PRELIMINARY GEOTECHNICAL EXPLORATION REPORT

ETOWAH GOLF COURSE,
ETOWAH, NORTH CAROLINA

Prepared For:
Tribute Companies
10 South Cardinal Drive
Wilmington, NC 28403

BLE Project Number J23-17210-04

September 20, 2023

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BUNNELL LAMMONS ENGINEERING

September 20, 2023

Tribute Construction
10 South Cardinal Drive
Wilmington, NC 28403

Attention: Mr. Kent Tanner

Subject: **PRELIMINARY GEOTECHNICAL EXPLORATION REPORT**
Etowah Golf Course Residential Development
Etowah, North Carolina
BLE Project No. J23-17210-04

Dear Mr. Tanner:

Bunnell-Lammons Engineering, Incorporated (BLE) is pleased to present this report of preliminary geotechnical exploration for the proposed development of the Etowah Golf Course located at 470 Brickyard Road in Etowah, North Carolina. The worked performed during this exploration was performed as described in Bunnell-Lammons Engineering (BLE) Proposal No. P23-1583 dated September 11, 2023. The exploration was authorized on September 13, 2023, by the signature of Mr. Kent Tanner on our Proposal Acceptance Sheet.

Sincerely,

BUNNELL LAMMONS ENGINEERING INC.
NC FIRM REGISTRATION # C-1538

Tim Woodcock
Project Manager

Jesse R. Jacobson, P.E.
Director of Technical Services
NC Registration #030948

NORTH CAROLINA PROFESSIONAL SEAL 030948 ENGINEER JESSE R. JACOBSON 9/21/23

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Appendix

1.0 AUTHORIZATION

A limited geotechnical assessment has been requested for the proposed new residential development to be located at the Etowah Golf Course, located at 470 Brickyard Rd in Etowah, North Carolina. The work performed during this exploration was performed as described in Bunnell-Lammons Engineering (BLE) Proposal No. P23-1583 dated September 11, 2023. The exploration was authorized on September 13, 2023, by the signature of Mr. Kent Tanner on our Proposal Acceptance Sheet.

2.0 SCOPE OF EXPLORATION

This report details the findings of the limited geotechnical exploration performed for the proposed residential development to be located at the Etowah Golf Course in Etowah, North Carolina (reference Figure 1 in Appendix A). The intent of this exploration was to evaluate the subsurface soil and groundwater conditions at the site and to evaluate the feasibility of the onsite soils to be used as structural fill material for the lots and infrastructure, and to provide preliminary geotechnical recommendations for design of the foundations, floor slabs and associated project elements. We have also included a discussion of secondary design considerations and provided geotechnical related construction recommendations.

3.0 PROJECT INFORMATION

A residential development is currently being planned for the site, located at the Etowah Golf and Resort with an address of 470 Brickyard Road, Etowah, North Carolina. The development will consist of two adjoining parcels with Henderson County property PINs 9529524218 (173.84-acres) and 9529351112 (65.97-cres). It is currently planned to include approximately 200 residential lots and associated amenities. BLE is generally familiar with the site, having performed a preliminary geotechnical exploration for a different design that has since been abandoned (please refer to BLE report J23-17210-02 dated March 31, 2023). Grading plans were not available at the time of the exploration, however, we were provided a drawing from CDC on September 7, 2023 titled “Etowah Residential Cut Areas Exhibit”. Based on this exhibit, we understand that the rolling hills west and east of the Gash Creek flood plain are the anticipated areas of cut, and also of the source material for raising grades in the lower lying areas. Anticipated maximum cut/fill depths are thought to be +/- 10 feet. Infrastructure is though to consist of timber framed homes supported by shallow foundations with slabs on grade. We anticipate relatively light loaded buildings, with bearing pressures not exceeding 2,000 psf.

4.0 FIELD EXPLORATION

The site was explored by excavating seven (7) test pits at the locations indicated by Tribute properties. The test pits were excavated at the approximate locations shown on the attached Test Pit Location Plan (reference Figure 1 in Appendix A). The locations were identified by Tribute personnel at the time of exploration. The test pit locations shown in Appendix A should be considered approximate. A description of our field procedures is also included as Appendix B.

