressive strength, in pounds per square feet (psf), for presentation on the logs. The unconfined compressive strength is estimated to be about two time the shear strength.

DESCRIPTORS OF MINOR CONSTITUENTS

Primary Constituent	Fine-Grained (Silt & Clay)	Coarse-Grained (Sand & Gravel)	
Descriptor of Other Constituents	**Relative Portion of Coarse Grained Soils as a % of Dry Weight**	**Relative Portion of Fine Grained Soils as a % of Dry Weight**	**Relative Portion of Coarse Grained Soils as a % of Dry Weight**
Trace	<5%	<5%	<5%
Few	≥5% - <15%	N/A	≥5% - <15%
With	≥15% - <30%	≥5% - 12%	≥15%
Modifier	≥30%	>12%	N/A

FINE-GRAINED SOILS / **COARSE-GRAINED SOILS**

Unconfined Compressive Strength Qu, psf	Consistency	N-Value	Apparent Density
< 500	Very Soft	0 – 4	Very Loose
500 - <1,000	Soft	5 – 9	Loose
1,000 - <2,000	Medium	10 – 29	Medium Dense
2,000 - <4,000	Stiff	30 – 49	Dense
4,000 - <8,000	Very Stiff	50 – 80	Very Dense
≥ 8,000	Hard	>80	Extremely Dense

DEFINITIONS OF PAVEMENT CONDITION

Condition		Description
Good	ACC	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks and transverse cracks (open ¼ inch). No patching or very few patches in excellent condition.
	PCC	Moderate scaling in several locations. A few isolated surface spalls. Shallow reinforcement causing cracks. Several corner cracks, tight or well sealed. Open (¼ inch wide) longitudinal or transverse joints.
Fair	ACC	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (½ inch deep or less).
	PCC	Severe polishing, scaling, map cracking, or spalling over 50% of the area. Joints and cracks show moderate to severe spalling. Pumping and faulting of joints (½ inch with fair ride). Several slabs have multiple transverse or meander cracks with moderate spalling.
Poor	ACC	Alligator cracking (over 25% of surface). Severe distortions (over 2 inches deep) Extensive patching in poor condition. Potholes.
	PCC	Extensive slab cracking, severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlement or frost heaves.

DEFINITIONS OF STRUCTURAL AND DEPOSITIONAL FEATURES

Term	Definition
Parting	≤ 1/16 inch (1.6 mm) thick
Seam	> 1/16 inch (1.6 mm) → ½ inch (12.7 mm) thick
Layer	> ½ inch (12.7 mm) to ≤ 12 inches (305 mm) thick
Pocket	Small, erratic deposits of limited lateral extent
Lens	Lenticular deposit
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Varved	Alternating partings or seams (1 mm – 12 mm) of silt and/or clay and sometimes fine sand
Stratified	Alternating layers of varying material or color with layers ≥ 6 mm thick
Laminated	Alternating layers of varying material or color with layers < 6 mm thick
Fissured	Contains shears or separations along planes of weakness
Slickensided	Shear planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Homogeneous	Same color and appearance throughout
Occasional	One or less per foot (305 mm) of thickness
Frequent	More than one per foot (305 mm) of thickness
Interbedded	Applied to strata of soil lying between or alternating with other strata of a different nature

GRAIN SIZE TERMINOLOGY

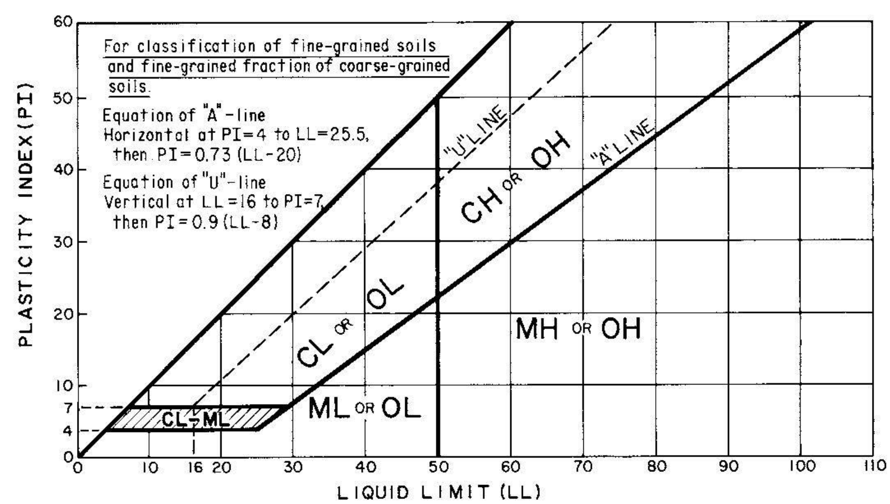
Major Component of Sample	Size Range
Boulders	≥ 12" (300 mm)
Cobbles	< 12" - 3" (300 mm – 75 mm)
Gravel - Coarse	< 3" - ¾" (75 mm – 19 mm)
Gravel – Fine	< ¾" - #4 (19 mm – 4.75 mm)
Sand – Coarse	< #4 - #10 (4.75 mm – 2 mm)
Sand – Medium	< #10 - #40 (2 mm - 0.425 mm)
Sand – Fine	< #40 - #200 (0.425 mm -0 .074 mm)
Silt	< 0.074 mm - 0.005 mm
Clay	<0 .005 mm

GENERAL NOTES

Unified Soil Classification System (USCS)
ASTM D2487

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
COARSE-GRAINED More than 50 % retained on No. 200 sieve	**Gravels** (More than 50 % of coarse fraction retained on No. 4 sieve)	**Clean Gravels** (Less than 5% fines [C])	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [D]	GW	Well-graded gravel [E]
			$Cu < 4$ and/or [$Cc < 1$ or $Cc > 3$] [D]	GP	Poorly graded gravel [E]
		Gravels with Fines (More than 12 % fines [C])	Fines classify as ML or MH	GM	Silty gravel [E,F,G]
			Fines classify as CL or CH	GC	Clayey gravel [E,F,G]
	Sands (50 % or more of coarse fraction passes No. 4 sieve)	**Clean Sands** (Less than 5 % fines [H])	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [D]	SW	Well-graded sand [I]
			$Cu < 6$ and/or [$Cc < 1$ or $Cc > 3$] [D]	SP	Poorly graded sand [I]
		Sands with Fines (More than 12 % fines [H])	Fines classify as ML or MH	SM	Silty sand [F,G,I]
			Fines classify as CL or CH	SC	Clayey sand [F,G,I]
FINE-GRAINED SOILS 50 % or more passes the No. 200 sieve	**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]
					Organic silt [K,L,M,O]
	Silts and Clays Liquid limit more than 50	**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]
					Organic silt [K,L,M,Q]
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			Pt	Peat

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 $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2/(D_{10} \times D_{60})$
E If soil contains ≥15 % sand, add "with sand" to group name.
F If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
G If fines are organic, add "with organic fines" to group name.
H 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
I If soil contains ≥15 % gravel, add "with gravel" to group name.
J If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
K If soil contains 15 to <30 % 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.



Order of Classification: 1) Consistency or Apparent Density, 2) Type of Soil, 3) Minor Soil Type(s), 4) Inclusions, 5) Layered Soils, 6) Color, 7) Water Content, 8) USCS Symbol, 9) Geological Name

APPENDIX C

LABORATORY TEST RESULTS

Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

SUMMARY OF LABORATORY RESULTS

PROJECT NO. 2021116A

Borehole	Top Depth of Test Sample (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	UCC (psf)	FIne Sg
TH-01								15.4			
TH-01	1.1									<>	
TH-01	8.5							18.3		3000*	
TH-01	13.5							14.1		9000*	
TH-01	18.5							10.4		4000*	
TH-01	23.5							21.8		2000*	
TH-02	0.9							11.9		<>	
TH-02	8.5							15.1		7000*	
TH-02	13.5							13.8		9000+*	
TH-02	23.5							23.2		2500*	
TH-02	28.5							23.7		1400#	
TH-02	33.5	49	21	28				41.0		400#	
TH-02	38.5							31.3	95.3	900	
TH-02	43.5							28.0		1000#	
TH-02	48.5							24.5		2000#	
TH-03	6.0							16.7		8000*	
TH-03	8.5							11.4		8000*	
TH-03	13.5							17.0	117.5	9270	
TH-03	23.5							23.4		2500*	
TH-04	6.0				2	5					
TH-04	8.5							15.4		9000+*	
TH-04	13.5							13.4		5500*	
TH-04	18.5							17.5		4000*	
TH-05	8.5							16.0		8500*	
TH-05	13.5							15.3		9000+*	
TH-05	18.5							19.0	113.1	5060	
TH-05	23.5							22.1		2000*	

