Geotechnical Engineering Report

Sharon Court at Pooler
Pooler, Georgia

January 14, 2022
Terracon Project No. ES215320

Prepared for:
Coastal Engineering & Consulting, LLC
Savannah, Georgia

Prepared by:
Terracon Consultants, Inc.
Savannah, Georgia

January 14, 2022

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6605 Abercorn Street, Suite 210D
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Attn: Mr. Scott Burns, P.E.
P: (912) 964 4509
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Re: Geotechnical Engineering Report
Sharon Court at Pooler
Pooler, Georgia
Terracon Project No. ES215320

Dear Mr. Burns:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PES215320 dated November 4, 2021. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Chao Zheng, Ph.D., E.I.T.
Senior Staff Geotechnical Engineer

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Senior Consultant

REPORT TOPICS

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Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

EXHIBITS

EXHIBIT A: Exploration and Testing Procedures

EXHIBIT A: Exploration and Testing Results

EXHIBIT A: Supporting Information

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

Topic	Overview Statement [1]
Project Description	■ The project will have one building with a footprint of 1000 square feet and a planned container yard for storing loaded/empty containers on chassis with associated driveway. ■ Loading information was not provided. Based on our experience with similar projects, we assumed the building has the following loading: a maximum slab load of 250 psf, a column load of 50 kips, and a wall load of 3 kips per linear foot. ■ We understand the container stacking would be no more than two (2), and assuming a maximum slab load of 500 psf on the paved area for settlement analysis. ■ The finished floor elevation was assumed to be close to the existing grade.
Geotechnical Characterization	■ Approximately 6 inches of topsoil as shown in most hand auger borings. The thickness of topsoil will vary, depending upon the near-surface soil distribution during the site preparation. ■ The site generally consists of soft to medium stiff sandy clay in the upper 6 to 10 feet below ground surface (BGS), followed by loose to dense silty sands to the depth of 26 to 32 feet BGS, and medium stiff to very stiff sandy clay to the depth of 35 feet BGS. Below the clay layer, it is underlain by medium dense to dense silty sand or stiff to very stiff sandy clay to the termination of CPT sounding at 50 feet below the existing ground surface (BGS). ■ Groundwater depths varied from approximately 3 to 5.3 feet BGS in CPT soundings and hand auger borings. Mottling was noted on hand auger borings at depths ranging from 2 to 3 feet BGS. These water tables may be perched water due to the shallow clayey soils. ■ Please refer to the **Geotechnical Characterization** section.
Earthwork	■ Install a site drainage system to lower the surface water; ■ Strip/grub topsoil; ■ Level, densify, proofroll subgrade during subgrade preparation. If detected any soft/weak areas, repair subgrade by densification or undercut and backfill. ■ The shallow soft clay has poor drainage characteristics and have the potential to cause a perched water table and destabilize the subgrade. ■ For details, please refer to the **Earthwork** section.
Building	■ The maximum settlement was estimated less than 1 inch for the building. ■ Shallow foundations will be sufficient after the subgrade has been improved with undercut and backfill or densification. The extent and depth of undercut will largely depend on the subgrade moisture, site drainage and the weather. ■ Allowable bearing pressure = 2,000 psf for shallow foundation design.

Chassis Yard	■ The settlements were estimated to range from less than 1 inch under 500 psf of uniform container loading. ■ No special ground improvement measures are necessary for the pavements, provided the subgrade is improved by undercutting and backfilling with structural fill as needed based on the subgrade stability during construction.
Pavements	The traffic load information has not been made available. Based on our experience with similar container yard projects in this area, we expect the equipment to move and stack the containers will be heavy and damaging to the pavements. We recommend asphalt pavement or gravel paved area for the stacked container as very thick concrete will be required for rigid paveemnts. We recommend the asphalt pavement section consisting of 6" asphalt, 10" dense graded aggregate base (DGAB) and 12" of imported granular subgrade (sand<10% fines) over the subgrade.
Seismic Consideration	For seismic design purposes, the subject site is classified as **Site Class D** in accordance with the International Building Code (IBC) 2018 and ASCE 7-16 Section 11.4.2.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

Sharon Court at Pooler

Pooler, Georgia

Terracon Project No. ES215320

January 14, 2022

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed container yard to be located near 108 Sharon Ct in Pooler, Georgia. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil condition
- Groundwater conditions
- Site preparation and earthwork
- Foundation design and construction
- Pavement design and construction
- Seismic site classification per IBC

The geotechnical engineering scope of services for this project included the advancement of 2 CPT soundings to depths of approximately 50 feet below existing site grades (BGS, refusal depths) and 4 hand auger borings to depths of approximately 5 feet BGS.

A general soil profile and discussion of subsurface conditions encountered at each sounding / boring location are included in the **Geotechnical Characterization** section of this report. Maps showing the site and boring locations are shown in **Exhibit A**.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located near 108 Sharon Court in Pooler, Georgia. Latitude: 32.1009°, Longitude -81.2287° See **Exhibit A**
Existing Improvements	Undeveloped
Current Ground Cover	Heavily wooded areas with partial wetland
Existing Topography	Not provided but assumed to be relatively level

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. Our final understanding of the project conditions is as follows:

Item	Description
Information Provided	A site plan EXA dated 7/30/2021 was provided by Coastal Engineering & Consulting in an email on November 2, 2021.
Project Description	The project will construct one building and container yard with associated driveway.
Proposed Structure	A building with footprint of 1,000 square feet. A container yard for 40' storage containers.
Finished Floor Elevation	Not provided but assumed to be close to existing grade.
Maximum Loads	We understand the container stacking would be no more than two (2), and the building will be lightly loaded. Based on our experience with similar projects, we assume the following values for our settlement analysis, Building ■ Slab load: 250 psf ■ Column load: 50 kips ■ Wall load: 3 kips per linear foot Chassis yard: ■ Compressive load: 500 psf (assumed for 2 loaded container stacking on the paved area, and possible conversion to empty containers)

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The following table provides our geotechnical characterization.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options, and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Characterization	Consistency/ Relative Density
Surface[1]	0.5	Topsoil: Fine silty sands with grass	N/A
1	6 to 10	Sandy clay	Soft to medium stiff
2	26 to 32	Silty sands	Loose to dense
3	35	Sandy clay	Medium stiff to very stiff
4 (various)	50, termination of CPT sounding	Silty sand	Medium dense to dense
		Sandy clay	Stiff to very stiff

1. Topsoil depth will vary throughout the site. The contractor should be prepared to strip/remove organics and unsuitable material prior to construction.

Conditions encountered at each exploration location are indicated on the individual logs shown in **Exhibit B** attached to this report. Stratification boundaries on the CPT sounding logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the logs in **Exploration and Testing Results**, and are summarized below.

Boring Number	Approximate Depth to Groundwater Below Ground Surface (feet)	Remark
C1	3.9	Ground Water Table (GWT) observed
C2	5.3	
HA1	3	
HA3	3	

Mottling, as a strong indicator of water seepage during seasonal high groundwater levels, was noted on hand auger boring locations at depths ranging from 2 to 3 feet BGS. This water table was likely perched water by the shallow clayey soils.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. The site is underlain by a thick layer of clays with silt below the topsoil and surface crust. This soft clay layer has poor drainage characteristics and has the potential to cause a perched water table and destabilize the subgrade.

Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

The following evaluation and recommendations are based upon our understanding of the proposed construction and the results from our field exploration. If the above-described project conditions are incorrect or changed after this report, or subsurface conditions encountered during construction are significantly different from those reported, Terracon should be notified, and these recommendations must be re-evaluated to make appropriate revisions.

