Thales Academy Building #4

Geotechnical Engineering Report

March 11, 2024 | Terracon Project No. 70245029

Prepared for:

Stocks Engineering
801 East Washington Street
Nashville, North Carolina 27856

Terracon
Explore with us

Nationwide
Terracon.com

- Facilities
- Environmental
- Geotechnical
- Materials

2401 Brentwood Road, Suite 107
Raleigh, NC 27604
P (919) 873-2211
North Carolina Registered Firm: F-0869

Terracon.com

March 11, 2024

Stocks Engineering
801 East Washington Street
Nashville, North Carolina 27856

Attn: J. Michael Stocks
P: 252-903-6891
E: mstocks@stocksengineering.com

Re: Geotechnical Engineering Report
Thales Academy Building #4
65 SE Flowers Parkway
Clayton, North Carolina
Terracon Project No. 70245029

Dear Mr. Stocks:

We have completed the scope of Geotechnical Engineering services for the above-referenced project in general accordance with Terracon Proposal No. P70245029 dated February 5, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations 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

NORTH CAROLINA PROFESSIONAL SEAL 19331 3/11/2024 ENGINEER THOMAS M. SCHIPPOREIT

Rachel E. Zelinsky

Rachel Zelinsky, EI
Senior Staff Engineer

Tom Schipporeit, PE, BC.GE
Senior Geotechnical Enginee

Table of Contents

Figures

Attachments

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Thales Academy building to be located at 65 SE Flowers Parkway in Clayton, North Carolina. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Site Location and Exploration Plans
- SPT Boring logs with field and laboratory data
- Stratification based on visual soil classification
- Groundwater levels observed during and after the completion of drilling
- Subsurface exploration procedures
- Seismic site class per 2018 North Carolina Building Code
- Earthwork recommendations
- Recommended foundation type and engineering design parameters
- Estimated settlement of foundations
- Recommendations for design and construction of floor slabs
- Recommended pavement materials and soil subgrade design parameters.

The geotechnical engineering Scope of Services for this project included the advancement of SPT borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and SPT boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included in the **Exploration and Laboratory Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	This report is based on the following sources of information: ▪ Emails between Mike Stocks with Stocks Engineering and Rachel Zelinsky with Terracon on February 1, 2024. ▪ Conceptual Layout with proposed boring layouts prepared by Stock Engineering dated January 19, 2024. ▪ Geotechnical Engineering Report by Stewart Engineering dated March 1, 2021. ▪ Grading and Drainage Plan designed by Stocks Engineering dated March 22, 2021.
Project Description	The project includes a 2-story school building and associated pavements on a 19.2-acre site.
Building Construction	We anticipate that the building will be constructed using metal frame and slab-on-grade construction techniques.
Finished Floor Elevation	Not provided; we have assumed that finished floor is not more than 3 feet below or above existing grade.
Maximum Loads	In the absence of information provided by the design team, we have used the following assumed loads in estimating settlement based on our experience with similar projects. ▪ Columns: 200 kips ▪ Walls: 6 kips per linear foot (klf) ▪ Slabs: 150 pounds per square foot (psf)
Pavements	We assume flexible (asphalt) pavement sections will be used. New pavements will include drive lanes and a parking lot. We understand that 1,920 trips for passenger cars and SUVs, 1 garbage truck per week, and 1 delivery truck per day are expected for traffic loading on the new drive lanes. The pavement design period is 20 years.
Building Code	2018 North Carolina

Terracon should be notified if any of the above information is inconsistent with the planned construction, as modifications to our recommendations may be necessary.

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 topographic maps.

Item	Description
Parcel Information	The project is located at 65 SE Flowers Parkway in Clayton, North Carolina. Project site is approximately 19.2 acres. See **Site Location**
Existing Improvements	Existing school facility with passenger vehicle parking lot.
Current Ground Cover	Asphalt paved parking lot with landscaped and grassed islands. The southern side of the site is a grassed vacant lot.
Existing Topography	The ground surface across the site is relatively flat.

We also collected photographs at the time of our field exploration program. Representative photos are provided in our **Photography Log**.

Geotechnical Characterization

Geology

The site is located within the Piedmont physiographic province. The Piedmont is characterized by residual overburden soils and rock weathered in place from the underlying igneous and metamorphic rock. The soils have variable thicknesses and are referred to as residuum or residual soils. The residuum is typically finer grained and has higher clay content near the surface because of the advanced weathering. The soils typically become coarser grained with increasing depth because of decreased weathering. The boundary between soil and bedrock in the Piedmont is not sharply defined. A transitional zone termed "partially weathered rock" is normally found overlying the parent bedrock. Partially weathered rock (PWR) is an intermediate geomaterial defined for engineering purposes as residual material with Standard Penetration Resistances (N-values) exceeding 100 blows per foot.

Soil and Rock Conditions

We have developed a general characterization of the subsurface conditions based upon our review of the previous subsurface explorations by others, the recent Terracon subsurface explorations, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Existing Fill**	Stiff to medium stiff Sandy Silt (ML), soft to medium stiff Elastic Silt with Sand (MH), and loose Silty Sand (SM)
2	**Residual Soils**	Loose to medium dense Clayey Sand (SC), medium dense to dense Silty Sand (SM), stiff to very stiff Sandy Lean Clay (CL), and stiff to medium stiff Sandy Silt (ML)
3	**Partially Weathered Rock**	Partially weathered rock sampled as Silty Sand

Groundwater Conditions

The borings were advanced in the dry using a hollow stem auger drilling technique that allows short term groundwater observations to be made while drilling and at the completion of drilling. Groundwater was encountered at a depth of 14.5 feet in Boring B-1. The remaining borings did not encounter groundwater above the cave-in depths at the time of our field exploration. Borehole cave-ins were measured at depths of 7.5 to 18 feet. Mapping by the Natural Resources Conservation Service (NRCS) indicates a seasonal high groundwater level greater than 6.5 feet below the original ground surface at the site prior to past construction activities.

Groundwater conditions may be different at the time of construction. Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time of drilling. Long-term groundwater monitoring was outside the scope of services for this project.