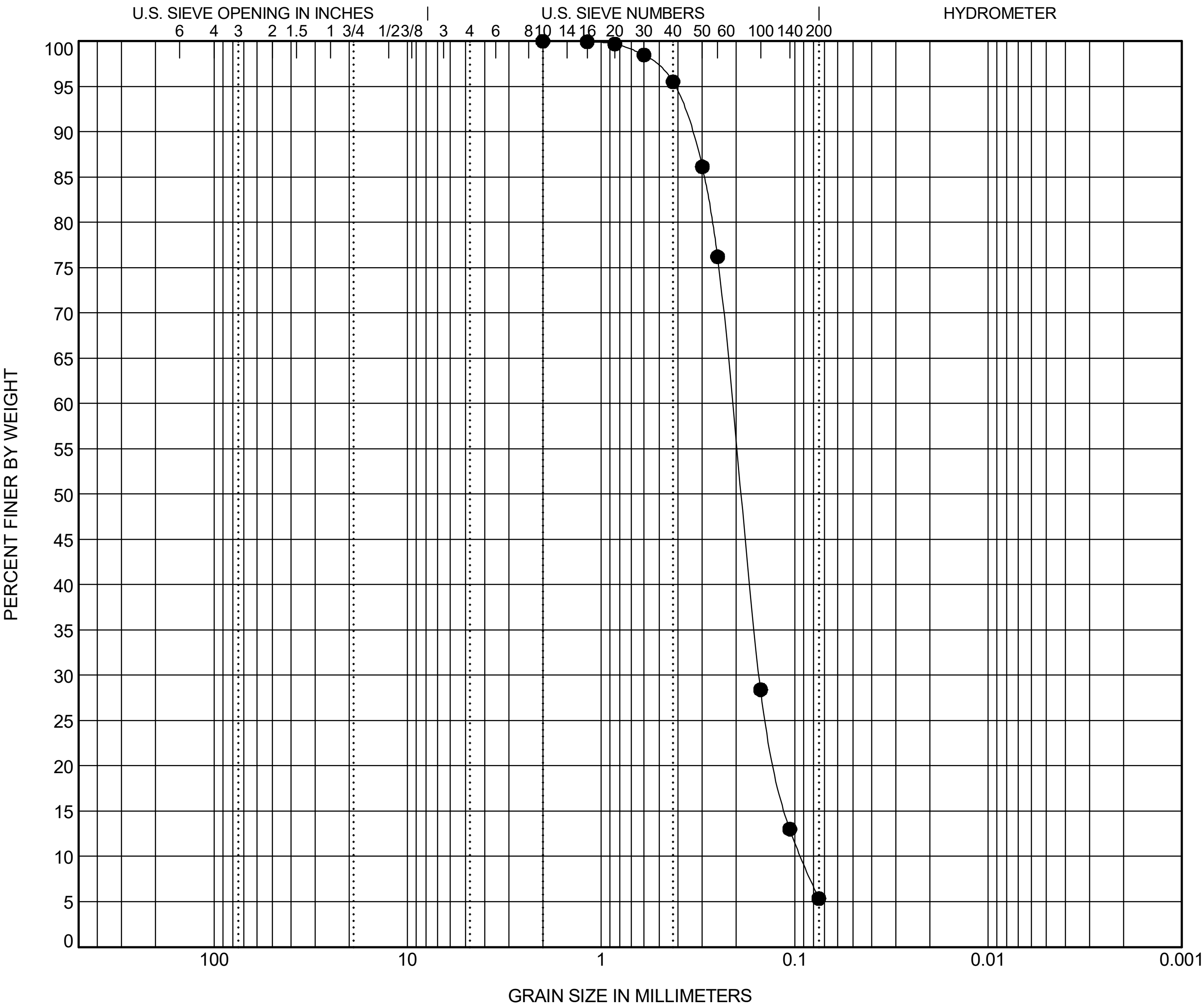
Torvane
* Pocket Penetrometer
<> Disturbed Sample

Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

GRAIN SIZE DISTRIBUTION

PROJECT NO. 2021116A



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Depth ft.	Remarks	LL	PL	PI	Cc	Cu
●	**TH-04**	**6.0**					**1.20**	**2.27**

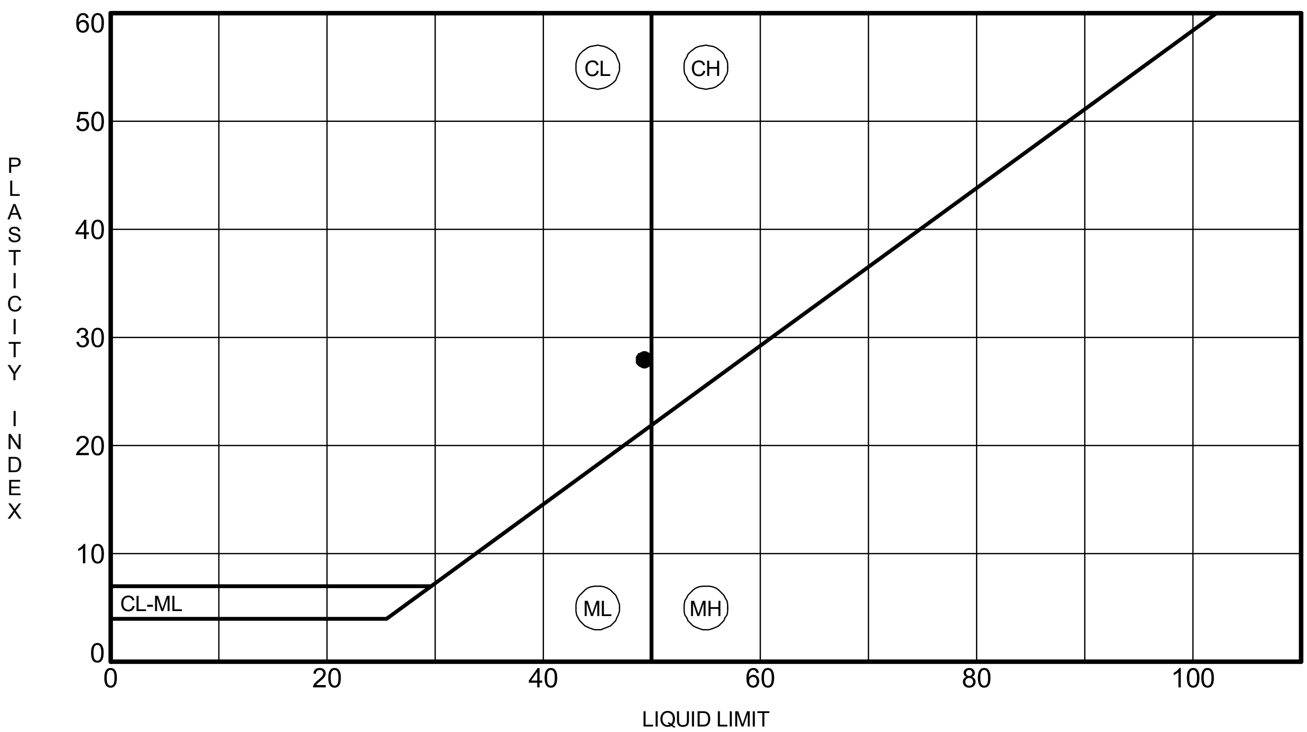
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TH-04**	**6.0**	**2**	**0.21**	**0.153**	**0.093**	**0.0**	**94.7**	**5.3**	

GRAIN SIZE PORT HURON AMTRAK STATION.GPJ SOMAT.GDT 8/4/22

Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

ATTERBERG LIMITS RESULTS
ASTM D4318
PROJECT NO. 2021116A



	Specimen Identification	Depth	LL	PL	PI	Fines	Remarks
●	**TH-02**	**33.5**	**49**	**21**	**28**		

APPENDIX D

"IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT"

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

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.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and 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 not 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.

Read this Report in Full

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.*

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.*

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.

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 <u>not</u> 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.*

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.

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.

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.

Geoenvironmental Concerns Are <u>Not</u> 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.

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 <u>not</u> 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 <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Appendix G:

Geotechnical Investigation

Infrastructure Consulting Engineers

4039 40th Street SE • Suite 4 • Grand Rapids • Michigan • 49512

REPORT ON PRELIMINARY GEOTECHNICAL INVESTIGATION

AMTRAK FACILITY FEASIBILITY STUDY
PORT HURON, MICHIGAN

Prepared for:

BERGMANN
ARCHITECTS ENGINEERS PLANNERS

Bergmann
7050 W. Saginaw Hwy., Suite 200
Lansing, Michigan 48917

July 13, 2023
2021116A

Somat Engineering, INCORPORATED

July 13, 2023
2021116A

Mr. Jeremy Hedden, P.E
Bergmann
7050 West Saginaw Highway, Suite 200
Lansing, Michigan 48917

RE: Report on Preliminary Geotechnical Investigation
Amtrak Facility Feasibility Study
Port Huron, Michigan

Dear Mr. Hedden:

We have completed the preliminary geotechnical investigation report to support the feasibility study for the proposed improvements to the existing Amtrak Station in Port Huron, Michigan. This report presents the results of our observations and results of the geotechnical investigation and general geotechnical recommendations and construction considerations for the proposed improvement concepts.

The soil samples collected during our field investigation will be retained in our laboratory for 90 days from the date of the final report, at which time these samples will be discarded unless otherwise directed by you.

Upon your review, if you should have any questions, please contact us. It is a pleasure working with you on this project.

Sincerely,
Somat Engineering, Inc.

Jane Abadir

Jane M. Abadir, P.E.
Principal Engineer

Jennifer S. Schmitzer
Project Manager

JSS/JMA/fks

GEOTECHNICAL INVESTIGATION REPORT
AMTRAK FACILITY FEASIBILITY STUDY
PORT HURON, MICHIGAN

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APPENDICES

GEOTECHNICAL INVESTIGATION REPORT
AMTRAK FACILITY FEASIBILITY STUDY
PORT HURON, MICHIGAN

1.0 INTRODUCTION

1.1 GENERAL

Upon authorization from Bergmann, Somat Engineering, Inc. (Somat) has conducted a geotechnical investigation for the site feasibility study for a new Amtrak facility in Port Huron, Michigan. The geotechnical investigation was performed in accordance with Somat Proposal No. P200048A dated February 11, 2020.

The following sections of this report provide our understanding of the feasibility study, a description of our field investigation, the results of the field and laboratory tests, the logs of test borings, our interpretation of subsoil and groundwater conditions, feasible foundation concepts and general geotechnical and construction considerations for the potential future development.

1.2 PROJECT INFORMATION

The existing Amtrak passenger station was constructed in 1979 and was constructed as a demonstration of a prototype that was being developed at the time (and not based on Amtrak Guidelines). As such, a new station is currently proposed to be improved to better accommodate existing passenger numbers and future growth. A larger facility is needed to improve parking and waiting areas as well as to meet the current Amtrak design requirements.

A specific design has not been completed for this facility so, at this stage, the purpose of the geotechnical investigation was to identify the subsurface conditions at the site and the suitability for supporting a new facility. The new facility will need an access track to the main rail line; adequate parking, adequate lighting, a station building with a waiting room; a level boarding platform; a side track for train parking/storage; and driveways connecting parking areas to roadways and the station building.