Geotechnical Considerations

The subsurface conditions are considered typical for the area. The generalized soil profile is presented in the **Geotechnical Characterization** section.

Below the topsoil and a thin layer of sand at the surface, the site is underlain by a layer of clayey soils localled call Pooler Gumbo. The clayey soils can be stiff when dry, but have poor drainage characteristics and can become unstable when wet. Special attention including subgrade protection will be required to reduce the need for undercut of the clay subgrade.

The information regarding the structural loads is not available and the assumed values are included in the section of **Project Description.** Shallow foundation settlement analyses were performed at each sounding location using the soil parameters derived from the CPT soundings and the assumed structural loads or the provided grading information.

Building

The loading information for the building has not been made available at this time. Based on our experience with similar projects, **we assumed a typical slab load of 250 psf, a column load of 50 kips and a wall load of 3 kips per linear foot, and the building will be at-grade.**

We performed the settlement analyses using the soil parameters derived from the CPT soundings and the structural loads discussed above. Based on the analysis, the settlements were estimated to be less than 1 inch. As such, after the subgrade densification and proofroll and subgrade repair as necessary by undercut and backfill, the building can be supported on a shallow foundation system, resting on an improved subgrade.

A net allowable bearing capacity of 2,000 pounds per square foot (psf) is recommended for shallow foundation design after achieving a stable subgrade. The allowable bearing capacity may be increased by 1/3 for transient wind load and seismic load conditions. Terracon should be retained to confirm and test the subgrade during construction to provide more specific recommendations on subgrade repair based on the conditions at the footing subgrade.

Container Yard

Based on email communication, we understand that the container yard will have up to 2 stacked containers. Based on our experience with similar projects, we assumed a typical ground contact pressure of 500 psf for settlement analysis.

Based on the results of settlement analysis, the long-term settlement was estimated to be less than 1 inch for the pavements subjected to a distributed uniform load of 500 psf. As such, **special ground improvements like soil surcharge, dynamic compaction or similar measures are NOT necessary for the pavement construction at this site.**

After stripping and grading, the native subgrade soils should be densified by a vibratory roller for sandy soils or a static roller for clayey soils. The entire subgrade should be proofrolled using a loaded dump truck. The areas of the subgrade that fail proofrolling should be repaired by undercut and backfilling.

If heavier structural loads are required than those discussed above, or if the site will receive significantly more fill, Terracon should be retained to perform the additional evaluation.

We anticipate undercutting and backfilling may be required in isolated loose/soft areas under the footings or pavements to achieve a stable subgrade. The extent and the depth of the undercut should be based on the subsurface conditions encountered during the subgrade preparation.

During site preparation, topsoil, organic matter, stumps, or other unsuitable materials should not be left in subgrade under buildings or pavements. All footings/slab and pavement should bear on suitable natural soil, or on properly compacted structural fills. Compacted fill should be placed directly on suitable natural soil. We recommend Terracon be retained to test the footing subgrade during construction so that Terracon can provide additional recommendations to prepare the subgrade based on the conditions uncovered during the footing preparation.

EARTHWORK

The site work conditions will be largely dependent on the weather and contractor's means and methods in controlling surface drainage and protecting the subgrade. Site preparation should include installation of a site drainage system, topsoil stripping and grubbing, subgrade preparation, densification, and proofrolling. **Please bear in mind,** due to the uneven ground surface of the site, the volume of topsoil and organics may be significantly greater than the area times the topsoil/organics thickness indicated in the boring logs. Rutting of the subgrade can also cause the mixing of topsoil/organics with underlying soils which will result in additional required topsoil/organics stripping. Deeper undercuts may be needed in some localized areas to remove unsuitable materials.

Site Drainage

An effective drainage system should be installed prior to logging, site preparation and grading activities to intercept surface water and to improve overall shallow drainage. The drainage system may consist of perimeter ditches supplemented with parallel ditches and swales. Pumping equipment should be prepared if the above ditch system cannot effectively drain water away from the site, especially during the rainy season. The site should be graded to shed water and avoid ponding over the subgrade.

Densification and Proofrolling

Prior to fill placement on the subgrade, the entire pavement areas should be densified with a heavy-duty static roller to achieve a uniform subgrade. The subgrade should be thoroughly proofrolled after the completion of densification. Proofrolling will help detect any isolated soft or loose areas that "pump", deflect or rut excessively, and also densify the near-surface soils for pavement support.

A loaded tandem axle dump truck, capable of transferring a load in excess of 20 tons, should be utilized for this operation. Proofrolling should be performed under the Geotechnical Engineer's observation. Areas where pumping, excessive deflection or rutting is observed after successive passes of the proofrolling equipment should be undercut, backfilled and then properly compacted. It is anticipated that some amount of subgrade undercutting may be required during subgrade preparation.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill. Earthen materials used for structural fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Parameters (for Structural Fill)
Granular	GW, GP, GM, GC, SW, SP, SM, SC	Less than 25% Passing No. 200 sieve

1. Structural fill should consist of approved materials free of organic matter and debris. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Based on the findings from our CPT sounding and hand auger borings, the subject site consists of soils varying from silty sands (SM) to clayey sands (SC) to sandy clays (CL) in the upper 5 feet

(BGS). The silty sands (SM) are generally considered suitable for structural fill, provided that the soils are free of roots, organics or other foreign materials. Clayey sands (SC) may be considered marginally suitable; and the sandy clays (CL) are deemed unsuitable for structural fill.

We define marginally suitable as the soils that may require extra effort to adjust the moisture before they can be compacted. The amount of effort required will be highly dependent on the season and the weather conditions during construction. We recommend Terracon be retained during construction to determine the suitability of the onsite soil as fill material.

Fill Compaction Requirements

Structural should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	8 to 10 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1]	95% of max. below foundations and below finished pavement subgrade
Water Content Range [1]	Granular: -3% to +3% of optimum

1. Maximum density and optimum water content as determined by the modified Proctor test (ASTM D 1557).

Some manipulation of the moisture content (such as wetting, drying) will be required during the filling operations to obtain the required degree of compaction. The manipulation of the moisture content is highly dependent on weather conditions and site drainage conditions. Therefore, the contractor should prepare both dry and wet fill materials to obtain the specified compaction during grading. A sufficient number of density tests should be performed to confirm the required compaction of the fill material.

Earthwork Construction Considerations

Shallow excavations for the proposed structures are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to the construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, the construction areas should be removed.

If the subgrade saturates or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction. The groundwater table could affect over-excavation efforts, especially for over-excavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps could be necessary to achieve the recommended depth of over-excavation.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency provided by the project plan and specifications.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

PAVEMENTS

General Pavement Comments

We understand that the proposed development will include asphalt paved roads. This section presents the recommendations for asphalt pavements and general considerations for pavement design and construction. The required pavement thickness will depend on:

- The traffic loads including traffic pattern and the service life of the pavement;
- Subgrade conditions including soil strength and drainage characteristics;

- Paving material characteristics;
- Climatic conditions of the region.

We understand the traffic loads for the container yard will mainly come from the toplift moving the containers. The pavement section is governed by the traffic loads, which include axle loads and repetitions. No specific traffic patterns and loads were not available for this site. However, based on our experience with similar projects, we have provided the typical thickness of the asphalt section for the pavement for preliminary planning and budget considerations. The typical pavement section was mostly based on the performance experience, not from theoretical design calculations. The recommended typical pavement design sections are provided as below.

