FROEHLING & ROBERTSON, INC.

Geotechnical Base Line Report

SC 277 Northbound Bridge over Interstate 77
Richland County, South Carolina

Prepared For:

South Carolina Department of Transportation
Design-Build Group
955 Park Street, Room 421
Columbia, South Carolina 29201

By:
FROEHLING & ROBERTSON, INC.
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F&R Project No. 65V-0109

SCDOT Project No. P030487

February 9, 2018

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F&R Project No. 65V-0109

South Carolina Department of Transportation
Design-Build Group
955 Park Street, Room 421
Columbia, South Carolina 29201

Attn: Mr. Trapp Harris, PE, DBIA

Re: **Geotechnical Base Line Report**
SC-277 Northbound Bridge over Interstate-77
Richland County, South Carolina

Dear Mr. Harris:

Froehling & Robertson, Inc. (F&R) is pleased to present this geotechnical base line report for the proposed SC-277 Northbound Bridge Replacement over Interstate 77 in Richland County, South Carolina.

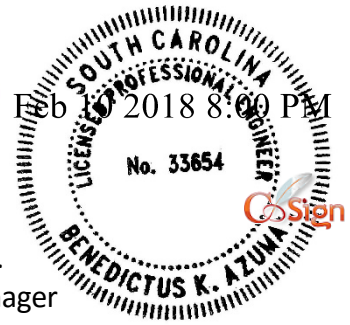
The purpose of this geotechnical base line report is to present the results of the subsurface exploration program and laboratory testing undertaken by Froehling & Robertson, Inc. (F&R). Our services were performed in general accordance with your Work Order Number FR#11-18-P030487 dated September 21, 2017, and the supplemental Work Order for additional services dated January 19, 2018. Both services were authorized by your office per our On-Call Contract with SCDOT (Contract Number S-147-14).

The attached report presents our understanding of the project, reviews our exploration and testing procedures, describes existing site and general subsurface conditions at the boring locations, presents the results of our field and laboratory tests and provides preliminary subsurface design and construction considerations that could be beneficial to the project.

We have enjoyed working with you on this project. Please contact us if you have any questions regarding this report or if we may be of further service.

Sincerely,
FROEHLING & ROBERTSON, INC.

Feb 15 2018 8:00 PM



Benedictus K. Azumah, P.E.
Geotechnical Services Manager

BKA/MLF

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1.0 PURPOSE & SCOPE OF SERVICE

The purpose of this geotechnical base line report is to provide the South Carolina Department of Transportation (SCDOT) and potential Design-Build contractors reference geotechnical information in the area of the proposed bridge development. Froehling & Robertson, Inc. (F&R) received the SCDOT Work Order No. FR#11-18-P030487 dated September 21, 2017, and a supplemental work order for additional services dated January 19, 2018, in reference to this project.

F&R's scope of services included the following:

- A site reconnaissance to observe existing surface conditions and layout proposed borings at two locations as close as possible to each existing bridge abutment and another location within the Interstate 77 median.
- Coordination of underground utility location and clearance with Palmetto Utility Protection Service (PUPS) – South Carolina 811.
- Review and summarize readily available geologic and subsurface information relative to the project site.
- Completion of three soil test borings (STB) with Standard Penetration Testing (SPT) designated as Borings STB-01, STB-02, and STB-03. Completion of one cone penetration test (CPT) designated as CPT-03. Boring locations were near the existing south abutment, the existing bent in the median of Interstate 77 northbound and southbound lanes, and near the existing north abutment on the east side of the existing bridge, respectively. The CPT sounding was performed adjacent to STB-03. The borings and sounding were advanced to termination depths of approximately 100, 90, 100, and 40 feet, respectively, below the existing ground surface. The exploration included making observations for the presence of groundwater, dense soil strata or rock, and measuring their depths below the existing ground surface. Also included in our scope, was rock coring using NQ-diameter rock coring bits to a minimum depth of 20 feet into auger and sampler refusal material encountered at a depth shallower than 100 feet.

- Performing a geophysical test to obtain a shear wave velocity of onsite soils using a Multi-channel Analysis of Surface Waves (MASW) method at the location of the proposed bridge.

- Preparation of boring logs using SCDOT formatted electronic gINT file template and provision of raw data generated from CPT soundings including tip resistance, sleeve friction, pore water pressure, friction ratio, and equivalent N60 values.

- Preparation of this geotechnical base line report summarizing our work on the project including a description of the subsurface conditions encountered near the existing bridge location. Including an assessment of the potential of the subsurface soil's susceptibility to seismic shear strength loss (SSL).

This report also provides preliminary subsurface information of the site for use by others in the planning of any future geotechnical exploration for the proposed bridge replacement project. It also attempts to provide preliminary design considerations such as site variability, seismic site classification including the liquefaction potential of the subsurface soils, and construction related considerations anticipated for the proposed construction.

F&R's geotechnical services did not include recommendations regarding the actual design of foundations for the proposed project, topographic or field surveying, development of quantity estimates, preparation of plans and specifications, or the identification and evaluation of wetlands or other environmental aspects of the project site.

2.0 PROJECT INFORMATION

2.1 Site Location and Description

The project site is located near the existing SC 277 Bridge over Interstate 77 near the northeastern limits of Columbia in Richland County, South Carolina. The existing SC 277 Bridge is about 600 feet long, consists of two end bents and three interior bents. The south interior bent is located west of Interstate 77 southbound lanes; the middle bent is located in the median of Interstate 77 southbound and northbound lanes; and the north bent is located on the west side of the northbound lanes. The bridge is oriented to the north-south and carries a two-lane road that forms part of the SC 277 on-ramp to the northbound lanes of Interstate 77 just northwest of Mile Marker 19. Interstate 77 northbound and southbound lanes are oriented to the northwest-southeast and consists of two travel lanes in each direction. Interstate 77 has a wide

gravel-covered median and hard shoulders. The areas beyond the outside shoulders are grass-covered and extend to existing on and off ramps at Exit 19. At the time of this writing, additional travel lanes were under construction in the median adjacent to the inner travel lanes. Concrete barriers were present in some of the areas along Interstate 77.

The topography of the site is generally level and flat with ground surface elevations ranging from about Elevation (EL) 275 to 279. A shallow drainage swale traverses the median along the site. Near the existing bridge abutments, the ground surfaces slope up several feet to meet the finished grades near the south and north bridge approach embankments. Concrete armoring is present on portions of the embankment slopes.

Information pertaining to the type and condition of the existing bridge foundations were not provided to us at the time of this writing.

The site location is shown on the attached Site Vicinity Map in Appendix I, Figure No. 1. F&R obtained information regarding the site from existing site aerial photos we received from your office along with the Work Order. F&R obtained additional site information from plans we received from Archer Western Construction, LLC, during our site visit, and through our review of available site aerial photography.

2.2 Project Information and Proposed Construction

The proposed project includes replacement of the existing SC 277 Bridge over Interstate 77 in Richland County, South Carolina. The project is in the development phase, therefore the actual location of the replacement bridge was not provided to F&R. As part of the project planning requirements, F&R was requested to perform a geotechnical exploration of the site including laboratory testing of the site soils and to provide a geotechnical base line report for the proposed development. F&R received a Work Order Request for Subsurface Exploration and Laboratory Testing dated September 20, 2017, a proposed boring location plan, and an SCDOT Work Order No. FR#11-18-P030487 dated September 21, 2017. Based on the findings of our initial subsurface exploration, F&R received a supplemental work order dated January 19, 2018 for additional subsurface exploration and evaluation of the soil's potential for seismic shear strength loss (SSL).

Per the work order, three soil test boring (STB) locations were identified and marked for our use during our subsurface exploration. The subsurface exploration at the STB locations included Standard Penetration Testing (SPT) to a depth of 100 feet and NQ diameter rock coring to a

minimum depth of 20 feet into auger and sampler refusal material encountered in the borings prior to a depth of 100.

The soil laboratory testing scope provided by SCDOT included moisture content, Atterberg limits, and partial grain size analysis with Wash No. 200 Sieve. A description of the soil laboratory tests performed are presented in subsequent sections of this report.

The base line subsurface information contained in this report provides a general description of the subsurface conditions at the site but does not provide detailed subsurface information sufficient enough for use in design of the actual replacement bridge foundations. Additional subsurface exploration with geotechnical foundation recommendations are recommended based upon the actual replacement bridge foundation design requirements.

F&R obtained the project information from our correspondence with SCDOT Design-Build Group.

3.0 EXPLORATION PROCEDURES

3.1 Subsurface Exploration

The subsurface exploration was conducted by geotechnical drilling personnel from F&R between November 9 and 19, 2017, under the supervision of a licensed Professional Engineer from F&R. The Standard Penetration Test (SPT) was performed at the boring locations in general accordance with ASTM D1586, "Standard Test Method for Penetration test and Split Barrel Sampling of Soils."

The drill rig used for this project was an All-Terrain-Vehicle (ATV)-mounted, CME-550X equipped with an automatic hammer. The test holes were advanced using the rotary wash technique. A 3⅞-inch diameter tri-cone roller bit attached to hollow AW drilling rods and several lineal feet of 4-inch diameter steel casings were used in the drilling process. A viscous consistency slurry mixture consisting of bentonite powder and water was introduced into the soil borings to wash out the soil cuttings and keep the walls of the boring open.

The subsurface exploration program consisted of three SPT borings. These borings were designated as Borings STB-01, STB-02, and STB-03 and were located near the south abutment, the bent in the median of Interstate 77 northbound and southbound lanes, and near the north abutment on the east side of the existing bridge, respectively. The borings were advanced to termination depths of approximately 100, 90, and 100 feet, respectively, below the existing ground

surface. Boring STB-02 was terminated at 90 feet below the ground surface due to a mechanical failure of our drill bit upon attempting to advance the boring below a depth of 90 feet. Due to the similarity of the subsurface materials encountered at depths approaching 100 feet in the nearby Borings STB-01 and STB-03, Boring STB-02 was not extended after drill bit replacement.

Since auger and sampler refusal on bedrock was not encountered prior to the planned boring termination depths, rock coring was not performed during our exploration.

SPT was performed almost continuously from the existing ground surface to a maximum depth of 10 feet. Thereafter, boreholes were advanced and SPT performed at approximate 5-foot intervals to their respective termination depths. Approximate boring locations are identified on Figure No. 2 – Location Plan, included in Appendix I of this report. Boring locations were staked at the site by personnel from F&R. We staked the borings by measuring from existing site features including the existing pavement edge, interior bents, and abutments, and by referencing the borings to the site features shown on the provided site plan. As such, the boring locations as shown on the figure should be considered approximate. Photographic logs of the STB borings being drilled are also included in this report and presented as Figure Nos. 3 through 5 in Appendix I.

Upon completion of drilling, our surveying subcontractor, Chao and Associates, Inc. of Columbia, South Carolina, surveyed the as-drilled borings and obtained, ground surface elevations, GPS northern and eastern coordinates, and station and offset data in reference to the alignment of Interstate 77. Surveying was performed in accordance with the rules and regulations governing the practice of surveying in the State of South Carolina. Horizontal datum was referenced to SCSPCS and Vertical datum was referenced to NGVD88. The survey data obtained from the as-drilled boring locations are presented on the soil boring logs included in Appendix III of this report.

Soil samples were obtained with a standard 2-inch O.D. and 30-inch long split-spoon sampler with each SPT being driven with a 140-lb safety hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and are shown on the boring logs. The first six-inch increment is used to seat the sampler with the sum of the second and third penetration increments being termed the SPT value, “N.” A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a glass jar, and returned to our laboratory for review and testing. The boring logs provided in Appendix II show the subsurface conditions encountered on the dates and at the approximate locations

indicated. A detailed description of subsurface conditions are presented in Section 4.0 of this report.

3.2 Cone Penetration Test Sounding

The CPT sounding conducted for our subsurface exploration was performed by our sub-contractor Palmetto Insitu, LLC, of Charleston, South Carolina, on January 24, 2018. The CPT was performed at about 5 feet south of Boring STB-03 location in general accordance with ASTM D5778. The CPT was designated as CPT-03 and extended to a depth of 40 feet below the existing ground surface. The CPT location is identified on Figure No. 2 - Location Plan included in Appendix I of this report. A photographic log of the CPT sounding being performed is also included in this report and presented as Figure No. 6 in Appendix I.

The equipment used for the CPT exploration includes an electronic 15 cm2 Vertek seismic cone which was hydraulically advanced into the soil using a Vertek S4 Scorpian CPT rig capable of 20 tons of thrust. The collected raw data was processed by Palmetto Insitu, LLC, using Bentley's gINT V8i SS2 software (version 08.30.04.206) and Dataforensics, RapidCPT software (version 4.2.2.0). The legend used for the SBT correlations is based on Robertson and Campanella: 1990 and is included with the CPT results provided in Appendix IV. An electronic file (in .CSV file format) containing the CPT results is being submitted under separate cover.

3.3 Geophysical Exploration

A Refraction Microtremor (ReMi) survey was performed at one location (array) along the east side of Interstate 77 northbound lanes and just below the existing bridge. The ReMi survey was conducted to provide estimated measurements of the soil shear wave velocity in the upper 100 feet. The dispersive characteristic of Rayleigh waves when traveling through a layered medium is measured from the surface, which makes the method nondestructive and nonintrusive. A seismic source (ambient "noise") is applied at the ground surface where vertical transducers record the propagation of surface waves. By analyzing the phase information for each frequency contained in the wave train, the Rayleigh and shear wave velocity can be determined. The data was processed using SeisOpt® ReMi™ software to reveal a one-dimensional average shear-wave (S-wave) velocity structure for the array. The survey was performed to provide the average shear wave velocity to a depth of 100 feet for use in the determination of seismic site classification in

accordance with Section 12.4 of the 2010 SCDOT GDM Version 1.1. The result of the geophysical test is included in Appendix III of this report.

3.4 Laboratory Review and Testing of Soil Samples

The recovered split-spoon samples were visually classified by F&R engineers in general accordance with the ASTM D2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Method)."

Laboratory testing was performed on some of the split-spoon samples for soil classification purposes. The testing was performed in accordance with the Unified Soil Classification System (USCS) and American Association of State Highway and Transportation Officials (AASHTO). The testing consisted of sixteen water content tests (ASTM D2216), sixteen amount finer than No. 200 Wash (Sieve) tests (ASTM D1140), and sixteen Atterberg Limits tests (ASTM D4318) on selected samples obtained from various depths in the borings. Some of the soil samples obtained from the upper portion of Boring STB-03 appeared to contain some organics during our review, therefore, we performed one organic content test (ASTM D2974) on one of these samples.

Laboratory test results are presented in the Summary of Laboratory Test Results table, Index Properties Versus Depth charts, and Atterberg Limits Results graph included in Appendix V of this report. Individual test data sheets are also included in the appendix. We will retain the recovered soil samples in our laboratories up to the completion of construction for the proposed structure or seven years from the date of this report.

4.0 REGIONAL GEOLOGY AND SUBSURFACE CONDITIONS

4.1 General

The subsurface conditions discussed in the following paragraphs and those shown on the attached boring logs represent an estimate of the subsurface conditions based on F&R's interpretation of the field and laboratory data using normally accepted geotechnical engineering judgments, specifically, the standardized format as presented in Chapter 6 of the SCDOT GDM – "Material Description Classification and Logging." Subsurface profiles for the project stratigraphy have been prepared for convenience only. Given the wide spacing between boring locations, it is anticipated that subsurface conditions may vary between each boring location.

Strata breaks designated on the boring logs represent approximate boundaries between soil types. The transitions between different soil strata are usually less distinct than those shown on the boring logs. Although individual soil test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times. Data from the specific soil test borings are shown on the individual boring logs included in Appendix II. A subsurface profile in the area of the proposed bridge replacement (Figure No. 6) is also included in Appendix II.

4.2 Regional Geology

The bridge site is located within the Upper Cretaceous Middendorf Formation deposits of the Coastal Plain physiographic province according to the Geologic Map of South Carolina (2005). The Upper Cretaceous Middendorf Formation deposits are reportedly underlain by mainly the residual soils and rock of the Carolina terrane (slate belt) of the Piedmont. The Carolina terrane is also known to have been separate from North America during Late Proterozoic and Cambrian time according to the fossil evidence.

The Upper Cretaceous Middendorf Formation soil materials are alluvial deposited materials generally consisting mostly of micaceous, kaolinitic sands with lenses of clay with variable thickness. The sands are mostly coarse sand to granule size, angular to sub-angular and poorly sorted, but some fine-grained, fairly well-sorted sand does occur. These sediments represent alluvial or upper delta-plain environments.

The upper part of the Carolina terrane generally consist of residual soils derived from the chemical and physical weathering of the predominantly clastic rocks. The boundary between soil and rock is not sharply defined. This transitional zone, termed “Partially Weathered Rock,” is normally found overlying the parent bedrock. The degree of weathering is facilitated by fractures, joints, and by the presence of less resistant rock types. Consequently, the profile of the Partially Weathered Rock and hard rock is quite irregular and erratic, even over short, horizontal distances.

The lower part of the Carolina terrane generally consist of intermediate to felsic pyroclastic rocks that are collectively greater than about 2 miles in thickness, and it has been interpreted as a sequence of ashflow tuffs, possibly deposited in a sub-aerial environment.

The topography of the Coastal Plain is generally flat with ground surface elevations varying from approximately just above sea level in the east to about 500 feet in the west.

4.3 Generalized Subsurface Conditions

Subsurface data obtained from the soil borings and CPT sounding are presented in the following paragraphs. The complete boring logs and CPT sounding results are presented in Appendices II and IV.

4.3.1 Surficial Materials

The three borings encountered approximately 4 to 6 inches of Surficial Soil at the ground surface.

Surficial Soil is typically a dark-colored soil material containing roots, fibrous matter, and or other organic components, and is generally unsuitable for engineering purposes. F&R has not performed any laboratory testing to determine the organic content or other horticultural properties of the observed Surficial Soil materials. Therefore, the term Surficial Soil is not intended to indicate suitability for landscaping and or other purposes.

The Surficial Soil depths provided in this report are based on driller observations and should be considered approximate. We note that the transition from Surficial Soil to underlying materials may be gradual, and therefore the observation and measurement of Surficial Soil depths is subjective. Actual Surficial Soil depths should be expected to vary.

4.3.2 Fill Soils

Boring STB-03 encountered existing fill soil below the ground surface to a depth of approximately 3 feet below the ground surface. The fill soils generally consisted of loose to medium dense, fine to medium Clayey Sand (SC, A-2-6) soils containing traces of organics. Standard penetration resistances (N-values) in the fill soils were 10 and 13 blows per foot (bpf).

Cone penetration test data corresponding to the fill soil within a depth of approximately 3 feet below the ground surface indicates tip resistances (q_t) ranging from approximately 20 to 80 tsf, sleeve friction (f_s) values ranging from approximately 0.1 to 2 tsf, friction ratios (R_f) ranging between >0 to 4 percent and equivalent N60 values ranging from approximately 7 to 15 bpf.

4.3.3 Alluvial Soils

Alluvial soils, formed by the deposition of eroded materials by forces of water, were encountered in Boring STB-03 directly below the existing fill to a depth of approximately 12.5 feet below the ground surface. Sampled alluvial soils were generally classified as very loose to medium, Silty Sand (SM, A-2-4) and Clayey Sand (SC, A-2-6) with varying amounts of organics. These soil samples were partly moist and partly wet and SPT resistance (N-values) in the alluvial soils ranged from WOH (Weight of Hammer) to 12 bpf.

Cone penetration test data corresponding to the alluvial soils between depths of approximately 3 to 12.5 feet indicates tip resistances (q_t) ranging from approximately 10 to 50 tsf, sleeve friction (f_s) values ranging from approximately 0.1 to 2 tsf, friction ratios (R_f) ranging between approximately 1 to 7 percent, and equivalent N60 values ranging from approximately 2 to 10 bpf.

4.3.4 Coastal Plain Soils (Middendorf Formation)

Coastal Plain soil deposits were encountered in Borings STB-01 through STB-03, below the alluvial soils and ground surface to depths ranging from about 33 to 40 feet below the existing ground surface. The sampled fine-grained Coastal Plain soils generally classified as stiff to very hard Sandy Lean Clay (CL, A-7-6), and coarse-grained Coastal Plain soils generally classified as medium dense to dense Clayey Sand (SC, A-2-4, A-2-6), Silty Sand (SM, A-2-4, A-2-7), and Silty, Clayey Sand (SC-SM, A-1-a). These soil samples were generally moist in the upper 6 to 9 feet and generally wet below these depths. The SPT resistance (N-values) in the Coastal Plain soil deposits ranged from 7 to 100 bpf.

Cone penetration test data corresponding to the coastal plain soils between depths of approximately 12.5 to 32.5 feet indicates tip resistances (q_t) ranging from approximately 10 to 500 tsf, sleeve friction (f_s) values ranging from approximately 0.1 to 10 tsf, friction ratios (R_f) generally ranging between approximately 1 to 3 percent, and equivalent N60 values ranging from approximately 2 to 70 bpf.

4.3.5 Piedmont Residual Soils

Piedmont residual soils, formed by in-place weathering of the parent rock, were encountered in the three borings below the Coastal Plain deposits to depths ranging from about 43 to 53 feet and interlayered with varying thicknesses of Partially Weathered Rock (PWR) from depths of approximately 48 to 73 feet below the ground surface. Sampled fine-grained residual soils were

generally classified as hard to very hard Sandy Lean Clay (CL), Sandy Silty Clay (CL-ML, A-4), Sandy Silt (ML, A-4), and Sandy Elastic Silt (MH, A-7-5). Sampled coarse-grained residual soils were generally classified as dense to very dense Silty Sand (SM, A-4, A-2-4) and Clayey Sand (SC, A-2-4). These soil samples were generally wet and SPT resistance (N-values) in the residual soils ranged from 42 to 99 bpf.

Cone penetration test data corresponding to the residual soils between depths of approximately 32.5 to 40.1 feet indicates tip resistances (q_t) ranging from approximately 200 to 500 tsf, sleeve friction (f_s) values ranging from approximately 2 to 8 tsf, friction ratios (R_f) generally ranging between approximately 1 to 2 percent, and equivalent N60 values ranging from approximately 50 to 90 bpf.

4.3.6 Partially Weathered Rock

Partially Weathered Rock (PWR) was encountered in the three borings from below the residual soils to the boring termination depths of approximately 90 or 100 feet. As indicated in the previous section, PWR is interlayerd with varying thicknesses of residual soils between depths of about 43 and 73 feet below the existing ground surface. Sampled PWR generally classified as very hard Sandy Silt (ML), Sandy Elastic Silt (MH) or very dense Silty Sandy (SM) with traces of rock fragments. PWR is defined for engineering purposes as residual material exhibiting corrected SPT N-Values equals to or greater than 100 blows. The PWR represents the transition between residual soils and crystalline rock or bedrock.

4.3.7 Groundwater Data

Groundwater was encountered during drilling, at depths of approximately 8.5, 6 and 8.5 feet below the ground surface in Borings STB-01, STB-02, and STB-03, respectively. The presence of groundwater was evaluated at each boring location by visually judging the moisture content of the recovered split-spoon soil samples. The completed borings were left open for a period of at least 24 hours after which groundwater levels were measured. Measured 24-hour groundwater levels in Borings STB-01, STB-02, and STB-03 were 8.5, 9, and 7.5 feet below the existing ground surface.

Pore pressure measurements obtained from CPT tests can be used to estimate the presence and depths to groundwater below the ground surface. The data we obtained from CPT-03 indicates

that pore pressures generally began to increase from an approximate depth of about 9 feet below the ground surface, indicating a depth to groundwater of about 9 feet.

Groundwater levels fluctuate with seasonal changes, periods of heavy or little rainfall, and other factors. Therefore, our evaluations of the groundwater level do not reveal the actual year-round groundwater conditions.

5.0 PRELIMINARY SUBSURFACE DESIGN AND CONSTRUCTION CONSIDERATIONS

5.1 General

The following preliminary subsurface design considerations are based on our observations at the site, interpretation of the field and laboratory data obtained during our subsurface exploration, and our experience with similar subsurface conditions and projects. Our preliminary subsurface design considerations do not take into account potential changes with the existing site grades.