Seismic Site Class

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration test (SPT) resistance (N-values), or undrained shear strength in accordance with the 2018 North Carolina Building Code. Based on the soil properties observed at the site and as described on the exploration logs and results, our professional opinion is that a **Seismic Site Classification of D** be considered for the project based on SPT N-values.

Subsurface explorations at this site were extended to a maximum depth of 20 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area.

Our experience indicates that evaluation of seismic site class using SPT N-values can be overly conservative. If it is determined that advantage could be gained with an improved Site Class, additional site testing could be performed to measure shear wave velocities at the site after design grades have been determined. Upcoming versions of ASCE 7-22, when adopted, will include site class designations that are entirely based on measured shear wave velocity profiles, and hybrid descriptions other than the common designations of "D" or "C" will be included. Terracon can provide a proposal for measuring the shear wave velocities at the site upon request.

Geotechnical Overview

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the SPT borings, provided that the recommendations provided in this report are implemented in the design and construction phases of this project.

Support of floor slabs and pavements on or above **undocumented existing fill** materials is discussed in this report. However, even with the recommended construction procedures, an inherent risk remains for the owner that compressible fill or unsuitable material, within or buried by the existing fill, will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report. To take advantage of the cost benefit of not removing the entire amount of undocumented fill, the owner must be willing to accept the risk of increased differential performance which can result in increased cracking and abrupt differential settlement. Should this risk be acceptable, floor slabs and pavements can be supported above the existing fill.

The majority of on-site soils are considered suitable to be used as **structural fill** materials.

The near surface silts and clays are **moisture-sensitive soils** and could become unstable with typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist.

We anticipate that **subgrade soil stabilization** of existing fill and soft or loose near-surface natural soils will be necessary in localized areas of the site. If site earthwork is performed during the typically cooler, wetter months of the year, additional undercutting is anticipated due to the potential for excessively wet unstable soils.

Based on the conditions encountered and estimated load-settlement relationships, the proposed structure can be supported on **shallow foundations** consisting of conventional continuous or spread footings.

We anticipate that undercutting of existing fill and soft or loose near-surface soils will be necessary in localized areas of the site. If site earthwork is performed during the typically cooler, wetter months of the year, additional undercutting is anticipated due to the potential for excessively wet unstable soils. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include stripping of topsoil and rootmat, excavations, and structural fill placement. The following sections provide recommendations for use in the preparation of specifications for earthwork. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Existing Fill

As noted in **Geotechnical Characterization**, Borings B-2 through B-5 encountered previously placed fill to depths ranging from about 3 to 8 feet. We have no records to indicate the degree of fill placement control, and consequently, the fill near Boring B-4 is considered unreliable for support of foundation loads. Support of buildings and pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction procedures, inherent risk exists for the owner that compressible fill or unsuitable material, within or buried by the fill will, not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report.

If the owner elects to construct the building and pavements on the existing fill to reduce initial construction costs in exchange for increased potential longer-term distress, the following protocol should be followed. Once the planned subgrade elevation has been reached, the building and pavement areas should be proofrolled. Areas of soft, loose, or unsuitable material should be undercut and replaced with structural fill.

Demolition

The proposed construction areas include existing site features which will need to be demolished, such as buildings, sidewalks, pavements, underground utilities, and/or stormwater pipes and structures. We recommend the existing site features be removed from within the proposed construction areas.

Special precautions should be made to remove existing underground utilities in proposed construction areas. Terracon considers removing the existing utilities and/or underground structures and backfilling the resulting trenches to be the preferred method of demolition. In-place abandonment by filling utility or stormwater pipes with grout should only be considered in the building footprint after checking the location of the piping in both plan and elevation space for potential conflict with the proposed foundations and new utilities. Care should be given to locating and addressing these items during the site preparation phase of the project. If overlooked, they could be detrimental to the long-term performance of the project.

Site Preparation

Vegetation, topsoil and rootmat should be removed completely from the proposed construction areas. Topsoil was encountered in the explorations to a depth of approximately 1 inch. The Geotechnical Engineer should field verify the stripping depth during construction. Stripped materials consisting of soil with organic material should be removed from the site or placed in non-structural areas to be landscaped. Subgrade Preparation

Proofrolling should be performed after stripping and prior to placing fill in fill areas and after stripping and excavating to design subgrade elevations in cut areas. The subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the observation of the Geotechnical Engineer or representative. Areas excessively deflecting and/or pumping under the proofrolling should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should be stabilized as described in the next section of this report.

Soil Subgrade Stabilization

Soft and loose near-surface soils were encountered in Borings B-4 and B-6. Stabilization of these soils will likely be required prior to fill placement or overlying construction in these areas and in other localized areas at the site.

Methods of subgrade improvement, as described below, could include scarification, moisture conditioning and recompaction; removal of unstable materials and replacement with granular fill (with or without geosynthetics); and chemical stabilization. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

If the exposed subgrade is unstable during proofrolling operations, it could be stabilized using one of the methods outlined below.

- **Scarification and Recompaction** - It may be feasible to scarify, dry, and recompact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Stable subgrades likely would not be achievable if the thickness of the unstable soil is greater than about 1 foot, if the unstable soil is at or near groundwater levels, or if construction is performed during a period of wet or cool weather when drying is difficult.

- **Undercut and Replace** - The use of undercutting and backfilling with select granular fill is a common procedure to improve subgrade stability. Typical undercut depths would be expected to range from about 12 to 24 inches below finished subgrade elevation. The use of high modulus geotextiles (i.e., engineering fabric or geogrid) could also be considered after underground work such as utility construction is completed. Prior to placing the geotextile or geogrid, we recommend that all below grade construction, such as utility line installation, be completed to avoid damaging the fabric or geogrid. Equipment should not be operated above the fabric or geogrid until one full lift of granular fill is placed above it. The maximum particle size of granular material placed over geotextile fabric or geogrid should not exceed 1-1/2 inches.

- **Chemical Modification** - Improvement of subgrades with Portland cement or lime could be considered for improving unstable soils. Chemical modification should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the geotechnical engineer prior to use. The hazards of chemicals blowing across the site or onto adjacent property should also be considered. Additional testing would be needed to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. Additional testing could include, but not be limited to, determining the most suitable stabilizing agent and the optimum amounts required.