1.3 SITE CONDITIONS

The site being considered for the new facility is the current Amtrak passenger station located at 2223 16th Street in the City of Port Huron. The site is a narrow parcel extending from 16th Street west for roughly 1,000 feet. Additionally, the parcel east of 16th Street is being considered, generally extending from 16th Street east to the St. Clair tunnel property. This station is the eastern terminus of the Blue Water passenger line, with only freight train traffic crossing through to the St. Clair Tunnel.

The existing Amtrak station building is located west of 16th Street and on the south side of the passenger rail line. There is an asphalt-paved access drive from 16th Street which leads to the parking lot situated on both the east and west sides of the building. The remainder of both parcels is covered with grass/weeds with sporadic trees. The topography is relatively flat.

2.0 SUBSURFACE INVESTIGATION

2.1 FIELD EXPLORATION

The field exploration program consisted of performing a total of five (5) soil borings spaced within the two parcels for the preliminary geotechnical investigation, designated as TH-01 through TH-05. TH-02 extended to 50 feet below existing grade, while the remainder each extended to 25 feet below existing grades.

Prior to drilling TH-01 and TH-02, the surface was hand augered to a depth of about 6 feet below existing grade to verify the absence of underground utilities, since there was no clear utility marking at the time of the investigation. Standard drilling with soil sampling was resumed to the planned exploration depth after no conflicts were found.

The locations of the soil borings were selected by Somat and approved through Bergmann. Somat staked the boring locations in the field, taking into consideration the locations of the utilities (underground and overhead) as well as physical access for the drill rig (i.e. thick brush, property lines, trees, etc.).

A schematic including the approximate locations of soil borings within the investigated sites is presented in Appendix A. Soil boring coordinates were recorded with a Trimble Geo7X GPS unit, except for boring TH-01 which was significantly moved from its original location due to trees preventing access to the undeveloped area at the west end of the property. These coordinates were estimated from Google Earth satellite images.

2.1.1 Drilling Operations

The soil borings were performed on July 11 and 12, 2022. The soil borings were drilled using an truck-mounted drill rig advancing 4¼-inch inside diameter, hollow-stem augers to the boring termination depths. Upon completion, all boreholes were backfilled with soil cuttings to the surface.

2.1.2 Standard Penetration Test (SPT)

Soil samples collected during the field portion of the subsoil exploration were labeled with the soil boring designation and a unique sample number. Soil samples were obtained by Standard Penetration Tests in accordance with ASTM D1586 procedures, whereby a conventional 2-inch O.D. split-spoon sampler is driven into the soil with a 140-pound hammer repeatedly dropped through a free-fall distance of 30 inches. The sampler is generally driven three successive 6-inch increments (occasionally four successive increments) with the blows for each 6-inch increment being recorded. The number of blows required to advance the sampler through 12 inches after an initial penetration of 6 inches is termed the Standard Penetration Test resistance (N-value) and is presented graphically on the individual Logs of Test Borings. As added information, the number of blows for each 6-inch increment are also presented on the boring logs.

The N-values reported on the Logs of Test Borings are the direct blow counts from the field and are uncorrected. The efficiency of each specific hammer is dependent on many factors, including type (auto vs. manual), material quality, regularity of maintenance, drill rig mechanics, etc., and can change with time. As such, SPT hammers on each drill rig are required to be calibrated every two years. Certificates are provided to us indicating each hammer's measured energy transfer ratio. For this investigation, DLZ American Drilling used a CME 55 (serial number 404185) drill rig. Based on the current certificate for this drill rig, the energy transfer ratio for the SPT hammer is 91.0%.

2.1.3 Sampling

Soil samples were recovered using split-spoon sampling procedures in accordance with ASTM Standard D1586 ("Standard Method for Penetration Tests and Split Barrel Sampling of Soils"). In general, the samples were obtained every 2.5 feet intervals to a depth of 10 feet and then every 5 feet intervals thereafter to the exploration depths of the borings. The samples were sealed in glass jars in the field to protect the soil and maintain the soil's natural moisture content.

All soil samples for the geotechnical investigation were transported to Somat's laboratory for further analysis and testing and will be retained in our laboratory for a period of 90 days after the date of the final report, after which they will be discarded unless we are notified otherwise.

2.1.4 Groundwater Level Observation Procedures

Whenever possible, groundwater level observations were made during the drilling operations and are shown on the individual Logs of Test Borings. During drilling, the depth at which free water was observed, where drill cuttings became saturated or where saturated samples were collected, was indicated as the groundwater level during drilling. In granular, pervious soils, the indicated water levels are considered relatively reliable when solid or hollow-stem augers are used for drilling. However, in cohesive soils, groundwater observations are not necessarily indicative of the static water table due to the low permeability rates of the soils, and due to the sealing off of natural paths of groundwater flow during drilling operations.

It should be noted that seasonal variations and recent precipitation conditions may influence the level of the groundwater table significantly. Groundwater observation wells are generally used if precise groundwater table information is needed, however the installation of groundwater monitoring wells was not included in the scope of the investigation. Therefore, the discussion and recommendations provided within the report are based on our knowledge of the soil and groundwater conditions in this area, which should provide for a reasonable approximation of the groundwater level.

2.2 LABORATORY TESTING

All soil samples were classified in accordance with the Unified Soil Classification System (USCS). Representative soil samples were subjected to laboratory tests consisting of moisture content determinations, hand penetrometer tests, unconfined compressive strength tests, and Atterberg Limits tests.

The results of all of the laboratory tests are included on the individual Logs of Test Borings in Appendix B and/or graphically in Appendix C. All laboratory tests were performed in accordance with their applicable ASTM procedures. Brief descriptions of the laboratory tests are included in Appendix C after the result sheets.

2.3 LIMITATIONS

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on, below or around this site.

Some soils have been identified on the Logs of Test Borings as “fill” if a soil deposit is suspected to have been placed by human activity, versus having been deposited by natural means. These designations were based on our professional engineering judgment considering factors such as our visual classification, the presence of foreign materials (i.e. bricks, concrete, plastic, etc.), and/or site topography, among many other possibilities. As such, the “fill” descriptions should be considered as secondary information to the standardized soil classification. Due to the large variation of types of fill, methods of fill placement, potential changes of historical use of the site, and soil sample size, it is difficult to discern whether the subject soil sample is native to this site, or fill material based on visual classification alone. As such, the designation of “fill” may not be reliable and hence should be considered as informational only. Conversely, where a soil is not designated as “fill” on the boring logs, it does not necessarily mean it is not a fill soil, only that there were no apparent observations indicating a fill material. Therefore, we cannot guarantee that our description of “fill” soils is accurate, or that we have identified all types of fill material encountered with our sampling on the site.

Further, Somat has made no observations or recommendations with regard to the presence or absence of mold or other biological contaminants (such as spores, fungi, bacteria, viruses and the byproducts of such organisms), now or in the future, on this site or within or on any structures to be constructed on this site. Any consideration with regard to the presence of mold or the possibility of mold growth in or on the structures to be constructed on this site is not within Somat’s scope of services on this project.

3.0 SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

Soil conditions encountered at the test boring locations have been evaluated and presented in the form of Logs of Test Borings. The logs include approximate soil stratification with detailed soil descriptions and selected physical properties for each stratum encountered in the test borings. In addition to the observed subsoil stratigraphy, the boring logs present information relating to sample data, Standard Penetration Test results, groundwater level conditions observed in the boring, personnel involved, and other pertinent data. For information, and to aid in understanding the data as presented on the boring logs, General Notes defining nomenclature used in soil descriptions are presented immediately following the Logs of Test Borings. It should be noted that the Logs of Test Borings included with this report have been prepared on the basis of laboratory classifications and testing as well as field logs of the soils encountered.

A generalized description of the soils encountered in the soil borings performed for this project, beginning at the existing ground surface and proceeding downward, is provided below:

Surface Material.

Asphaltic cement concrete (ACC) was encountered at the surface of borings TH-01 and TH-02 in an 8-inch thickness. An apparent base layer was found below the ACC consisting of 2 to 4 inches of gravel/crushed aggregate. Topsoil was encountered at the surface of borings TH-03 and TH-05 in thicknesses of 2 and 18 inches, respectively. TH-04 encountered 18 inches of sand and gravel fill.

Fill Soils.

Apparent fill soils (beyond the pavement base layer) were encountered in borings TH-03, TH-04, and TH-05 extending to a depth of about 3.5 feet below existing grades. These soils consisted of loose silty sand (mixed with topsoil in TH-03) and medium dense poorly graded sand with silt.

Clay.

Below the surface and fill soil layers, the soils in all of the borings were predominantly lean clay. The consistency of the clay ranged widely from very soft to hard, generally decreasing in strength with depth. Atterberg limits tests performed on the soft clay encountered in boring TH-02 at a depth of 33.5 feet was on the borderline between lean clay and high plasticity clay (fat clay).

Occasional layers of poorly graded sand (with varied amounts of silt), silt, and clayey sand were encountered within the clay strata. The apparent density of these layers ranged from very loose to medium dense.

Please refer to the boring logs for the soil conditions at the specific boring locations. It is emphasized that the stratification lines shown on the Logs of Test Borings are approximate indications of change from one soil type to another at the tested locations. The actual transition from one stratum to the next may be gradual and may vary within the area represented by the test location.

3.2 GROUNDWATER LEVEL OBSERVATIONS

During the drilling process, groundwater was encountered either during drilling or upon completion in all of the soil borings except TH-03. The groundwater levels observed are as follows, with depths referenced from existing ground surface at the time of drilling:

Boring No.	*Groundwater Depth (during drilling)*	*Groundwater Depth (upon completion of drilling)*
TH-01	6 feet	19 feet (borehole collapsed at 19 feet)
TH-02	5.5 feet	none
TH-03	none	none
TH-04	6 feet	none
TH-05	6 feet	none

A lack of groundwater observed does not necessarily indicate that there is no groundwater, due to the sealing off of natural flow paths during the drilling process. In our experience, the depth at which clayey soils change from brown to gray in color (an indication of oxidation) is frequently indicative of the long-term groundwater level. Based on the change of color of the soils encountered in the soil borings, we anticipate the long-term groundwater level at this site is situated at a depth of about 5 to 6 feet below the existing ground surface. However, perched water trapped in the granular layers above the clay should be expected above the long-term groundwater level.