Soil penetration data and geophysical test data have been used to evaluate the subsurface conditions based on established correlations. Subsurface conditions in unexplored locations may vary from those encountered. If the proposed replacement bridge location is changed, F&R requests that we be advised so that our preliminary subsurface design considerations can be re-evaluated.

Based on our geotechnical engineering experience with typical SCDOT bridges in the project vicinity and the provided scope of subsurface exploration, F&R anticipates the proposed replacement bridge may be supported on deep foundations at interior bent locations or a combination of deep and shallow foundations at the end bent locations. We also anticipate earth retaining structures and new roadway embankments could be included in the final project design.

We anticipate relatively high bridge foundation loads for both axial and lateral directions. Therefore, deep foundations such as driven piles or drilled shafts will be required. Based on the existing subsurface conditions, feasible deep foundations systems for use on this project may include; prestressed concrete piles, steel H-piles, steel pipe piles, composite piles consisting of concrete and steel-H piles, and drilled shafts (drilled caissons). Any of these deep foundations installed to suitable depths within the PWR (or bedrock, if encountered) are expected to develop adequate resistance to provide support for anticipated foundation loads. The use of multiple deep foundation elements or larger diameter piles should also be considered depending on anticipated axial and lateral foundation loads and resistance requirements.

Other deep foundations such as drilled piles, timber piles, or continuous flight auger cast pile are generally not considered suitable and should not be considered for bridge foundation support due to the existing subsurface conditions we encountered. Shallow foundations are also generally not considered suitable for bridge foundation support, however, they may be used for other ancillary structures such as retaining walls.

Selection and design of appropriate foundation systems for use on this project and selection and performance of any required subsurface exploration should be performed in accordance with the most current version of the 2010 SCDOT Geotechnical Design Manual (GDM). In addition, preliminary design and construction considerations that could be beneficial to the overall project should include but not be limited to:

1. Additional subsurface exploration of the site using SPT methods and more desirable subsurface exploration methods such as Cone Penetration Testing to better define the vertical and lateral extents of subsurface soil strata indicated on the attached Soil Test Logs and identification of any additional strata;
2. Laboratory testing of existing on-site clay soils and development of consolidation settlement parameters;
3. Monitoring of seasonal variation of groundwater conditions;
4. Provision of Acceleration Design Response Spectrum curves specific to the site;
5. Seismic earthquake hazard analysis of the site;
6. Structural fill placement and compaction during construction;
7. Surface water control and vibration monitoring during construction.

5.2 Site Variability

The site variability was determined in accordance with Section 7.5 of the SCDOT GDM and is based on our engineering judgement using our STBs.

F&R's interpretation of the subsurface conditions encountered by our STBs are shown on the boring logs and subsurface profile included in Appendix II of this report. These records represent our interpretation of the subsurface conditions based on the test data. Stratification lines on the boring records represent approximate boundaries between soil types; however, the actual transition may be gradual and the thicknesses of the strata will vary across the site. We estimate a coefficient of variability for the site to be low (less than 25 percent) in accordance with Table 7-1 of the GDM.

5.3 Seismic Site Classification

The project seismic site classification presented herein is in accordance with Sections 12.3.4 and 12.4 of the 2010 SCDOT GDM Version 1.1 and uses subsurface information we obtained from the STBs and geophysical test data. We also assume that the replacement bridge will have different structural components potentially consisting of deep and or shallow foundations and have considered a minimum depth-to-motion, which coincides with the existing ground surface. Viz., foundation depths will be at the existing ground surface.

The soil borings for this project were terminated at depths of 90 or 100 feet for foundation design considerations. To the extent permissible by our interpretation of the limited laboratory testing, subsurface conditions requiring Site Classes E or F were not encountered by the borings.

Shear wave velocity measurements acquired from the ReMi™ test array performed along Interstate 77 was used for the analysis. The results from the forward and reverse modeling of the individual run indicated shear wave velocities within the upper 100 feet ranging between approximately 1,068 to 3,319 feet per second (fps). An earth model developed with the SeisOpt® program was segregated into three horizontal layers. According to Table 12-22 of the SCDOT GDM, the model indicates a stiff soil layer over a very dense soil and soft rock layer over a rock layer profile.

The average V_s in the upper 100 feet was calculated to be 2,097 fps; which meets the shear wave velocity requirements for a seismic Site Classification of "C" (velocities between 1,200 and 2,500 fps in accordance with Table 12-22 of the SCDOT GDM). Based on results of our baseline seismic evaluation for the proposed site, we recommend that a seismic Site Classification of "C" be used in preliminary design for the proposed replacement bridge.

5.4 Liquefaction Potential Screening

Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Our evaluation of the liquefaction potential of the site soils was performed with the computer software program CLiq version 1.7 by Geo Logismiki Software. The software uses CPT data or SPT data, groundwater data, fines content, and anticipated Peak Ground Acceleration (PGA) values to calculate the liquefaction potential index (LPI) and post-earthquake vertical settlements of site soils. We considered the data from CPT-03 and laboratory test data from STB-03 during our evaluation. We also obtained PGA for the

vicinity of the proposed bridge site from the Geotechnical Base Line Report for the I-77 Widening project dated May 19, 2015.

For liquefaction potential evaluation, the program computes Cyclic Stress Ratios (CSR) and Cyclic Resistance Ratios (CRR) of site soils at varying depths below the ground surface. The software program output plots the site soils CSR and CRR variations against depth below the ground surface. The potential for cyclic liquefaction exists when the ratio of CSR to CRR is greater than 1 for given depth of soil.

Based on our analysis under Safety Earthquake Evaluation (SEE) conditions with a PGA of 0.34, we anticipate the potential for liquefaction exists at this site although minimal. Thin lenses of liquefiable saturated sands with thicknesses of about 6 to 12 inches are present between depths of approximately 11 to 17 feet below the existing ground surface at CPT-03.

6.0 LIMITATIONS

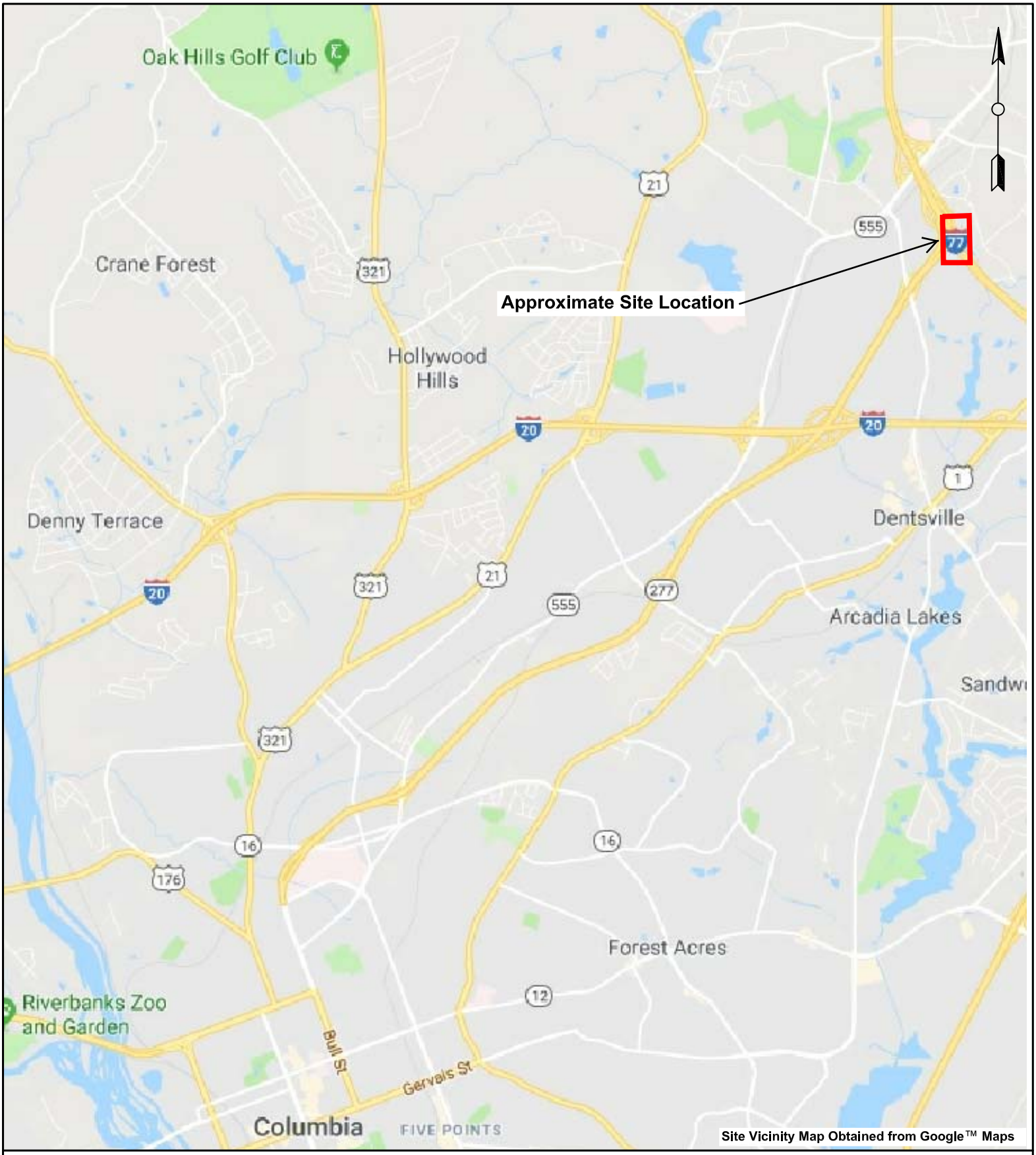
There are important limitations to this and all geotechnical studies. Some of these limitations are discussed in the information prepared by the Geoprofessional Business Association (GBA), which is included in Appendix VI. We recommend that you review the GBA information.

This report has been prepared for the exclusive use of South Carolina Department of Transportation – Design-Build Group or their agents, for the specific application to the proposed SC 277 bridge replacement over Interstate 77 project located in Richland County, South Carolina, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. Our exploration is based on site location information furnished to us; and generally accepted geotechnical engineering practice. The subsurface exploration logs included herein, do not reflect variations in subsurface conditions, which could exist intermediate of the boring locations or in unexplored areas of the site. In areas where variations from the available subsurface data become apparent during construction, it will be necessary to perform additional subsurface exploration based upon on-site observations of the conditions.

In the event that changes are made in the design or location of the proposed bridge, the preliminary recommendations presented in this geotechnical base line report shall not be considered valid unless the changes are reviewed by our firm and conclusions of this base line report modified and or verified in writing. If this base line report is copied or transmitted to a

third party, it must be copied or transmitted in its entirety, including text, attachments, and enclosures. Interpretations based on only a part of this report may not be valid.

APPENDIX I

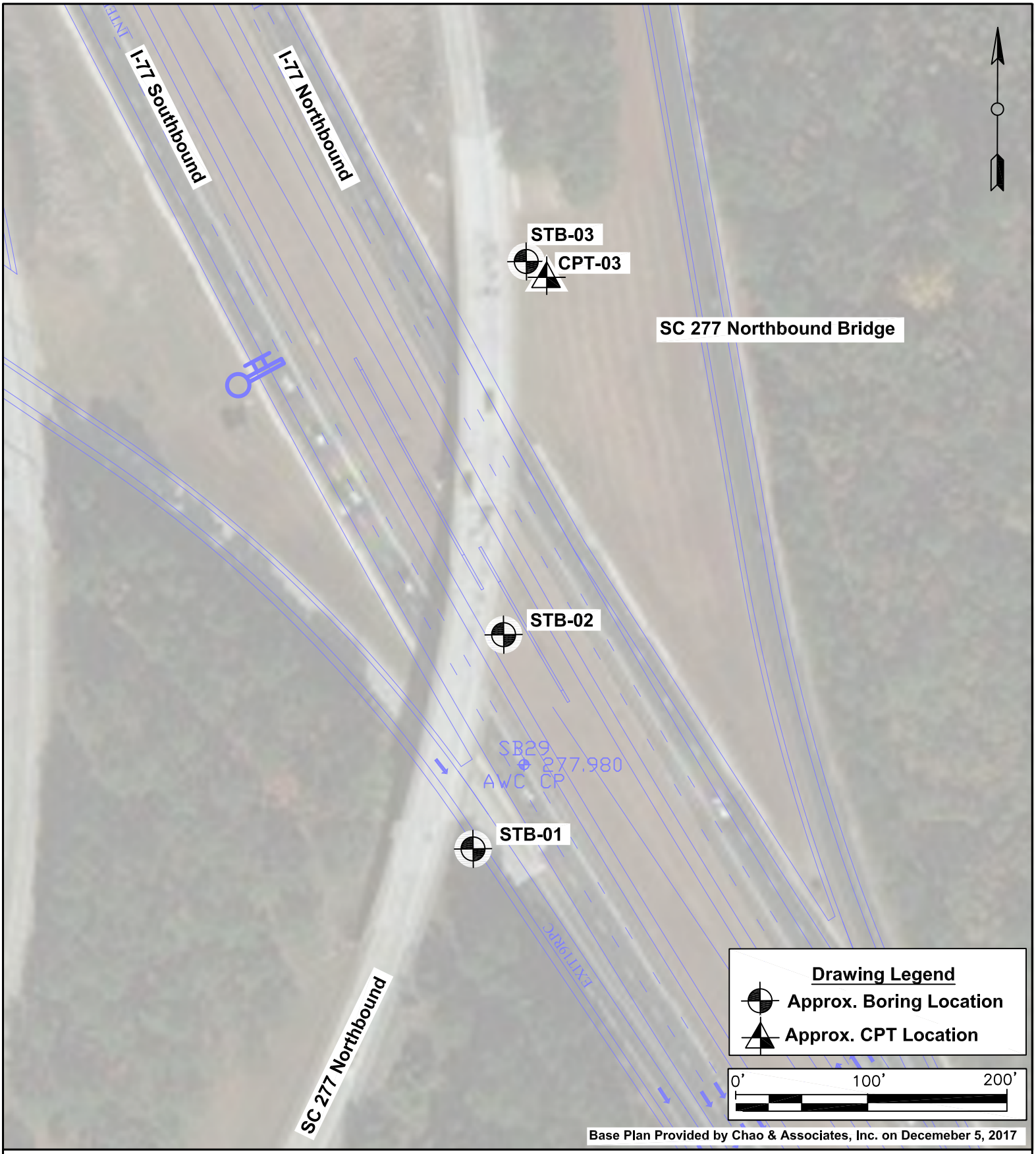


Site Vicinity Map Obtained from Google™ Maps

FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881
18 Woods Lake Road, Greenville, SC 29607 I USA
T 864.271.2840 I F 864.271.8124

Site Vicinity Map
SC 277 Northbound Bridge Over Interstate 77
Richland County, South Carolina

Job No.:	65U-0109	Scale:	1 inch = Approx. 5,000 ft
Date:	01/03/2018	Drawn By:	K. Ryan
Figure No.:	1	Checked By:	B. Azumah



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Location Plan
SC 277 Northbound Bridge Over Interstate 77
Richland County, South Carolina

Job No.:	65U-0109	Scale:	1 inch = Approx. 100 feet
Date:	02/1/2018	Drawn By:	K. Ryan
Figure No.:	2	Checked By:	B. Azumah

Figure No. 3: Photograph of Boring STB-01 After Drilling

Figure No. 4: Photograph of Boring STB-02 Being Drilled

Figure No. 5: Photograph of Boring STB-03 Being Drilled

Figure No. 6: Photograph of CPT-03 Being Drilled

APPENDIX II

Key to Boring Log Soil Classifications
Unified Soil Classification System
SCDOT Material Description, Classification, and Logging
Soil Test Boring Logs (STB-01, STB-02, and STB-03)
Subsurface Profile below Existing SC 277 Bridge Over I-77 (Figure No. 6)

KEY TO SOIL CLASSIFICATION

Correlation of Penetration Resistance with Relative Density and Consistency

Sands and Gravels

No. of Blows, N	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium dense
31 - 50	Dense
Over 50	Very dense

Silts and Clays

No. of Blows, N	Relative Density
0 - 2	Very soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very stiff
31 - 50	Hard
Over 50	Very hard

Particle Size Identification (Unified Classification System)

Boulders:	Diameter exceeds 8 inches
Cobbles:	3 to 8 inches diameter
Gravel:	**Coarse** - 3/4 to 3 inches diameter **Fine** - 4.76 mm to 3/4 inch diameter
Sand:	**Coarse** - 2.0 mm to 4.76 mm diameter **Medium** - 0.42 mm to 2.0 mm diameter **Fine** - 0.074 mm to 0.42 mm diameter
Silt and Clay:	Less than 0.07 mm (particles cannot be seen with naked eye)

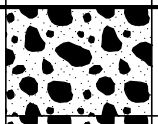
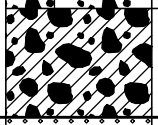
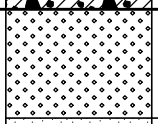
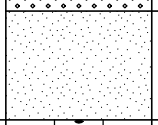
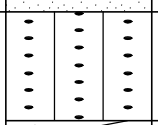
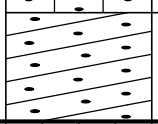
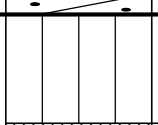
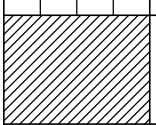
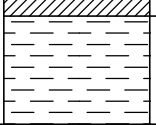
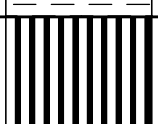
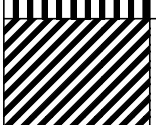
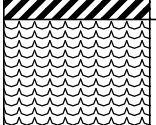
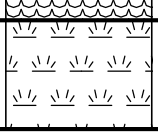
Modifiers

The modifiers provide our estimate of the amount of silt, clay or sand size particles in the soil sample.

Approximate Content	Modifiers
≤ 5%:	Trace
5% to 12%:	Slightly silty, slightly clayey, slightly sandy
12% to 30%:	Silty, clayey, sandy
30% to 50%:	Very silty, very clayey, very sandy

Field Moisture Description	
Saturated:	Usually liquid; very wet, usually from below the groundwater table
Wet:	Semisolid; requires drying to attain optimum moisture
Moist:	Solid; at or near optimum moisture
Dry:	Requires additional water to attain optimum moisture

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SCDOT Soil Test Boring Log

File No.:	727.615	**Project No. (PIN):**	23546	**County:**	Beaufort/Jasper	**Eng./Geo.:**	A. Bore		
Site Description:	RBO New River					**Route:**	SC 170/46		
Boring No.:	B-722	**Boring Location:**	722+00	**Offset:**	5 ft LT	**Alignment:**	Mainline		
Elev.:	1,500 ft	**Latitude:**	34.3750	**Longitude:**	81.0944	**Date Started:**	07/15/03		
Total Depth:	45 ft	**Soil Depth:**	39 ft	**Core Depth:**	6 ft	**Date Completed:**	07/16/03		
Bore Hole Diameter (in):	4.5	**Sampler Configuration**		**Liner required:**	Y N	**Liner used:**	Y N		
Drill Machine:	CME-750	**Drill Method:**	Wash Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	100%		
Core Size:	NQ Wireline	**Driller:**	I. Core	**Groundwater:**	**TOB**	7.5 ft	**24 hr**	15 ft	

Depth (feet)	Elevation (ft msl)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (feet)	Sample Type / No.	1 st / 2 nd / 3 rd	SPT N-Value	• - SPT N-Value (blows / foot) PL MC LL x-------o-------x ▲ - % fines 10 20 30 40 50 60 70 80 90 100
		Soil Description a , b , c , d , e , f , g h , i , j , Munsell , LL PL , PI , NMC , %#200 Munsell = Munsell Color Chart Designation LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index NMC = Natural Moisture Content %#200 = Percent Passing #200 Sieve						
		Rock Description (as required) Lithologic description: rock type, color, texture, grain size, foliation, weathering and strength with k , l , m , n , o , p , q r , Munsell , RQD , %REC RMR Munsell = Munsell Color Chart Designation RQD = Rock Quality Designation %REC = Percent Recovery RMR = Rock Mass Rating						

Figure 6-10, SCDOT Soil Test Boring Log

SCDOT Soil Test Boring Log Descriptors

a - Relative Density / Consistency Terms

Relative Density[1]

Descriptive Term	Relative Density	SPT Blow Count
Very Loose	0 to 15%	< 4
Loose	16 to 35%	5 to 10
Medium Dense	36 to 65%	11 to 30
Dense	66 to 85%	31 to 50
Very Dense	86to 100%	>51

Consistency[2]

Descriptive Term	Unconfined Compression Strength (q_u) (tsf)	SPT Blow Count
Very Soft	<0.25	<2
Soft	0.26 to 0.50	3 to 4
Firm	0.51 to 1.00	5 to 8
Stiff	1.01 to 2.00	9 to 15
Very Stiff	2.01 to 4.00	16 to 30
Hard	>4.01	> 31

b - Moisture Condition

Descriptive Term	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually in coarse-grained soils below the water table

c - Color

Describe the sample color while sample is still moist, using Munsell color chart.

d - Angularity[1]

Descriptive Term	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

e - HCl Reaction[3]

Descriptive Term	Criteria
None Reactive	No visible reaction
Weakly Reactive	Some reaction, with bubbles forming slowly
Strongly Reactive	Violent reaction, with bubbles forming immediately

f - Cementation[3]

Descriptive Term	Criteria
Weakly Cemented	Crumbles or breaks with handling or little finger pressure
Moderately Cemented	Crumbles or breaks with considerable finger pressure
Strongly Cemented	Will not crumble or break with finger pressure

g - Particle-Size Range[1]

Gravel	mm	Sieve size
Fine	4.76 to 19.1	#4 to ¾ inch
Coarse	19.1 to 76.2	¾ inch to 3 inch

Sand	mm	Sieve size
Fine	0.074 to 0.42	#200 to #40
Medium	0.42 to 2.00	#40 to #10
Coarse	4.00 to 4.76	#10 to #4

h - Primary Soil Type[1, 2]

The primary soil type will be shown in all capital letters

i - USCS Soil Designation

Indicate USCS soil designation as defined in ASTM D-2487 and D-2488

j - AASHTO Soil Designation

Indicate AASHTO soil designation as defined in AASHTO M-145 and ASTM D-3282

[1]Applies to coarse-grained soils (major portion retained on No. 200 sieve)
[2]Appiles to fine-grained soils (major portion passing No. 200 sieve)
[3]Use as required

Figure 6-11, SCDOT Soil Test Boring Log Descriptors - Soil

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-01
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1352+58.19	**Offset:**	118.17 ft LT	**Alignment:**	I-77
Elev.:	277.2 ft	**Latitude:**	34.0929665	**Longitude:**	-80.9544085	**Date Started:**	10/10/2017
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/10/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 8.5 ft	**24HR**	8.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0		0.0	SS-1	3	5	5	10
	0.4	**4 inches TOPSOIL**						
	1.5	**COASTAL PLAIN - MIDDENDORF FORMATION:** Stiff, moist, brownish gray, **SANDY LEAN CLAY (CL, A-7-6)**, trace root fragments (7.5YR 5/2)	1.5	SS-2	12	15	24	39
	3.0		3.0	SS-3	13	22	33	55
	4.5		4.5	SS-4	3	13	27	40
272.2		Hard to very hard, moist, light grayish brown, **SANDY LEAN CLAY (CL, A-7-6)** (7.5YR 5/2) SS-2: LL=46%, PL=20%, PI=26, NMC=15.3%, #200=64%						
	8.5		8.5	SS-5	40	50/4"		100
267.2		Hard, moist, light grayish brown, **SANDY LEAN CLAY (CL, A-7-6)** (7.5YR 5/2) SS-4: LL=37%, PL=17%, PI=20, NMC=14.2%, #200=59%						
	12.5		13.5	SS-6	9	13	17	30
262.2		Very dense, wet, light yellowish brown to light brownish gray, fine to coarse, **CLAYEY SAND (SC, A-2-6)** (7.5YR 5/2)						
		Medium dense, wet, light brownish gray, fine to coarse, **SILTY, CLAYEY SAND (SC-SM, A-1-a)** (7.5YR 5/2) SS-6: LL=21%, PL=16%, PI=5, NMC=20.2%, #200=12.2%	18.5	SS-7	12	14	16	30
257.2								
	22.5		23.5	SS-8	8	11	8	19
252.2		Medium dense, wet, orangish brown to light brownish gray, fine to coarse, **CLAYEY SAND (SC, A-2-7)** (7.5YR 5/2) SS-8: LL=56%, PL=25%, PI=31, NMC=23.5%, #200=17%						
	27.5		28.5	SS-9	4	4	4	8
		Loose to medium dense, wet, light brownish gray to light pinkish gray, fine to coarse, **SILTY SAND (SM, A-2-7)**, few to little rock fragments						