Pavement Design Recommendations

Material[1]	Asphalt Section Thickness (inches)
	2-high Stacked Loaded Containers
Asphalt Surface Course	2.5
Asphalt Intermediate Course	3.5
Aggregate Base Course	10
Total Pavement Section	**16**
Select fill[2]/improved subgrade[3]	24

1. Asphalt concrete aggregates and base course materials should conform to the following GDOT material specifications.
   - Section 815 for Graded Aggregate
   - Section 828 for Hot Mix Asphalt Concrete Mixture. The surface course may use polymer-modified 12.5mm Superpave (PG76-22) for the heavy-duty pavement, 19 mm Superpave (PG67-22) is recommended for the intermediate course.
2. The select fill should be relatively clean sands with percent fines less than 15%. The fill material should be compacted to a minimum of 95% of the soil's Modified Proctor maximum dry density (ASTM D-1557).
3. If SP or SP-SM or SM soils exist at the proposed subgrade elevation extending to a depth at least 24 inches below the proposed subgrade level, the in-situ soils can replace the select fill and the subgrade should be improved using densification as discussed in **Earth work** section.

Notes:

- Proper surface and subgrade drainage system should be installed to avoid saturation of subgrade soils underneath the asphalt pavements. The site drainage should be designed to maintain the groundwater at least 2 feet below the top of the subgrade.
- Some subgrade soil undercutting and backfilling with suitable structural fill will be required if unstable subgrade soils are encountered during subgrade preparation. The use of geogrid (Tensar BX1100 or equivalent) may be necessary to help reduce the depth of undercut to achieve stability if the unstable subgrade soils extend to greater depths. The need for geogrid and/or the need for undercutting and backfilling should be determined in the field during subgrade preparation.

A design life of 20 years was assumed to develop the total traffic in the thickness design. However, as typical for pavements, some maintenance repairs are required after a period of 7 to10 years.

The subgrade conditions will depend on the in-situ soils at the subgrade level, characteristics of fill material for the subgrade as well as site preparation procedures. Assuming the finished subgrade will be near the existing ground surface, after the removal of topsoil, the near-surface soils vary from silty sands to clayey sands to sandy clays. Silty sands with low fine content (i.e., less than 25%) are typically considered suitable for subgrade support, but the clayey sands to sandy clays in most of the areas which have poor drainage characteristics and are deemed unsuitable for subgrade support. In general, we recommend the upper two feet of the subgrade be relatively clean sands with percent fines less than 15 percent. A California Bearing Ratio (CBR) value of 8 has been estimated based on the in-situ soils at the site and typical imported fills available in this area.

Climatic conditions are considered in the design subgrade support value and in the paving material characteristics. Recommended paving material characteristics, in reference to the Georgia Department of Transportation's (GDOT) 2001 edition of Standard Specifications for Construction of Transportation Systems, are included for the asphalt pavement sections.

Pavement and Subgrade Drainage

Poor subgrade drainage is the most common cause of pavement failure. Pavement should be sloped to provide rapid drainage of surface water. Water should not be allowed to pond on or adjacent to the pavement which would saturate the subgrade soils and weaken the subgrade support. We recommend the site drainage be designed to maintain the groundwater at least two feet below the top of the subgrade.

Pavement subgrade drains may not be effective or necessary for a majority of the asphalt paved yard as the groundwater is controlled by the site drainage. Pavement subgrade drainage should be used to surround the areas anticipated to have frequent wetting or having poor natural drainage, such as landscaped islands, along curbs, and gutters and around drainage structures like box inlets. All landscaped areas in or adjacent to pavements should include subgrade drains to intercept water migrating from the grass areas to the pavement subgrade. The subgrade drains should be installed at the bottom of the Graded Aggregate Base (GAB) level. The civil engineer should decide the placement of the subgrade drains to avoid the saturation of the pavement subgrade.

Pavement Maintenance

The performance of pavements will require regular maintenance. One key component of the maintenance is to minimize infiltration of water into the pavement base and subgrade. Preventive maintenance should include crack and joint sealing and patching as well as overall surface sealing and overlay. Additional engineering observation and evaluation is recommended prior to any major maintenance.

Pavement Construction Considerations

Pavement subgrades prepared early in the project should be carefully evaluated as the time for pavement construction approaches. We recommend the pavement areas be rough graded and then thoroughly proofrolled with a loaded tandem-axle dump truck. Particular attention should be paid to high traffic areas that are rutted and disturbed, and to areas where backfilled trenches are located. Areas where unsuitable conditions are noted should be repaired by removing and replacing the materials with properly compacted fill. After proofrolling and repairing subgrade deficiencies, the entire subgrade should be scarified to a depth of 12 inches, and uniformly compacted to at least 95 percent of the materials' modified Proctor maximum dry density.

SEISMIC CONSIDERATIONS

According to the International Building Code (IBC) 2018 and ASCE 7-16, structures should be designed and constructed to withstand the effects of earthquakes and avoid failure during a maximum considered earthquake. The maximum considered earthquake (MCE) is a seismic event that has a 50-year exposure period with a 2% probability of exceedance. The 2500-year earthquake has a Moment Magnitude (Mw) of 7.3 and a Site Class Adjusted Peak Ground Acceleration (PGA_M) of **0.236g**, as determined by data provided by the IBC 2018 and ASCE 7-16 Standards.

Based on our findings from the field exploration and our knowledge of the local geological formation in the project area, the site can be classified as **Site Class D** in accordance with International Building Code (IBC) 2018 and ASCE 7-16. The seismic design parameters obtained based on IBC2018 and ASCE 7-16 are summarized in the table below. The design response spectrum curve, as presented in the appendix, was developed based on the S_{DS} and S_{D1} values according to IBC2018 and ASCE 7-16.

Summary of Seismic Design Parameters

Site Location (Latitude, Longitude)	Site Classification	S_s	S_1	F_a	F_v	S_{DS}	S_{D1}
32.1009°, -81.2286°	D	0.294g	0.109g	1.565	2.382	0.306g	0.173g

- The Site Class for this site was determined based on the soil properties to the maximum exploration depth and estimated soil properties below the maximum exploration depth to 50 feet based on our experience with the geologic conditions of the site area in accordance with the 2018 IBC and ASCE 7-2016.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

EXHIBITS

EXHIBIT A:	EXPLORATION PLAN AND PROCEDURES
EXHIBIT B:	EXPLORATION AND TESTING RESULTS
EXHIBIT C:	SUPPORTING INFORMATION

EXHIBIT A

EXPLORATION PLAN AND PROCEDURES

- **Exhibit A-1** Site Location Plan
- **Exhibit A-2** Exploration Plan
- **Exhibit A-3** Exploration and Testing Procedures