Undercutting and replacement of existing undocumented fill and/or soft or loose subgrade soil in localized areas should be anticipated for this project and should be addressed contractually through allowances and unit prices.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the geotechnical conditions are exposed.

Excavation Considerations

Excavatability

We anticipate that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

Excavation Safety

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.

Excavations or other activities resulting in ground disturbance have the potential to affect structures, pavements, and utilities. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities should be monitored or instrumented for potential ground movements that could negatively affect nearby structures, pavements, and utilities.

Excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

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.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below or within 10 feet of structures, pavements, retaining walls, berms, or constructed slopes. General fill is material used to achieve grade outside of these areas.

Reuse of On-Site Soil: Material property requirements for on-site soil for use as general fill and structural fill are noted in the table below:

Property	General Fill	Structural Fill
Composition	Free of deleterious material	Free of deleterious material
Maximum particle size	6 inches (or 2/3 of the lift thickness)	3 inches
Fines content	Not limited	Not limited
Plasticity	Not limited	Maximum liquid limit of 50 Maximum plasticity index of 30

1. Based on subsurface exploration. Actual material suitability should be determined in the field at time of construction.

Imported Fill Materials: Imported fill materials should meet the following material property requirements. Regardless of its source, structural fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

Soil Type[1]	USCS Classification	Acceptable Parameters (for Structural Fill)
Low-Plasticity, Fine Grained Soil	CL, CL-ML ML	Liquid Limit less than 50 Plasticity index less than 30
Coarse-Grained Soil	GW, GP, GM, GC, SW, SP, SM, SC	Less than 50% passing No. 200 sieve Liquid Limit less than 50 Plasticity index less than 30
Select Granular Fill[2]	SP, SP-SM, SW, or SW-SM	Less than 12% passing No. 200 sieve Plasticity index less than 10

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site. Additional geotechnical consultation should be provided prior to use of uniformly graded gravel (GP) on the site.
2. NCDOT Class II, Type 1 Select Material. Manufactured materials such as processed fill screenings meeting this specification can be used.

Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Structural Fill	General Fill
Maximum Lift Thickness	10 inches in loose thickness when heavy, self-propelled compaction equipment is used 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as structural fill
Minimum Compaction Requirements[1,2]	Minimum of 95% of the material's standard Proctor maximum dry density (ASTM D698). The top lift of structural fill should be compacted to a minimum of 98% of the material's standard Proctor maximum dry density (ASTM D698) for floor slabs and pavements.	92% of max.
Water Content Range[1]	Low-plasticity fine-grained soil: -3% to +3% of optimum Coarse-grained soil: -3% to +3% of optimum	As required to achieve min. compaction requirements and stability

Item	Structural Fill	General Fill

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer or representative.

Grading and Drainage

All grades must provide effective drainage away from the building(s) during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements resulting in cracked slabs and walls.

Subgrade Protection and Repair

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. 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 construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

Construction Observation and Testing

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proofrolling, placement and compaction of engineered fill, backfilling of excavations, and just prior to construction of building floor slabs and pavements.

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and pavements), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of structural fill should be tested, evaluated, and reworked, as necessary, as recommended 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 of at least one test for every 2,500 square feet of structural fill in the building areas and 5,000 square feet in pavement areas. Where not specified by local ordinance, one density and water content test should be performed for every 100 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. A representative of the geotechnical engineer should use a combination of hand auger borings and dynamic cone penetrometer (DCP) testing to determine the suitability of the bearing materials for the design bearing pressure. DCP testing should be performed to a depth of 3 to 5 feet below the bottom of foundation excavation. If existing fill is found below the proposed foundation the hand auger and DCP should be extended to natural soils. In areas were existing fill remains under the proposed building the frequency of testing should be increased. If unanticipated conditions are observed, the Geotechnical Engineer should recommend 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.

Shallow Foundations

The proposed building can be supported by shallow foundations. If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive and Lateral Loads

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	3,000 psf
Required Bearing Stratum [3]	Undisturbed low-plasticity (PI<30) native soils or structural fill.
Minimum Foundation Dimensions	Per 2018 North Carolina Building Code
Ultimate Passive Resistance[4] **(Equivalent fluid pressure)**	274 pcf

Item	Description
Sliding Resistance [5]	0.30 ultimate coefficient of friction
Minimum Embedment below Finished Grade [6]	12 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2, 7]	About 1/2 of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Unsuitable or soft/loose soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. Assumes no hydrostatic pressure.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for coarse-grained materials is dependent on the bearing pressure which may vary due to load combinations. For fine-grained materials, lateral resistance using cohesion should not exceed ½ the dead load.
6. Embedment necessary to minimize the effects of frost. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
7. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

Design Parameters – Overturning and Uplift Loads

Shallow foundations subjected to overturning loads should be proportioned such that the resultant eccentricity is maintained in the center-third of the foundation (e.g., $e < b/6$, where b is the foundation width). This requirement is intended to keep the entire foundation area in compression during the extreme lateral/overturning load event. Foundation oversizing may be required to satisfy this condition.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils with consideration to the IBC basic load combinations.

Item	Description
Soil Moist Unit Weight	115 pcf
Soil Effective Unit Weight[1]	52 pcf
Soil weight included in uplift resistance	Soil included within the prism extending up from the top perimeter of the footing vertically to ground surface

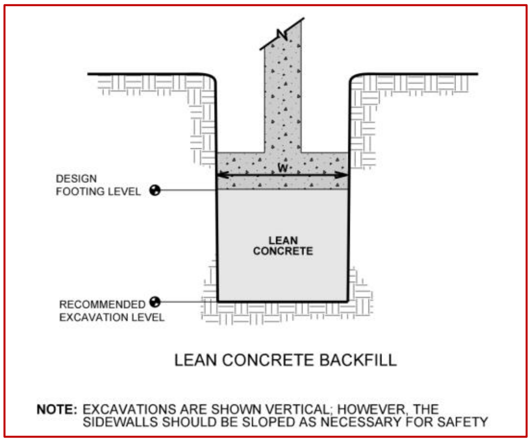
1. Effective (or buoyant) unit weight should be used for soil above the foundation level and below a water level. The high groundwater level should be used in uplift design as applicable.