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-01
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1352+58.19	**Offset:**	118.17 ft LT	**Alignment:**	I-77
Elev.:	277.2 ft	**Latitude:**	34.0929665	**Longitude:**	-80.9544085	**Date Started:**	10/10/2017
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/10/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 8.5 ft	**24HR**	8.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		(10R 7/2)		33.5	SS-10	7	10	12	22	
242.2				38.5	SS-11	9	11	13	24	
237.2	40.0	**PIEDMONT RESIDUUM:** Dense, wet, pinkish gray, fine to coarse, **CLAYEY SAND (SC, A-2-4)**, little to some rock fragments (10R 7/2) SS-12: LL=23%, PL=13%, PI=10, NMC=13.6%, #200=26%		43.5	SS-12	11	21	20	41	
232.2				48.5	SS-13	12	25	45	70	
227.2	47.5	Very hard, wet, light gray, **ELASTIC SILT WITH SAND (MH, A-7-5)** (GLEY 1 5/2)		53.5	SS-14	21	37	50/4"	100	
222.2	52.5	**PARTIALLY WEATHERED ROCK**, Sampled as very hard, moist, light gray, **SILT WITH SAND (ML, A-4)**, trace rock fragments (GLEY 1 5/2)		58.5	SS-15	16	29	35	64	
	57.5	Very hard, moist, light gray, **SANDY, SILTY CLAY (CL-ML, A-4)** (GLEY 1 5/2)								

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-01
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1352+58.19	**Offset:**	118.17 ft LT	**Alignment:**	I-77
Elev.:	277.2 ft	**Latitude:**	34.0929665	**Longitude:**	-80.9544085	**Date Started:**	10/10/2017
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/10/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 8.5 ft	**24HR**	8.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		SS-16: LL=27%, PL=21%, PI=6, NMC=25.6%, #200=70%		63.5	SS-16	30	39	50/5"	99
212.2				68.5	SS-17	29	36	50	86
207.2	72.5	**PARTIALLY WEATHERED ROCK**, Sampled as very hard, moist, light gray, **SANDY SILT (ML, A-4)**, trace rock fragments (GLEY 1 5/2)		73.5	SS-18	33	50/4"		100
202.2				78.5	SS-19	24	50/4"		100
197.2				83.5	SS-20	50/3"			100
192.2				88.5	SS-21	50/5"			100

SPT N VALUE ● PL × MC ○ LL × ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-01
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1352+58.19	**Offset:**	118.17 ft LT	**Alignment:**	I-77
Elev.:	277.2 ft	**Latitude:**	34.0929665	**Longitude:**	-80.9544085	**Date Started:**	10/10/2017
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/10/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 8.5 ft	**24HR**	8.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6"	N Value
				93.5	SS-22	50/3"	100
182.2				98.5	SS-23	50/3"	100
177.2	100.0	Boring terminated at 100'					
172.2							
167.2							
162.2							

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT 65V0109 BORING LOGS.GPJ SCDOT DATA TEMPLATE_12_30_2014.GDT 1/5/18

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-02
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1353+91.11	**Offset:**	6.46 ft RT	**Alignment:**	I-77
Elev.:	278.2 ft	**Latitude:**	34.0934568	**Longitude:**	-80.9542758	**Date Started:**	10/9/2017
Total Depth:	90 ft	**Soil Depth:**	90 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/16/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 6 ft	**24HR**	9 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0		0.0					
	0.5	**6 inches TOPSOIL**						
		COASTAL PLAIN - MIDDENDORF FORMATION: Medium dense to loose, moist, pinkish brown to pinkish gray, fine to coarse **CLAYEY SANDY (SC, A-2-4)**, trace root fragments	1.5	SS-1	7	7	7	14
	3.0	(5YR 7/3 to 10R 7/2)	3.0	SS-2	4	3	4	7
273.2		SS-2: LL=22%, PL=12%, PI=10, NMC=9.2%, #200=27%	4.5	SS-3	8	11	19	30
	6.0	▽		SS-4	9	20	29	49
		Medium dense to dense, moist, pinkish brown to pinkish gray, fine to coarse **CLAYEY SAND (SC, A-2-4)**	8.5					
		▼(10R 7/2)		SS-5	17	24	22	46
268.2		Dense to medium dense, wet, light grayish brown to light yellowish brown, fine to coarse, **SILTY SAND (SM, A-2-4)**	13.5					
		(2.5Y 5/6)		SS-6	12	10	12	22
		SS-5: LL=33%, PL=26%, PI=7, NMC=16.3%, #200=19%						
263.2			18.5					
				SS-7	14	13	5	18
258.2								
	22.5	Medium dense, wet, pinkish brown, fine to coarse, **CLAYEY SAND (SC, A-2-4)**	23.5					
		(5YR 7/3)		SS-8	7	8	12	20
253.2		SS-8: LL=25%, PL=15%, PI=10, NMC=21.6%, #200=16%						
	27.5		28.5					
		Dense to medium dense, wet, light grayish brown, fine to coarse, **CLAYEY SAND (SC, A-2-6)**		SS-9	22	22	21	43
		(7.5YR 5/2)						

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-02
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1353+91.11	**Offset:**	6.46 ft RT	**Alignment:**	I-77
Elev.:	278.2 ft	**Latitude:**	34.0934568	**Longitude:**	-80.9542758	**Date Started:**	10/9/2017
Total Depth:	90 ft	**Soil Depth:**	90 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/16/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 6 ft	**24HR**	9 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		SS-10: LL=33%, PL=14%, PI=19, NMC=20.9%, #200=14%		33.5	SS-10	11	12	16	28
243.2	37.5	**PIEDMONT RESIDUUM:** Dense, wet, light grayish brown, fine to coarse, **SILTY SAND (SM, A-2-4)** (10YR 6/2)		38.5	SS-11	10	15	30	45
238.2	42.5	Very dense, wet, light grayish brown, fine to coarse, **SILTY SAND (SM, A-2-4)** (10YR 6/2)		43.5	SS-12	15	34	40	74
233.2	47.5	**PARTIALLY WEATHERED ROCK**, Sampled as very dense, wet, light grayish brown, fine to coarse, **SILTY SAND (SM, A-2-4)**, trace rock fragments (10YR 6/2)		48.5	SS-13	20	42	50/4"	100
228.2	52.5	**PARTIALLY WEATHERED ROCK**, Sampled as very hard, moist, light gray, **SILT WITH SAND (ML, A-4)**, trace rock fragments (GLEY 1 5/2) SS-14: LL=30%, PL=23%, PI=7, NMC=28.1%, #200=84%		53.5	SS-14	36	50/3"		100
223.2				58.5	SS-15	26	40	50/4"	100

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-02
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1353+91.11	**Offset:**	6.46 ft RT	**Alignment:**	I-77
Elev.:	278.2 ft	**Latitude:**	34.0934568	**Longitude:**	-80.9542758	**Date Started:**	10/9/2017
Total Depth:	90 ft	**Soil Depth:**	90 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/16/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 6 ft	**24HR**	9 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" 2nd 6" 3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
				63.5	SS-16	20 50/5"	100	
213.2								
				68.5	SS-17	23 50/4"	100	
208.2								
				73.5	SS-18	36 50/3"	100	
203.2								
				78.5	SS-19	20 50/4"	100	
198.2								
				83.5	SS-20	50/5"	100	
193.2								
				88.5	SS-21	50/2"	100	
	90.0							

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-02
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1353+91.11	**Offset:**	6.46 ft RT	**Alignment:**	I-77
Elev.:	278.2 ft	**Latitude:**	34.0934568	**Longitude:**	-80.9542758	**Date Started:**	10/9/2017
Total Depth:	90 ft	**Soil Depth:**	90 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/16/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 6 ft	**24HR**	9 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		Boring terminated at 90'						
183.2								
178.2								
173.2								
168.2								
163.2								

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-03
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1356+29.68	**Offset:**	150.95 ft RT	**Alignment:**	I-77
Elev.:	276.2 ft	**Latitude:**	34.0942171	**Longitude:**	-80.9542358	**Date Started:**	10/13/2017
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/14/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 8.5 ft	**24HR**	7.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0							
	0.5	**6 inches TOPSOIL**	0.0	SS-1	3	4	6	10
		FILL: Loose to medium dense, moist, grayish brown, fine to medium, **CLAYEY SAND (SC, A-2-6)**, trace organics	1.5	SS-2	6	6	7	13
	3.0	(7.5YR 5/2)	3.0	SS-3	6	6	4	10
		SS-2: LL=31%, PL=14%, PI=17, NMC=10.4%, #200=31.5%	4.5	SS-4	8	6	6	12
271.2	4.5	**ALLUVIUM:** Loose, moist, grayish brown, fine to medium, **SILTY SAND (SM, A-2-4)**						
		(7.5YR 5/2)	8.5	SS-5	WOH/18"			0
	8.5	Medium dense, moist, brownish gray, fine to medium, **CLAYEY SAND (SC, A-2-6)**						
		(7.5YR 5/2)						
266.2		Very loose, wet, dark grayish brown, fine to medium **SILTY SAND (SM, A-2-4)**, some organics	13.5	SS-6	6	8	7	15
	12.5	(7.5YR 5/2)						
		SS-5: LL=32%, PL=24%, PI=8, NMC=44.8%, #200=34%, Organics=8.1%	18.5	SS-7	8	12	20	32
261.2		**COASTAL PLAIN - MIDDENDORF FORMATION:** Medium dense, wet, light yellowish brown, fine to coarse, **SILTY SAND (SM, A-2-4)**						
	17.5	(2.5Y 5/6)						
		Dense to medium dense, wet, pinkish brown, fine to coarse, **SILTY, CLAYEY SAND (SC-SM, A-1-b)**	23.5	SS-8	7	14	11	25
256.2		(5YR 7/3)						
		SS-7: LL=22%, PL=18%, PI=4, NMC=18.9%, #200=18%						
251.2			28.5	SS-9	12	16	19	35

SPT N VALUE

PL MC LL

FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

SC

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-03
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1356+29.68	**Offset:**	150.95 ft RT	**Alignment:**	I-77
Elev.:	276.2 ft	**Latitude:**	34.0942171	**Longitude:**	-80.9542358	**Date Started:**	10/13/2017
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/14/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 8.5 ft	**24HR**	7.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	32.5		33.5	SS-10	8	19	23	42
241.2		**PIEDMONT RESIDUUM:** Dense to very dense, wet, orangish brown to yellowish brown, fine to coarse, **SILTY SAND (SM, A-2-4)** , few clay pockets (10YR 5/6 to 2.5Y 5/6)	38.5	SS-11	12	39	23	62
236.2	42.5	**PARTIALLY WEATHERED ROCK**, Sampled as very hard, wet, light yellowish gray to light brownish gray, **SANDY SILT (ML, A-4)**, trace rock fragments (10YR 6/2 to 2.5Y 5/6)	43.5	SS-12	21	45	50/4"	100
231.2	47.5	Very hard, wet, light yellowish gray to light brownish gray, **SANDY SILTY CLAY (CL-ML, A-4)** (10YR 6/2 to 2.5Y 5/6) SS-13: LL=25%, PL=21%, PI=4, NMC=25.3%, #200=55%	48.5	SS-13	13	30	36	66
226.2	52.5	**PARTIALLY WEATHERED ROCK**, Sampled as very hard, wet, light yellowish gray to light brownish gray, **SANDY SILT (ML, A-4)**, trace rock fragments (10YR 6/2 to 2.5Y 5/6)	53.5	SS-14	24	50/6"		100
221.2			58.5	SS-15	50/5"			100

SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-03
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1356+29.68	**Offset:**	150.95 ft RT	**Alignment:**	I-77
Elev.:	276.2 ft	**Latitude:**	34.0942171	**Longitude:**	-80.9542358	**Date Started:**	10/13/2017
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/14/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 8.5 ft	**24HR**	7.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	62.5	Very hard, wet, light yellowish gray to light brownish gray, **SANDY SILT (ML, A-4)** (10YR 6/2 to 2.5Y 5/6)		63.5	SS-16	14	29	50	79
211.2	67.5	Hard, wet, yellowish brown to yellowish gray, **SANDY ELASTIC SILT (MH, A-7-5)** (10YR 6/2 to 2.5Y 5/6)		68.5	SS-17	28	22	24	46
206.2	72.5	**PARTIALLY WEATHERED ROCK**, Sampled as very dense, wet, light grayish brown to light yellowish brown, fine to coarse **SILTY SAND (SM, A-4)**, trace rock fragments (10YR 6/2 to 2.5Y 5/6) SS-19: LL=27%, PL=22%, PI=5, NMC=23.2%, #200=49%		73.5	SS-18	22	50/3"		100
201.2				78.5	SS-19	50/5"			100
196.2				83.5	SS-20	50/2"			100
191.2				88.5	SS-21	50/2"			100

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Log

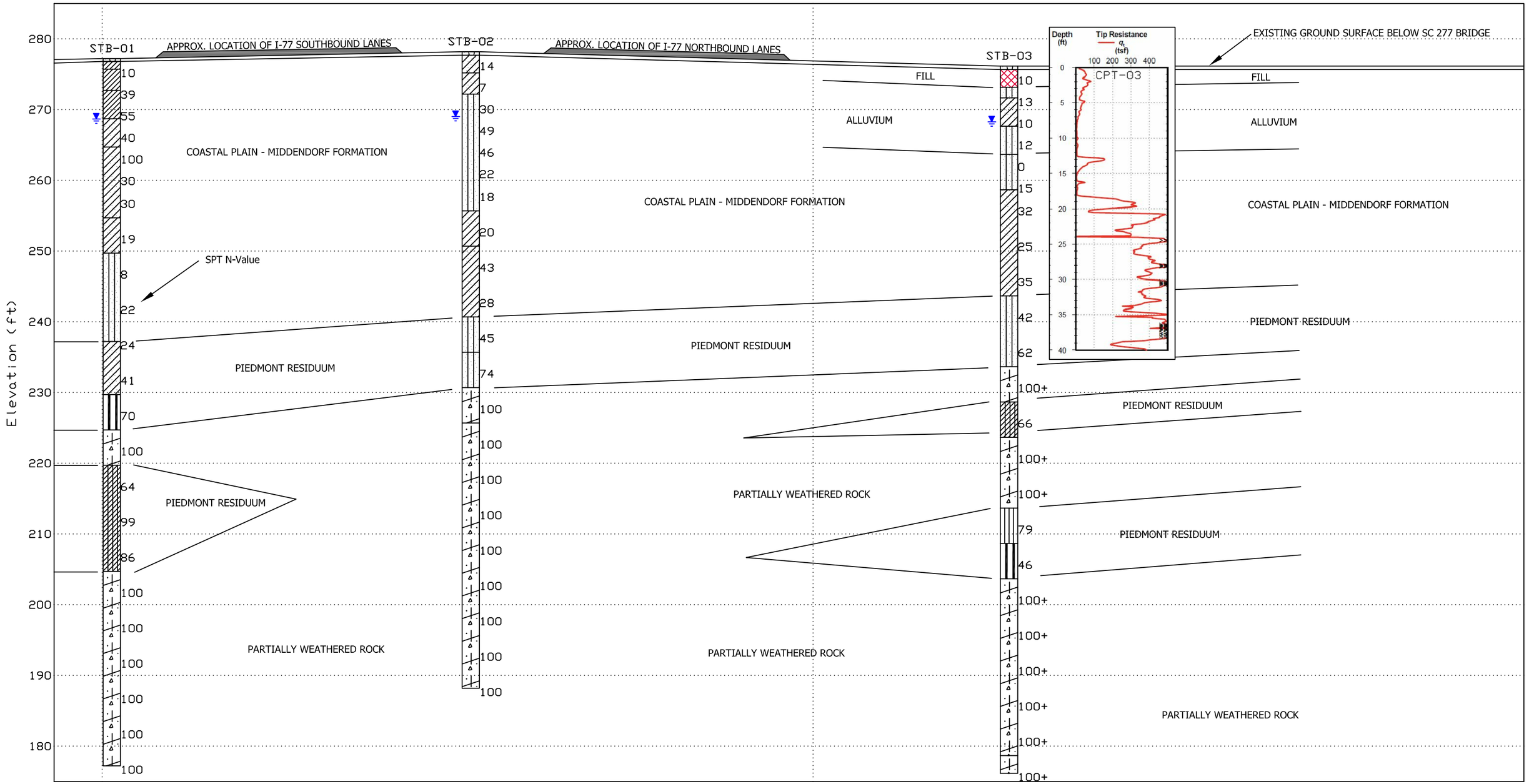
Project ID:	P030487			**County:**	Richland County	**Boring No.:**	STB-03
Site Description:	SC 277 North Bound Bridge over I-77					**Route:**	SC 277
Eng./Geo.:	K. Ryan	**Boring Location:**	1356+29.68	**Offset:**	150.95 ft RT	**Alignment:**	I-77
Elev.:	276.2 ft	**Latitude:**	34.0942171	**Longitude:**	-80.9542358	**Date Started:**	10/13/2017
Total Depth:	100 ft	**Soil Depth:**	100 ft	**Core Depth:**	N/A ft	**Date Completed:**	10/14/2017
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME-550X	**Drill Method:**	Mud Rotary	**Hammer Type:**	Automatic	**Energy Ratio:**	85.5%
Core Size:	N/A	**Driller:**	F&R, Inc.	**Groundwater:**	**TOB** 8.5 ft	**24HR**	7.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" 2nd 6" 3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
				93.5	SS-22	50/2"	100	
181.2	97.5	**PARTIALLY WEATHERED ROCK**, Sampled as very hard, wet, brownish gray, **SANDY ELASTIC SILT (MH, A-7-5)**, trace rock fragments		98.5	SS-23	22 50/3"	100	
176.2	100.0	(7.5YR 5/2)						
		Boring terminated at 100'						
171.2								
166.2								
161.2								

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT 65V0109 BORING LOGS.GPJ SCDOT DATA TEMPLATE_12_30_2014.GDT 1/5/18



Description of Soil Stratigraphy Symbols

- Fill - Sand (SC)
- Alluvium - Clayey Sand (SC)
- Alluvium - Silty Sand (SM)
- Coastal Plain - Silty Sand (SM)
- Coastal Plain - Clayey Sand, Silty Clayey Sand (SC, SC-SM)
- Coastal Plain - Lean Clay (CL)
- Piedmont Residuum - Silty Sand (SM)
- Piedmont Residuum - Clayey Sand (SC)
- Piedmont Residuum - Sandy Silty Clay (CL-ML)
- Piedmont Residuum - Silt (ML)
- Piedmont Residuum - Elastic Silt (MH)
- Partially Weathered Rock (SM, ML)

FROEHLING & ROBERTSON, INC.
Engineering Stability Since 1881
18 Woods Lake Road, Greenville, SC 29607 I USA
T 864.271.2840 I F 864.271.8124

Drawing Title: Subsurface Profile Below Existing SC 277 Bridge Over I-77

Client:	South Carolina Department of Transportation	**Job No.:**	65V-0109	**Scale:**	NTS
Project:	SC 277 Northbound Bridge Over Interstate 77 Richland County, South Carolina	**Date:**	2/1/2018	**Drawn By:**	K. Ryan
		Figure No.:	7	Checked By:	B. Azumah

APPENDIX III

Geophysical Test Data Sheet – MASW Shear Wave Velocity Test

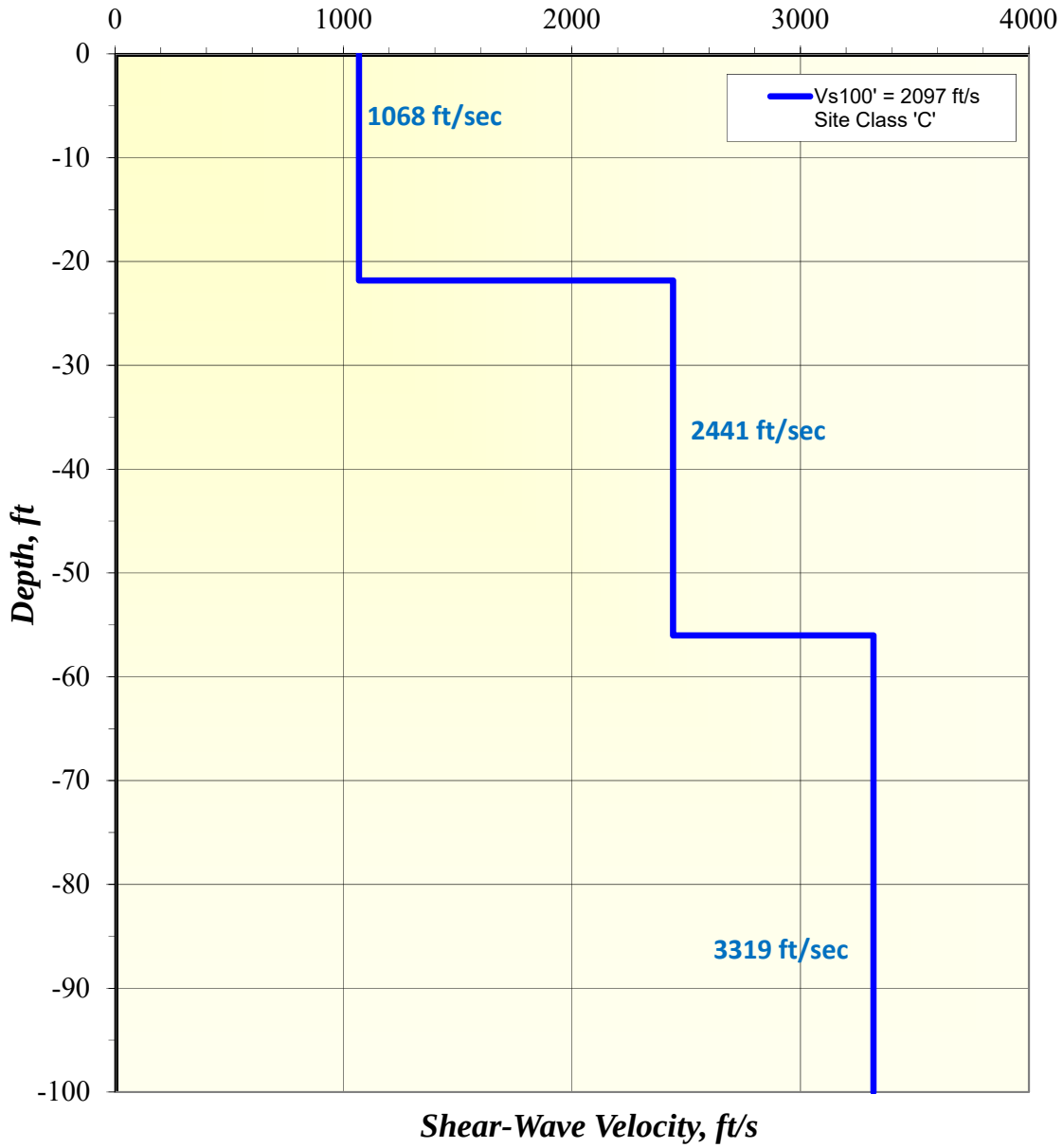
SINCE 1881

FROEHLING & ROBERTSON, INC.