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH

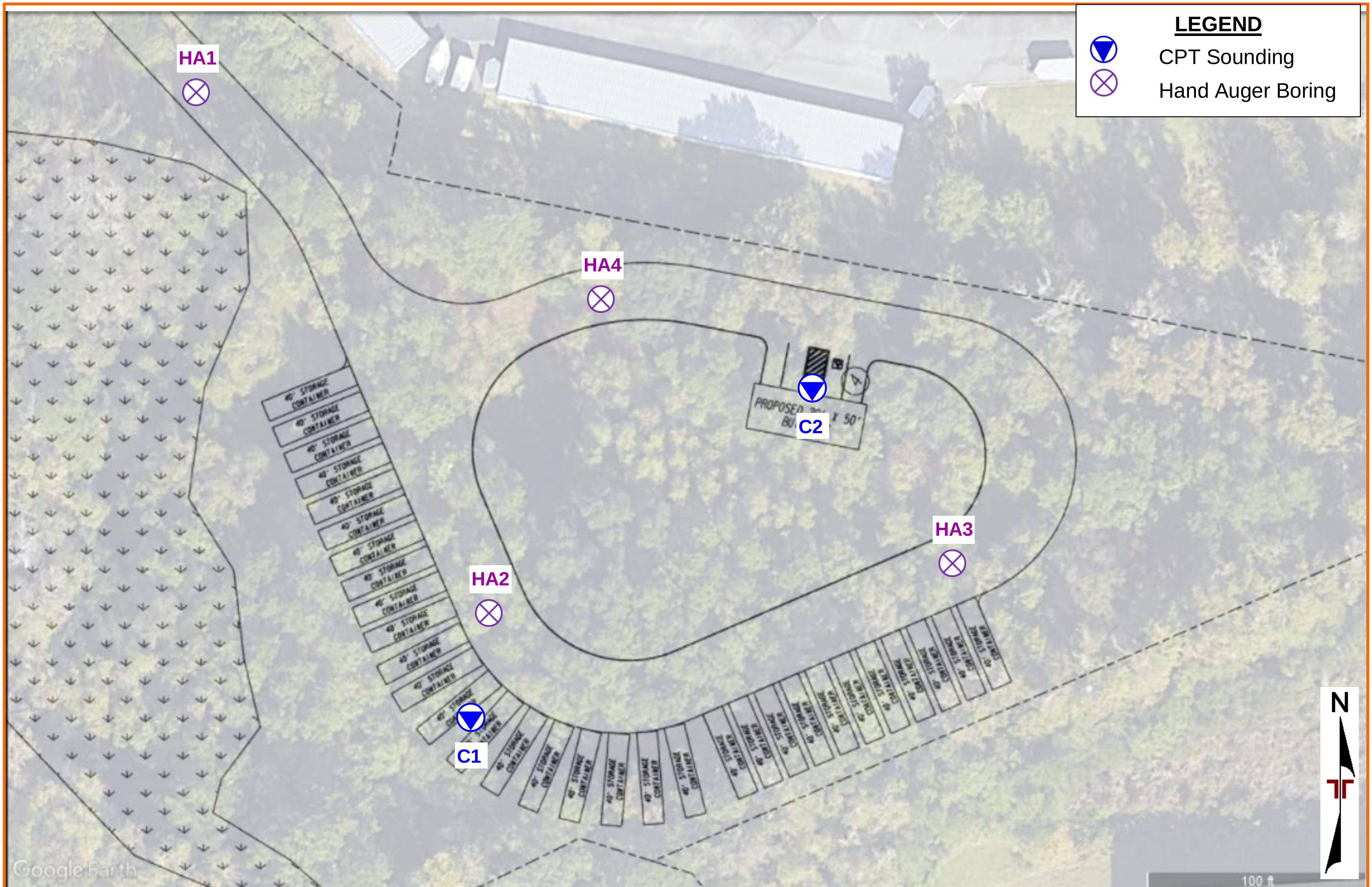


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH

Field Exploration

No. of Exploration Locations	Type of Exploration	Boring Depth (feet, below ground surface)	Location
2	Cone Penetration Test (CPT) Sounding	50	Building/ Container Yard Area
4	Hand Auger	5	Pavement Area

Boring Layout and Elevations: We used handheld GPS equipment to locate borings with an estimated horizontal accuracy of +/-20 feet. Field measurements from existing site features was utilized.

Subsurface Exploration Procedures:

We pushed the CPT soundings with a track-mounted drill rig. CPT sounding is a new technology in which an electronically instrumented cone penetrometer is hydraulically pushed through the soil while nearly continuous readings are recorded to a portable computer. The cone is equipped with electronic load cells to measure tip resistance and sleeve resistance and a pressure transducer to measure the generated ambient pore pressure. The face of the cone has an apex angle of 60° and an area of 10 cm^2. Digital data representing the tip resistance, friction resistance, pore water pressure, and probe inclination angle are recorded about every 2 centimeters while advancing through the ground at a rate between 1½ and 2½ centimeters per second. These measurements are correlated to various soil properties used for geotechnical design. No soil samples are gathered through this subsurface investigation technique.

CPT testing was conducted in general accordance with ASTM D5778 "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils." Upon completion, the CPT data collected was analyzed and processed by the project engineer.

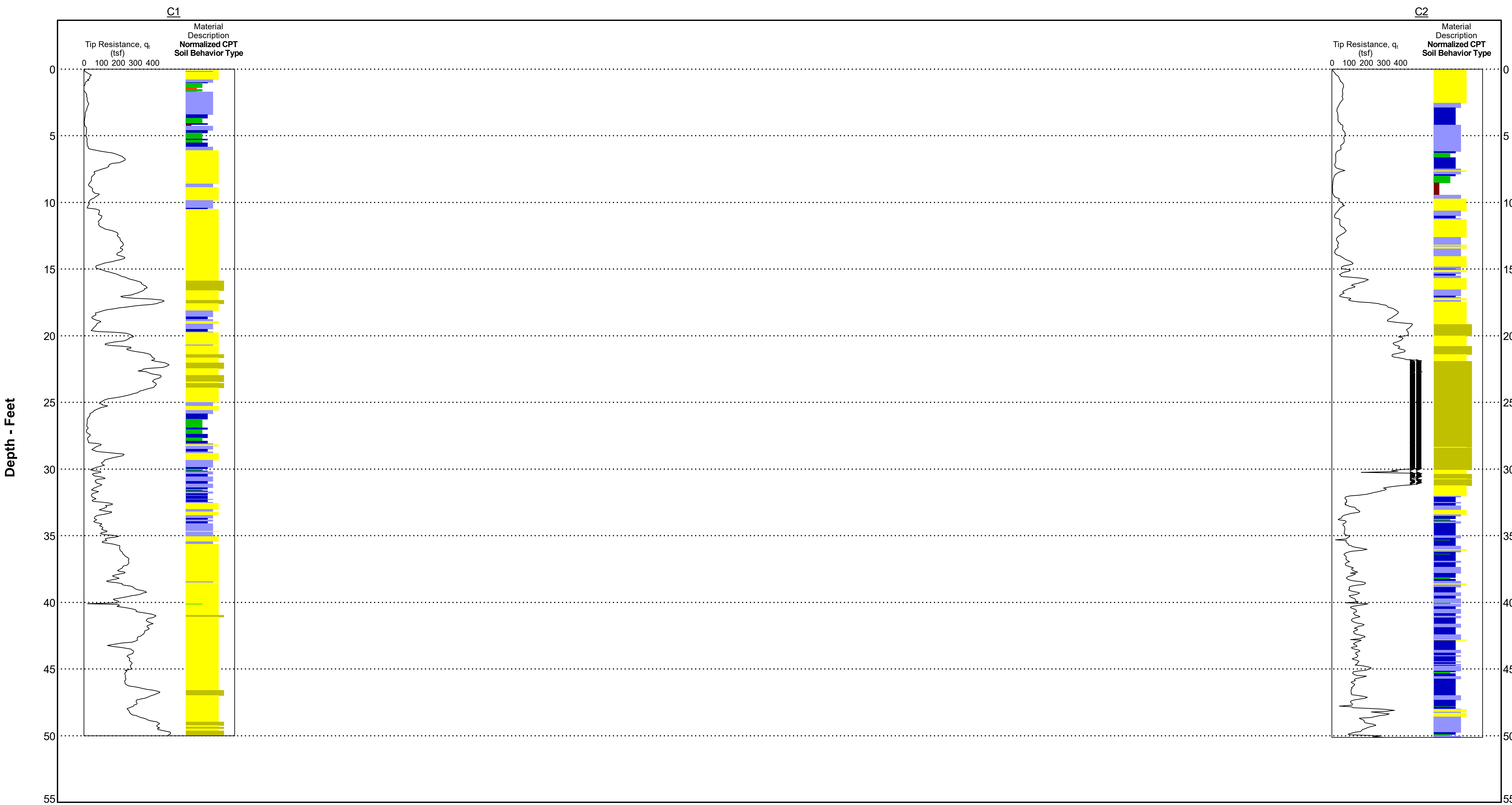
Hand auger borings were conducted in general accordance with ASTM D 1452-80, Standard Practice for Soil Investigation and Sampling by Auger Borings. In this test, hand auger borings are drilled by rotating and advancing a bucket auger to the desired depths while periodically removing the auger from the hole to clear and examine the auger cuttings. The soils are classified in accordance with ASTM D2488.