5.0 SITE GEOLOGY

The project site is in the Blue Ridge Physiographic Province. The bedrock in this region is a complex crystalline formation that has been faulted and contorted by past tectonic movements. The rock has weathered to residual soils which form the mantle for the hillsides and hilltops. The typical residual soil profile in areas not disturbed by erosion or human activities consists of silty and/or clayey soils near the surface where weathering is more advanced, underlain by sandy silts and silty sands.

The boundary between soil and rock is not sharply defined, and there often is a transitional zone, termed "partially weathered rock," overlying the parent bedrock. Partially weathered rock is defined, for engineering purposes, as residual material with standard penetration resistances in excess of 100 blows per foot (bpf). Weathering is facilitated by fractures, joints, and the presence of less resistant rock types. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is relatively common to find lenses and boulders of hard rock and/or zones of partially weathered rock within the soil mantle, well above the general bedrock level.

Areas near drainage features and in valleys often contain alluvial, or water-deposited, soils that have been deposited over geologic time by streams, past floods, and gradual erosion from higher elevations. In mountainous areas, colluvial, or gravity-deposited, materials are commonly found on the sides and at the base of steep slopes, in swales, and along drainage features from past landslides and erosion.

6.0 SITE CONDITIONS

Site conditions were observed by BLE personnel during the excavation of the test pits. The site under consideration is currently in use as the Etowah Valley Golf Course and Resort. Most of the site is characterized by grassy areas with occasional trees and bushes scattered throughout. There is also a network of asphalt walkways/driveways on the property for pedestrian and golf cart access.

The existing clubhouse for the golf course is in the central section of the site (The building has an address of 470 Brickyard Lane). This is a single-story building with a brick veneer. No structural distress was noted in the building. The building type and the year of construction are unknown to BLE at the time of writing this report.

Gash Creek runs through the center of the site, in a north-south direction, with two unnamed tributaries flowing to the creek. Gash Creek exits the site at the southern site boundary (beside Brevard Road) and continues in a southerly direction towards the French Broad River. There is also an unnamed lake located in the south-central section of the site. BLE understands that all of these water features will remain in place as part of the development.

7.0 SUBSURFACE CONDITIONS

<u>Surface Cover</u>
The surface cover at the boring locations generally consisted of a 1- to 6-inch layer of organics. The organic material varied between root mat and topsoil. It is possible that organic surface matter will vary across the site.

Alluvium & Terraced Alluvium
Material interpreted as alluvium and terraced alluvium was encountered below the surface cover on test pits TP-1, TP-2 and TP-3 The sampled alluvial material extended to a depth of at least 4 feet in each of the test pits. Alluvium is soil that was transported to its current location by water. The sampled alluvial material mainly consisted of dark gray clayey silt with occasional gravel and some organics (small roots). The terraced alluvium generally consisted of reddish brown sandy silt.

Residuum
Soil interpreted as a residual material was encountered in stest pits TP-1 and TP-3 through TP-7 at depths varying from 6" of 5 to 6 feet. This stratum is identified by its higher clay content, reddish brown color, lack of original rock texture, and homogenization. This material mainly consisted of clayey silt or a clayey sand with trace amounts of gravel and trace organics (small roots).

Groundwater
Groundwater was not encountered during the exploration; however, TP-2, performed within the presumptive flood plain, had redoxomorphic features indicative of the past presence of high groundwater.

8.0 LABORATORY TEST RESULTS

Soil samples processed for laboratory testing were obtained from soil test pits TP-1, TP-3, TP-5, TP-6 and TP-7. One bulk sample was collected from each test pit from the material excavated. See Table 1 for the depths where the bulk samples were collected. A Standard Proctor test (ASTM D-698) was run on samples from TP-1 and TP-3. A composite sample from Test pits 5, 6, and 7 was also tested. See Appendix E for the laboratory test data.

The bulk soil samples collected were classified silty sands (SM). The samples were found to have natural moisture content between 2.2 and 11.0 percent wet of the optimum moisture content, as determined by the laboratory test results. It should be noted that moisture contents on a large grading project will be dictated to some degree by the prevailing weather at the time of construction.