Refraction Microtremor (REMI) Results

Project: SC277 NB Bridge Over I-77
Client: SCDOT Geotechnical Design Group
Test Date: 10/18/2017
Report Date: 10/19/17
Record No.: 65V-0109

Vs Model



APPENDIX IV

Cone Penetration Test Specification Sheet
Cone Penetration Test Result – (CPT-03)

Exploration Findings - SC-277 Over I-77 NB

Richland County, South Carolina

Client: Froehling and Robertson, Inc.

PILLC No.: 18-006

January 24, 2018

TEST METHODS:

PalmettoINSITU, LLC executes exploration projects in general accordance with published American Society for Testing and Material (ASTM) procedures; the United States Department of Transportation (USDOT), Federal Highway Administration (FHA), National Highway Institute (NHI) recommendations; and within generally acceptable industry practices. These include but are not limited to:

⇒ **ASTM D5778:** *Standard Test Method for Performing Electronic Friction Cone and Piezo Cone Penetration Testing of Soils* (CPTu)
⇒ **ASTM D7400:** *Standard Test Methods for Downhole Seismic Testing* (SCPTu)
⇒ **ASTM D6635:** *Standard Test Method for Performing the Flat Plate Dilatometer* (DMT)
⇒ **International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE):** *The Flat Dilatometer Test (DMT) in Soil Investigations: A Report by the ISSMGE Committee TC16*
⇒ **USDOT, FHA and NHI**: *Subsurface Investigation Publication No. FHWA-NHI-05-035*. July 2006.

INSTRUMENTATION :

PalmettoINSITU, LLC Performs Daily Inspections of its Instrumentation as part of its Quality Assurance (QA) Program.

Each Instrument or Critical Measuring Gauge is calibrated as prescribed within one or more of the aforementioned Standards by its manufacturer; an American National Standard Institute (ANSI); or an International Standard (ISO) Laboratory Capable of testing to ISO/IEC 1705:2005 or a laboratory capable of meeting Standard Reference Materials of the National Institute of Standards and Technology (NIST), a non-regulated agency of the United States Department of Commerce.

⇒ **All of PalmettoINSITU's Cone Penetrometer (SCPTu and CPTu) Probes are:**

- Manufactured by Vertek, a division of Applied Research Associates, Inc.(ARA);
- Vertek (VTK) series;
- 1.75 inches (15 cm^2 tip area);
  And, are Capable of:
- Measuring Pore Water Pressure at the U_2 Position;
- Performing Downhole Seismic Testing using Tri-Axial Geophones and;
- Recording the Deviation from Vertical (inclination) about the cone's X and Y-Axis

⇒ **Cone Penetrometer Data Acquisition Systems:**

- Are Manufactured by Vertek, a Division of ARA, Inc. and;
- Are Vertek (VTK) Series.

⇒ **Marchetti Flat Plate Dilatometer (DMT) Tooling**

- Provided by GPE, Inc
- Membranes are H2.5, Unless Otherwise Specified

RIG DESCRIPTION AND GENERALIZED DATA ACQUISITION PROCESS:

The geotechnical exploration program is performed using an S4-Scorpian, Manufactured by Vertek. The S4-Scorpian:

⇒ **Rig Description**:

- Anchors into the soil to achieve a thrust which can exceed 20 tons;
- Using anchors that may range in diameter from 300 to 500 cm;
- Which attach to hydraulically telescoping Anchors
- Uses a Bobcat T770 mini track loader with rubber tracks to convey and for hydraulical power;
- Has a combined weight, including Bobcat T770, and drill string, of approximately 12,000 pounds

⇒ **Generalized Data Acquisition Process:**

The Processes Following Assumes the Instrument has Met its Pre-Test Inspection and Baseline Requirements.

- All tests are pushed to the a target depth, the rigs maximum reaction, equipment failure or maximum lateral support of the push rods.
- The CPT probe or DMT blade is connected to its required control system by pre-stringing a pre-determined length of in-situ rods.
- CPTu data is acquired at a push rate of two centimeters per second. The tip, sleeve friction, pore water pressure and inclination are automatically recorded with relation to depth.
- Downhole Seismic Data is acquired at approximately one meter intervals, unless otherwise specified.
- Dissipation data is acquired at a logarithmic rate with regards to dynamic pore water pressure and depth.
- DMT data is collected at one foot intervals. Delta-A and Delta-B, both pre- and post-sounding are determined. The Z-reading, if necessary, is noted. A-readings and B-Readings are both recorded with respect to depth.

SIGNIFICANT SOFTWARE UTILIZED FOR DATA REDUCTION, LOG AND GRAPH PRODUCTION:

Finalized Output is Routinely Published using RAPIDCPT. However, PalmettoINSITU, LLC may use other Software if Required. The Client will be Notified in Advance if such a Situation Occurs.

⇒ **Bentley Systems, Inc. Supplied:**

- *gINT V8i SS2 Version 08.30.04.285 (gINT V8i Professional)*

⇒ **Vertek Provided:**

- *Coneplot version 2.0.4 (Beta)*
- *CPT Processor version 1.7.19971*

⇒ **Dataforensics, LLC**

- *gINT add-on: RAPIDCPT version 4.2.2.0*

SIGNIFICANT SOFTWARE UTILIZED FOR DATA REDUCTION, LOG AND GRAPH PRODUCTION (CONTINUED) **:**

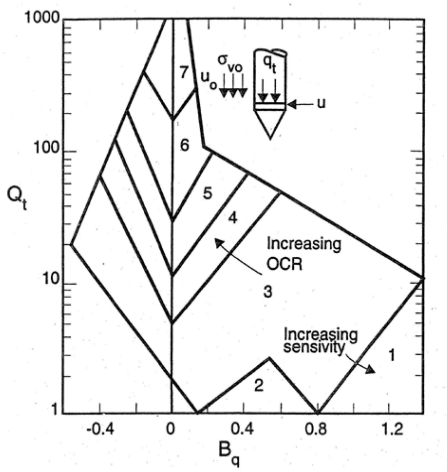
⇒ **Dataforensics, LLC** (Continued):

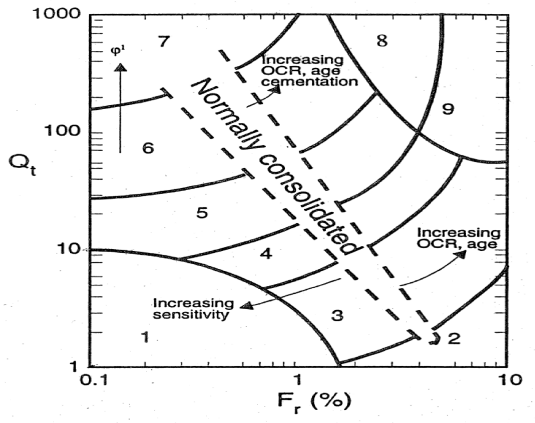
- *The application utilizes the Fuzzy CPT Soil Classification (Zhang & Tumay, 1999) algorithm developed for the classification software created by Louisiana Transportation Research Center (LTRC) under Project No. 98-3GT (Titi & Abu-Farsakh, 1999); its use in this application was developed with the support and assistance under LTRC Project No. 10-2GT, Geotechnical Information Database, Phase 2*

RAPIDCPT DEFAULT VARIABLES:

Min Drained Threshold Zone	5	Dr in M Calc	Dr (1)
Max Drained Threshold Zone	7	Nu	7
Drained Threshold Soil Behavior Type	Qt vs Fr	NkT	15
Phi in K0 Calc	Phi' (1)	Nk	15
OCR in K0 Calc	OCR (1)	Nc	20

NORMALIZED SOIL BEHAVIOR TYPES - ROBERTSON & CAMPANELLA (1990):





SOIL BEHAVIOR TYPE (SBT) MATERIAL LEGEND:

	1 – Sensitive, Fine Grained Soils		4 – Silt Mixtures-Clay Silt to Silty Clay		7 – Gravelly Sand to Sand
	2 – Organic Soils, Peats		5 – Sand Mixtures-Silty Sand to Sandy Silt		8– Very Stiff Clay to Clayey Sand
	3 – Clays-Clay to Silty Clay		6 – Sands-Clean Sand to Silty Sand		9 – Very Stiff Fine Grained Soils

Robertson and Campanella: 1990

PalmettoINSITU
Geotechnical Exploration

SC-277 at I-77 NB
Richland County, SC
Project Number :18-006

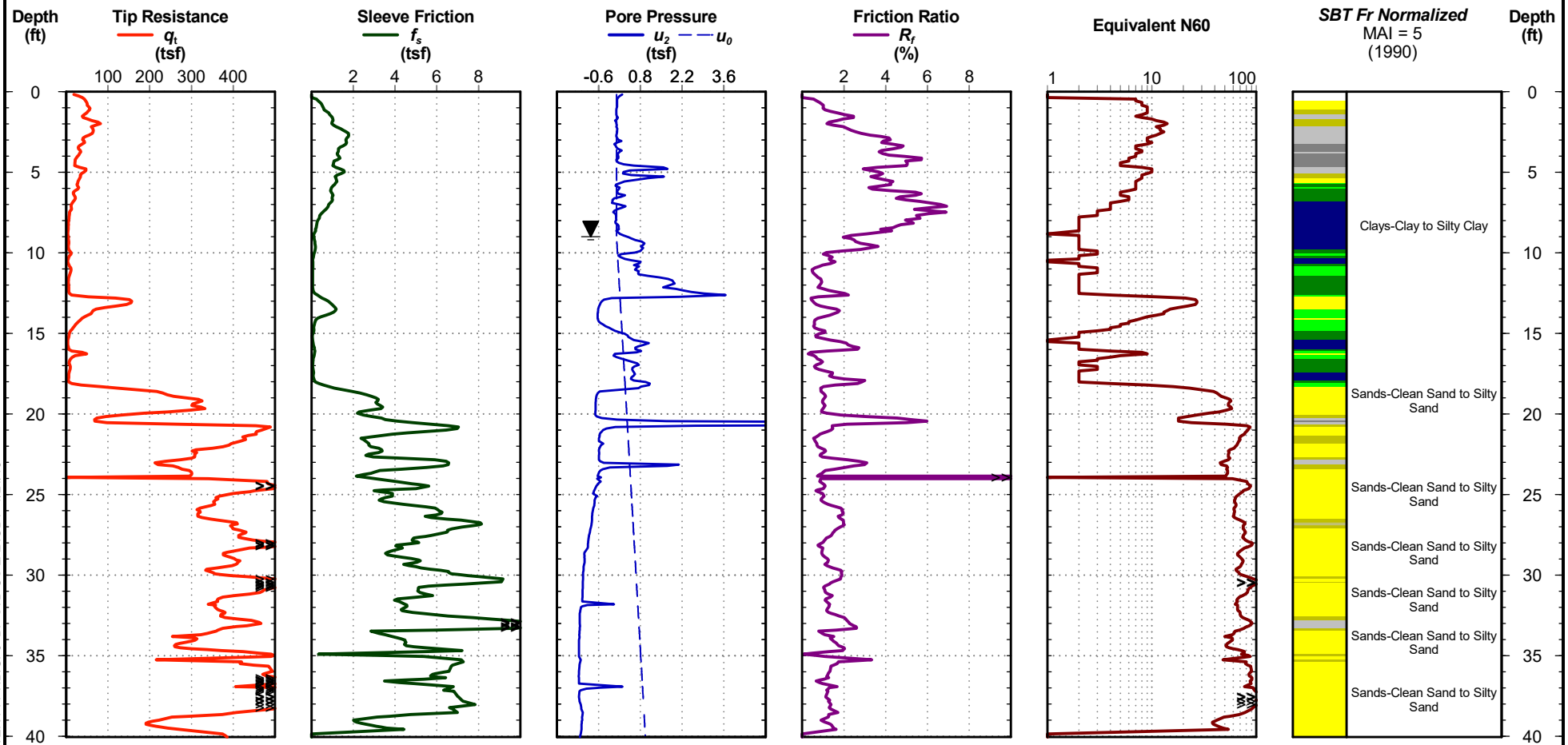
Cone Penetration Test

CPT-03

Date: Jan. 24, 2018
Estimated Water Depth: 9 ft
Rig/Operator: M. Cox | J. Croom

Latitude: 34.0942034
Longitude.: -80.9542358
Elevation: 276.2 feet

Total Depth: 40.1 ft
Termination Criteria: Target Depth
Cone Size: 1.75



CPT REPORT - STANDARD SC-277 OVER I-77 NB.GPJ DF STD US LAB.GDT 1/24/18

CPT-03

Page 1 of 1

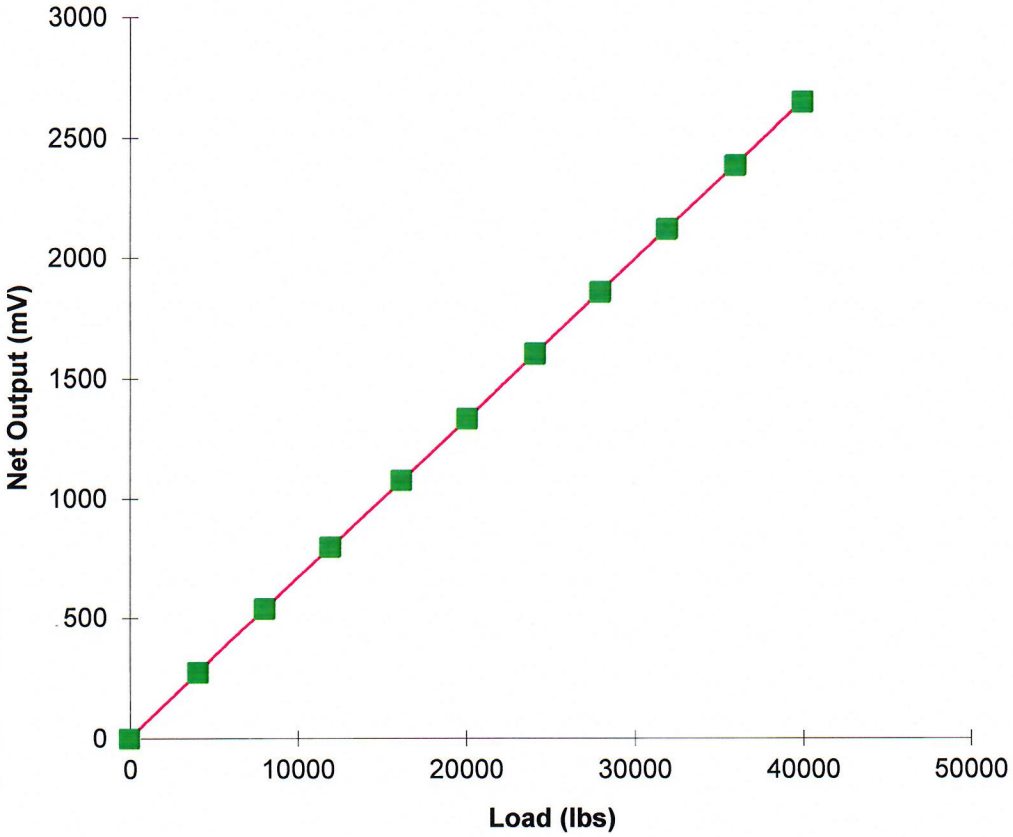
Electronic File Name: B24J1801C.DAT

250 Beanville Road
Randolph, Vermont 05060
phone: (800)639-6315 fax: (802)728-9871

Cone Penetrometer Calibration
Digital Cone Tip

Cone Serial No.:	4444.149
Rated Range:	50000 lbs
Load Reference:	Ref LC-SN: 390752A
Ref. DVM:	MY47029221
Ref. Excitation:	9.887 V_{dc}

Date: 20-Mar-17
Calibrated By: L Smith
Approved By: J. Haas



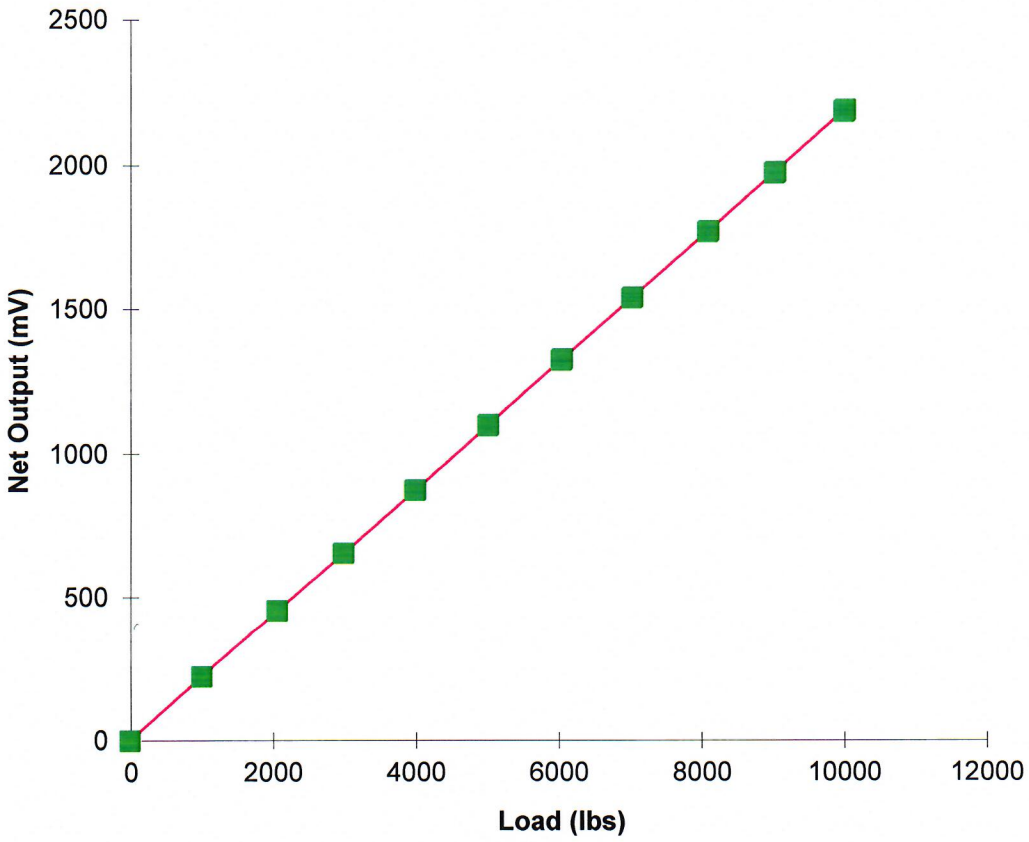
Cal Factor:	**66.387E-3 mV/lbs**	*52.000E-3 nominal*
R^2:	1.00000	
Nonlinearity:	0.16	
Zero Load Output:	206.984E-3 mV	

produced with Cone_Cal v 2003.02.04

250 Beanville Road
Randolph, Vermont 05060
phone: (800)639-6315 fax: (802)728-9871

Cone Penetrometer Calibration
Digital Cone Sleeve

Cone Serial No.:	4444.149	Date:	20-Mar-17
Rated Range:	10000 lbs		
Load Reference:	Ref LC-SN: 390752A	Calibrated By:	L Smith
Ref. DVM:	MY47029221		
Ref. Excitation:	9.886 V_{dc}	Approved By:	T. Haas



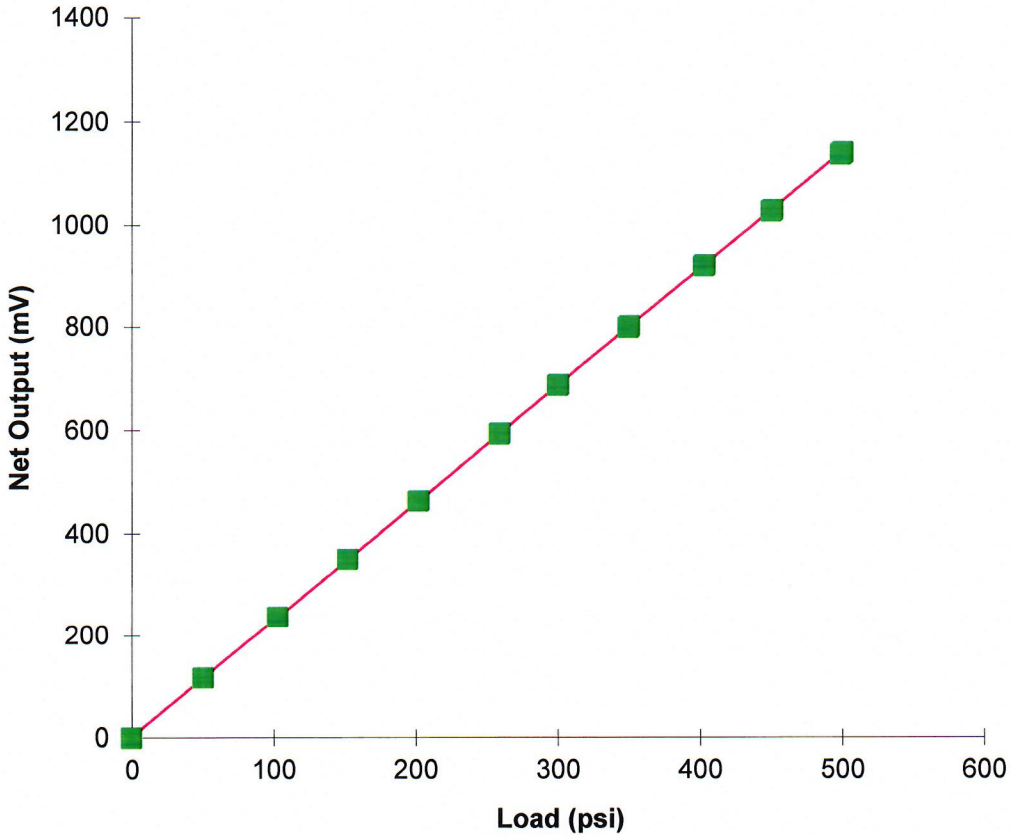
Cal Factor:	**218.749E-3 mV/lbs**	*212.000E-3 nominal*
R^2:	1.00000	
Nonlinearity:	0.13	
Zero Load Output:	271.799E-3 mV	

produced with Cone_Cal v 2003.02.04

250 Beanville Road
Randolph, Vermont 05060
phone: (800)639-6315 fax: (802)728-9871

Cone Penetrometer Calibration
Digital Cone Pore Pressure

Cone Serial No.:	4444.149	Date:	20-Mar-17
Rated Range:	1000 psi		
Load Reference:	Ref PT-16244-01PDKV	Calibrated By:	L Smith
Ref. DVM:	MY47029221		
Ref. Excitation:	5.034 V_{dc}	Approved By:	T. Haas



Cal Factor:	**2.282E+0 mV/psi**	*2.500E+0 nominal*
R^2:	0.99999	
Nonlinearity:	0.20	
Zero Load Output:	173.731E-3 mV	

produced with Cone_Cal v 2003.02.04

CPT Correlations

References are in parenthesis next to the appropriate equation.