Our exploration team prepared field boring logs as part of the drilling operations. The field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Ground water observations were also recorded. Final boring logs were prepared from the field logs. The final boring logs represent the engineer's interpretation of the field logs.

EXHIBIT B

EXPLORATION AND TESTING RESULTS

- **Exhibit B-1** CPT Sounding Cross Section
- **Exhibit B-2** CPT Sounding Log
- **Exhibit B-3** Hand Auger Boring Logs



Explanation

C1 — Borehole Number
Moisture Content — %w
LL PL — Liquid and Plastic Limits
Sampling
Borehole Lithology
AR BT — Borehole Termination Type
Water Level Reading at time of drilling.
Water Level Reading after drilling.

NOTES:
See Exhibit for orientation of soil profile.
See General Notes in Appendix for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ.
AR - Auger Refusal
BT - Boring Termination

Project Manager: CZ	Project No.: ES215320	Terracon 2201 Rowland Ave Savannah, GA PH. 912-629-4000 FAX. 912-629-4001	**SUBSURFACE PROFILE**	EXHIBIT
Drawn by: NAA	Scale: N.T.S.		SHARON COURT AT POOLER POOLER, GA	B-1
Approved by: GL	File Name: ES215320			
Date: 1/14/2022				

CPT LOG NO. C1

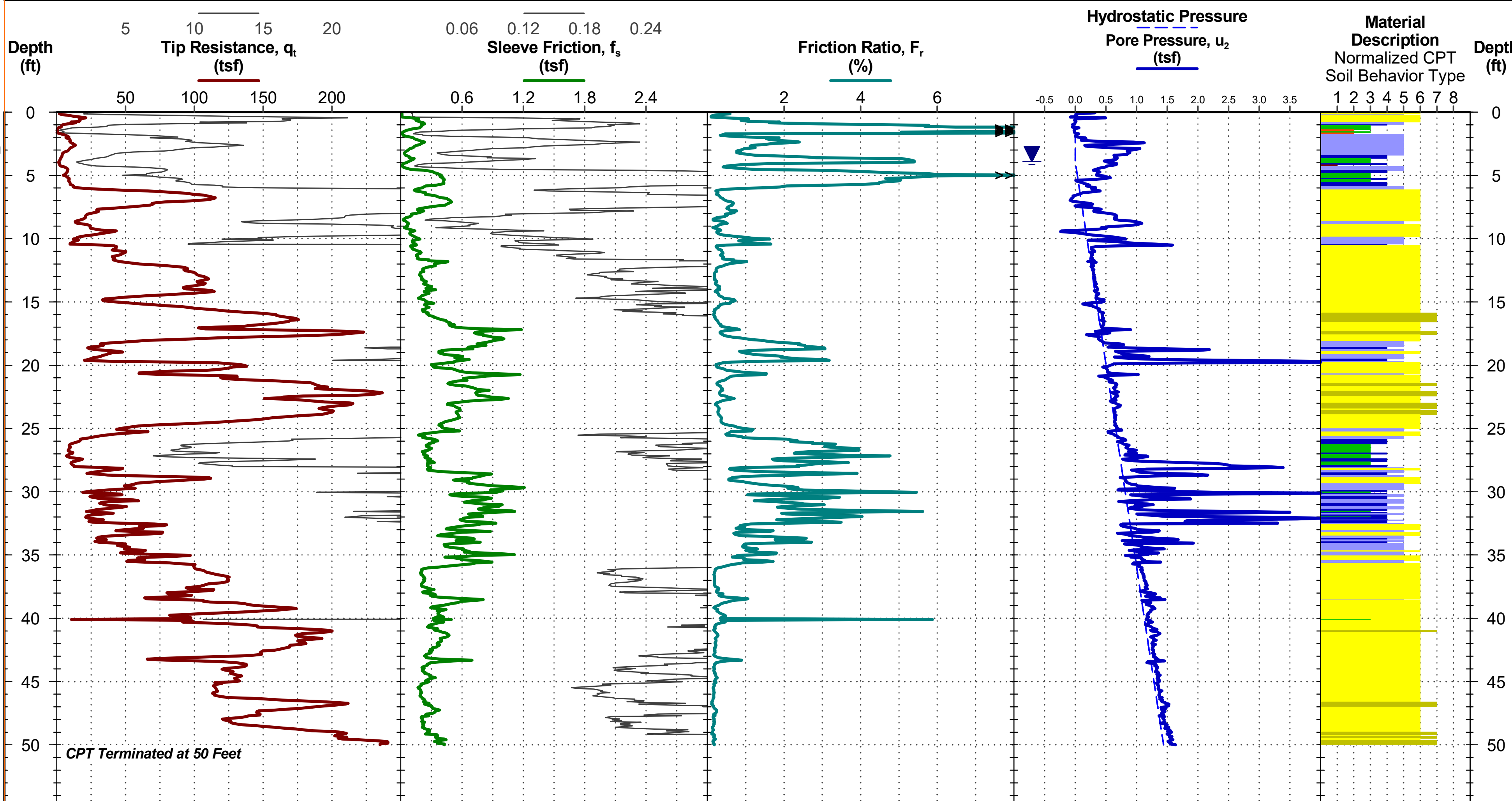
PROJECT: Sharon Court at Pooler

CLIENT: Coastal Engineering & Consulting LLC
Savannah, GA

TEST LOCATION: See Exploration Plan

SITE: Pooler, GA

Latitude: 32.1009°
Longitude: -81.2288°



See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION				
3.9 ft measured water depth (used in normalizations and correlations; See Supporting Information)	Probe no. 5354 with net area ratio of .864 Calibrated 5/31/2021 Tip and sleeve areas of 10 cm^2 and 150 cm^2	Terracon 2201 Rowland Ave Savannah, GA	CPT Started: 1/7/2022 Rig: Geoprobe Project No.: ES215320	CPT Completed: 1/7/2022 Operator: T.I. Exhibit: B-2-1