Foundation Construction Considerations

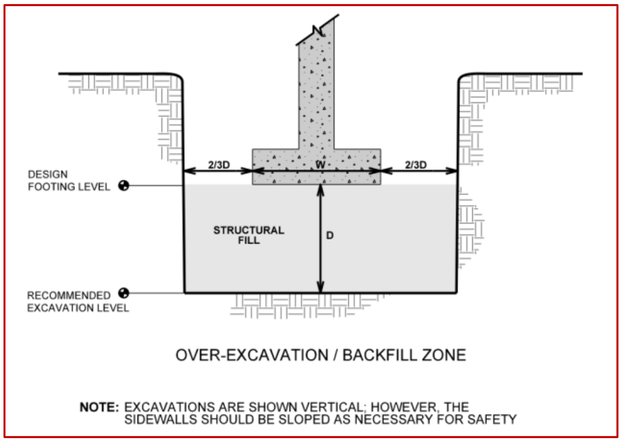
As noted in **Earthwork**, the footing excavations should be evaluated under the observation of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Loose or soft soils exposed at the surface of footing excavations may require surficial compaction with hand-held dynamic compaction equipment prior to placing structural fill, reinforcing steel, and/or concrete. Should surficial compaction not be adequate, construction of a working surface consisting of either well-graded crushed stone (ABC) or a lean concrete mud mat may be required prior to the placement of reinforcing steel and construction of foundations.

If unsuitable bearing soils are observed at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The lean concrete replacement zone is illustrated on the sketch below.



Overexcavation for structural fill placement below footings should be conducted as shown below. The overexcavation should be backfilled up to the footing base elevation with structural fill placed as recommended in the **Earthwork** section. If poorly-graded gravel (e.g., No. 57 stone) is used, it should be wrapped in a woven geotextile that can be used for both separation and filtration (e.g., Mirafi HP270).



Floor Slabs

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the base course beneath the floor slab.

Existing fill materials were observed at the site to depths of 3 to 8 feet below existing grade. As previously discussed, any existing fill present beneath floor slabs should be completely removed or further evaluated by the Geotechnical Engineer during construction.

Floor Slab Design Parameters

Item	Description
Floor Slab Support[1]	Use 4 inches of base course. For slabs above exterior grades[2], the base course material should consist of compactible, easy-to-trim, granular fill that will remain stable and support construction traffic. Suitable materials include soil which classifies as SP, SW, or SM. ABC[3], No. 57 stone, or No. 67 stone can also be used. Subgrade compacted to recommendations in **Earthwork**
Estimated Modulus of Subgrade Reaction [4]	125 pounds per square inch per inch (psi/in) for point loads

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation (unless a post-tensioned monolithic slab is used).
2. A base course is not required by 2018 NC Building Code nor ACI 302 for floor slabs above exterior grade. However, it is good design and construction practice to include a base course to provide uniform support and improve constructability, especially over fine-grained subrade soils.
3. Per ACI 360R-12, ABC produces more uniform support and provides an all-weather working surface to speed construction during inclement weather.
4. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

The use of a vapor retarder or vapor barrier should be considered beneath concrete slabs-on-grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder or barrier, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder or barrier.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Settlement of floor slabs supported on existing fill materials cannot be accurately predicted but could be larger than normal and result in some cracking. Mitigation measures, as noted in **Existing Fill** within **Earthwork**, are critical to the performance of floor slabs. In addition to the mitigation measures, the floor slab can be stiffened by adding steel reinforcement, grade beams, and/or post-tensioned elements.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab base course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Pavements

General Pavement Comments

Pavement section thicknesses are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement section thicknesses noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

A California Bearing Ratio (CBR) of 5 was used to determine recommendation pavement section thicknesses for the asphaltic concrete (AC) pavement. This value was empirically derived based upon our experience with the anticipated subgrade soils and our expectation of the quality of the subgrade as prescribed in **Earthwork**. A modulus of rupture of 630 psi was used in our analysis for the concrete pavement sections (based on correlations with a minimum 28-day compressive strength of 4,000 psi).

Pavement Section Thicknesses

The following table provides our opinion of minimum thickness for AC sections for private drives and parking areas:

Asphaltic Concrete Design

Layer	Thickness (inches)	
	Light Duty (Parking Lot) [1]	Heavy Duty (Drive Lanes) [1]
AC Surface Course [2]	3[3]	3[3]
Aggregate Base Course (ABC)	6	8

1. See **Project Description** for more specifics regarding traffic assumptions.
2. All materials should meet the current North Carolina Department of Transportation (NCDOT) Standard Specifications for Highway and Bridge Construction.
    - Asphaltic Surface - NCDOT Type S9.5B Asphaltic Cement Concrete: Section 600
    - Aggregate Base Course – NCDOT ABC: Division 10, Section 1005
3. Placed in two equal-thickness lifts

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles.

The placement of a partial pavement thickness for use during construction is not recommended without a detailed pavement analysis incorporating construction traffic. In addition, we should be contacted to confirm the traffic assumptions outlined above. If the actual traffic varies from the assumptions outlined above, modification of the pavement section thickness could be required.

Although not required for structural support, a minimum 4-inch-thick base course layer under concrete pavements is recommended to help reduce potential for slab curl, shrinkage cracking, and subgrade pumping through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer. PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330 and ACI 325.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. Islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils are particular areas of concern. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the stormwater collection system, longitudinal subdrains, or other suitable outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

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. 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 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 affect 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. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. 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.