The groundwater levels observed are only accurate for the date and time of drilling. The elevation of the natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation and percolation in the area, as well as the water level in nearby surface water bodies in the vicinity affecting the groundwater flow pattern.

4.0 ANALYSIS AND RECOMMENDATIONS

The purpose of the preliminary geotechnical investigation performed for this project was to provide a general overview of the subsurface soil and groundwater conditions at the site and to provide general subsurface data to be used to assess the feasibility of the potential foundation concepts for the proposed development. Once a final design has been completed, additional soil borings and in-situ geotechnical tests should be performed at specific areas of interest to the design and tailored to provide specific design information for the proposed structures.

4.1 BUILDING FOUNDATION CONSIDERATIONS

4.1.1 Foundation Design Recommendations

We anticipate new buildings for this facility would be a new station building and smaller maintenance or storage-type buildings. These buildings are assumed to be relatively lightly loaded, single story structures with no below grade areas (i.e. no basements). Further, we anticipate that shallow foundations (spread footings, continuous footings, or mat foundations) constructed at conventional frost depths (42 inches below final site grade) would be the desired foundation support.

Based on all of the soil borings drilled for this preliminary geotechnical investigation, at the conventional 3.5-foot depth below the current existing ground surface, bearing soils are anticipated to consist of lean clay and loose to medium dense sand. These soils are considered suitable for support of the anticipated building structures, provided the looser granular soils are improved (compacted or replaced with properly compacted engineered fill) during construction.

The net allowable bearing capacity of the bearing soils anticipated at 3.5 feet depth should be in the range of 2,500 to 5,000 psf, with potentially higher bearing capacity in isolated areas, such as at boring TH-03, where a bearing capacity of 7,000 psf may be achieved. These preliminary estimates of bearing capacity pressures are based on a factor of safety of 3 on the ultimate pressures.

Across the sites, predominantly clay soils were encountered and relatively consistent in strength in all of the borings. Boring TH-02 was drilled to a depth of 50 feet in order to provide deeper soil information. Based on this soil boring (and the bottoms of the other borings), the strength of the clay soils decreases significantly below about 20 to 25 feet in depth. Atterberg limits test performed on the soft clay encountered in boring TH-02 at a depth of 33.5 feet was on the borderline between lean clay and high plasticity clay (fat clay). As such, if below grade structures are considered, then allowable bearing pressures will need to be significantly reduced to prevent significant settlement or bearing failures.

Because the soils are predominantly clay, long term consolidation settlement should be expected. The amount of settlement will ultimately depend on the load and the width of the footings, but in general for loads not exceeding the bearing capacities of 3,000 to 5,000 psf, we would expect settlement to be up to 2 inches over the life of the structure. Bottom heave potential due to the soft and high plasticity clays should also be checked depending on the depth and geometry of the excavations.

For bearing capacity and settlement considerations, isolated spread footing type foundations should be at least 30 inches wide, and continuous strip foundations should be at least 18 inches wide. Foundations along exterior walls, or in any unheated areas, should be situated a minimum of 42 inches below final site grade for protection against frost heave during normal winters.

Light loads are anticipated for the proposed structures, however, depending on the load requirements, shallow pile systems such as geopiers, helical piers, or micropiles piles could also be feasible alternative shallow foundation options, if needed. We anticipate an allowable axial capacity ranging between 15 and 30 feet per pile could be achieved when driven approximately 25 to 30 feet below grade. A more detailed evaluation and analysis will be required to determine the anticipated axial, lateral and uplift capacities based on the type of foundation system and the applied loads.

4.1.2 Groundwater Control Recommendations

With the groundwater table situated at about 5 to 6 feet below existing grade, excavations for conventional footing depths are not anticipated to extend below the groundwater table unless undercuts are necessary. However, perched water could be trapped in sand layers that are situated above less permeable clay layers. There were sand layers encountered from the surface in several of the soil borings, which could be water-bearing depending on weather conditions during the time of construction. In general, it appears that groundwater flow into open excavations may be handled by standard sump pits and pumps. Sheet piles sufficiently toed in the clay layer could also help retain the soils and reduce the flow of groundwater into the excavations.

It should be noted that the elevation of the natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation and percolation in the area, as well as on the water level of surface water bodies in the vicinity affecting the groundwater flow pattern.

4.1.3 Seismic Site Classification Recommendations

Based on our knowledge of the general geotechnical conditions in the vicinity of the project, we classify this site as Site Class D, as per the Michigan 2006 Building Code Table 1615.1.5. Deep soil borings extending to a depth of 100 feet will be required to classify the seismic class specific to this site.

4.2 PAVEMENT & BUILDING SLAB CONSIDERATIONS

4.2.1 Anticipated Subgrade Soils

We expect the new facility will require paved driveways and parking areas. Depending on the final pavement design, we anticipate a pavement section thickness of about 18 inches including pavement and base/subbase layers. In borings TH-01 through TH-05, at the 18-inch depth, the subgrade soils are anticipated to consist of sand/silty sand fill and lean clay. In general, these soils are suitable for support of new pavement, provided the loose sands are improved through compaction. If compaction is not feasible due to saturated subgrade conditions, then it may be necessary to undercut some of these soils and replace with well compacted, and drainable engineered fill. Alternatively, mixing cement or lime into the subgrade soils or using geogrids placed below the base course may help distribute the vertical loading at localized areas where soft and loose areas are identified during proofrolling.

A fill layer in TH-03 was found to be sand mixed with topsoil. We recommend any soils with organics to be completely removed prior to constructing any new pavements.

4.2.2 Drainage Considerations for Pavement and Slab-On-Grade Structures

While structurally these soils are suitable, consideration will need to be given to drainage below the new pavement. Some of the sand was found to contain significant "fines", which reduces the permeability of the subgrade soils and increases their susceptibility to frost action. The clayey/silty soils are considered highly susceptible to frost action and the negative consequences. Any areas where water is not allowed to drain freely either due to subsoil conditions, site grades, or other factors, will have a detrimental effect on the pavement condition over time. As such, new pavement on this site will likely require some undercut of the clay and silty sand soils and replacement with a clean sand or an open graded aggregate to improve drainage.

A provision for edge drains should be considered to enhance drainage conditions in pavement areas and to reduce the effects of frost heave. These drains should consist of corrugated, perforated HDPE pipe in conjunction with a geotextile separator in accordance with MDOT Standards. The spacing will depend on the grade of the new pavement, the locations of the catch basins, and other factors considered by the engineer designing the drainage system. Edge drains should be installed at all catch basin structures in the pavement construction areas within the project limits. In addition, the subgrade should be graded to provide for positive drainage to these structures.

For proposed slabs-on-grade for buildings, we expect similar subgrade soils for support, which will require the same improvements as those noted above for pavement. We anticipate they will be situated above the long-term groundwater level; therefore, we do not believe that an underfloor drainage system would be necessary. However, a properly functioning perimeter foundation drainage system should be constructed; the perimeter drainage systems should drain by gravity to the existing site drainage structures within the project limits. In addition, we believe a vapor barrier beneath the slab would be beneficial in these soil conditions. Though, this should be re-evaluated once structure-specific soil borings are performed for the final design.

4.3 STORMWATER MANAGEMENT CONSIDERATIONS

With constructing new impervious surfaces, we anticipate a stormwater management plan will need to be developed. The plan will likely include a system of storm sewers but could also incorporate other surface drainage structures such as bioswales or retention basins.

Based on the soil borings drilled for this preliminary evaluation, the soils in the upper 10 feet include layers of both sand and lean clay. The clay is not considered permeable (especially in terms of site drainage) with coefficients of permeability (k) values of about 10^{-5} to 10^{-7} cm/s. The sand layers may provide suitable drainage depending on the amount of fines (silt and clay) they contain. Though the thickness of the sand is limited and is saturated starting at about 5 to 6 feet. Coefficients of permeability for the cleaner sand encountered could be about 10^{-2} to 10^{-3} cm/s whereas the "silty" sands would be 10^{-3} to 10^{-5} cm/s.

For final design, we recommend performing in-situ infiltration tests to evaluate the permeability of potential basin locations.

4.4 GEOTECHNICAL INSTRUMENTATION MONITORING

A geotechnical instrumentation program may need to be implemented to monitor any potential settlement or harmful vibrations due to the construction methods used. As required for all construction activity, consideration should be given to the effect of ground vibrations induced from pile driving or other vibratory installations. Generally, the existing soil conditions would not be considered highly susceptible to seismic movement. However, construction activities in close proximity (within 100 feet) to existing structures may cause damage due to vibrations. In addition to above grade structures, consideration should be below grade structures, such as utilities, which may be more susceptible to vibration damage, but may not be readily visible for monitoring. If significant construction vibration is anticipated near existing critical structures, consideration should be given to a proactive monitoring program or the use of non-vibratory techniques.

5.0 GENERAL OBSERVATIONS AND CONSTRUCTION CONSIDERATIONS

While on site for drilling, we observed the surface conditions of the site, and did not find any apparent evidence of contamination, buried debris, or surface debris. Though the old passenger railroad tracks are still present in the parcel east of 16th Street, grown over with weeds and brush. We also did not observe any areas of standing water or wetland/marsh-type areas.