CPT LOG NO. C2

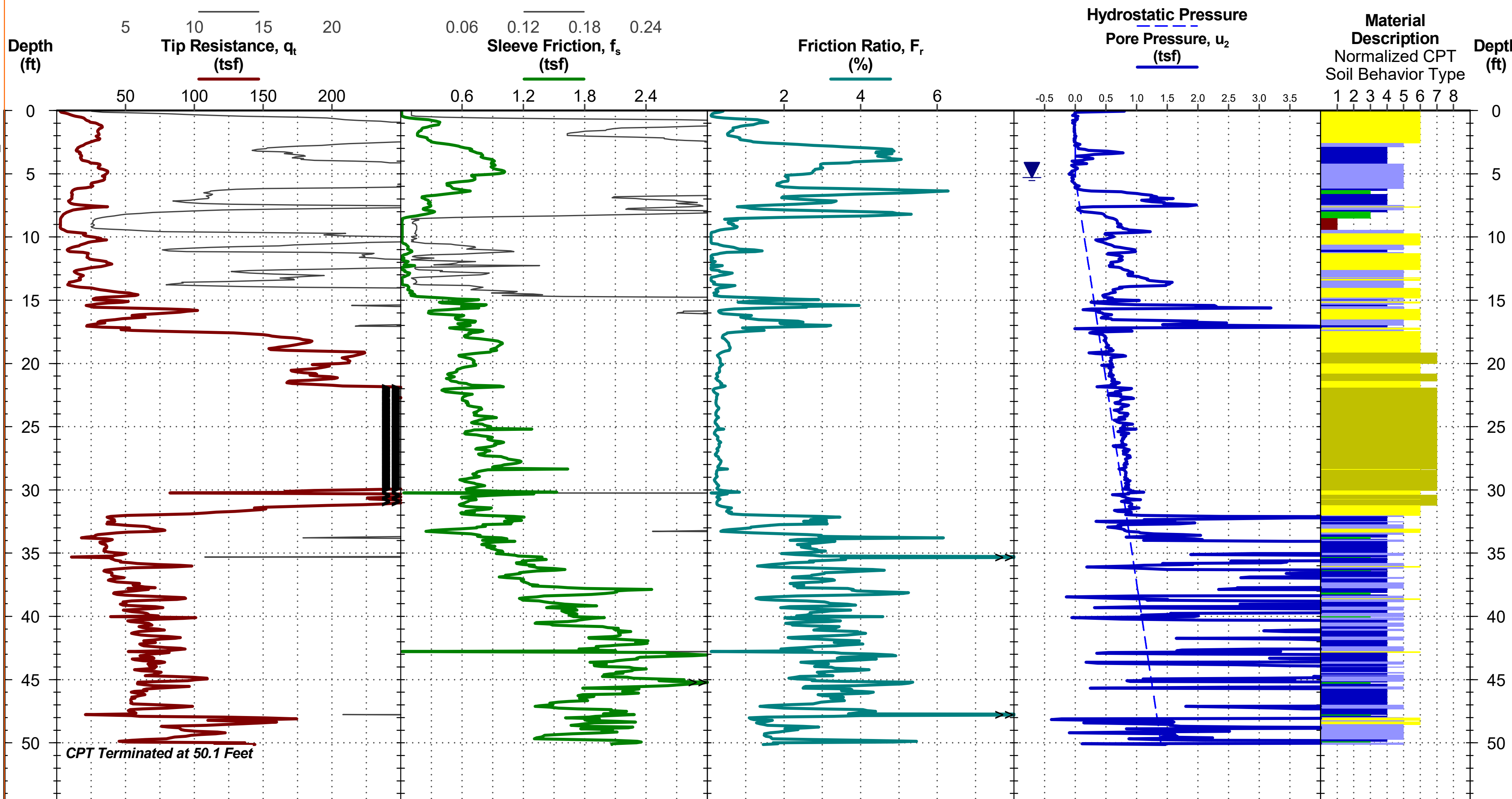
PROJECT: Sharon Court at Pooler

CLIENT: Coastal Engineering & Consulting LLC
Savannah, GA

TEST LOCATION: See Exploration Plan

SITE: Pooler, GA

Latitude: 32.1013°
Longitude: -81.2283°



See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

5.3 ft measured water depth
(used in normalizations and correlations; See Supporting Information)

Probe no. 5354 with net area ratio of .864

Calibrated 5/31/2021
Tip and sleeve areas of 10 cm² and 150 cm²

Terracon
2201 Rowland Ave
Savannah, GA

CPT Started: 1/7/2022

CPT Completed: 1/7/2022

Rig: Geoprobe

Operator: T.I.

Project No.: ES215320

Exhibit: B-2-2

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CPT REPORT ES215320 SHARON COURT AT P.GPJ TERRACON_DATATEMPLATE.GDT 1/13/22

BORING LOG NO. HA1

PROJECT: Sharon Court at Pooler

CLIENT: Coastal Engineering & Consulting LLC Savannah, GA

SITE: Pooler, GA

LOCATION See Exploration Plan

Latitude: 32.1010° Longitude: -81.2288°

GRAPHIC LOG / DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
0.5	**TOPSOIL**, fine to medium grained, dark brown, silty sands with pinestraws and roots			
2.5	**SILTY SAND (SM)**, fine to medium grained, light brown, with trace roots in upper 2 feet	1, 2		
4.0	**CLAYEY SAND (SC)**, fine to medium grained, dark brown	3, 4		
5.0	**SANDY LEAN CLAY (CL)**, dark brown	5		
	Boring Terminated at 5 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual - Hand Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No Groundwater encountered

Mottling @ 40"

Terracon
2201 Rowland Ave
Savannah, GA

Boring Started: 12-27-2021	Boring Completed: 12-27-2021
Drill Rig: Hand Auger	Driller:
Project No.: ES215320	Exhibit: B-3-1

BORING LOG NO. HA2

PROJECT: Sharon Court at Pooler

CLIENT: Coastal Engineering & Consulting LLC
Savannah, GA

SITE:
Pooler, GA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1017° Longitude: -81.2292° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	TOPSOIL, fine to medium grained, dark brown, silty sands with pinestraws and roots			
	0.5			
	SILTY SAND (SM), fine to medium grained, brown, with trace roots in upper 2 feet	1 2 3 4	▽ (at 3)	
	5.0	5		
	Boring Terminated at 5 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual - Hand Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered @ 36"*

Mottling @ 36"

Terracon
2201 Rowland Ave
Savannah, GA

Boring Started: 12-27-2021	Boring Completed: 12-27-2021
Drill Rig: Hand Auger	Driller:
Project No.: ES215320	Exhibit: B-3-2

BORING LOG NO. HA3

PROJECT: Sharon Court at Pooler

CLIENT: Coastal Engineering & Consulting LLC
Savannah, GA

SITE:
Pooler, GA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1011° Longitude: -81.2281° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	TOPSOIL, fine to medium grained, dark brown, silty sands with pinestraws and roots			
	0.5			
	CLAYEY SAND (SC), fine to medium grained, dark brown	1		
		2		
		3	▽	
		4		
	5.0	5		
	Boring Terminated at 5 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual - Hand Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered @ 36"*

Mottling @ 36"

Terracon
2201 Rowland Ave
Savannah, GA

Boring Started: 12-27-2021	Boring Completed: 12-27-2021
Drill Rig: Hand Auger	Driller:
Project No.: ES215320	Exhibit: B-3-3

BORING LOG NO. HA4

PROJECT: Sharon Court at Pooler

CLIENT: Coastal Engineering & Consulting LLC
Savannah, GA

SITE:
Pooler, GA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 32.1014° Longitude: -81.2285° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	TOPSOIL, fine to medium grained, dark brown, silty sands with pinestraws and roots			
	0.5			
	SILTY SAND (SM), fine to medium grained, light brown, with trace roots in upper 2 feet	1 2		
	2.3			
	SANDY LEAN CLAY (CL), dark brown and light brown	3 4		
	5.0	5		
	Boring Terminated at 5 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Manual - Hand Auger Abandonment Method: Boring backfilled with auger cuttings upon completion.	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.	Notes:

WATER LEVEL OBSERVATIONS

No Groundwater encountered

Mottling @ 28"

Terracon
2201 Rowland Ave
Savannah, GA

Boring Started: 12-27-2021	Boring Completed: 12-27-2021
Drill Rig: Hand Auger	Driller:
Project No.: ES215320	Exhibit: B-3-4