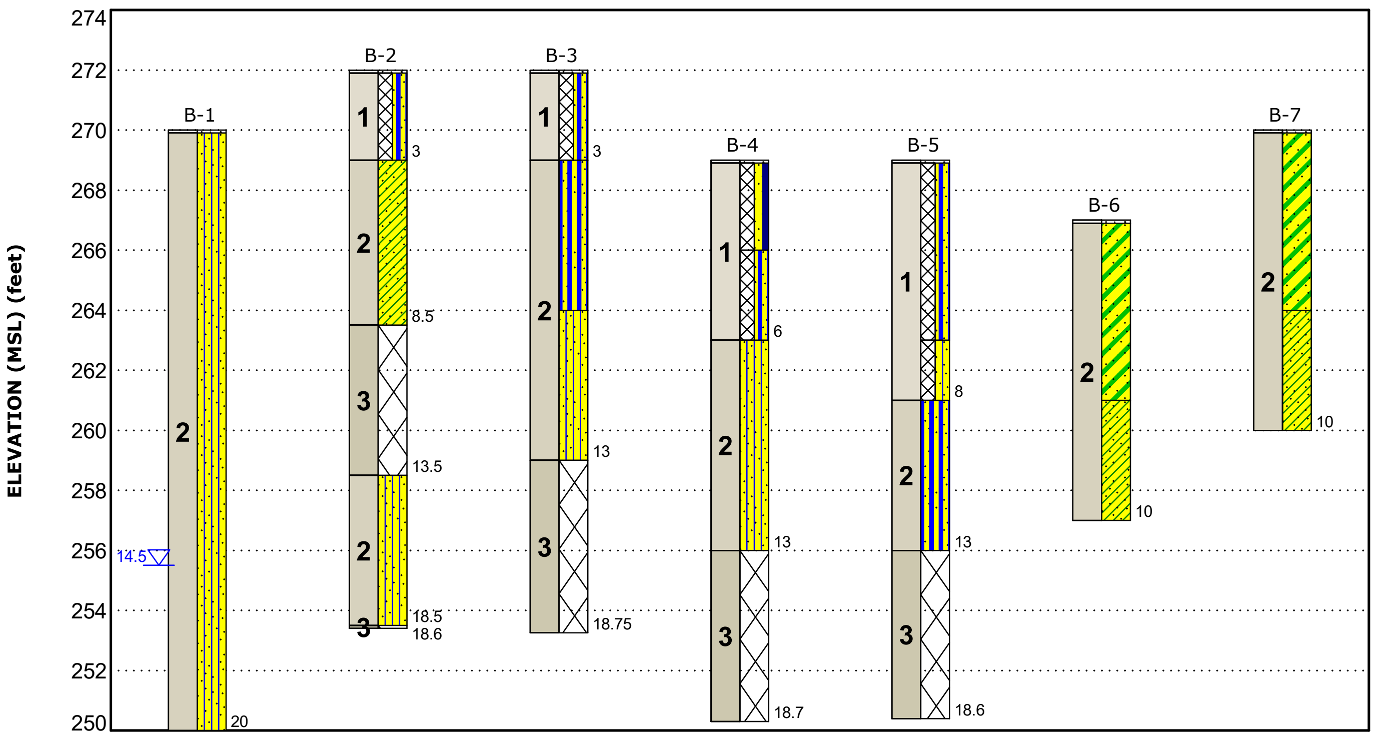
Figures

Contents:

GeoModel

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Existing Fill**	Stiff to medium stiff Sandy Silt (ML), soft to medium stiff Elastic Silt with Sand (MH), and loose Silty Sand (SM)
2	**Residual Soil**	Loose to medium dense Clayey Sand (SC), medium dense to dense Silty Sand (SM), stiff to very stiff Sandy Lean Clay (CL), and stiff to medium stiff Sandy Silt (ML)
3	**Partially Weathered Rock**	Partially weathered rock sampled as Silty Sand (SM)

Legend

- Topsoil
- Silty Sand
- Sandy Silt
- Sandy Lean Clay
- Weathered Rock
- Elastic Silt with Sand
- Clayey Sand

First Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
5	18.5 to 20	Building
2	10	Pavement

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±20 feet) and referencing existing site features. Approximate ground surface elevations were estimated using Grading and Drainage Plan prepared by Stocks Engineering dated March 22, 2021.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted rotary drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions). Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. For safety purposes, all borings were backfilled with auger cuttings after their completion.

We also observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. The groundwater levels at the time of our exploration are shown on the attached boring logs.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by geotechnical staff. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent our interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

Geotechnical staff reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Atterberg Limits
- Percent Fines

The laboratory testing program included examination of soil samples by geotechnical staff. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Photography Log

View of the existing stormwater pond. Taken on February 6, 2024.

View of Borings B-6 and B-7 for the proposed parking lot. Taken on February 6, 2024.

View of Boring B-4 and the current construction on site. Taken on February 6, 2024.

View of the constructed building and Boring B-4. Taken on February 6, 2024.

Site Location and Exploration Plans

Contents:

Note: All attachments are one page unless noted above.