We anticipate excavations in the natural sand soils and site fill soils will be prone to caving and sloughing of the excavation sidewalls, especially in areas where the soil conditions are in a loose condition (‘N’ value of 9 or less). Appropriate measures will be required to maintain the stability of excavation sidewalls. The required measures will depend on the depth and width of excavation and groundwater conditions at specific locations. In general, excavation walls should be sloped back to a stable angle in accordance with published MI-OSHA guidelines. If sufficient room is not available for sloping the excavation walls, then an earth retention system will be required to maintain the stability of the sidewalls. Construction traffic, stockpiles of soil and construction materials should be kept away from the edges of the excavations for a distance equal to the depth of the excavation. If such clearances cannot be maintained, the resulting surcharge loads should be considered in the design of the shoring system. Likewise, loads from traffic on adjacent road areas also need to be considered in the design. In all cases, MI-OSHA and other regulatory requirements must be followed and adequate protection provided for workers.

6.0 GENERAL QUALIFICATIONS

This report and the attached Logs of Test Borings are instruments of service, which have been prepared in accordance with generally accepted soil and foundation engineering practices. We make no warranties either expressed or implied as to the professional advice included in this report.

The contents of this report have been prepared in order to aid in the evaluation of expected subsoil properties to assist the engineer in verifying the feasibility of developing this site for a future facility. The contents of this report should not be relied upon for other projects or purposes. As this report was intended to provide preliminary subsurface information for consideration of site development, a final geotechnical investigation will need to be performed for design of specific site structures.

Since the information obtained from the soil borings is specific to the exact test locations, soil and water conditions could be different from those occurring at other locations of the site. This report does not reflect variations which may occur between the soil borings. The nature and extent of these variations may not become evident until the time of construction.

This report and the associated Logs of Test Borings should be made available to bidders prior to submitting their proposals and to the successful contractor and subcontractors for their information only, and to supply them with facts relative to the subsurface investigation, laboratory tests, etc.

Somat is not responsible for failure to provide services that other project participants, apart from our client, have assigned to Somat either directly or indirectly. Somat is not responsible for failing to comply with the requirements of design manuals or other documents specified by other project participants that impart responsibilities to the geotechnical engineer without our knowledge and written consent. We are not liable for services related to this project that are not outlined in our scope of services, detailed in our project proposal.

If you have any questions regarding this report, please contact us. Please review the important information regarding geotechnical reports included in Appendix D.

APPENDIX A

SOIL BORING LOCATION DIAGRAM

Adapted from GoogleEarth satellite imagery

Drawing Scale as noted

Legend:

Approximate Soil Boring Locations

SOIL BORING LOCATION DIAGRAM

Amtrak Facility Feasibility Study
Port Huron, Michigan

Somat Project No.: *2021116A*

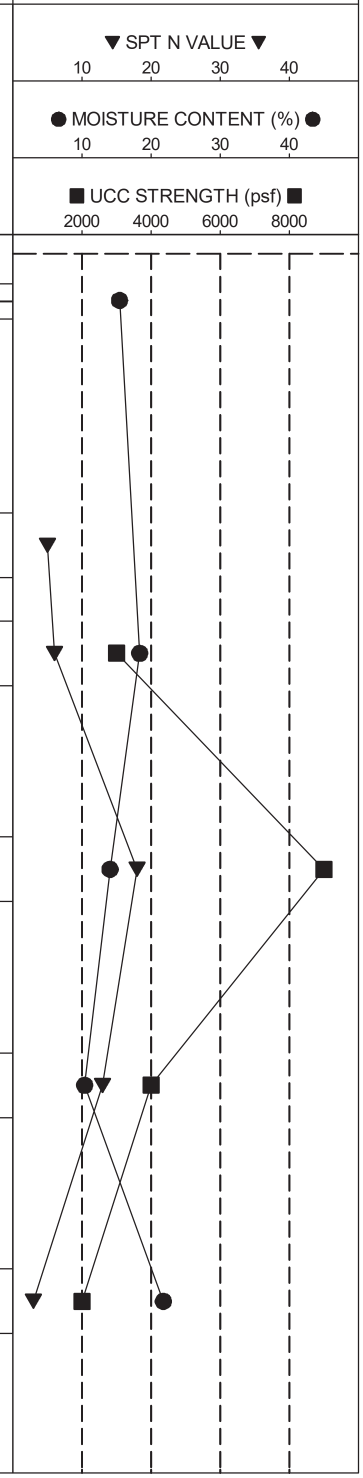
APPENDIX B

LOGS OF TEST BORINGS
AND GENERAL NOTES

LOG OF TEST BORING TH-01

PROJECT NO. 2021116A **DATE STARTED:** 7/12/2022 **DATE COMPLETED:** 7/12/2022

Elevation (ft)	Depth (ft)	Log of Soil Profile	Sample No.	Sample Recovery (in)	No. of Blows for 6-inch Drive	N Value	Sample Tip Depth (ft)	Unconfined Comp Strength (psf)	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Passing #200
		Ground Surface Elevation											
	0–0.7	8 inches of ASPHALTIC CEMENT CONCRETE											
	0.7–1.1	FILL - Poorly graded fine gravel/crushed aggregate, trace sand, trace silt (GP)	BS	3			1.1		15.4				
	1.1–6.0	LEAN CLAY with sand, trace gravel, gray (CL) (Hand augered to 6 feet to verify no conflict with utilities)	HA1	5			1.5	<>					
	6.0–8.5	Loose poorly graded FINE SAND with silt, trace gravel, gray-brown, wet (SP-SM)	SS2	18	2-2-3	5	7.5						
	8.5–18.5	Stiff to hard LEAN CLAY, few sand, trace gravel, gray (CL)	SS3	18	2-2-4	6	10.0	3000*	18.3				
			SS4	18	4-7-11	18	15.0	9000*	14.1				
	18.5–23.5	Very stiff LEAN CLAY with sand, trace gravel, gray (CL)	SS5	18	3-6-7	13	20.0	4000*	10.4				
	23.5–25.0	Stiff LEAN CLAY, few sand, trace gravel, gray (CL)	SS6	18	1-1-2	3	25.0	2000*	21.8				
	25.0	End of Boring at 25 feet											



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: 19 feet

BORING LOCATION INFORMATION
Latitude: 42.960506
Longitude: -82.444567

Coordinates/GSE determined by:
Estimated form Google Earth

KEY
\# Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:
Wet collapse at 19 ft.

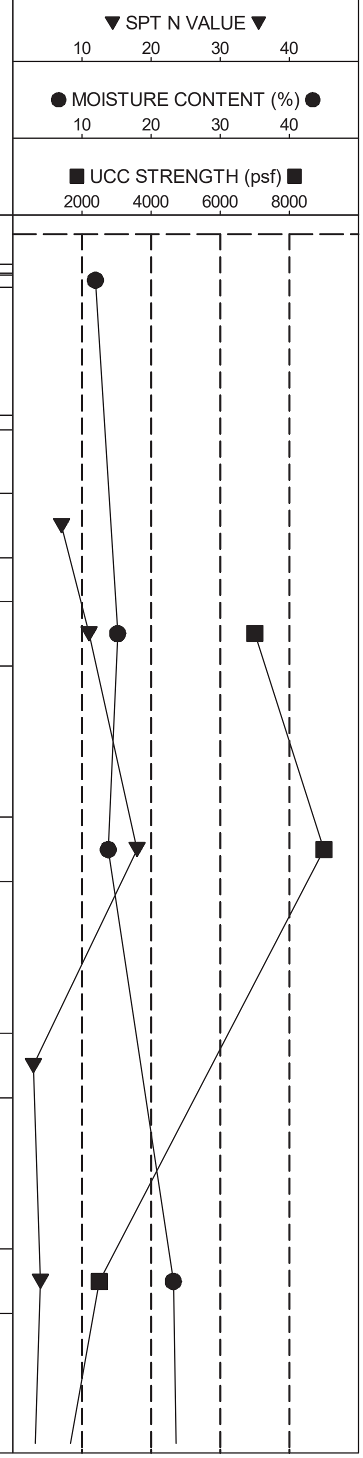
Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

LOG OF TEST BORING TH-02

PROJECT NO. 2021116A **DATE STARTED:** 7/12/2022 **DATE COMPLETED:** 7/12/2022

ELEVATION ft	LOG OF SOIL PROFILE	Strata depth (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation		0											
	8 inches of ASPHALTIC CEMENT CONCRETE	0.7												
	FILL - Poorly graded fine gravel/crushed aggregate, trace sand, trace silt (GP)	0.9		BS	4			1.0	<>	11.9				
				HA1	4			1.2						
	LEAN CLAY with sand, trace gravel, gray (CL) (Hand augered to 6 feet to verify no conflict with utilities)	3.5												
	Poorly graded FINE SAND with silt, trace gravel, brown, moist (SP-SM)	5.5	5	HA2	4			4.5						
	Loose poorly graded FINE SAND with silt, trace gravel, gray-brown, wet (SP-SM)	8.5		SS3	18	4-5-2	7	7.5						
	Very stiff to hard LEAN CLAY, few sand, trace gravel, gray (CL)	18.5	10	SS4	18	2-4-7	11	10.0	7000*	15.1				
			15	SS5	18	4-8-10	18	15.0	9000+*	13.8				
	Very loose CLAYEY FINE SAND, few gravel, gray, wet (SC)	23.5	20	SS6	18	1-1-2	3	20.0						
	Stiff to medium LEAN CLAY, few sand, trace gravel, gray (CL)		25	SS7	18	1-2-2	4	25.0	2500*	23.2				



GROUNDWATER READINGS
First Encountered: 5.5 feet
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.960459
Longitude: -82.44332

Coordinates/GSE determined by: Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