General

p_a=atmospheric pressure (for unit normalization)
q_t=corrected cone tip resistance (tsf)
f_s=friction sleeve resistance (tsf)
$R_f = 100\% \cdot (f_s/q_t)$
u_2=pore pressure behind cone tip (tsf)
u_0=hydrostatic pressure

$B_q = (u_2-u_0)/(q_t-\sigma_{vo})$
$Q_t=(q_t-\sigma_{vo})/ \sigma'_{vo}$
$F_r=100\% \cdot f_s/(q_t-\sigma_{vo})$
$I_c = ((3.47-\log Q_t)^2 + (\log F_r+1.22)^2)^{0.5}$ 2
$I_{SBT} = ((3.47-\log(q_c/p_a))^2+(\log F_r+1.22)^2)^{0.5}$ 23

$$I_{c\ J\&D} = \sqrt{\{3 - \log(Q_t \cdot (1 - B_q)\}^2 + [1.5 + 1.3 \cdot \log(F_r)]^2}$$ 27

$$I_{c\ J\&B} = \sqrt{\{3 - \log(Q_t \cdot (1 - B_q) + 1\}^2 + [1.5 + 1.3 \cdot \log(F_r)]^2}$$ 28

K_o

K_0 (1) $K_o = (1-\sin\varphi)OCR^{\sin\varphi}$
K_0 (2) $K_o = 0.1(Q_t)$ 1

Stress History

$OCR = \sigma_p'/\sigma'_{vo}$
OCR (1) $\sigma_p' = 0.33(q_t - \sigma_{vo})$ - clays 8
OCR (2) $\sigma_p' = 0.53(u_2 - u_o)$ - clays 9
OCR (3) $\sigma_p' = 0.60(q_t - u_2)$ - clays 9
OCR (4) $OCR = 0.25\ Q_t^{1.25}$ – clays 37
OCR (5) $OCR = \left[\frac{0.192*(q_t/p_a)^{0.22}}{(1-\sin(\emptyset')\cdot(\sigma'_{v0}/p_a{}^{0.31})}\right]^{\frac{1}{\sin(\emptyset'-0.27)}}$ – sands 35
OCR (6) $\sigma_p' = .101 \cdot p_a{}^{0.102} \cdot G_{max}{}^{0.478} \cdot \sigma'_{v0}{}^{0.420}$ – all soils 36

N-Value

$N_{60} = (q_t/p_a)/[8.5(1-I_c/4.6)]$ 6

Undrained Shear Strength

S_u (1) $S_u = (u_2 - u_o)/N_u$ where $7 \le N_u \le 9$ 10
S_u (2) $S_u = (q_t - \sigma_{vo})/N_{kT}$ where $15 \le N_{kT} \le 20$ 11
S_u (3) $S_u = 0.091 * ((\sigma'_{vo}{}^{0.2}) * (q_t - \sigma_{vo})^{0.8}$ 21
S_u (4) $S_u = (q_c - \sigma_{vo})/N_k$ where $15 \le N_k \le 20$ 11
S_u (5) $S_u = q_t/N_c$ where $XXX \le N_c \le YYY$
S_u (6) $S_u = q_c/N_c$ where $XXX \le N_c \le YYY$

Effective Cohesion

$c' = 0.02 * \sigma_p'$ 38

Drained Friction Angle

φ′ (1)	$\varphi' = 17.6 + 11.0\text{Log}[q_t/(\sigma_{vo}')^{0.5}]$	1
φ′ (2)	$\varphi' = \arctan[0.1 + 0.38\text{Log}(q_t/\sigma_{vo}')]$	13
φ′ (3)	$\varphi' = 30.8\text{Log}[(f_s/\sigma_{vo}')+1.26]$ (for clays or sands)	14
φ′ (4)	$\varphi' = 29.5\ B_q^{0.121}\ (0.256 + 0.33\ B_q + \text{Log}(Q_t))$	24

Unit Weight

$\rho = \gamma/\gamma_w$

$\rho = 0.8\text{Log}(V_s)$ V_s in m/sec 17

Relative Density and Void Ratio

D_R (1)	$D_R = 100(q_{c1}/305)^{1/2}$	where, $q_{c1} = q_c/(\sigma_{vo}')^{1/2}$	1
D_R (2)	$D_R = -1.292 + 0.268\ln(q_c \cdot (\sigma_{vo}'^{-0.5}))$		18
D_R (3)	$D_R = (1/2.41)\cdot\ln(q_{c1}/15.7)$		3
D_R (4)	$D_R = 1/2.91 * \ln((q_c/(61* \sigma'^{0.71}_{vo}))*100$		20
D_R (5)	$D_R = 100*(0.268*\ln((q_t/p_a)/(\sigma'_{vo}/p_a)\text{^}0.5) - 0.675)$		34

$e_o = 1.099 - 0.204\log(q_{c1})$ 1

$E_D = 5\ q_t$ $I_D = 2.0 - 0.14(R_f)$ $K_D = E_D/(34.7\cdot I_D\cdot \sigma_{vo}')$

Compressibility

M (1) = $R_m\ E_D$ where R_m= function(I_D, K_D) see the following table 22

$I_D <= 0.6$	$R_M = 0.14 + 2.36 \log K_D$
$I_D >= 3$	$R_M = 0.5 + 2 \log K_D$
$0.6 < I_D < 3$	$R_M = R_{M,D} + (2.5 - R_{M,D})\log K_D$
	$R_{M,D} = 0.14 + 0.15(I_D - 0.6)$
$K_D > 10$	$R_M = 0.32 + 2.18 \log K_D$
$R_M < 0.85$	$R_M = 0.85$

M (2)	$M = q_c\cdot 10^{(1.09-0.0075D}R^{)}$ *sands*	1
M (3)	$M = 8.25\ (q_t - \sigma_{vo})$ *clays*	1
M (4)	$M = \alpha \cdot G_{max}$ *where* $0.02 < \alpha < 2$ and G_{max} *is from* Vs	33

Rigidity Index

$I_R = exp\left[\left(\frac{1.5}{M} + 2.925\right)\cdot\left(\frac{q_t-\sigma_{vo}}{q_t-u_2}\right) - 2.925\right]$ where $M = 6\sin\emptyset'/(3-\sin\emptyset')$ 39

Sensitivity

S_t (1)	$S_t = 7.5/R_f$	2
S_t (2)	$S_t = (q_t - \sigma_{vo})/(15\cdot f_s)$	2

Fines Content

$FC = [(3.58-\log(q_t))^2+(1.43+\log(R_f))^2]^{1.8}$ 4

$FC = [5.31(I_{cfs})^{2.31}]+9.61$, where $I_{cfs} = [(1.95-\text{Log}Q_t)^2+(\log F_r+1.78)^2]^{0.5}$

Shear Wave Velocity

$V_s(1) = 277 \cdot q_t^{0.13} \cdot {\sigma'_{vo}}^{0.27}$ (sands) - m/s and MPa 29

$V_s(2) = 1.75 \cdot q_t^{0.627}$ (clays) - m/s and kPa 30

$V_s(3) = (10.1 \cdot \log q_t - 11.4)^{1.67} \cdot (\frac{f_s}{q_t} \cdot 100)^{0.3}$ (all soils) – m/s and kPa 31

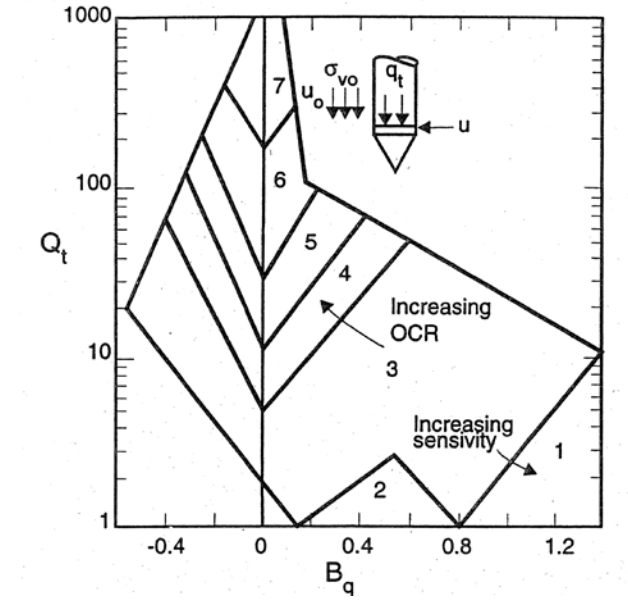
$V_s(4) = 118.8 \cdot \log f_s + 18.5$ (all soils) – m/s and kPa 32

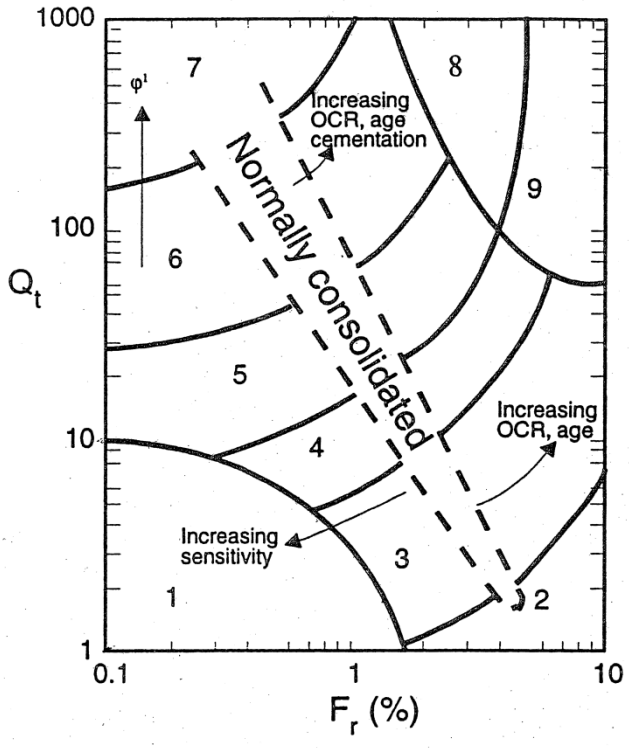
$G_{max} = \rho V_s^2$

Hydraulic Conductivity

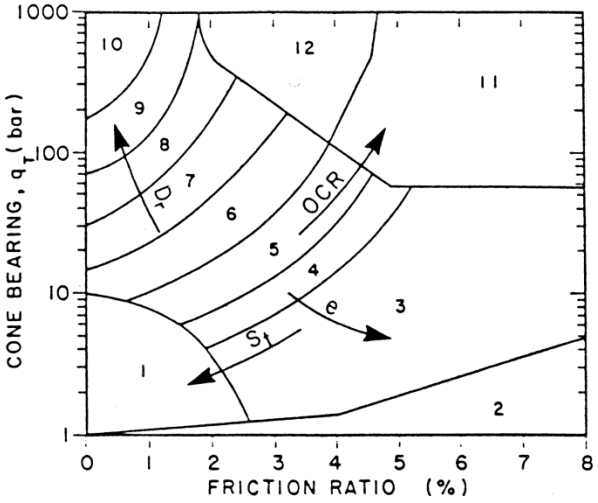
Lookup based on SBT and SBTn (1986 and 1990) 40

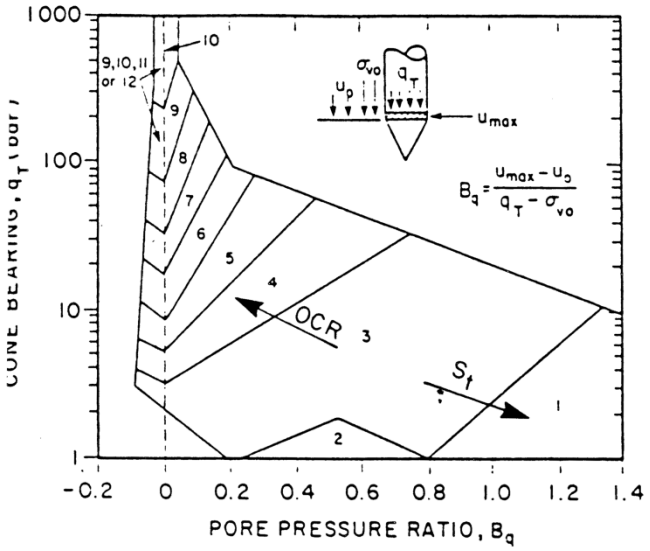
Normalized Soil Behavior Types - Robertson & Campanella (1990)





Non-Normalized Soil Behavior Types – Robertson & Campanella (1986)





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APPENDIX V

Summary of Laboratory Results
Index Properties versus Depth
Atterberg Limits Results
Laboratory Test Data Sheets

- Water Content
- Atterberg Limits
- Wash No. 200
- Organic Content Test

SUMMARY OF LABORATORY RESULTS

PROJECT ID P030487 **PROJECT NAME** SC 277 North Bound Bridge over I-77

PROJECT COUNTY Richland County

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
STB-01	1.5	46	20	26	0.075	64	CL	15.3			
STB-01	4.5	37	17	20	0.075	59	CL	14.2			
STB-01	13.5	21	16	5	0.075	12		20.2			
STB-01	23.5	56	25	31	0.075	17	SC	23.5			
STB-01	43.5	23	13	10	0.075	26	SC	13.6			
STB-01	63.5	27	21	6	0.075	70	CL-ML	25.6			
STB-02	1.5	22	12	10	0.075	27	SC	9.2			
STB-02	8.5	33	26	7	0.075	19	SM	16.3			
STB-02	23.5	25	15	10	0.075	16	SC	21.6			
STB-02	33.5	33	14	19	0.075	14	SC	20.9			
STB-02	53.5	30	23	7	0.075	84	ML	28.1			
STB-03	1.5	31	14	17	0.075	32	SC	10.4			
STB-03	8.5	32	24	8	0.075	34	SM	44.8			
STB-03	18.5	22	18	4	0.075	18	SC-SM	18.9			
STB-03	48.5	25	21	4	0.075	55	CL-ML	25.3			
STB-03	78.5	27	22	5	0.075	49	SM	23.2			