Site Location

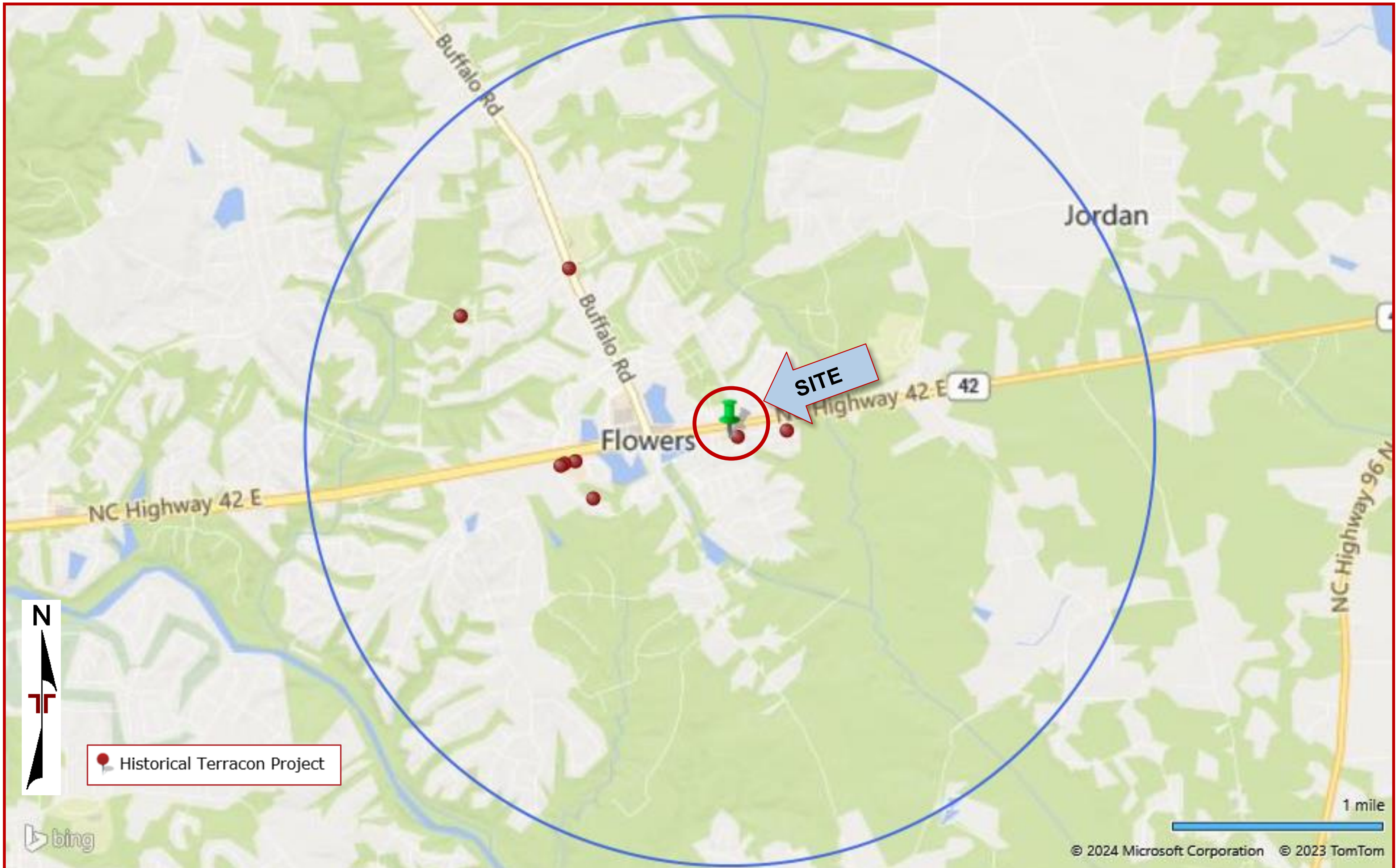


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

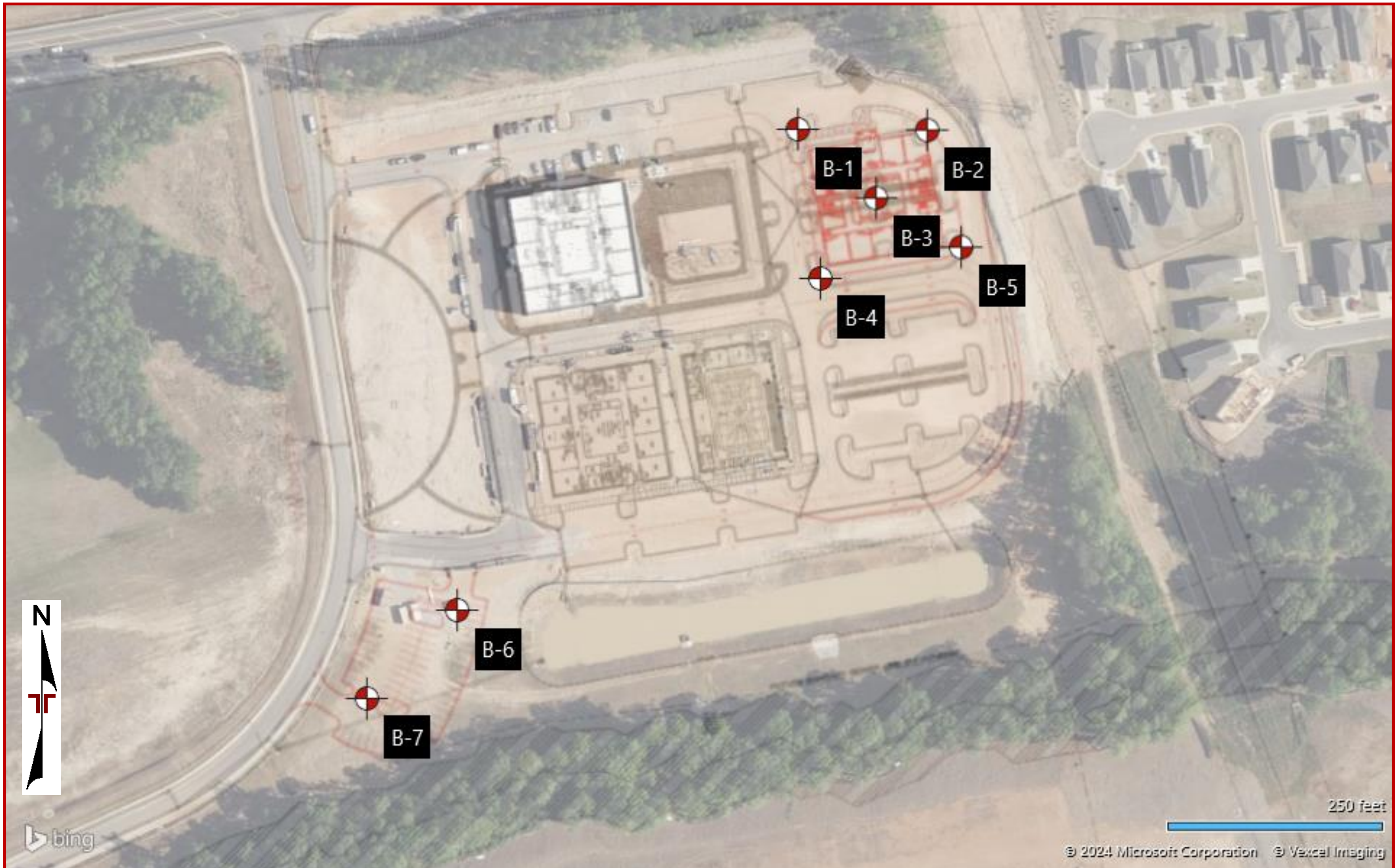


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

2024 CONCEPTUAL SITE PLAN PREPARED BY STOCKS

Exploration and Laboratory Results

Contents:

Note: All attachments are one page unless noted above.