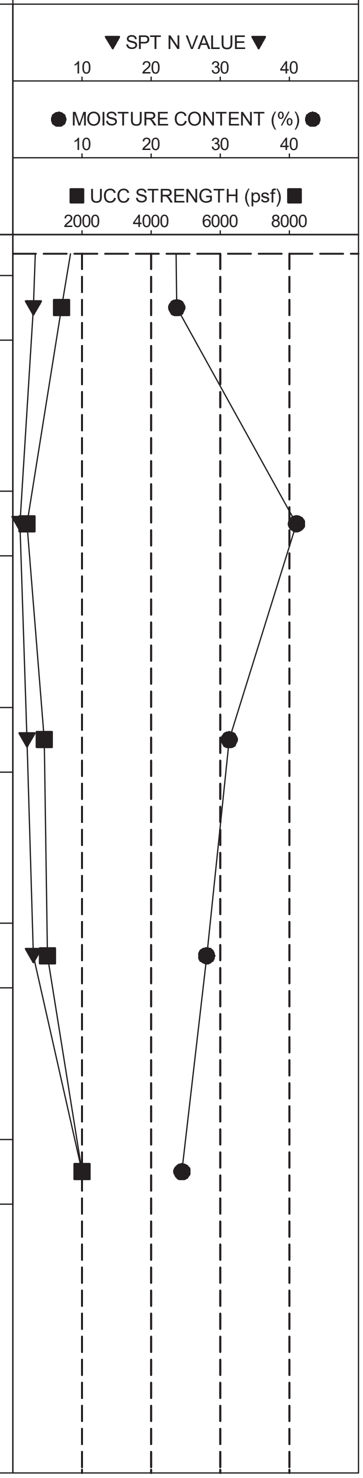
Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

LOG OF TEST BORING TH-02

PROJECT NO. 2021116A **DATE STARTED:** 7/12/2022 **DATE COMPLETED:** 7/12/2022

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation												
	Stiff to medium LEAN CLAY, few sand, trace gravel, gray (CL)		SS8	18	1-1-2	3	30.0	1400#	23.7				
	33.5	30											
	Very soft to medium LEAN CLAY, trace sand, trace gravel, gray (CL)		SS9	18	0-0-1	1	35.0	400#	41.0		49	28	
		35											
			SS10	18	0-1-1	2	40.0	900	31.3	95			
		40											
			SS11	18	1-1-2	3	45.0	1000#	28.0				
	48.5	45											
	Stiff LEAN CLAY, few sand, trace gravel, gray (CL)		SS12	18	2-4-6	10	50.0	2000#	24.5				
	50.0	50											
	End of Boring at 50 feet												
		55											



GROUNDWATER READINGS
First Encountered: 5.5 feet
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.960459
Longitude: -82.44332

Coordinates/GSE determined by:
Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

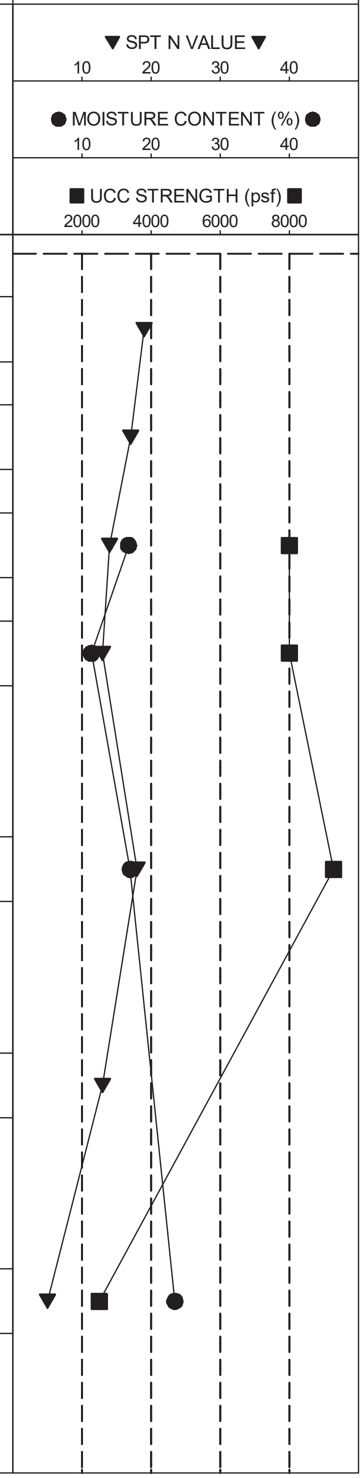
Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

LOG OF TEST BORING TH-03

PROJECT NO. 2021116A **DATE STARTED:** 7/11/2022 **DATE COMPLETED:** 7/11/2022

LOG OF SOIL PROFILE		FIELD DATA					LABORATORY DATA					
Description	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
Ground Surface Elevation												
2 inches of TOPSOIL	0 – 0.2											
FILL - Mixed medium dense silty fine sand and topsoil, trace gravel, occasional clay pockets, brown and black, moist (SM)	0.2 – 3.5	SS1	11	6-9-10	19	2.5						
Medium dense poorly graded FINE SAND, trace silt, trace gravel, brown with pockets of black, moist (SP)	3.5 – 6.0	SS2	13	5-8-9	17	5.0						
Hard LEAN CLAY, few sand, trace gravel, gray (CL)	6.0 – 18.5	SS3	8	4-6-8	14	7.5	8000*	16.7				
		SS4	18	4-6-7	13	10.0	8000*	11.4				
		SS5	18	6-8-10	18	15.0	9270	17.0	118			
Medium dense SILT, trace sand, occasional clay seams, gray, moist (ML)	18.5 – 23.5	SS6	16	6-7-6	13	20.0						
Stiff LEAN CLAY, few sand, trace gravel, gray (CL)	23.5 – 25.0	SS7	18	2-3-2	5	25.0	2500*	23.4				
End of Boring at 25 feet												



GROUNDWATER READINGS
First Encountered: none
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.960293
Longitude: -82.44243

Coordinates/GSE determined by: Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

LOG OF TEST BORING TH-04

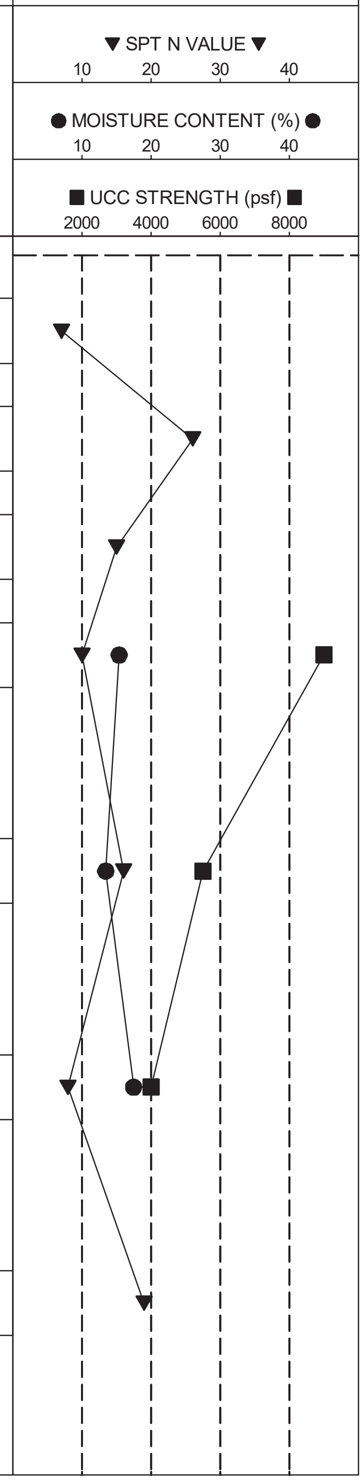
PROJECT NO. 2021116A **DATE STARTED:** 7/11/2022 **DATE COMPLETED:** 7/11/2022

LOG OF SOIL PROFILE

ELEVATION ft	Depth to bottom (ft)	Description
		Ground Surface Elevation
	1.5	18 inches of sand and gravel FILL
	3.5	FILL - Loose silty fine sand, trace gravel, orange-brown, moist (SM)
	8.5	Medium dense poorly graded FINE SAND with silt, brown, moist to wet (SP-SM)
	23.5	Hard to very stiff LEAN CLAY, few sand, trace gravel, gray (CL)
	25.0	Medium dense SILT, trace sand, occasional clay seams, gray, moist (ML)
		End of Boring at 25 feet

FIELD DATA / LABORATORY DATA

SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
SS1	18	3-3-4	7	2.5						
SS2	18	5-12-14	26	5.0						
SS3	18	5-7-8	15	7.5						5
SS4	18	2-4-6	10	10.0	9000+*	15.4				
SS5	18	3-7-9	16	15.0	5500*	13.4				
SS6	18	2-3-5	8	20.0	4000*	17.5				
SS7	18	3-7-12	19	25.0						



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.960314
Longitude: -82.441239

Coordinates/GSE determined by:
Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

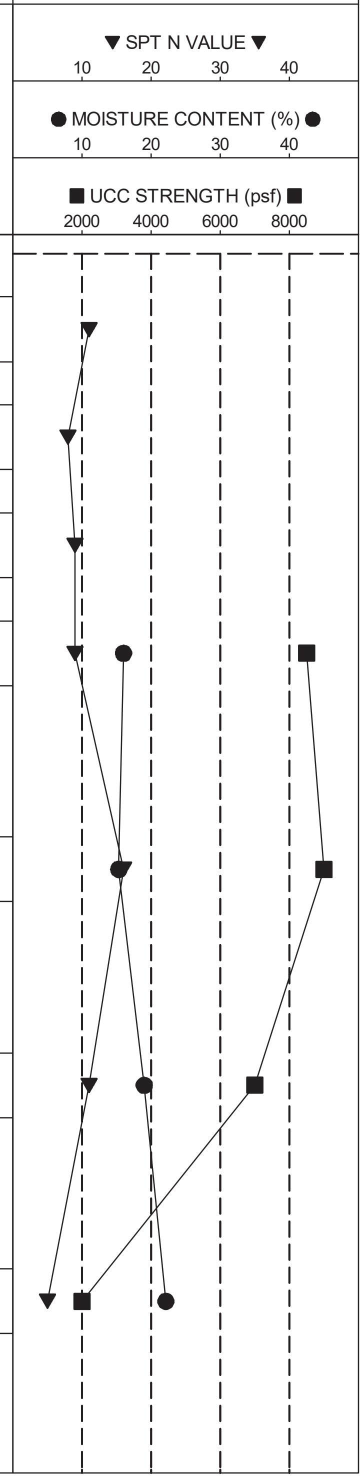
Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