Table 1: Laboratory Test Results

Sample No.	Sample Depth (feet)	Natural Moisture (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	USCS Classification
TP-1	0.0-4.0	32.7	92.5	23.5	SM
TP-3	0.0-4.0	20.43	107.3	18.2	SM
TP-5,6,7	0.0-4.0	24.96	98.9	19.8	SM

9.0 ANALYSIS AND DESIGN RECOMMENDATIONS

The obtained test pit data generally indicates subsurface conditions consist of firm terraced alluvium and residual soils on the higher portions of the site, east and west of the Gash Creek geologic floodplain. Softer alluvial soils were encountered in the lower lying flood plain nearer to the creek. Development is generally expected to consist of excavating the higher hillsides and moving the material into the lower lying areas. It is generally anticipated that the areas exposed by the excavation process will be firm and suitable for pavement and building support, with some remediation, where necessary. The lower lying areas will be heavily influenced by the prevailing conditions at the time of grading; in wet periods, significant subgrade stabilization may be required prior to fill placement and/or home construction. Ideally, a five foot thick layer of new fill would be placed beneath home foundation and allowed to consolidate prior to vertical construction. The borrow sources are currently slightly above the moisture range needed for compaction. As such, some drying may be needed prior to using the material as fill, particularly if grading is done during wet period.

9.1 Building Foundations

Provided that the soil conditions are improved with the recommendations of this report, we recommend an allowable bearing capacity of 1,500 psf be utilized when designing foundations. We recommend that the minimum widths for individual column and continuous wall footings be 18 and 24 inches, respectively. The minimum widths are considered advisable to provide a margin of safety against a local or punching shear failure of the foundation soils. Exterior/perimeter footings should bear at least 30 inches below final exterior grade for embedment needed to develop the recommended allowable design bearing pressure range and to provide frost protection.

The same protective embedment recommended for the interior and exterior footings should be used for the thickened perimeter and interior portions of a monolithic foundation slab, if such a slab is used in lieu of individual strip and spread footing foundations.

Exposure to the environment may weaken the soils at the foundation bearing level if the foundation excavations remain open for long periods of time. Therefore, we recommend that once each foundation excavation is extended to final grade, the foundation be constructed as soon as possible to minimize the potential damage to bearing soils. The foundation bearing area should be level or benched and free of loose soil, ponded water and debris. Foundation concrete should not be placed on soils that have been disturbed by seepage. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom prior to placement of concrete. If the excavation must remain open overnight or if rainfall becomes imminent while the bearing soils are exposed, we recommend that a 2 to 4 inch thick "mud mat" of "lean" (2,000 psi) concrete be placed on the bearing soils for protection before the placement of reinforcing steel.

To observe that the soils encountered in footing excavations are similar to the assumptions made in this report, we recommend that foundation excavations be examined prior to concrete placement. Part of this examination should include checking the bearing soils with a dynamic cone penetrometer performed by an experienced engineering technician working under the direction of the geotechnical engineer.

9.2 Grade Slabs

Grade slabs may be soil-supported provided that the site is prepared in accordance with the recommendations in this report. recommends that the slabs-on-grade be uniformly supported on a layer of aggregate base course, (ABC Stone) as specified in the North Carolina Department of Transportation Standard Specifications for Roads and Structures, 2018 Edition. The aggregate base course layer should have a minimum thickness of at least 6 inches and be compacted to at least 98 percent of its standard Proctor maximum dry density.

Based on previous experience with similar soils, a maximum modulus of subgrade reaction (k) equal to 110 pounds per cubic inch should be used for design of slabs on properly prepared subgrades supported by an adequate depth of base coarse. A vapor barrier should be included below the slab if vapor penetration is not acceptable. The need for a vapor barrier is also dependent on the floor covering type. Floor slabs supported on grade which will be carpeted, tiled, painted or receive some other covering or sealant should incorporate a vapor barrier. The vapor barrier should be installed in accordance with the manufacturer's recommendations.

Completed slabs should be protected from excessive surface moisture prior to and during periods of prolonged, below-freezing temperatures to prevent subgrade freezing and resulting heave. The slab subgrade area should be evaluated by BLE prior to placement of crushed stone.