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 35.6539° Longitude: -78.3380°

Model Layer	Depth (Ft.)	Material Description	Elevation: 270 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
2	0.1	**TOPSOIL (1 inch)**	269.9							
		SILTY SAND (SM), tan, orange, gray, medium dense								
						X	6-4-7 N=11			
						X	4-5-8 N=13	16.7	36-35-1	43
				5						
						X	4-6-8 N=14			
						X	7-9-9 N=18			
				10						
					▽	X	5-6-9 N=15			
				15						
					Cave in					
						X	2-3-7 N=10			
	20.0		250	20						

Boring Terminated at 20 Feet

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.

Elevation Reference: Elevations were interpolated from a topographic site plan.

Water Level Observations
▽ Water level at 14.5 feet at completion of drilling.

Cave in at a depth of 16.5 feet.

Drill Rig
Geoprobe

Hammer Type
Automatic

Driller
Quantex

Notes

Advancement Method
2.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
Rachel Zelinsky

Boring Started
02-13-2024

Boring Completed
02-13-2024

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 35.6539° Longitude: -78.3376°

Elevation.: 272 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
	0.1	**TOPSOIL (1 inch)**	271.9						
1	3.0	**FILL - SANDY SILT (ML)**, brown, gray, stiff	269			4-4-5 N=9			
2	8.5	**SANDY LEAN CLAY (CL)**, red, gray, brown, very stiff to stiff	263.5			5-8-9 N=17; 2-4-7 N=11			
3	13.5	**PARTIALLY WEATHERED ROCK (sampled as Silty Sand)**, white, orange	258.5			9-50/1"			
2	18.5	**SILTY SAND (SM)**, white, orange, dense	253.5	Cave in (18 ft)		13-14-17 N=31			
3	18.6	**PARTIALLY WEATHERED ROCK (sampled as Silty Sand)**, white, orange	253.4			14-50/1"			

Boring Terminated at 18.6 Feet

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.

Elevation Reference: Elevations were interpolated from a topographic site plan.

Water Level Observations
Dry to 18 feet at completion of drilling.

Cave in at a depth of 18 feet.

Drill Rig
Geoprobe

Hammer Type
Automatic

Driller
Quantex

Notes

Advancement Method
2.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
Rachel Zelinsky

Boring Started
02-13-2024

Boring Completed
02-13-2024

2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 35.6537° Longitude: -78.3377°

Model Layer	Depth (Ft.)	Material Description	Elevation.: 272 (Ft.)	Field Test Results
1	0.1	**TOPSOIL (1 inch)**	271.9	
		FILL - SANDY SILT (ML), brown, orange, medium stiff		1-2-4 N=6
	3.0		269	
2		**SANDY SILT (ML)**, brown, orange, stiff to medium stiff		3-3-6 N=9; 2-4-4 N=8
	8.0		264	
		SILTY SAND (SM), white, orange, medium dense		14-11-18 N=29
	13.0		259	
3		**PARTIALLY WEATHERED ROCK (sampled as Silty Sand)**, white, orange		6-31-50/4"; 50/3"
	18.8		253.25	

Boring Terminated at 18.75 Feet

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.

Elevation Reference: Elevations were interpolated from a topographic site plan.

Water Level Observations
Dry to 17.5 feet at completion of drilling.

Cave in at a depth of 17.5 feet.

Drill Rig
Geoprobe

Hammer Type
Automatic

Driller
Quantex

Notes

Advancement Method
2.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
Rachel Zelinsky

Boring Started
02-13-2024

Boring Completed
02-13-2024

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 35.6535° Longitude: -78.3380°

Model Layer	Depth (Ft.)	Description	Elevation.: 269 (Ft.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.1	**TOPSOIL (1 inch)**	268.9				
1		**FILL - ELASTIC SILT WITH SAND (MH)**, orangish brown, soft to medium stiff		1-2-2 N=4	29.5	50-30-20	74
1	3.0	**FILL - SANDY SILT (ML)**, reddish brown, stiff	266	1-4-6 N=10			
2	6.0	**SILTY SAND (SM)**, red, brown, medium dense	263	4-5-5 N=10			
2				5-8-2 N=10			
3	13.0	**PARTIALLY WEATHERED ROCK (sampled as Silty Sand)**, white, tan	256	50/5"			
3	18.7		250.3	50/2"			
		Boring Terminated at 18.7 Feet					

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.

Elevation Reference: Elevations were interpolated from a topographic site plan.

Water Level Observations
Dry to 17.5 feet at completion of drilling.

Cave in at a depth of 17.5 feet.

Drill Rig
Geoprobe

Hammer Type
Automatic

Driller
Quantex

Notes

Advancement Method
2.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
Rachel Zelinsky

Boring Started
02-13-2024

Boring Completed
02-13-2024

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 35.6536° Longitude: -78.3374°

Elevation.: 269 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.1	**TOPSOIL (1 inch)**	268.9				
1	6.0	**FILL - SANDY SILT (ML)**, reddish brown, stiff to medium stiff	263	2-4-5 N=9			
				2-2-3 N=5	27.0	48-39-9	62
1	8.0	**FILL - SILTY SAND (SM)**, reddish brown, loose	261	1-2-4 N=6			
2	13.0	**SANDY SILT (ML)**, reddish brown, medium stiff to stiff	256	4-4-4 N=8			
3	18.6	**PARTIALLY WEATHERED ROCK (sampled as Silty Sand)**, white	250.4	50/5"			
				50/1"			

Boring Terminated at 18.6 Feet

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.

Elevation Reference: Elevations were interpolated from a topographic site plan.

Water Level Observations
Dry to 18 feet at completion of drilling.

Cave in at a depth of 18 feet.

Drill Rig
Geoprobe

Hammer Type
Automatic

Driller
Quantex

Notes

Advancement Method
2.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
Rachel Zelinsky

Boring Started
02-13-2024

Boring Completed
02-13-2024

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Log No. B-6

Location: See Exploration Plan

Latitude: 35.6524° Longitude: -78.3394°

Model Layer	Graphic Log	Depth (Ft.)	Material Description	Elevation.: 267 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
2		0.1	**TOPSOIL (1 inch)**	266.9							
			CLAYEY SAND (SC), dark brown, red, loose to medium dense					2-2-2 N=4			
								4-5-8 N=13			
		6.0		261	5						
			SANDY LEAN CLAY (CL), light gray, very stiff					4-8-11 N=19			
						Cave in					
								5-7-10 N=17			
		10.0		257	10						
			Boring Terminated at 10 Feet								

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.