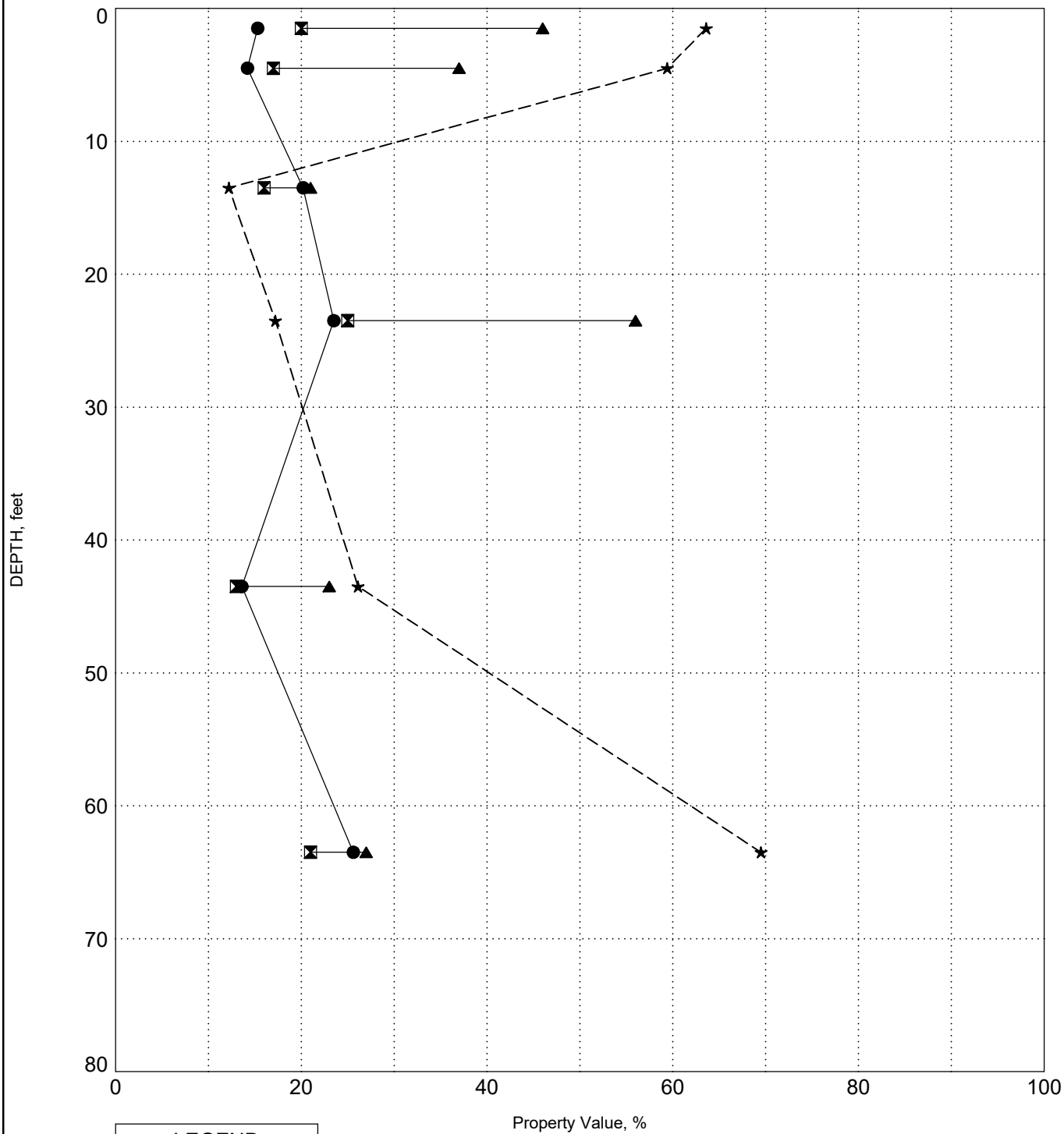
INDEX PROPERTIES VERSUS DEPTH

PROJECT ID P030487 **PROJECT NAME** SC 277 North Bound Bridge over I-77

PROJECT COUNTY Richland County

BORING STB-01

SURFACE ELEVATION: 277.2



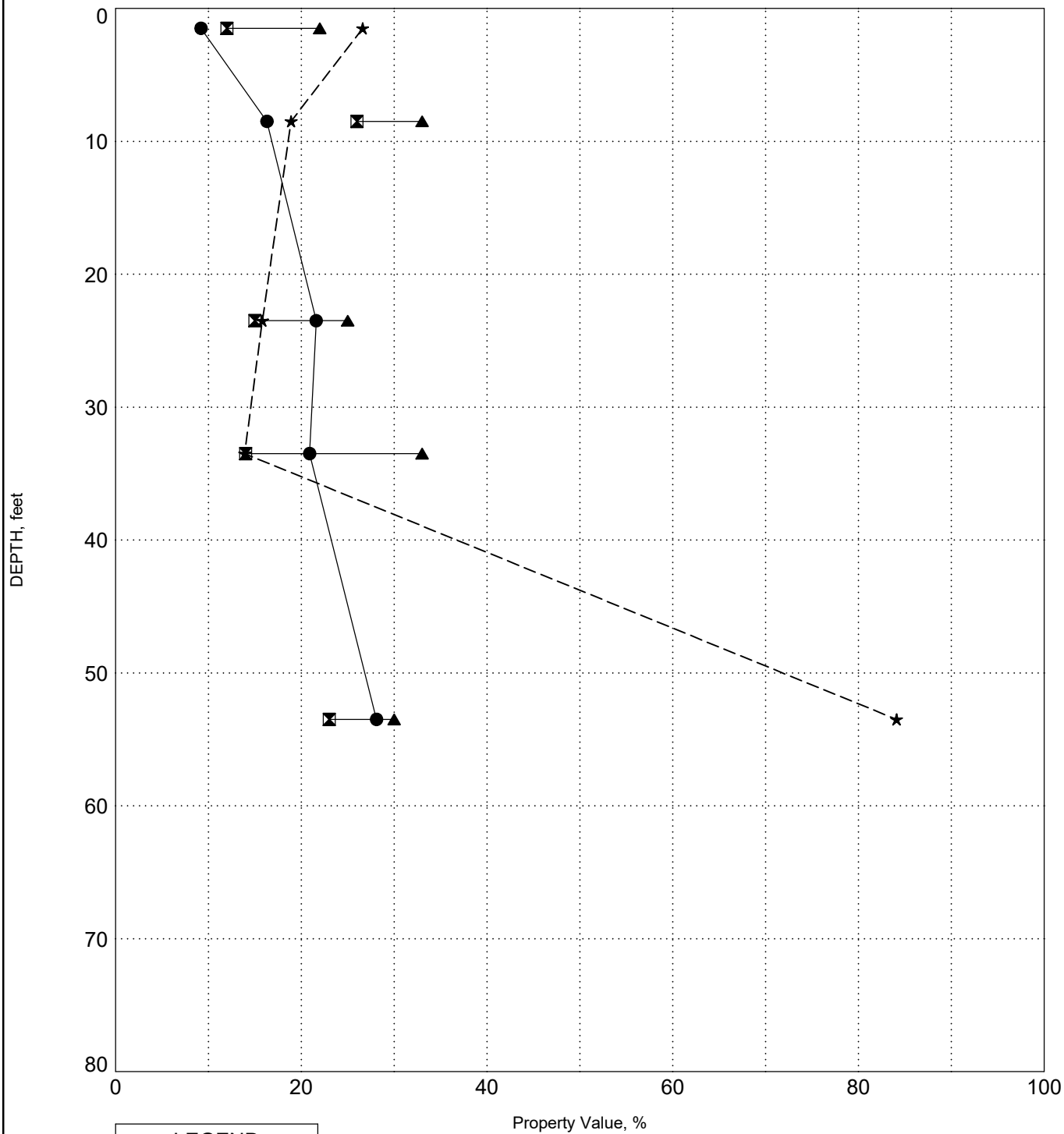
INDEX PROPERTIES VERSUS DEPTH

PROJECT ID P030487 **PROJECT NAME** SC 277 North Bound Bridge over I-77

PROJECT COUNTY Richland County

BORING STB-02

SURFACE ELEVATION: 278.2



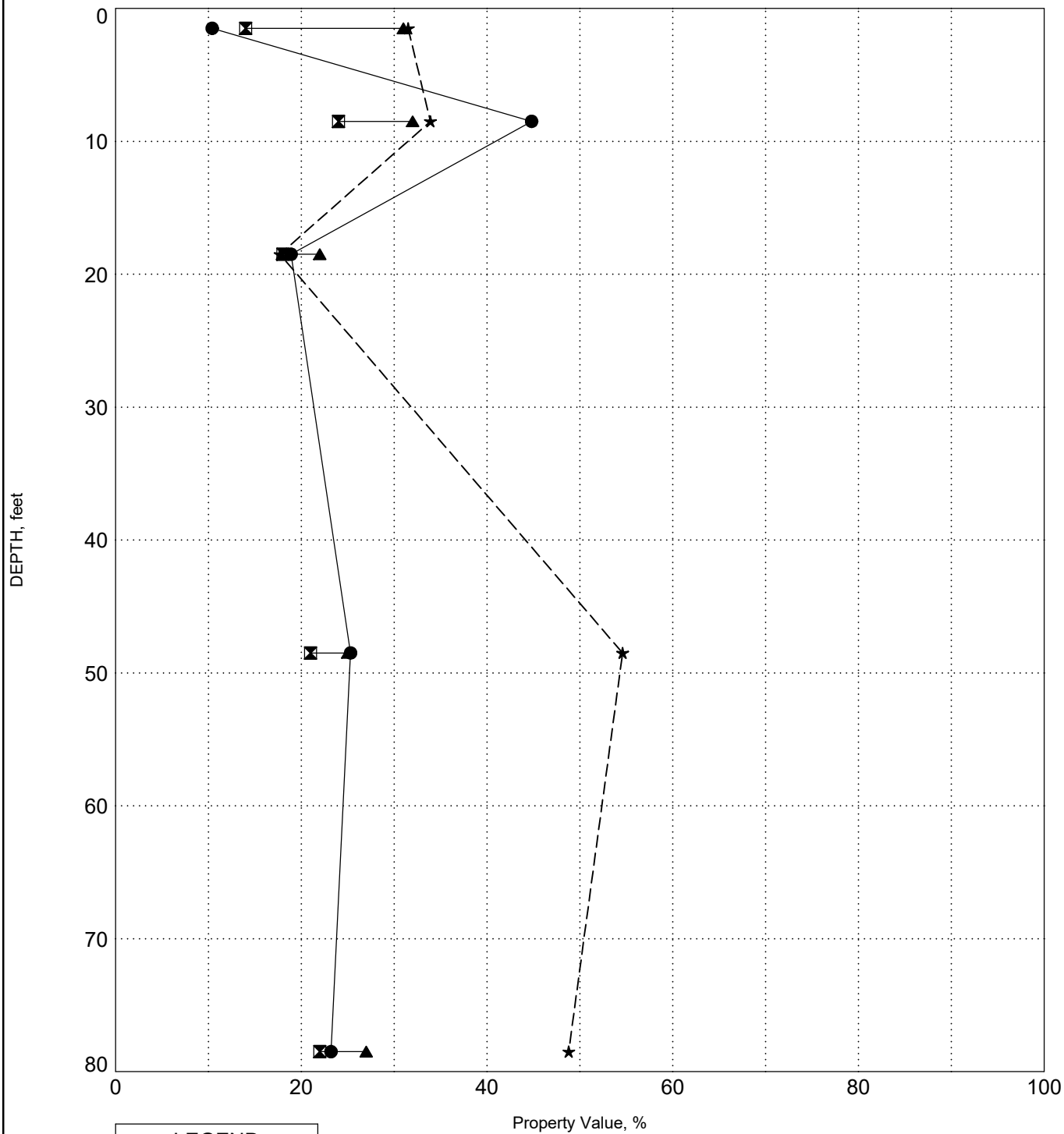
INDEX PROPERTIES VERSUS DEPTH

PROJECT ID P030487 **PROJECT NAME** SC 277 North Bound Bridge over I-77

PROJECT COUNTY Richland County

BORING STB-03

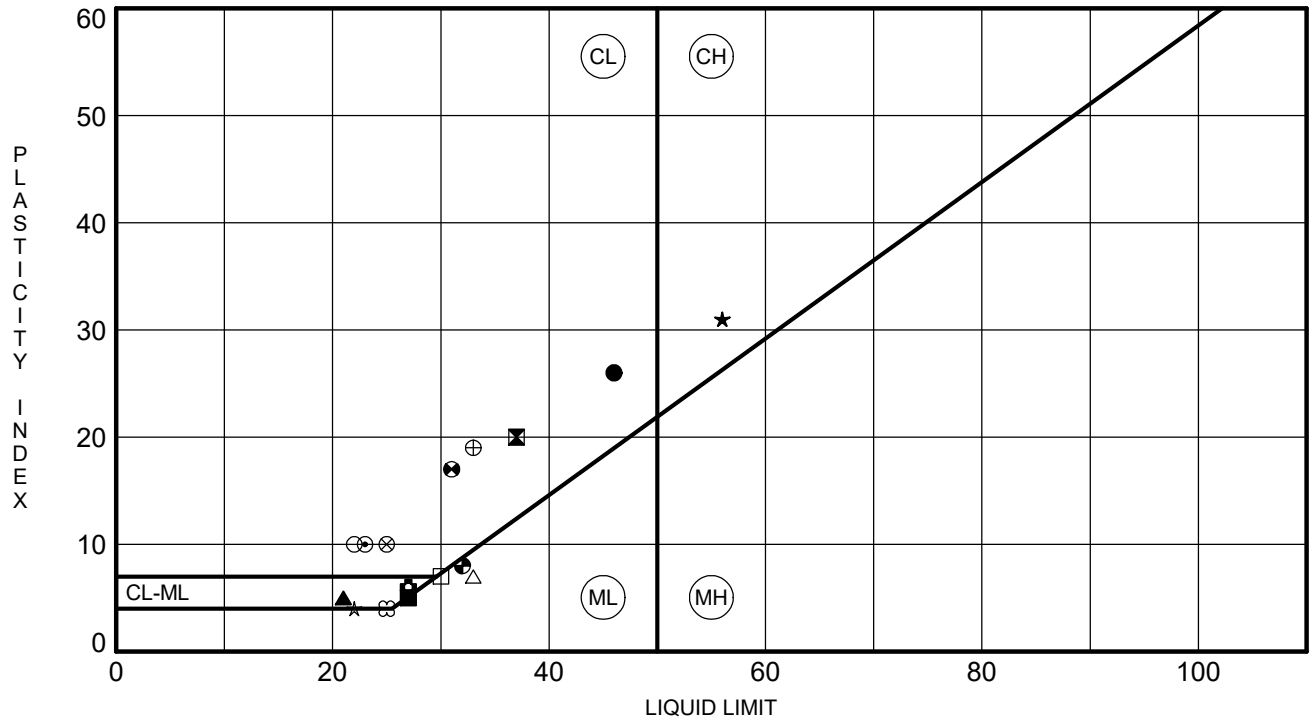
SURFACE ELEVATION: 276.2



ATTERBERG LIMITS' RESULTS

PROJECT ID P030487 **PROJECT NAME** SC 277 North Bound Bridge over I-77

PROJECT COUNTY Richland County



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	STB-01	1.5	46	20	26	64	SANDY LEAN CLAY(CL)
⊠	STB-01	4.5	37	17	20	59	SANDY LEAN CLAY(CL)
▲	STB-01	13.5	21	16	5	12	SC-SM
★	STB-01	23.5	56	25	31	17	CLAYEY SAND(SC)
⊙	STB-01	43.5	23	13	10	26	CLAYEY SAND(SC)
✿	STB-01	63.5	27	21	6	70	SANDY SILTY CLAY(CL-ML)
○	STB-02	1.5	22	12	10	27	CLAYEY SAND(SC)
△	STB-02	8.5	33	26	7	19	SILTY SAND(SM)
⊗	STB-02	23.5	25	15	10	16	CLAYEY SAND(SC)
⊕	STB-02	33.5	33	14	19	14	CLAYEY SAND(SC)
□	STB-02	53.5	30	23	7	84	SILT with SAND(ML)
⊛	STB-03	1.5	31	14	17	32	SC
◕	STB-03	8.5	32	24	8	34	SILTY SAND(SM)
☆	STB-03	18.5	22	18	4	18	SILTY, CLAYEY SAND(SC-SM)
⊠	STB-03	48.5	25	21	4	55	SANDY SILTY CLAY(CL-ML)
■	STB-03	78.5	27	22	5	49	SILTY SAND(SM)

December 19, 2017

Project No. R-2017-884-001

Mr. Ben Azumah
Froehling & Robertson, Inc.
18 Woods Lake Rd.
Greenville, SC 29607

bazumah@fandr.com

Transmittal
Laboratory Test Results
P030487 – SC 277 NB Over I-77

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens which were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
Geotechnics, Inc.

Michael P. Smith
Regional Manager

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

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MOISTURE CONTENT

ASTM D 2216-10

Client: Froehling & Robertson, Inc.
Client Reference: P030487 - SC 277 NB OVER I-77
Project No.: R-2017-884-001

Lab ID:	001	002	003	004	005
Boring No.:	STB-01	STB-01	STB-01	STB-01	STB-01
Depth (ft):	1.5-3	4.5-6	13.5-15	23.5-25	43.5-45
Sample No.:	SS-2	SS-4	SS-6	SS-8	SS-12
Tare Number	1545	1482	1537	1519	1461
Wt. of Tare & Wet Sample (g)	378.96	369.23	386.21	407.75	401.47
Wt. of Tare & Dry Sample (g)	342.69	348.08	380.10	401.18	390.94
Weight of Tare (g)	147.50	147.69	143.97	147.67	146.15
Weight of Water (g)	36.27	21.15	6.11	6.57	10.53
Weight of Dry Sample (g)	195.19	200.39	236.13	253.51	244.79
Water Content (%)	**18.6**	**10.6**	**2.6**	**2.6**	**4.3**

Lab ID	006	007	008	009	010
Boring No.	STB-01	STB-02	STB-02	STB-02	STB-02
Depth (ft)	63.5-65	1.5-3	8.5-10	23.5-25	33.5-35
Sample No.	SS-16	SS-2	SS-5	SS-8	SS-10
Tare Number	1416	1439	27	31	26
Wt. of Tare & Wet Sample (g)	377.30	311.88	482.13	467.12	474.30
Wt. of Tare & Dry Sample (g)	353.02	303.82	470.23	459.78	472.37
Weight of Tare (g)	145.65	144.73	204.30	203.17	200.61
Weight of Water (g)	24.28	8.06	11.90	7.34	1.93
Weight of Dry Sample (g)	207.37	159.09	265.93	256.61	271.76
Water Content (%)	**11.7**	**5.1**	**4.5**	**2.9**	**0.7**

Notes :

Tested By *RT* *Date* *12/19/17* *Checked By* *NM* *Date* *12/19/17*

DCN: CT-S1 DATE: 3/18/13 REVISION: 4

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MOISTURE CONTENT

ASTM D 2216-10

Client: Froehling & Robertson, Inc.
Client Reference: P030487 - SC 277 NB OVER I-77
Project No.: R-2017-884-001

Lab ID:	011	012	013	014	015
Boring No.:	STB-02	STB-03	STB-03	STB-03	STB-03
Depth (ft):	53.5-55	1.5-3	8.5-10	18.5-20	48.5-50
Sample No.:	SS-15	SS-2	SS-5	SS-7	SS-13
Tare Number	29	Z10	48	585	1562
Wt. of Tare & Wet Sample (g)	391.09	393.45	352.68	567.13	513.68
Wt. of Tare & Dry Sample (g)	368.43	381.13	336.41	549.69	492.46
Weight of Tare (g)	204.37	201.99	202.78	308.83	310.69
Weight of Water (g)	22.66	12.32	16.27	17.44	21.22
Weight of Dry Sample (g)	164.06	179.14	133.63	240.86	181.77
Water Content (%)	**13.8**	**6.9**	**12.2**	**7.2**	**11.7**

Lab ID	016
Boring No.	STB-03
Depth (ft)	78.5-80
Sample No.	SS-19
Tare Number	1560
Wt. of Tare & Wet Sample (g)	524.62
Wt. of Tare & Dry Sample (g)	500.47
Weight of Tare (g)	305.39
Weight of Water (g)	24.15
Weight of Dry Sample (g)	195.08
Water Content (%)	**12.4**

Notes :

Tested By *RT* *Date* *12/15/17* *Checked By* *NM* *Date* *12/19/17*

DCN: CT-S1 DATE: 3/18/13 REVISION: 4

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-01
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	1.5-3
Project No.:	R-2017-884-001	Sample No.:	SS-2
Lab ID:	R-2017-884-001-001	Soil Description:	LIGHT TAN LEAN CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
***sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.**

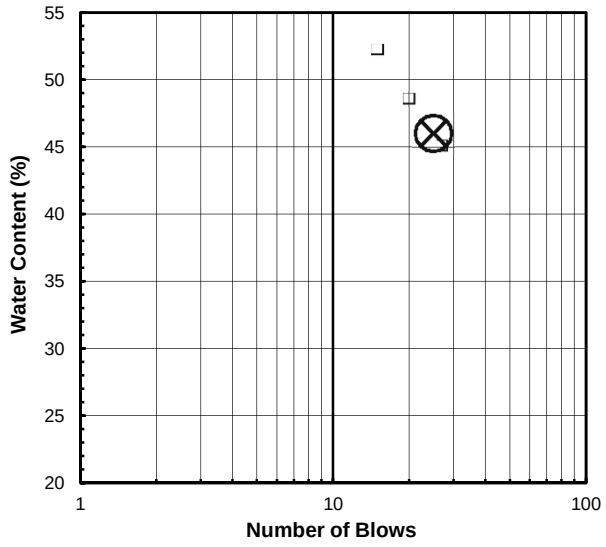
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1545	36	30	35	U
Wt. of Tare & Wet Sample (g):	384.93	39.66	40.33	39.74	L
Wt. of Tare & Dry Sample (g):	353.49	33.15	33.68	32.49	T
Weight of Tare (g):	147.50	18.71	19.99	18.61	I
Weight of Water (g):	31.4	6.5	6.7	7.3	P
Weight of Dry Sample (g):	206.0	14.4	13.7	13.9	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**15.3**	**45.1**	**48.6**	**52.2**	N
Number of Blows:		**27**	**20**	**15**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	48	4	
Wt. of Tare & Wet Sample (g):	25.38	24.35	
Wt. of Tare & Dry Sample (g):	24.32	23.28	
Weight of Tare (g):	19.04	17.86	
Weight of Water (g):	1.1	1.1	
Weight of Dry Sample (g):	5.3	5.4	
Moisture Content (%):	**20.1**	**19.7**	**0.3**

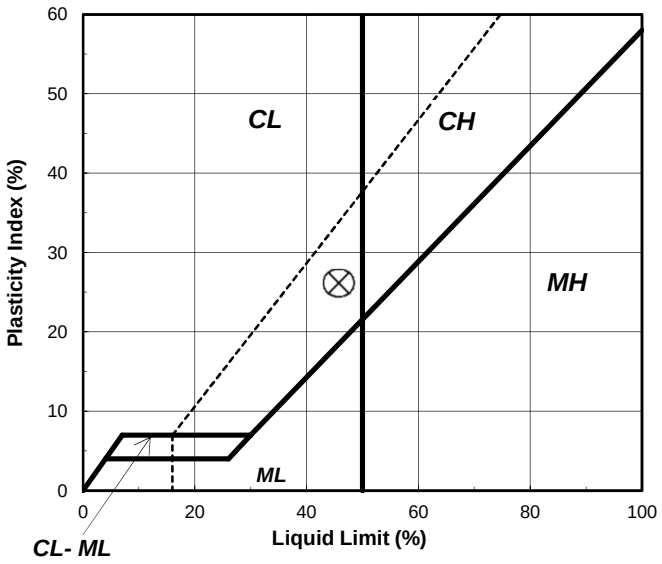
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**46**
Plastic Limit (%):	**20**
Plasticity Index (%):	**26**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By PF *Date* 12/12/17 *Checked By* NC *Date* 12/13/17

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-01
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	4.5-6
Project No.:	R-2017-884-001	Sample No.:	SS-4
Lab ID:	R-2017-884-001-002	Soil Description:	LIGHT TAN LEAN CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
***sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.**

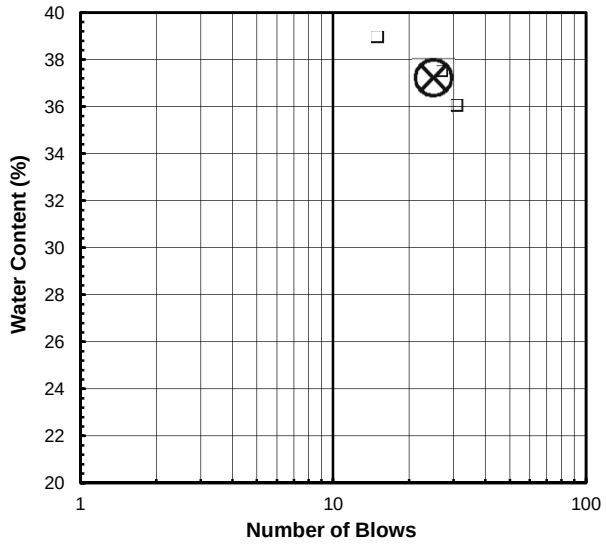
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1482	27	26	14	U
Wt. of Tare & Wet Sample (g):	383.21	39.97	39.87	39.61	L
Wt. of Tare & Dry Sample (g):	353.97	34.46	34.36	33.71	T
Weight of Tare (g):	147.69	19.16	19.65	18.56	I
Weight of Water (g):	29.2	5.5	5.5	5.9	P
Weight of Dry Sample (g):	206.3	15.3	14.7	15.2	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**14.2**	**36.0**	**37.5**	**38.9**	N
Number of Blows:		**31**	**27**	**15**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	39	10	
Wt. of Tare & Wet Sample (g):	25.03	24.51	
Wt. of Tare & Dry Sample (g):	24.16	23.59	
Weight of Tare (g):	18.92	18.27	
Weight of Water (g):	0.9	0.9	
Weight of Dry Sample (g):	5.2	5.3	
Moisture Content (%):	**16.6**	**17.3**	**-0.7**

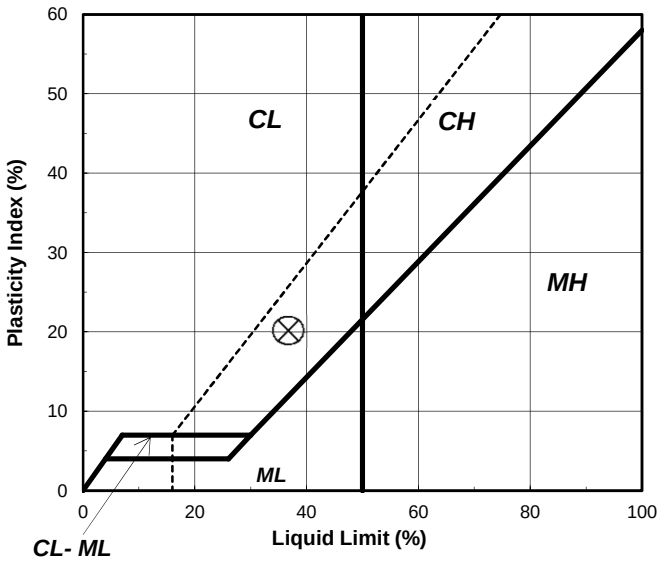
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**37**
Plastic Limit (%):	**17**
Plasticity Index (%):	**20**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



Tested By PF *Date* 12/13/17 *Checked By* NC *Date* 12/14/17

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-01
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	13.5-15
Project No.:	R-2017-884-001	Sample No.:	SS-6
Lab ID:	R-2017-884-001-003	Soil Description:	LIGHT TAN SILTY CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

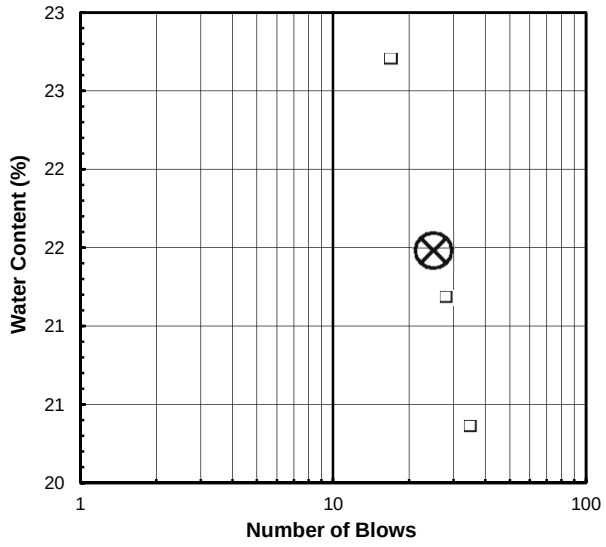
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1537	15	29	32	U
Wt. of Tare & Wet Sample (g):	434.77	34.92	34.12	36.82	L
Wt. of Tare & Dry Sample (g):	385.97	32.28	31.36	33.71	T
Weight of Tare (g):	143.97	19.31	18.33	20.01	I
Weight of Water (g):	48.8	2.6	2.8	3.1	P
Weight of Dry Sample (g):	242.0	13.0	13.0	13.7	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**20.2**	**20.4**	**21.2**	**22.7**	N
Number of Blows:		**35**	**28**	**17**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	5	37	
Wt. of Tare & Wet Sample (g):	24.72	23.93	
Wt. of Tare & Dry Sample (g):	23.86	23.06	
Weight of Tare (g):	18.57	17.71	
Weight of Water (g):	0.9	0.9	
Weight of Dry Sample (g):	5.3	5.4	
Moisture Content (%):	**16.3**	**16.3**	**0.0**

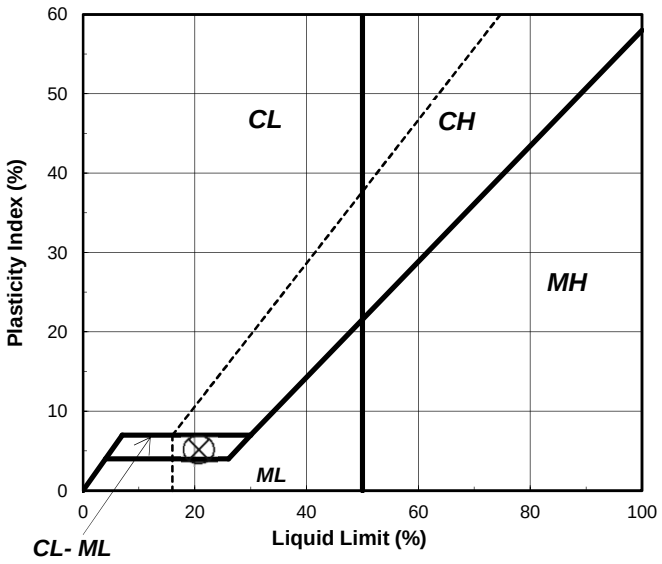
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**21**
Plastic Limit (%):	**16**
Plasticity Index (%):	**5**
USCS Symbol:	**CL-ML**

Flow Curve



Plasticity Chart



Tested By PF *Date* 12/13/17 *Checked By* NC *Date* 12/16/17

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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-01
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	23.5-25
Project No.:	R-2017-884-001	Sample No.:	SS-8
Lab ID:	R-2017-884-001-004	Soil Description:	REDDISH BROWN FAT CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
***sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.**

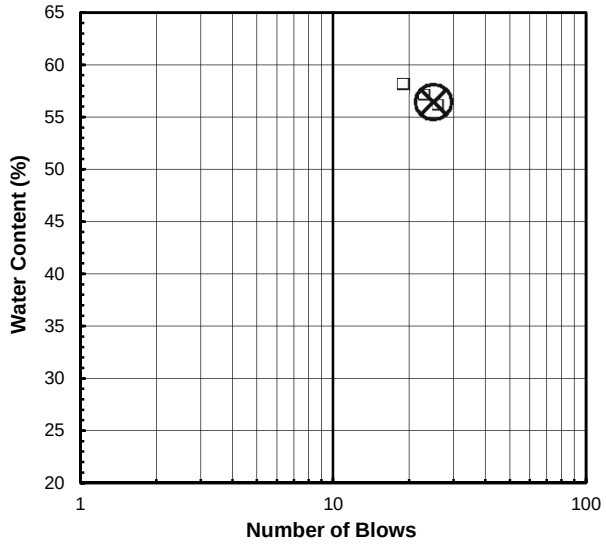
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1519	35	36	17	U
Wt. of Tare & Wet Sample (g):	467.61	34.61	34.35	39.03	L
Wt. of Tare & Dry Sample (g):	406.72	28.86	28.67	31.48	T
Weight of Tare (g):	147.67	18.61	18.71	18.49	I
Weight of Water (g):	60.9	5.8	5.7	7.6	P
Weight of Dry Sample (g):	259.1	10.3	10.0	13.0	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**23.5**	**56.1**	**57.0**	**58.1**	N
Number of Blows:		**26**	**23**	**19**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	48	4	
Wt. of Tare & Wet Sample (g):	25.15	23.93	
Wt. of Tare & Dry Sample (g):	23.94	22.73	
Weight of Tare (g):	19.02	17.85	
Weight of Water (g):	1.2	1.2	
Weight of Dry Sample (g):	4.9	4.9	
Moisture Content (%):	**24.6**	**24.6**	**0.0**

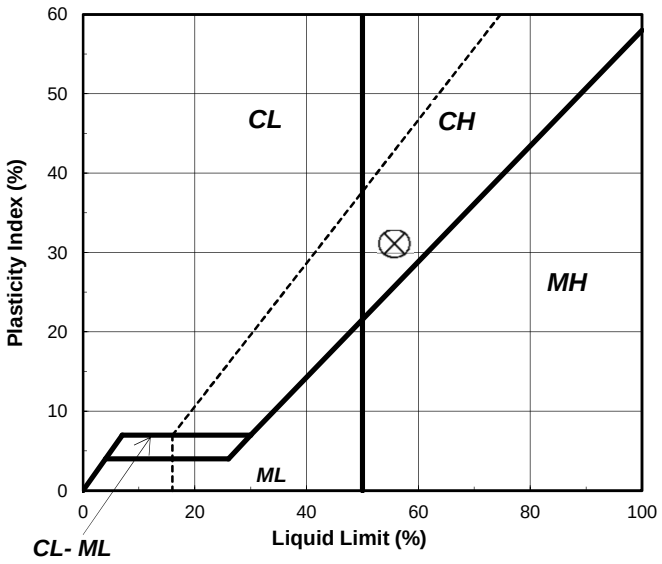
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**56**
Plastic Limit (%):	**25**
Plasticity Index (%):	**31**
USCS Symbol:	**CH**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-01
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	43.5-45
Project No.:	R-2017-884-001	Sample No.:	SS-12
Lab ID:	R-2017-884-001-005	Soil Description:	REDDISH TAN LEAN CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