EXHIBIT C

SUPPORTING DOCUMENTS

- **Exhibit C-1** Seismic Design Parameters
- **Exhibit C-2** CPT General Notes
- **Exhibit C-3** General Notes
- **Exhibit C-4** Unified Soil Classification System

Seismic Design Parameters Based on IBC2018 Code and ASCE 7-16 Standard

Terracon Project Name: Sharon Court at Pooler
Terracon Project No: ES215320

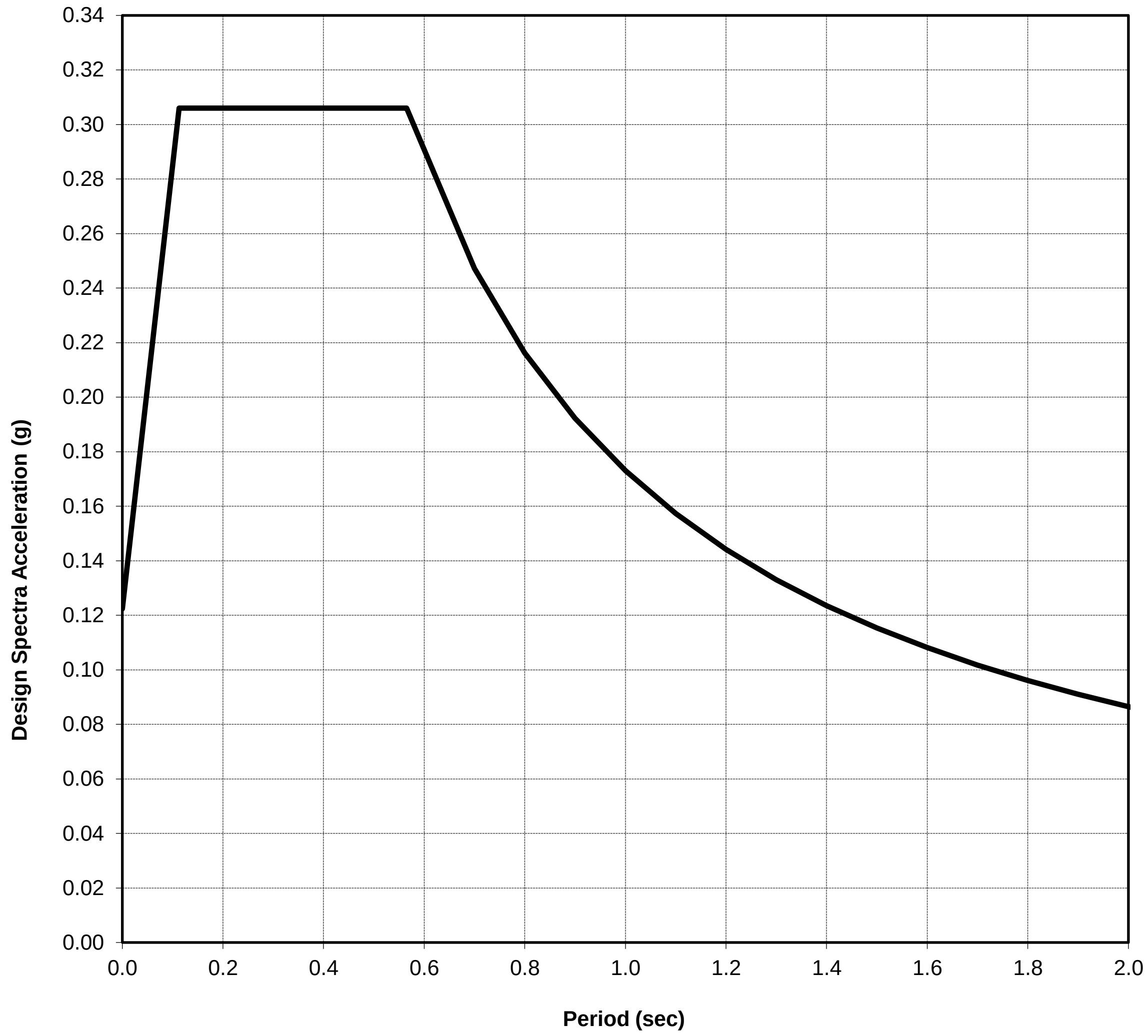
Site Location: Pooler, Georgia
Latitude : 32.1009°
Longitude : -81.2287°

Site Class: **D**

Design Response Spectrum for the Site Class

S_s = 0.294	S_1 = 0.109
F_a = 1.565	F_v = 2.382
S_{MS} = 0.460	S_{M1} = 0.260
S_{DS} = 0.306	S_{D1} = 0.173

	Period (sec)	Sa (g)
	0.000	0.122
T_0 =	0.113	0.306
	0.200	0.306
T_S =	0.565	0.306
T =	0.700	0.247
	0.800	0.216
	0.900	0.192
	1.000	0.173
	1.100	0.157
	1.200	0.144
	1.300	0.133
	1.400	0.124
	1.500	0.115
	1.600	0.108
	1.700	0.102
	1.800	0.096
	1.900	0.091
	2.000	0.087
	2.100	0.082



CPT GENERAL NOTES

DESCRIPTION OF MEASUREMENTS AND CALIBRATIONS

To be reported per ASTM D5778:

Uncorrected Tip Resistance, q_c
Measured force acting on the cone divided by the cone's projected area

Corrected Tip Resistance, q_t
Cone resistance corrected for porewater and net area ratio effects
$q_t = q_c + U2(1 - a)$
Where a is the net area ratio, a lab calibration of the cone typically between 0.70 and 0.85

Pore Pressure, U1/U2
Pore pressure generated during penetration
U1 - sensor on the face of the cone
U2 - sensor on the shoulder (more common)

Sleeve Friction, fs
Frictional force acting on the sleeve divided by its surface area

Normalized Friction Ratio, FR
The ratio as a percentage of fs to q_t, accounting for overburden pressure

To be reported per ASTM D7400, if collected:

Shear Wave Velocity, Vs
Measured in a Seismic CPT and provides direct measure of soil stiffness

DESCRIPTION OF GEOTECHNICAL CORRELATIONS

Normalized Tip Resistance, Q_t
$Q_t = (q_t - \sigma_{V0})/\sigma'_{V0}$

Over Consolidation Ratio, OCR
$OCR\ (1) = 0.25(Q_t)^{1.25}$
$OCR\ (2) = 0.33(Q_t)$

Undrained Shear Strength, Su
$Su = Q_t \times \sigma'_{V0}/N_{kt}$
N_{kt} is a geographical factor (shown on Su plot)

Sensitivy, St
$St = (q_t - \sigma_{V0}/N_{kt}) \times (1/fs)$

Effective Friction Angle, ϕ'
$\phi'\ (1) = \tan^{-1}(0.373[\log(q_t/\sigma'_{V0}) + 0.29])$
$\phi'\ (2) = 17.6 + 11[\log(Q_t)]$

Unit Weight
$UW = (0.27[\log(FR)]+0.36[\log(q_t/atm)]+1.236) \times UW_{water}$
σ_{V0} is taken as the incremental sum of the unit weights

SPT N_{60}
$N_{60} = (q_t/atm) / 10^{(1.1268 - 0.2817Ic)}$

Soil Behavior Type Index, Ic
$Ic = [(3.47 - \log(Q_t))^2 + (\log(FR) + 1.22)^2]^{0.5}$