Elevation Reference: Elevations were interpolated from a topographic site plan.

Water Level Observations
Dry to 7.5 feet at completion of drilling.

Cave in at a depth of 7.5 feet.

Drill Rig
Geoprobe

Hammer Type
Automatic

Driller
Quantex

Notes

Advancement Method
2.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
Rachel Zelinsky

Boring Started
02-13-2024

Boring Completed
02-13-2024

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

Boring Log No. B-7

Location: See Exploration Plan

Latitude: 35.6522° Longitude: -78.3397°

Model Layer	Graphic Log	Depth (Ft.)	Description	Elevation.: 270 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
2		0.1	**TOPSOIL (1 inch)**	269.9							
			CLAYEY SAND (SC), dark gray, medium dense					4-5-8 N=13			
								2-5-7 N=12	19.4	38-22-16	46
		6.0		264	5						
			SANDY LEAN CLAY (CL), tan, orange, light gray, very stiff					8-11-10 N=21			
						Cave in		7-8-10 N=18			
		10.0		260	10						

Boring Terminated at 10 Feet

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.

Elevation Reference: Elevations were interpolated from a topographic site plan.

Water Level Observations
Dry to 7.5 feet at completion of drilling.

Cave in at a depth of 7.5 feet.

Drill Rig
Geoprobe

Hammer Type
Automatic

Driller
Quantex

Notes

Advancement Method
2.25" Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
Rachel Zelinsky

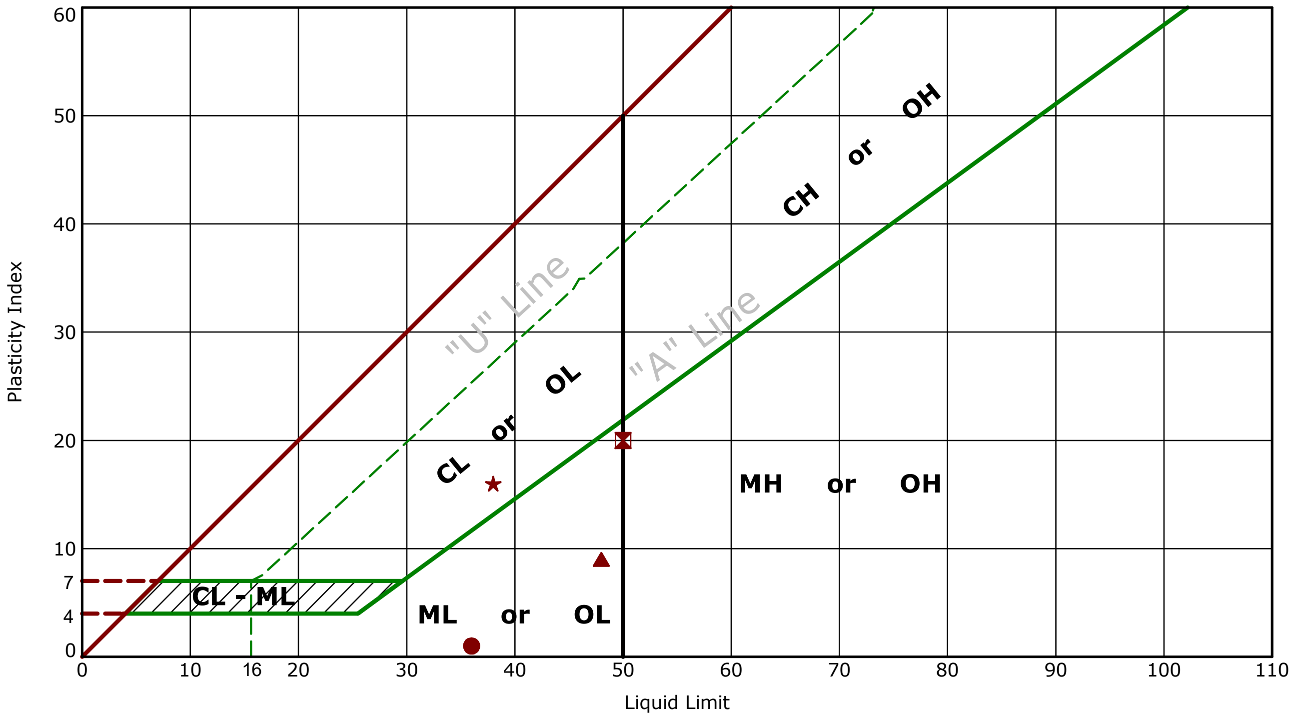
Boring Started
02-13-2024

Boring Completed
02-13-2024

2401 Brentwood Rd Ste 107
Raleigh, NC

Atterberg Limit Results

ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	3.5 - 5	36	35	1	43.1	SM	SILTY SAND
⊠	B-4	1 - 2.5	50	30	20	74.2	MH	ELASTIC SILT with SAND
▲	B-5	3.5 - 5	48	39	9	61.5	ML	SANDY SILT
★	B-7	3.5 - 5	38	22	16	46.0	SC	CLAYEY SAND

Supporting Information

Contents:

Terracon
2401 Brentwood Rd Ste 107
Raleigh, NC

General Notes

Sampling	Water Level		Field Tests	
Split Spoon		Water Initially Encountered	N	Standard Penetration Test Resistance (Blows/Ft.)
		Water Level After a Specified Period of Time	(HP)	Hand Penetrometer
		Water Level After a Specified Period of Time	(T)	Torvane
		Cave In Encountered	(DCP)	Dynamic Cone Penetrometer
	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.		UC	Unconfined Compressive Strength
			(PID)	Photo-Ionization Detector
			(OVA)	Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. 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		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		
Relative Density	**Standard Penetration or N-Value (Blows/Ft.)**	**Consistency**	**Unconfined Compressive Strength Qu (tsf)**	**Standard Penetration or N-Value (Blows/Ft.)**
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	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	**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≥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≥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 above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	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] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot 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 ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.