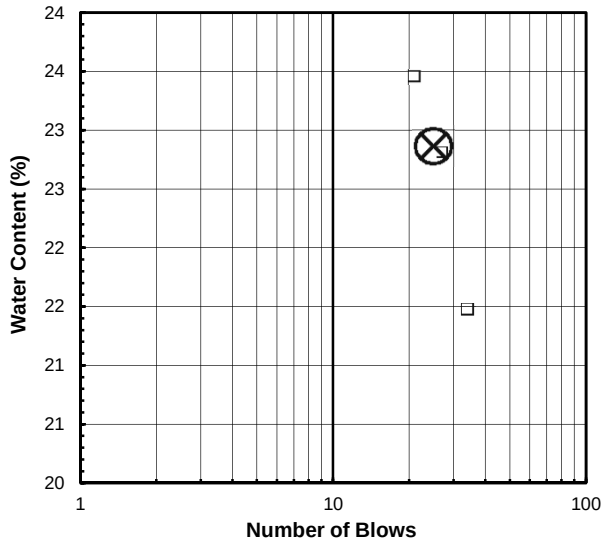
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1461	23	24	16	U
Wt. of Tare & Wet Sample (g):	428.93	39.18	38.99	38.71	L
Wt. of Tare & Dry Sample (g):	395.01	35.62	35.22	34.88	T
Weight of Tare (g):	146.15	19.04	18.69	18.55	I
Weight of Water (g):	33.9	3.6	3.8	3.8	P
Weight of Dry Sample (g):	248.9	16.6	16.5	16.3	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**13.6**	**21.5**	**22.8**	**23.5**	N
Number of Blows:		**34**	**27**	**21**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	43	41	
Wt. of Tare & Wet Sample (g):	25.87	24.27	
Wt. of Tare & Dry Sample (g):	25.09	23.56	
Weight of Tare (g):	18.90	18.15	
Weight of Water (g):	0.8	0.7	
Weight of Dry Sample (g):	6.2	5.4	
Moisture Content (%):	**12.6**	**13.1**	**-0.5**

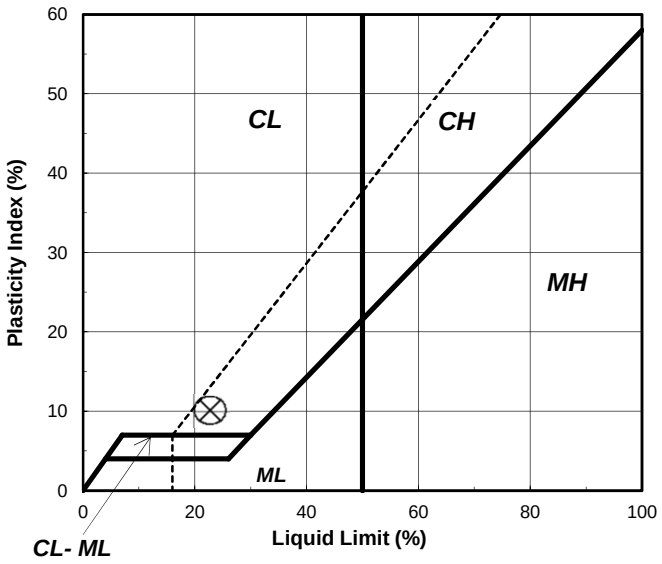
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**23**
Plastic Limit (%):	**13**
Plasticity Index (%):	**10**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-01
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	63.5-65
Project No.:	R-2017-884-001	Sample No.:	SS-16
Lab ID:	R-2017-884-001-006	Soil Description:	WHITISH TAN SILTY CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

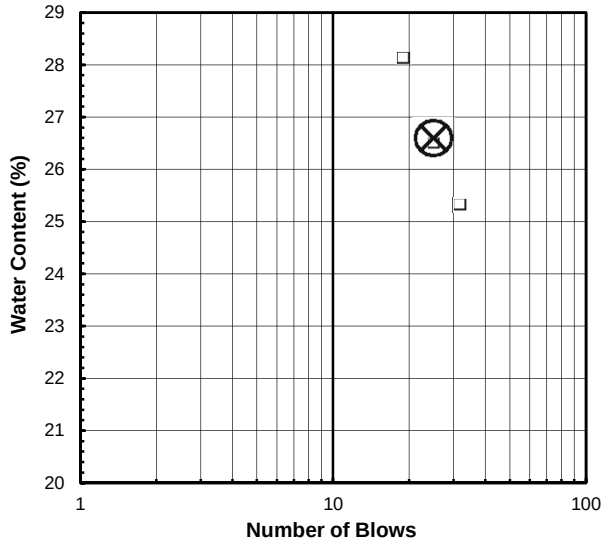
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1416	21	22	36	U
Wt. of Tare & Wet Sample (g):	413.62	40.57	39.50	38.74	L
Wt. of Tare & Dry Sample (g):	359.08	36.29	35.25	34.34	T
Weight of Tare (g):	145.65	19.38	19.21	18.69	I
Weight of Water (g):	54.5	4.3	4.3	4.4	P
Weight of Dry Sample (g):	213.4	16.9	16.0	15.7	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**25.6**	**25.3**	**26.5**	**28.1**	N
Number of Blows:		**32**	**25**	**19**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	44	7	
Wt. of Tare & Wet Sample (g):	24.63	25.33	
Wt. of Tare & Dry Sample (g):	23.53	24.22	
Weight of Tare (g):	18.19	18.94	
Weight of Water (g):	1.1	1.1	
Weight of Dry Sample (g):	5.3	5.3	
Moisture Content (%):	**20.6**	**21.0**	**-0.4**

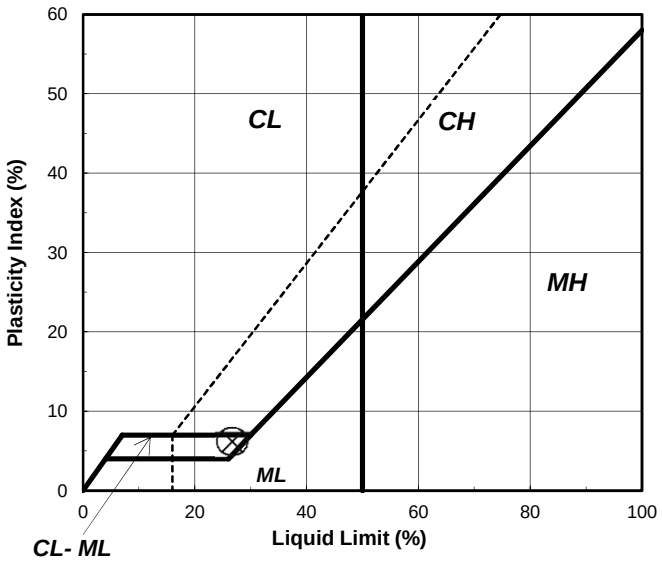
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**27**
Plastic Limit (%):	**21**
Plasticity Index (%):	**6**
USCS Symbol:	**CL-ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-02
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	1.5-3
Project No.:	R-2017-884-001	Sample No.:	SS-2
Lab ID:	R-2017-884-001-007	Soil Description:	LIGHT BROWN LEAN CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

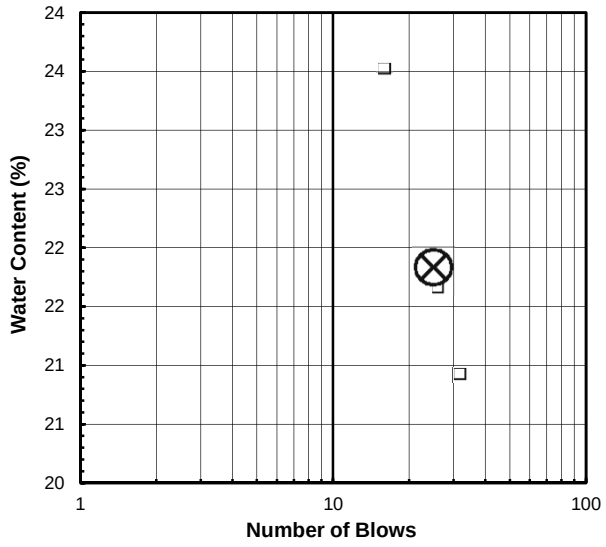
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1439	30	20	34	U
Wt. of Tare & Wet Sample (g):	323.57	35.25	33.23	39.25	L
Wt. of Tare & Dry Sample (g):	308.46	32.61	30.56	35.24	T
Weight of Tare (g):	144.73	19.99	18.23	18.19	I
Weight of Water (g):	15.1	2.6	2.7	4.0	P
Weight of Dry Sample (g):	163.7	12.6	12.3	17.1	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**9.2**	**20.9**	**21.7**	**23.5**	N
Number of Blows:		**32**	**26**	**16**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	42	38	
Wt. of Tare & Wet Sample (g):	24.12	23.30	
Wt. of Tare & Dry Sample (g):	23.47	22.65	
Weight of Tare (g):	18.12	17.25	
Weight of Water (g):	0.7	0.7	
Weight of Dry Sample (g):	5.4	5.4	
Moisture Content (%):	**12.1**	**12.0**	**0.1**

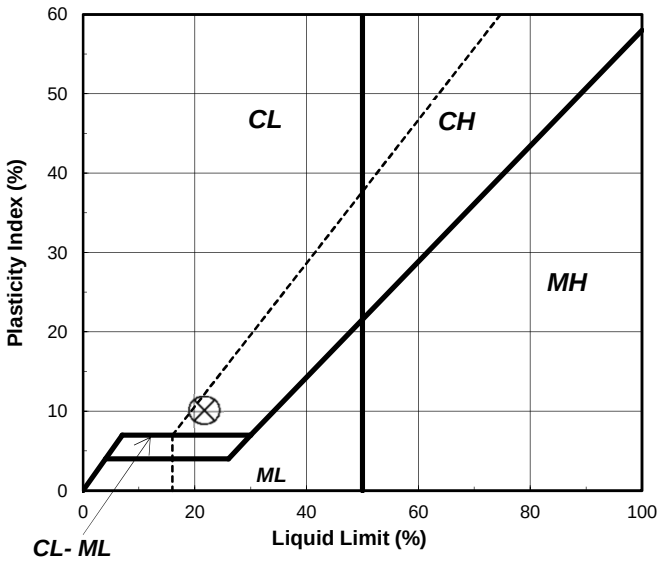
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**22**
Plastic Limit (%):	**12**
Plasticity Index (%):	**10**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-02
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	8.5-10
Project No.:	R-2017-884-001	Sample No.:	SS-5
Lab ID:	R-2017-884-001-008	Soil Description:	LIGHT TAN SILT

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

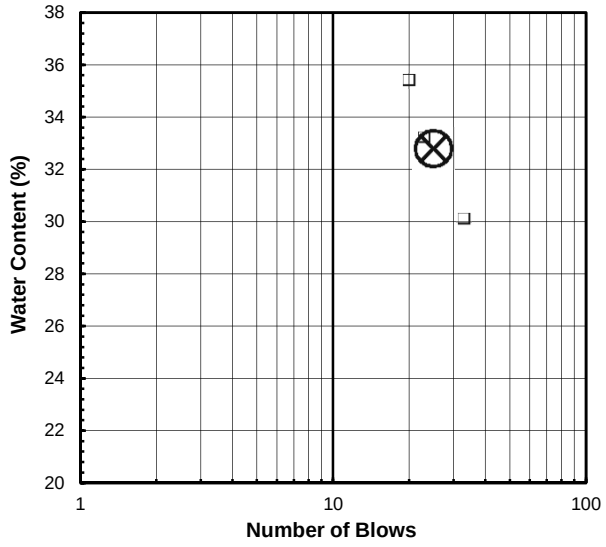
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	27	28	13	31	U
Wt. of Tare & Wet Sample (g):	517.29	34.44	34.46	39.05	L
Wt. of Tare & Dry Sample (g):	473.47	30.96	30.69	33.62	T
Weight of Tare (g):	204.30	19.39	19.33	18.27	I
Weight of Water (g):	43.8	3.5	3.8	5.4	P
Weight of Dry Sample (g):	269.2	11.6	11.4	15.4	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**16.3**	**30.1**	**33.2**	**35.4**	N
Number of Blows:		**33**	**23**	**20**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	3	8	
Wt. of Tare & Wet Sample (g):	25.35	25.07	
Wt. of Tare & Dry Sample (g):	23.99	23.69	
Weight of Tare (g):	18.70	18.42	
Weight of Water (g):	1.4	1.4	
Weight of Dry Sample (g):	5.3	5.3	
Moisture Content (%):	**25.7**	**26.2**	**-0.5**

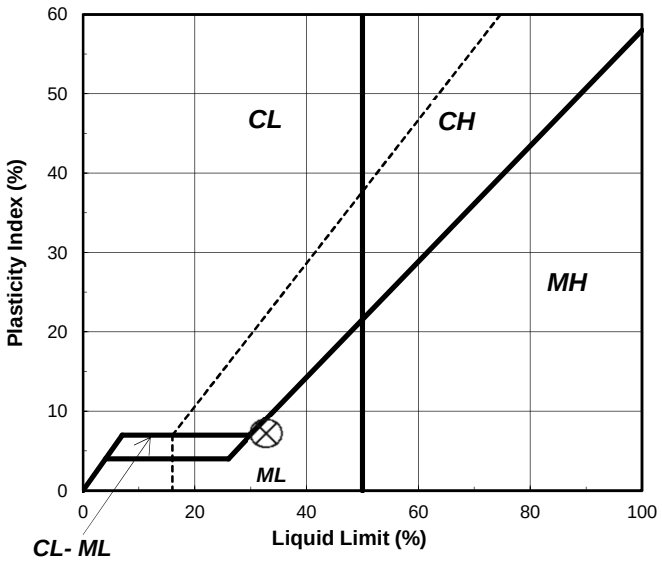
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**33**
Plastic Limit (%):	**26**
Plasticity Index (%):	**7**
USCS Symbol:	**ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-02
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	23.5-25
Project No.:	R-2017-884-001	Sample No.:	SS-8
Lab ID:	R-2017-884-001-009	Soil Description:	PINK LEAN CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

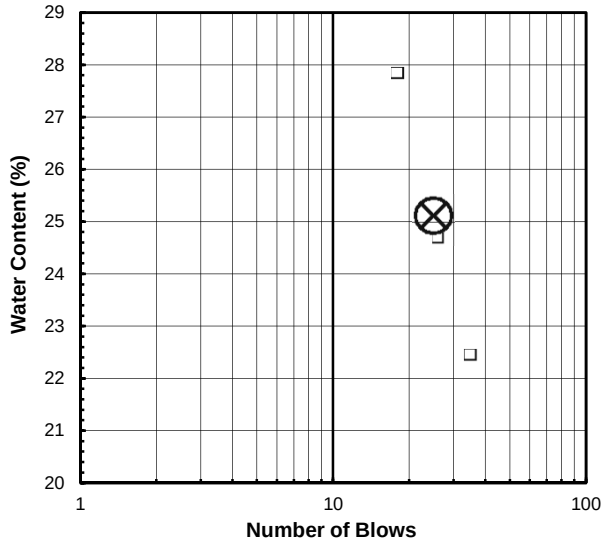
As Received Moisture Content		Liquid Limit Test			
ASTM D2216-10		1	2	3	M
Tare Number:	31	17	22	33	U
Wt. of Tare & Wet Sample (g):	519.46	33.82	34.44	33.97	L
Wt. of Tare & Dry Sample (g):	463.26	31.01	31.43	30.57	T
Weight of Tare (g):	203.17	18.49	19.24	18.35	I
Weight of Water (g):	56.2	2.8	3.0	3.4	P
Weight of Dry Sample (g):	260.1	12.5	12.2	12.2	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**21.6**	**22.4**	**24.7**	**27.8**	N
Number of Blows:		**35**	**26**	**18**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	7	11	
Wt. of Tare & Wet Sample (g):	25.55	24.47	
Wt. of Tare & Dry Sample (g):	24.70	23.70	
Weight of Tare (g):	18.94	18.44	
Weight of Water (g):	0.9	0.8	
Weight of Dry Sample (g):	5.8	5.3	
Moisture Content (%):	**14.8**	**14.6**	**0.1**

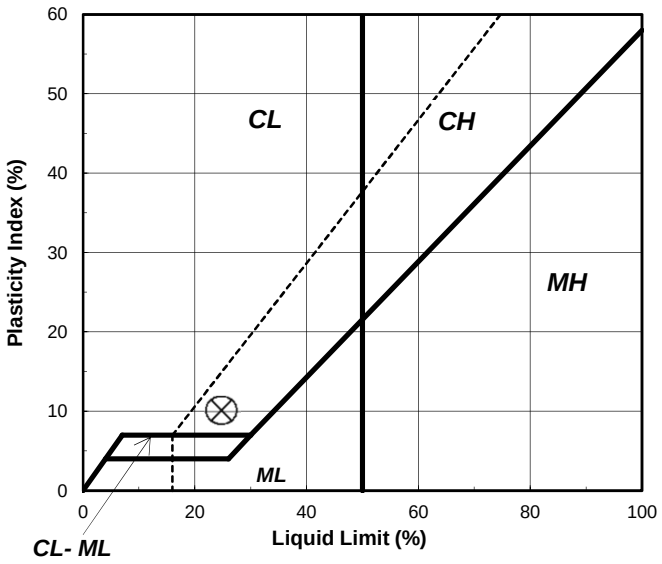
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**25**
Plastic Limit (%):	**15**
Plasticity Index (%):	**10**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-02
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	33.5-35
Project No.:	R-2017-884-001	Sample No.:	SS-10
Lab ID:	R-2017-884-001-010	Soil Description:	WHITISH TAN LEAN CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
***sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.**

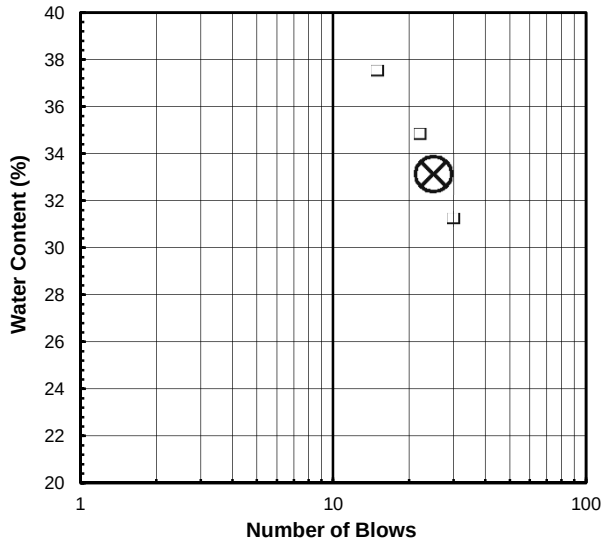
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	26	36	19	29	U
Wt. of Tare & Wet Sample (g):	533.91	33.76	33.67	33.43	L
Wt. of Tare & Dry Sample (g):	476.22	30.18	29.75	29.31	T
Weight of Tare (g):	200.61	18.71	18.48	18.32	I
Weight of Water (g):	57.7	3.6	3.9	4.1	P
Weight of Dry Sample (g):	275.6	11.5	11.3	11.0	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**20.9**	**31.2**	**34.8**	**37.5**	N
Number of Blows:		**30**	**22**	**15**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	38	43	
Wt. of Tare & Wet Sample (g):	21.39	23.23	
Wt. of Tare & Dry Sample (g):	20.87	22.69	
Weight of Tare (g):	17.25	18.89	
Weight of Water (g):	0.5	0.5	
Weight of Dry Sample (g):	3.6	3.8	
Moisture Content (%):	**14.4**	**14.2**	**0.2**

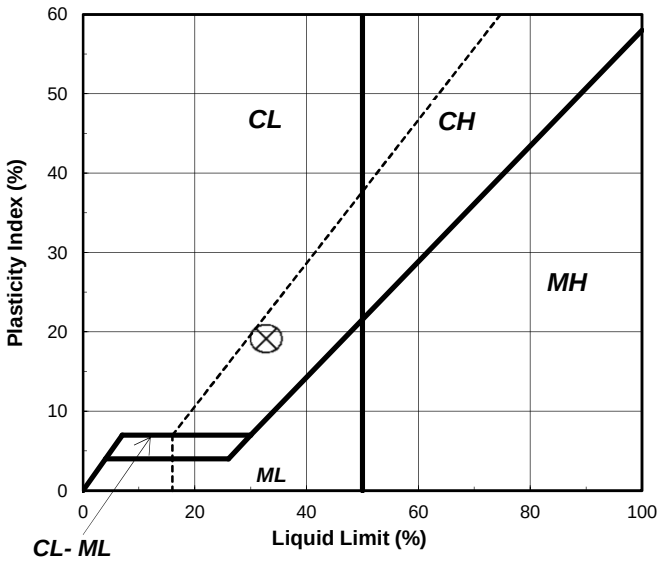
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**33**
Plastic Limit (%):	**14**
Plasticity Index (%):	**19**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-02
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	53.5-55
Project No.:	R-2017-884-001	Sample No.:	SS-15
Lab ID:	R-2017-884-001-011	Soil Description:	WHITISH TAN SILT

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

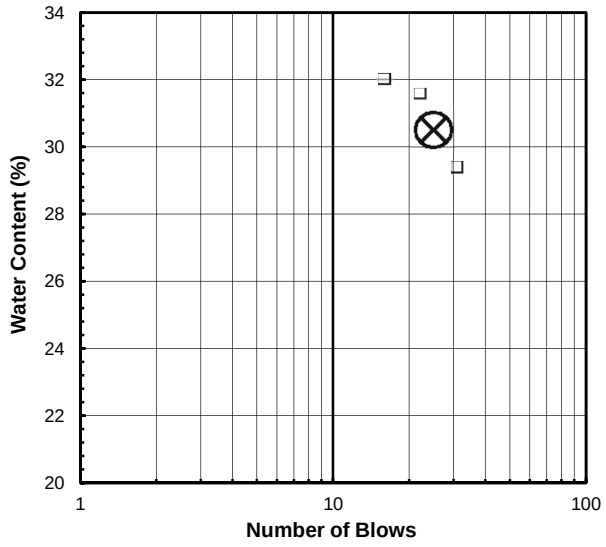
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	29	16	20	13	U
Wt. of Tare & Wet Sample (g):	418.91	38.82	39.03	41.63	L
Wt. of Tare & Dry Sample (g):	371.89	34.22	34.04	36.22	T
Weight of Tare (g):	204.37	18.56	18.23	19.31	I
Weight of Water (g):	47.0	4.6	5.0	5.4	P
Weight of Dry Sample (g):	167.5	15.7	15.8	16.9	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**28.1**	**29.4**	**31.6**	**32.0**	N
Number of Blows:		**31**	**22**	**16**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	6	5	
Wt. of Tare & Wet Sample (g):	25.64	25.04	
Wt. of Tare & Dry Sample (g):	24.37	23.84	
Weight of Tare (g):	18.68	18.56	
Weight of Water (g):	1.3	1.2	
Weight of Dry Sample (g):	5.7	5.3	
Moisture Content (%):	**22.3**	**22.7**	**-0.4**

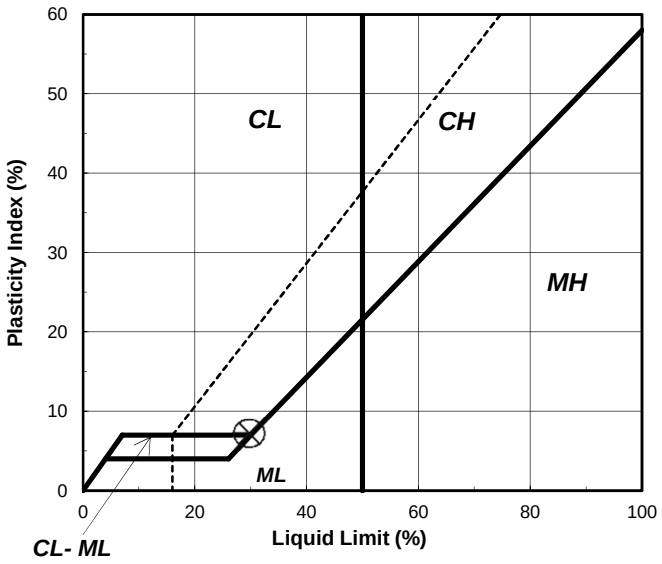
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**30**
Plastic Limit (%):	**23**
Plasticity Index (%):	**7**
USCS Symbol:	**ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-03
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	1.5-3
Project No.:	R-2017-884-001	Sample No.:	SS-2
Lab ID:	R-2017-884-001-012	Soil Description:	PINKISH TAN LEAN CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
***sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.**