LOG OF TEST BORING TH-05

PROJECT NO. 2021116A **DATE STARTED:** 7/11/2022 **DATE COMPLETED:** 7/11/2022

ELEVATION ft	LOG OF SOIL PROFILE	Depth to bottom of stratum (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation												
	18 inches of TOPSOIL	1.5											
	FILL - Medium dense poorly graded fine sand, trace silt, trace gravel, orange-brown with pockets of black, moist (SP)	3.5	SS1	15	4-5-6	11	2.5						
	Loose poorly graded FINE SAND, trace silt, brown, moist to wet (SP)	8.5	SS2	18	2-3-5	8	5.0						
			SS3	18	2-4-5	9	7.5						
	Hard to stiff LEAN CLAY, few sand, trace gravel, gray (CL)	25.0	SS4	18	3-4-5	9	10.0	8500*	16.0				
			SS5	18	4-7-9	16	15.0	9000+*	15.3				
			SS6	18	3-4-7	11	20.0	5060	19.0	113			
			SS7	18	2-2-3	5	25.0	2000*	22.1				
	End of Boring at 25 feet												



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.95997
Longitude: -82.438518

Coordinates/GSE determined by:
Trimble Geo7X

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 55 (Rig 404185)
Logged By: R. Calkins
Drilling Method: 4 1/4 inch HSA
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: JSS
Remarks:

Somat Engineering

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

GENERAL NOTES

Unified Soil Classification System (USCS)
ASTM D2488 (Modified)

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1 3/8" I.D., 2" O.D. (standard)	BS:	Bulk Sample	RC:	Rock Core with diamond bit, NX size, (unless otherwise noted)
S:	Split Spoon – non-standard size, as noted	HSA:	Hollow Stem Auger		
ST:	Thin-Walled Tube – 3" O.D., (unless otherwise noted)	DP:	Direct Push	RB:	Rock Bit/Roller Bit
LS:	Liner Sample	PS:	Piston Sample	WR:	Wash Rotary
PA:	Power Auger	PT:	Pitcher Sample	NR:	No Recovery
HA:	Hand Auger	WS:	Wash Sample	VS:	Vane Shear Test
AU:	Auger Sample			ER:	Hammer Energy Ratio

Standard Penetration Test Resistance, N-Value: Sum of 2nd and 3rd 6-inch increments, in blows per foot of a 140-pound hammer falling 30 inches and driving an 18-inch to 30-inch long, 2-inch OD split spoon.

WATER LEVEL MEASUREMENT:
Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of a groundwater table. In low permeability soils (clays and silts), the accurate determination of groundwater levels may not be possible with only short-term observations. Groundwater levels at times and locations other than when and where individual borings were performed could vary.

DESCRIPTIVE SOIL CLASSIFICATION:
Soil classification is based on the Unified Soil Classification (USC) System and ASTM Standards D-2487 and D-2488. Coarse-grained soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are generally described as: clays, if they are plastic, and silts, if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their apparent in-place density and fine-grained soils on the basis of their apparent in-place density (silty soils) or consistency (clayey soils).

CONSISTENCIES OF COHESIVE SOILS:
The pocket penetrometer, pocket torvane, and in-situ vane shear tests are converted into an estimated unconfined compressive strength, in pounds per square feet (psf), for presentation on the logs. The unconfined compressive strength is estimated to be about two time the shear strength.

DESCRIPTORS OF MINOR CONSTITUENTS

Primary Constituent	Fine-Grained (Silt & Clay)	Coarse-Grained (Sand & Gravel)	
Descriptor of Other Constituents	**Relative Portion of Coarse Grained Soils as a % of Dry Weight**	**Relative Portion of Fine Grained Soils as a % of Dry Weight**	**Relative Portion of Coarse Grained Soils as a % of Dry Weight**
Trace	<5%	<5%	<5%
Few	≥5% - <15%	N/A	≥5% - <15%
With	≥15% - <30%	≥5% - 12%	≥15%
Modifier	≥30%	>12%	N/A

FINE-GRAINED SOILS | **COARSE-GRAINED SOILS**

Unconfined Compressive Strength Qu, psf	Consistency	N-Value	Apparent Density
< 500	Very Soft	0 – 4	Very Loose
500 - <1,000	Soft	5 – 9	Loose
1,000 - <2,000	Medium	10 – 29	Medium Dense
2,000 - <4,000	Stiff	30 – 49	Dense
4,000 - <8,000	Very Stiff	50 – 80	Very Dense
≥ 8,000	Hard	>80	Extremely Dense

DEFINITIONS OF PAVEMENT CONDITION

Condition		Description
Good	ACC	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks and transverse cracks (open ¼ inch). No patching or very few patches in excellent condition.
	PCC	Moderate scaling in several locations. A few isolated surface spalls. Shallow reinforcement causing cracks. Several corner cracks, tight or well sealed. Open (¼ inch wide) longitudinal or transverse joints.
Fair	ACC	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (½ inch deep or less).
	PCC	Severe polishing, scaling, map cracking, or spalling over 50% of the area. Joints and cracks show moderate to severe spalling. Pumping and faulting of joints (½ inch with fair ride). Several slabs have multiple transverse or meander cracks with moderate spalling.
Poor	ACC	Alligator cracking (over 25% of surface). Severe distortions (over 2 inches deep) Extensive patching in poor condition. Potholes.
	PCC	Extensive slab cracking, severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlement or frost heaves.

DEFINITIONS OF STRUCTURAL AND DEPOSITIONAL FEATURES

Term	Definition
Parting	≤ 1/16 inch (1.6 mm) thick
Seam	> 1/16 inch (1.6 mm) → ½ inch (12.7 mm) thick
Layer	> ½ inch (12.7 mm) to ≤ 12 inches (305 mm) thick
Pocket	Small, erratic deposits of limited lateral extent
Lens	Lenticular deposit
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Varved	Alternating partings or seams (1 mm – 12 mm) of silt and/or clay and sometimes fine sand
Stratified	Alternating layers of varying material or color with layers ≥ 6 mm thick
Laminated	Alternating layers of varying material or color with layers < 6 mm thick
Fissured	Contains shears or separations along planes of weakness
Slickensided	Shear planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Homogeneous	Same color and appearance throughout
Occasional	One or less per foot (305 mm) of thickness
Frequent	More than one per foot (305 mm) of thickness
Interbedded	Applied to strata of soil lying between or alternating with other strata of a different nature

GRAIN SIZE TERMINOLOGY

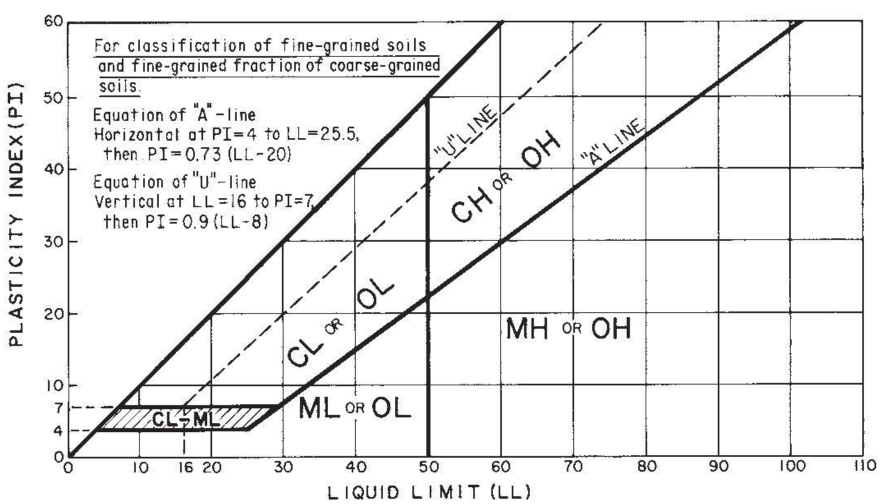
Major Component of Sample	Size Range
Boulders	≥ 12" (300 mm)
Cobbles	< 12" - 3" (300 mm – 75 mm)
Gravel - Coarse	< 3" - ¾" (75 mm – 19 mm)
Gravel – Fine	< ¾" - #4 (19 mm – 4.75 mm)
Sand – Coarse	< #4 - #10 (4.75 mm – 2 mm)
Sand – Medium	< #10 - #40 (2 mm - 0.425 mm)
Sand – Fine	< #40 - #200 (0.425 mm -0 .074 mm)
Silt	< 0.074 mm - 0.005 mm
Clay	<0 .005 mm

GENERAL NOTES

Unified Soil Classification System (USCS)
ASTM D2487

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
COARSE-GRAINED More than 50 % retained on No. 200 sieve	**Gravels** (More than 50 % of coarse fraction retained on No. 4 sieve)	**Clean Gravels**	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [D]	GW	Well-graded gravel [E]
		(Less than 5% fines [C])	$Cu < 4$ and/or [$Cc < 1$ or $Cc > 3$] [D]	GP	Poorly graded gravel [E]
		Gravels with Fines	Fines classify as ML or MH	GM	Silty gravel [E,F,G]
		(More than 12 % fines [C])	Fines classify as CL or CH	GC	Clayey gravel [E,F,G]
	Sands (50 % or more of coarse fraction passes No. 4 sieve)	**Clean Sands**	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [D]	SW	Well-graded sand [I]
		(Less than 5 % fines [H])	$Cu < 6$ and/or [$Cc < 1$ or $Cc > 3$] [D]	SP	Poorly graded sand [I]
		Sands with Fines	Fines classify as ML or MH	SM	Silty sand [F,G,I]
		(More than 12 % fines [H])	Fines classify as CL or CH	SC	Clayey sand [F,G,I]
FINE-GRAINED SOILS 50 % or more passes the No. 200 sieve	**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]
					Organic silt [K,L,M,O]
	Silts and Clays Liquid limit more than 50	**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]
					Organic silt [K,L,M,Q]
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			Pt	Peat

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 $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2/(D_{10} \times D_{60})$
E If soil contains ≥15 % sand, add "with sand" to group name.
F If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
G If fines are organic, add "with organic fines" to group name.
H 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
I If soil contains ≥15 % gravel, add "with gravel" to group name.
J If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
K If soil contains 15 to <30 % 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.