Small Strain Modulus, G_0
$G_0 = \rho Vs^2$

Elastic Modulus, Es (assumes $q/q_{ultimate} \sim 0.3$, i.e. FS = 3)
$Es\ (1) = 2.6\psi G_0$
where $\psi = 0.56 - 0.33\log Q_{t,clean\ sand}$
$Es\ (2) = G_0$
$Es\ (3) = 0.015 \times 10^{(0.55Ic + 1.68)}(q_t - \sigma_{V0})$
$Es\ (4) = 2.5q_t$

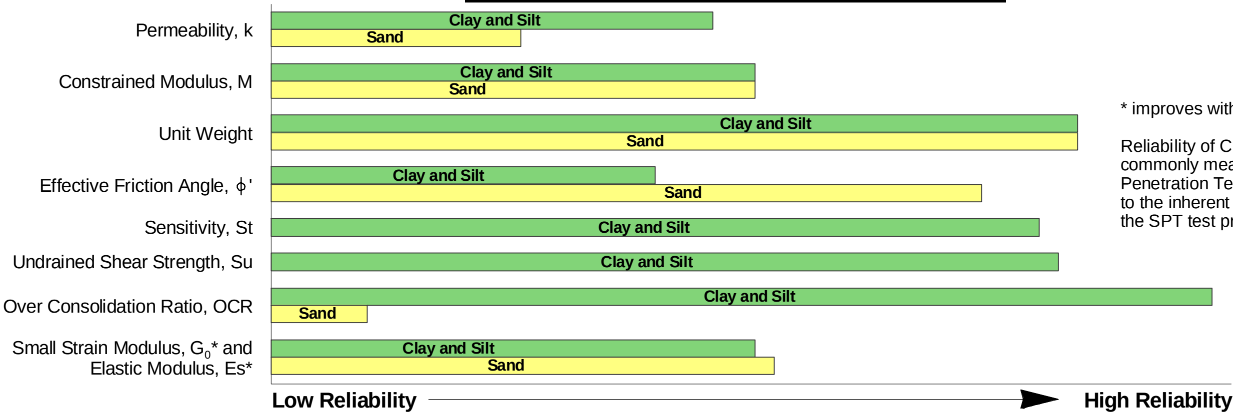
Constrained Modulus, M
$M = \alpha_M(q_t - \sigma_{V0})$
For Ic > 2.2 (fine-grained soils)
$\alpha_M = Q_t$ with maximum of 14
For Ic < 2.2 (coarse-grained soils)
$\alpha_M = 0.0188 \times 10^{(0.55Ic + 1.68)}$

Hydraulic Conductivity, k
For 1.0 < Ic < 3.27 $k = 10^{(0.952 - 3.04Ic)}$
For 3.27 < Ic < 4.0 $k = 10^{(-4.52 - 1.37Ic)}$

REPORTED PARAMETERS

CPT logs as provided, at a minimum, report the data as required by ASTM D5778 and ASTM D7400 (if applicable). This minimum data include tip resistance, sleeve resistance, and porewater pressure. Other correlated parameters may also be provided. These other correlated parameters are interpretations of the measured data based upon published and reliable references, but they do not necessarily represent the actual values that would be derived from direct testing to determine the various parameters. The following chart illustrates estimates of reliability associated with correlated parameters based upon the literature referenced below.

RELATIVE RELIABILITY OF CPT CORRELATIONS



* improves with seismic Vs measurements

Reliability of CPT-predicted N_{60} values as commonly measured by the Standard Penetration Test (SPT) is not provided due to the inherent inaccuracy associated with the SPT test procedure.

WATER LEVEL

The groundwater level at the CPT location is used to normalize the measurements for vertical overburden pressures and as a result influences the normalized soil behavior type classification and correlated soil parameters. The water level may either be "measured" or "estimated:"

Measured - Depth to water directly measured in the field

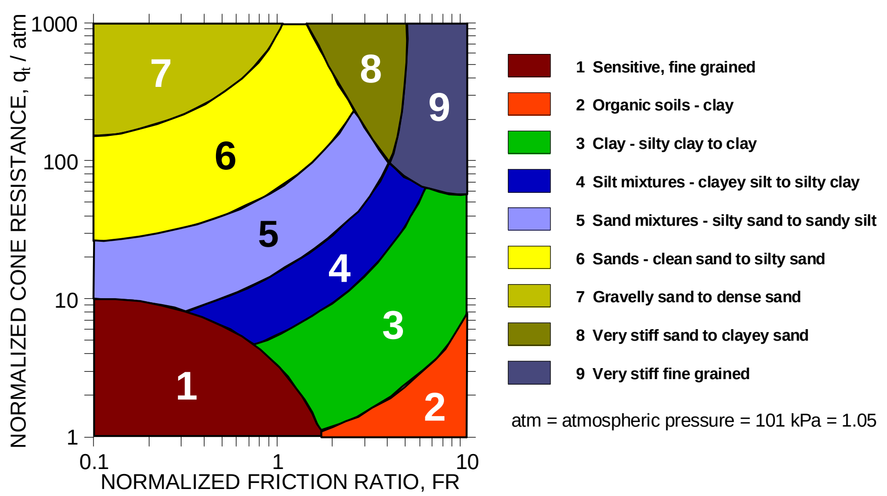
Estimated - Depth to water interpolated by the practitioner using pore pressure measurements in coarse grained soils and known site conditions

While groundwater levels displayed as "measured" more accurately represent site conditions at the time of testing than those "estimated," in either case the groundwater should be further defined prior to construction as groundwater level variations will occur over time.

CONE PENETRATION SOIL BEHAVIOR TYPE

The estimated stratigraphic profiles included in the CPT logs are based on relationships between corrected tip resistance (q_t), friction resistance (fs), and porewater pressure (U2). The normalized friction ratio (FR) is used to classify the soil behavior type.

Typically, silts and clays have high FR values and generate large excess penetration porewater pressures; sands have lower FRs and do not generate excess penetration porewater pressures. Negative pore pressure measurements are indicative of fissured fine-grained material. The adjacent graph (Robertson et al.) presents the soil behavior type correlation used for the logs. This normalized SBT chart, generally considered the most reliable, does not use pore pressure to determine SBT due to its lack of repeatability in onshore CPTs.



atm = atmospheric pressure = 101 kPa = 1.05 tsf

REFERENCES

Kulhawy, F.H., Mayne, P.W., (1997). "Manual on Estimating Soil Properties for Foundation Design," Electric Power Research Institute, Palo Alto, CA.
Mayne, P.W., (2013). "Geotechnical Site Exploration in the Year 2013," Georgia Institue of Technology, Atlanta, GA.
Robertson, P.K., Cabal, K.L. (2012). "Guide to Cone Penetration Testing for Geotechnical Engineering," Signal Hill, CA.
Schmertmann, J.H., (1970). "Static Cone to Compute Static Settlement over Sand," *Journal of the Soil Mechanics and Foundations Division*, 96(SM3), 1011-1043.

GENERAL NOTES

Terracon

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

- Auger
- Split Spoon
- Shelby Tube
- Macro Core
- No Recovery
- Rock Core
- Ring Sampler

GROUNDWATER

- Groundwater Initially Encountered
- Groundwater Level After a Specified Period of Time
- Static Groundwater Level After a Specified Period of Time
- No Groundwater Observed

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Std. Penetration Resistance (blows per foot)	Descriptive Term (Consistency)	Undrained Shear Strength (kips per square foot)	Std. Penetration Resistance (blows per foot)
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium-Stiff	0.50 to 1.00	5 - 7
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 14
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	above 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Descriptive Term(s) of other constituents	Percent of Dry Weight
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ³ 4 and 1 £ Cc £ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ³ 6 and 1 £ Cc £ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K, L, M, N] / Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K, L, M, P] / Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

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

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

[F] If soil contains ³ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ³ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ³ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ³ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ³ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.