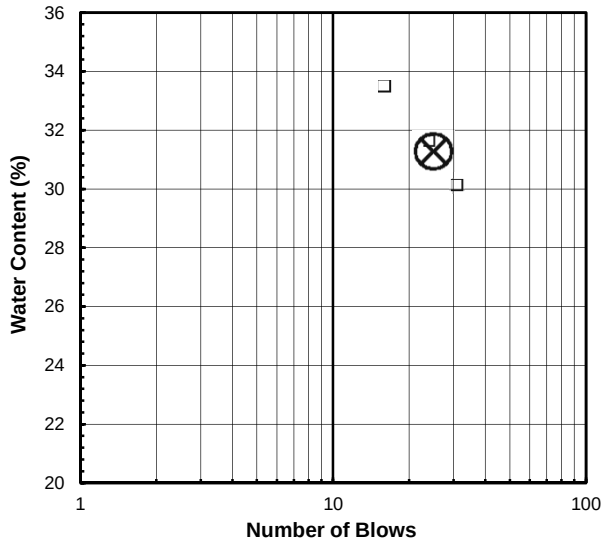
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	Z10	21	27	18	U
Wt. of Tare & Wet Sample (g):	403.67	39.47	40.04	41.01	L
Wt. of Tare & Dry Sample (g):	384.73	34.82	35.03	35.54	T
Weight of Tare (g):	201.99	19.37	19.17	19.20	I
Weight of Water (g):	18.9	4.7	5.0	5.5	P
Weight of Dry Sample (g):	182.7	15.5	15.9	16.3	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**10.4**	**30.1**	**31.6**	**33.5**	N
Number of Blows:		**31**	**24**	**16**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	37	8	
Wt. of Tare & Wet Sample (g):	23.85	24.65	
Wt. of Tare & Dry Sample (g):	23.08	23.86	
Weight of Tare (g):	17.70	18.42	
Weight of Water (g):	0.8	0.8	
Weight of Dry Sample (g):	5.4	5.4	
Moisture Content (%):	**14.3**	**14.5**	**-0.2**

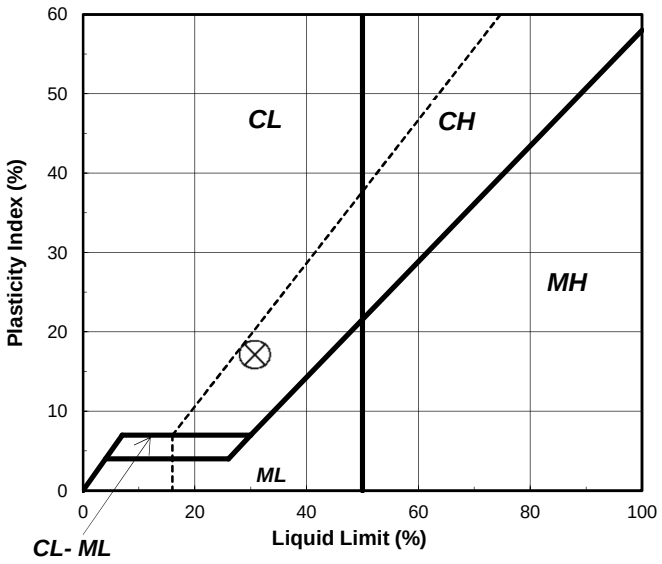
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**31**
Plastic Limit (%):	**14**
Plasticity Index (%):	**17**
USCS Symbol:	**CL**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-03
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	8.5-10
Project No.:	R-2017-884-001	Sample No.:	SS-5
Lab ID:	R-2017-884-001-013	Soil Description:	DARK BROWN SILT

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

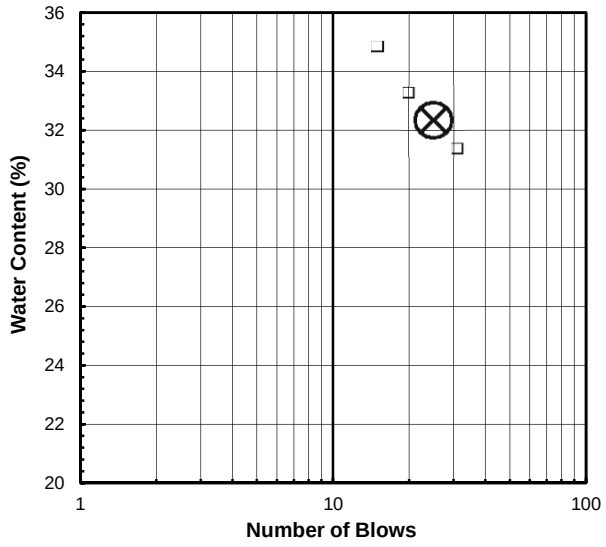
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	48	19	29	33	U
Wt. of Tare & Wet Sample (g):	405.86	38.86	39.64	38.54	L
Wt. of Tare & Dry Sample (g):	342.99	33.99	34.32	33.32	T
Weight of Tare (g):	202.78	18.47	18.31	18.33	I
Weight of Water (g):	62.9	4.9	5.3	5.2	P
Weight of Dry Sample (g):	140.2	15.5	16.0	15.0	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**44.8**	**31.4**	**33.2**	**34.8**	N
Number of Blows:		**31**	**20**	**15**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	9	2	
Wt. of Tare & Wet Sample (g):	25.04	24.56	
Wt. of Tare & Dry Sample (g):	23.81	23.36	
Weight of Tare (g):	18.69	18.42	
Weight of Water (g):	1.2	1.2	
Weight of Dry Sample (g):	5.1	4.9	
Moisture Content (%):	**24.0**	**24.3**	**-0.3**

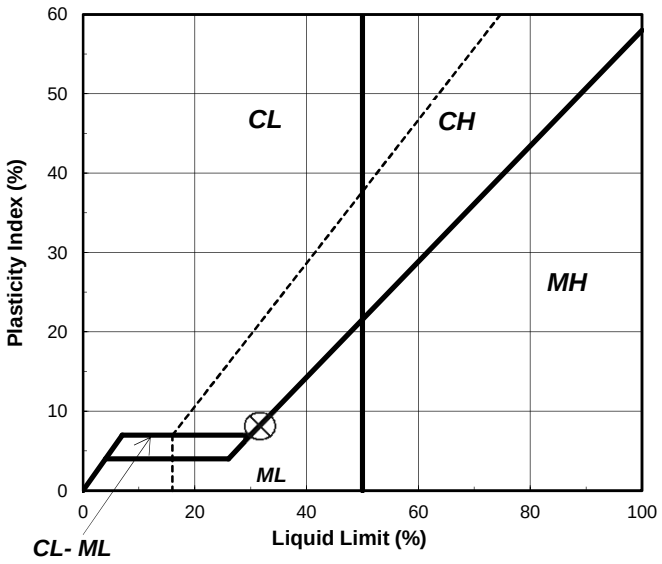
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**32**
Plastic Limit (%):	**24**
Plasticity Index (%):	**8**
USCS Symbol:	**ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-03
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	18.5-20
Project No.:	R-2017-884-001	Sample No.:	SS-7
Lab ID:	R-2017-884-001-014	Soil Description:	PINK SILTY CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

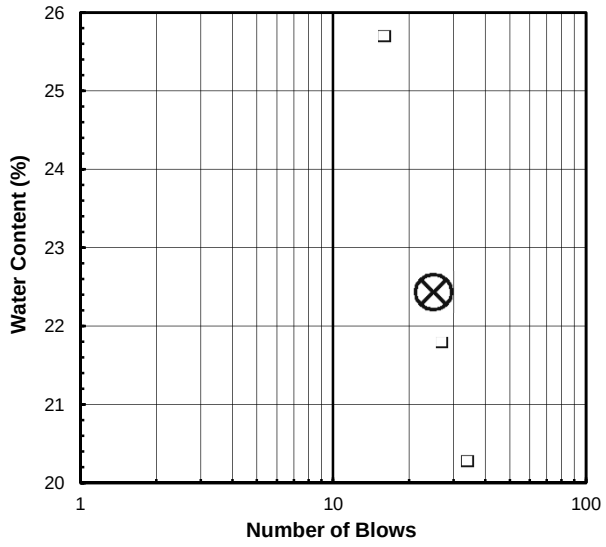
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	585	47	18	21	U
Wt. of Tare & Wet Sample (g):	600.29	33.52	34.14	33.67	L
Wt. of Tare & Dry Sample (g):	553.99	30.99	31.47	30.53	T
Weight of Tare (g):	308.83	18.51	19.21	18.31	I
Weight of Water (g):	46.3	2.5	2.7	3.1	P
Weight of Dry Sample (g):	245.2	12.5	12.3	12.2	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**18.9**	**20.3**	**21.8**	**25.7**	N
Number of Blows:		**34**	**27**	**16**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	44	46	
Wt. of Tare & Wet Sample (g):	24.63	25.03	
Wt. of Tare & Dry Sample (g):	23.67	24.13	
Weight of Tare (g):	18.20	19.03	
Weight of Water (g):	1.0	0.9	
Weight of Dry Sample (g):	5.5	5.1	
Moisture Content (%):	**17.6**	**17.6**	**-0.1**

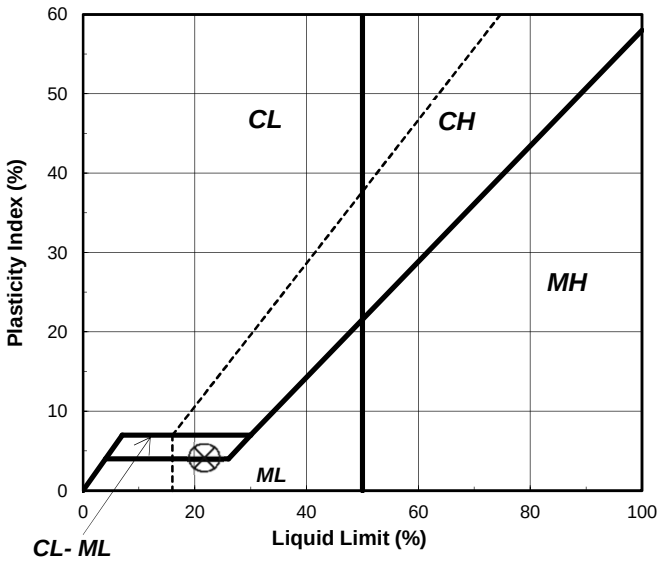
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**22**
Plastic Limit (%):	**18**
Plasticity Index (%):	**4**
USCS Symbol:	**CL-ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-03
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	48.5-50
Project No.:	R-2017-884-001	Sample No.:	SS-13
Lab ID:	R-2017-884-001-015	Soil Description:	WHITISH TAN SILTY CLAY

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
***sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description*.**

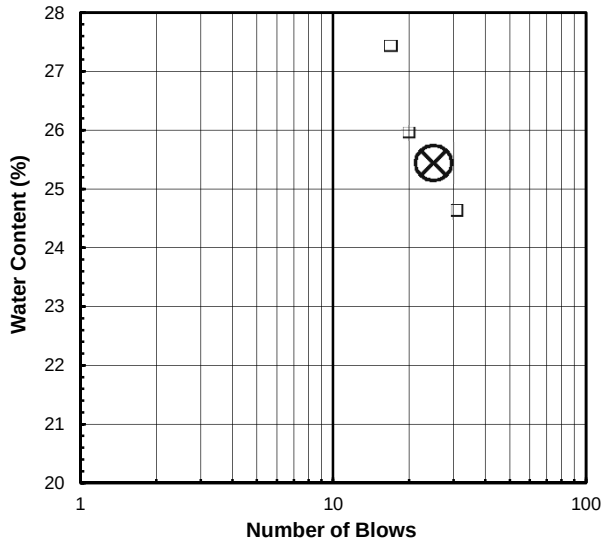
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1562	28	23	31	U
Wt. of Tare & Wet Sample (g):	542.15	39.78	39.81	39.73	L
Wt. of Tare & Dry Sample (g):	495.46	35.75	35.53	35.11	T
Weight of Tare (g):	310.69	19.38	19.04	18.26	I
Weight of Water (g):	46.7	4.0	4.3	4.6	P
Weight of Dry Sample (g):	184.8	16.4	16.5	16.9	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**25.3**	**24.6**	**26.0**	**27.4**	N
Number of Blows:		**31**	**20**	**17**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	38	42	
Wt. of Tare & Wet Sample (g):	23.65	24.79	
Wt. of Tare & Dry Sample (g):	22.55	23.64	
Weight of Tare (g):	17.24	18.10	
Weight of Water (g):	1.1	1.2	
Weight of Dry Sample (g):	5.3	5.5	
Moisture Content (%):	**20.7**	**20.8**	**0.0**

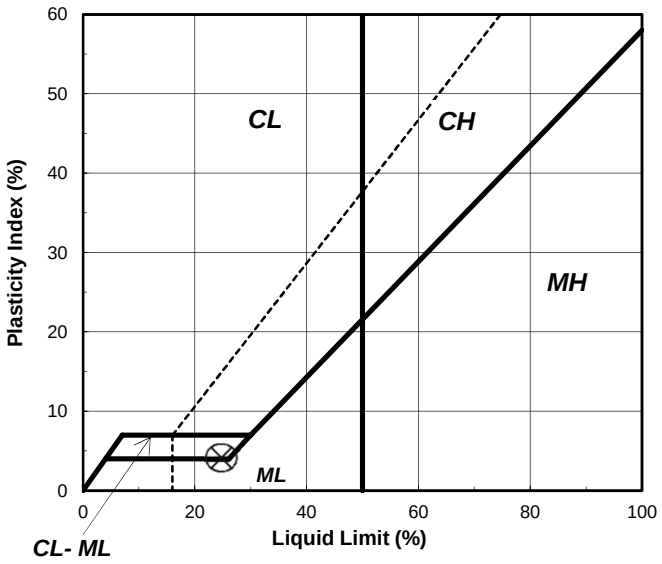
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**25**
Plastic Limit (%):	**21**
Plasticity Index (%):	**4**
USCS Symbol:	**CL-ML**

Flow Curve



Plasticity Chart



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ATTERBERG LIMITS

ASTM D 4318-17

Client:	Froehling & Robertson, Inc.	Boring No.:	STB-03
Client Reference:	P030487 - SC 277 OVER I-77	Depth (ft):	78.5-80
Project No.:	R-2017-884-001	Sample No.:	SS-19
Lab ID:	R-2017-884-001-016	Soil Description:	ORANGISH TAN SILT

Note: The* USCS *symbol used with this test refers only to the minus No. 40 (Minus No. 40 sieve material, Air dried)
sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

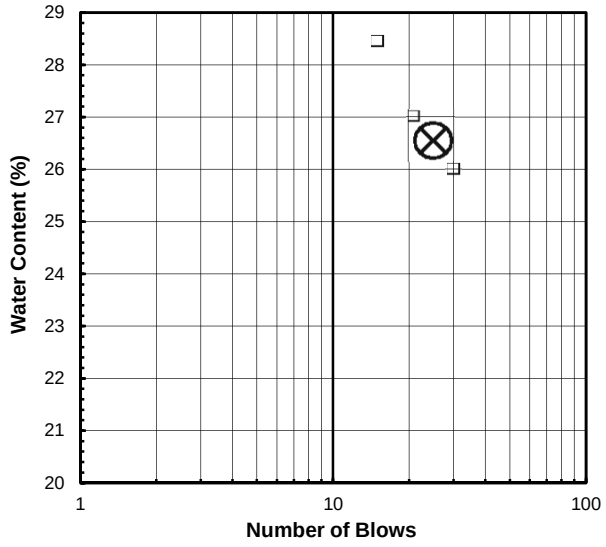
As Received Moisture Content ASTM D2216-10		**Liquid Limit Test** 1	2	3	M
Tare Number:	1560	24	17	22	U
Wt. of Tare & Wet Sample (g):	552.58	38.81	38.53	39.30	L
Wt. of Tare & Dry Sample (g):	505.95	34.66	34.27	34.86	T
Weight of Tare (g):	305.39	18.69	18.49	19.25	I
Weight of Water (g):	46.6	4.2	4.3	4.4	P
Weight of Dry Sample (g):	200.6	16.0	15.8	15.6	O
Was As Received MC Preserved:	**Yes**				I
Moisture Content (%):	**23.2**	**26.0**	**27.0**	**28.4**	N
Number of Blows:		**30**	**21**	**15**	T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number:	11	41	
Wt. of Tare & Wet Sample (g):	25.20	24.34	
Wt. of Tare & Dry Sample (g):	23.98	23.24	
Weight of Tare (g):	18.44	18.14	
Weight of Water (g):	1.2	1.1	
Weight of Dry Sample (g):	5.5	5.1	
Moisture Content (%):	**22.0**	**21.6**	**0.5**

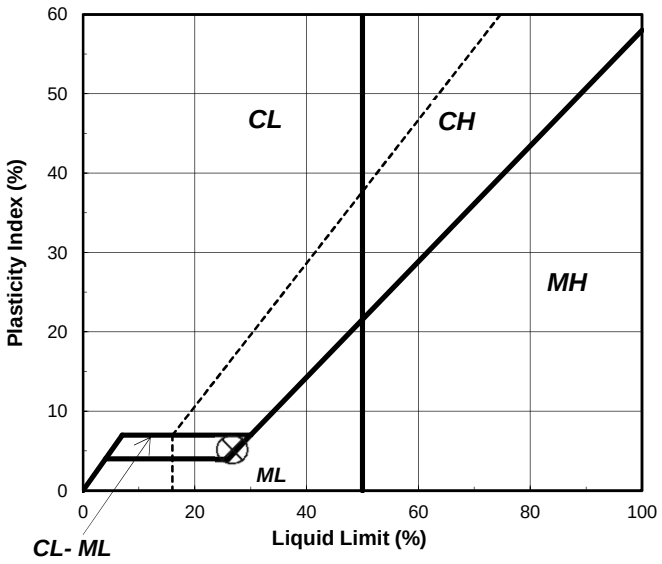
Note: The acceptable range of the two Moisture contents is ± 1.4

Test Results	
Liquid Limit (%):	**27**
Plastic Limit (%):	**22**
Plasticity Index (%):	**5**
USCS Symbol:	**ML**

Flow Curve



Plasticity Chart



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PERCENT PASSING # 200 SIEVE

ASTM D 1140-14

Client	Froehling & Robertson, Inc.
Client Reference	P030487 - SC 277 NB OVER I-77
Project No.	R-2017-884-001

Lab Id.	001	002	003	004	005
Boring No.	STB-01	STB-01	STB-01	STB-01	STB-01
Depth (ft)	1.5-3	4.5-6	13.5-15	23.5-25	43.5-45
Sample No.	SS-2	SS-4	SS-6	SS-8	SS-12
Tare Number	1545	1482	1537	1519	1461
Wt. of Tare & WS (gm)	378.96	369.23	386.21	407.75	401.47
Wt. of Tare & DS (gm)	342.69	348.08	380.10	401.18	390.94
Wt. of Tare (gm)	147.50	147.69	143.97	147.67	146.15
Wt. of Water (gm)	36.27	21.15	6.11	6.57	10.53
Wt. of DS (gm)	195.19	200.39	236.13	253.51	244.79
Water Content (%)	**18.6**	**10.6**	**2.6**	**2.6**	**4.3**
Wt. of Washed Soil & Tare	218.58	229.10	351.18	357.66	327.14
Percent Passing #200	**63.6**	**59.4**	**12.2**	**17.2**	**26.1**

Lab Id.	006	007	008	009	010
Boring No.	STB-01	STB-02	STB-02	STB-02	STB-02
Depth (ft)	63.5-65	1.5-3	8.5-10	23.5-25	33.5-35
Sample No.	SS-16	SS-2	SS-5	SS-8	SS-10
Tare Number	1416	1439	27	31	26
Wt. of Tare & WS (gm)	377.30	311.88	482.13	467.12	474.30
Wt. of Tare & DS (gm)	353.02	303.82	470.23	459.78	472.37
Wt. of Tare (gm)	145.65	144.73	204.30	203.17	200.61
Wt. of Water (gm)	24.28	8.06	11.9	7.34	1.93
Wt. of DS (gm)	207.37	159.09	265.93	256.61	271.76
Water Content (%)	**11.7**	**5.1**	**4.5**	**2.9**	**0.7**
Wt. of Washed Soil & Tare	208.87	261.44	420.03	419.24	434.68
Percent Passing #200	**69.5**	**26.6**	**18.9**	**15.8**	**13.9**

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PERCENT PASSING # 200 SIEVE

ASTM D 1140-14

Client	Froehling & Robertson, Inc.
Client Reference	P030487 - SC 277 NB OVER I-77
Project No.	R-2017-884-001

Lab Id.	011	012	013	014	015
Boring No.	STB-02	STB-03	STB-03	STB-03	STB-03
Depth (ft)	53.5-55	1.5-3	8.5-10	18.5-20	48.5-50
Sample No.	SS-15	SS-2	SS-5	SS-7	SS-13
Tare Number	29	Z10	48	585	1562
Wt. of Tare & WS (gm)	391.09	393.45	352.68	567.13	513.68
Wt. of Tare & DS (gm)	368.43	381.13	336.41	549.69	492.46
Wt. of Tare (gm)	204.37	201.99	202.78	308.83	310.69
Wt. of Water (gm)	22.66	12.32	16.27	17.44	21.22
Wt. of DS (gm)	164.06	179.14	133.63	240.86	181.77
Water Content (%)	**13.8**	**6.9**	**12.2**	**7.2**	**11.7**
Wt. of Washed Soil & Tare	230.53	324.62	291.07	506.96	393.21
Percent Passing #200	**84.1**	**31.5**	**33.9**	**17.7**	**54.6**

Lab Id.	016
Boring No.	STB-03
Depth (ft)	78.5-80
Sample No.	SS-19
Tare Number	1560
Wt. of Tare & WS (gm)	524.62
Wt. of Tare & DS (gm)	500.47
Wt. of Tare (gm)	305.39
Wt. of Water (gm)	24.15
Wt. of DS (gm)	195.08
Water Content (%)	**12.4**
Wt. of Washed Soil & Tare	405.20
Percent Passing #200	**48.8**

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Moisture, Ash, and Organic Matter (Loss on Ignition)

ASTM D 2974-13, AASHTO T 267-86

Client:	Froehling & Robertson, Inc.
Client Reference:	P0304487 - SC 277 NB OVER I-77
Project No.:	R-2017-884-001

Moisture Content (Oven Dried, minus #10 Sieve Material)

Lab ID:	-013
Boring No.:	STB-03
Depth (ft):	8.5-10
Sample No.:	SS-5
Tare Number	CR-6
Weight of Tare & Wet Sample (g)	59.75
Weight of Tare & Dry Sample (g)	47.84
Weight of Tare (g)	23.01
Weight of Water (g)	11.91
Weight of Dry Sample (g)	24.83
Moisture Content	**48.0%**

Ash Content, Organic Matter

Furnace Temperature (°C)	440
Weight of Tare & Ash (g)	45.84
Weight of Volatiles (g)	2.00
Weight of Ash (g)	22.83
Ash Content (%)	**91.9%**
Organic Matter (%)	**8.1%**

Tested By SFS *Date* 12/13/17 *Checked By* GEM *Date* 12/14/17

DCN: CT-S8 DATE: 11/15/10 REVISION:4

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APPENDIX VI

Geoprofessional Business Association (GBA) Document

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, clients can benefit from a lowered exposure to the subsurface problems 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 below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a 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. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *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.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- 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, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been 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 your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment 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 from project start to project finish, so the individual can provide 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 not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed 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 full-time 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 on hand quickly 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 observation.

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 informational 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, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. 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. 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 Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any 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 yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

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, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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