Order of Classification: 1) Consistency or Apparent Density, 2) Type of Soil, 3) Minor Soil Type(s), 4) Inclusions, 5) Layered Soils, 6) Color, 7) Water Content, 8) USCS Symbol, 9) Geological Name

APPENDIX C

LABORATORY TEST RESULTS

Somat Engineering

SUMMARY OF LABORATORY RESULTS

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

PROJECT NO. 2021116A

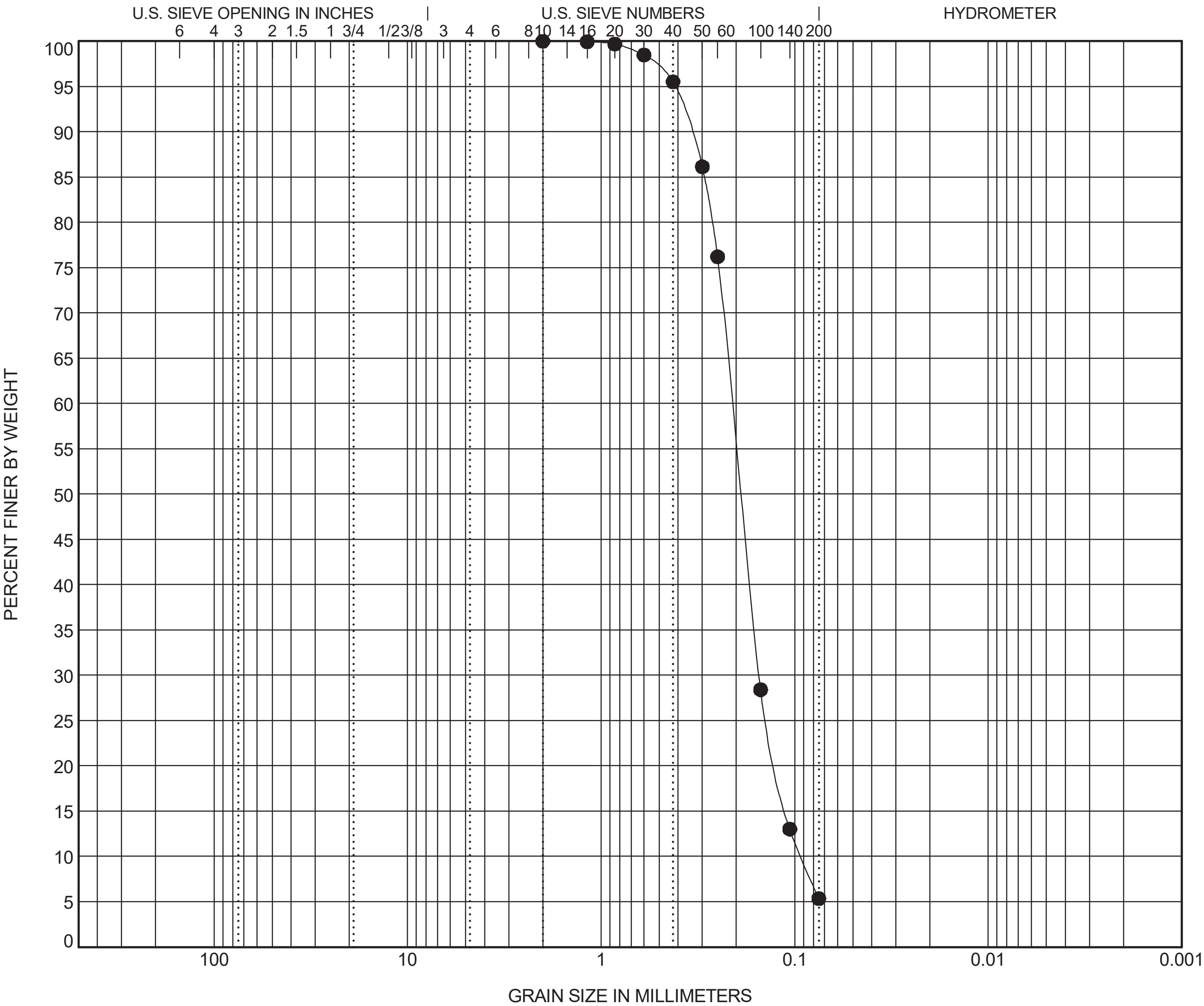
Borehole	Top Depth of Test Sample (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	UCC (psf)	FIne Sg
TH-01								15.4			
TH-01	1.1									<>	
TH-01	8.5							18.3		3000*	
TH-01	13.5							14.1		9000*	
TH-01	18.5							10.4		4000*	
TH-01	23.5							21.8		2000*	
TH-02	0.9							11.9		<>	
TH-02	8.5							15.1		7000*	
TH-02	13.5							13.8		9000+*	
TH-02	23.5							23.2		2500*	
TH-02	28.5							23.7		1400#	
TH-02	33.5	49	21	28				41.0		400#	
TH-02	38.5							31.3	95.3	900	
TH-02	43.5							28.0		1000#	
TH-02	48.5							24.5		2000#	
TH-03	6.0							16.7		8000*	
TH-03	8.5							11.4		8000*	
TH-03	13.5							17.0	117.5	9270	
TH-03	23.5							23.4		2500*	
TH-04	6.0				2	5					
TH-04	8.5							15.4		9000+*	
TH-04	13.5							13.4		5500*	
TH-04	18.5							17.5		4000*	
TH-05	8.5							16.0		8500*	
TH-05	13.5							15.3		9000+*	
TH-05	18.5							19.0	113.1	5060	
TH-05	23.5							22.1		2000*	

Torvane
* Pocket Penetrometer
<> Disturbed Sample

GRAIN SIZE DISTRIBUTION

Feasibility Study for Amtrak Station Improvements
Port Huron, Michigan

PROJECT NO. 2021116A



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Depth ft.	Remarks	LL	PL	PI	Cc	Cu
●	**TH-04**	**6.0**					**1.20**	**2.27**

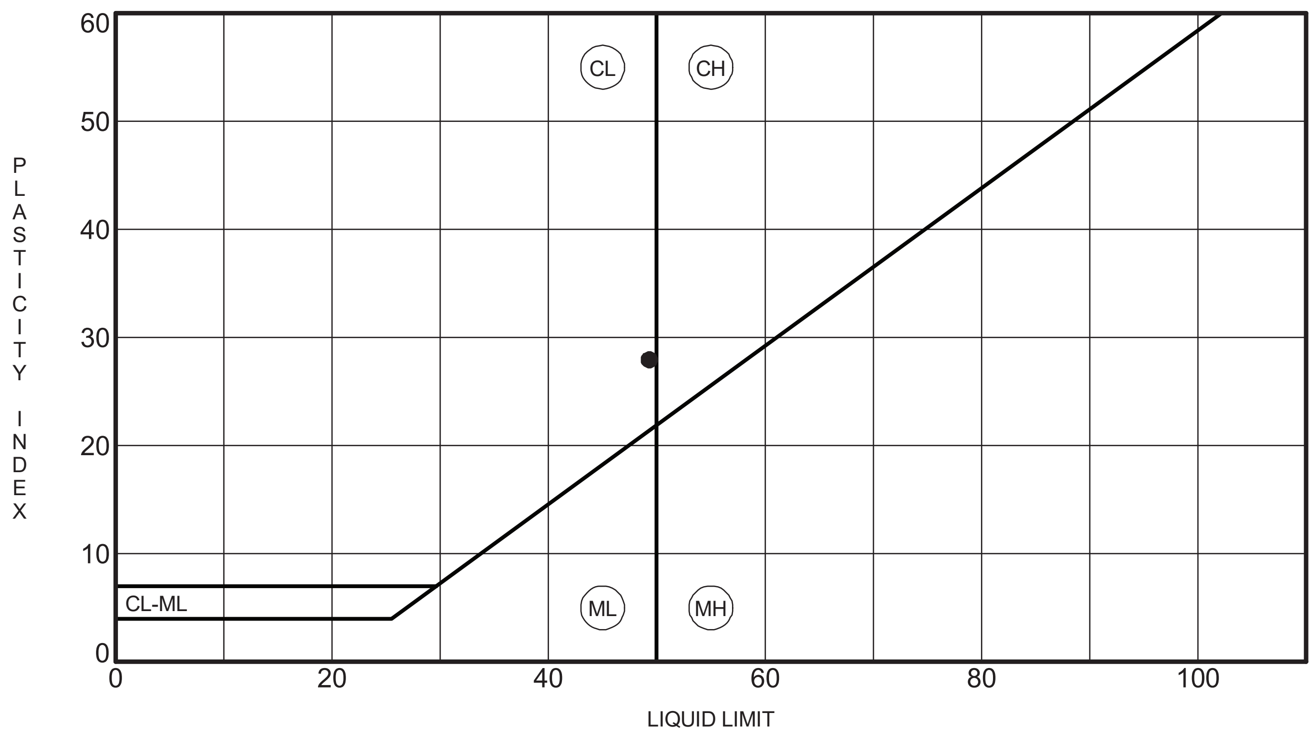
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TH-04**	**6.0**	**2**	**0.21**	**0.153**	**0.093**	**0.0**	**94.7**	**5.3**	

Somat Engineering

Feasibility Study for Amtrak Station Improvements

Port Huron, Michigan

ATTERBERG LIMITS RESULTS
ASTM D4318
PROJECT NO. 2021116A



	Specimen Identification	Depth	LL	PL	PI	Fines	Remarks
●	**TH-02**	**33.5**	**49**	**21**	**28**		

APPENDIX D

"IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT"

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

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.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and 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 not 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.

Read this Report in Full

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.*

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.*

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.

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 <u>not</u> 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.*

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.

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.

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.

Geoenvironmental Concerns Are <u>Not</u> 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.

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 <u>not</u> 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 <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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