The grade slab should be jointed around columns and along footing-supported walls so that the slab and foundations can settle differentially without damage. This jointing is not required when slabs and foundations are cast as a single unit (i.e. thickened edge foundations). If slab thickness permits, joints containing dowels or keys may be used in the slab to permit movement between parts of the slab without cracking or sharp vertical displacements.

9.3 Pavement - General

A site-specific pavement design requires detailed information about projected traffic frequency and intensity, acceptable service limits, life expectancy and other factors which are not currently available. It also requires site specific laboratory testing which was not part of the scope of this exploration. However, Table 3 shows recommended pavement sections based on our experience on similar projects in this region. These pavement sections have demonstrated acceptable performance with subsurface conditions similar to this site.

BLE anticipates that some pavement areas will be unstable under a proofroll. Therefore, some subgrade stabilization may also be required for these pavement areas (See Section 10.4). Assuming the subgrade is prepared with Section 10.4, the pavement sections presented below could be expected to provide adequate performance considering a 15 to 20-year service life. For the purpose of this report, light duty pavement is considered to be subject to automobile traffic, such as a car parking lot. Medium duty pavement is considered to be subject to a heavy concentration of automobiles, and occasional loaded trucks, such as drive lanes.

Table 3: Recommended Pavement Sections

Pavement Type	Layers	Material	Thickness (Inches)	
			Light-Duty	Medium Duty
Flexible	a.	Asphaltic concrete surface course	2.5	3
	b.	Aggregate base course	10	12
Rigid	a.	Concrete	6	6
	b.	Aggregate Base Course	6	6

The asphalt surface course should conform to the North Carolina Department of Transportation (NCDOT) Standard Specification, Section 610, for Type S-9.5 Superpave mixture. The base course material should be Aggregate Base Course conforming to NCDOT Standard Specification, Section 520, for Type B aggregate. The base course should be compacted to 100 percent of the standard Proctor (ASTM D-698) maximum dry density. All materials and workmanship should meet the North Carolina Department of Transportation Standard Specifications for Roads and Structures, current edition.

The concrete for rigid pavement should be air-entrained and have a minimum flexural strength (third point loading) of 550 psi which could likely be achieved by a concrete mix having a compressive strength of at least 4,000 psi at 28 days. Recommended air contents from the Portland Cement Association (PCA) are as follows:

Maximum Aggregate Size	Percent Air
1½ inches	5 percent plus or minus 1½ percent
¾ to 1-inch	6 percent plus or minus 1½ percent

In addition, we recommend a maximum slump of 4 inches.

Joint spacing for this concrete thickness should be on the order of 12 to 15 feet. Control joints should be sawed as soon as the cut can be made, without raveling (aggregate pulling out of the concrete matrix) or cracks forming ahead of the saw blade. Joints should be sawed consecutively so that the joints commence working together. The American Association of State Highway and Transportation Officials (AASHTO) suggests that transverse contraction joints should be one quarter of the slab thickness and longitudinal joints should be one third of the slab thickness. All joints should be filled with flexible joint filler.

Curing of the concrete slab should begin as soon as the slab has been finished and the joints sawed. Moist curing by fog spray nozzles or wet burlap is the most dependable curing procedure. Other methods of curing could consist of spray applied curing compounds or covering the slab with waterproof paper or heavy plastic. If paper or plastic is used for curing, the edges of the cover should be anchored and joints between sheets should be taped or sealed.

Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations, and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required.

9.4 Secondary Design Considerations

The following items are presented for your consideration. These items are known to generally enhance performance of structural and pavement systems.

- Roof drainage should be collected by a system of gutters and downspouts and directed away from all structures.
- Sidewalks should be sloped so that water drains away from the structures.
- Site grading and paving should result in positive drainage away from the structures. Water should not be allowed to pond around the structures or in such locations that would lead to saturation of pavement subgrade materials. A minimum slope of approximately ¼ to ½-inch per foot should provide adequate drainage.
- Backfill for utility lines should be placed in accordance with the requirements for engineered fill to minimize the potential for differential settlement.

10.0 CONSTRUCTION RECOMMENDATIONS

10.1 Clearing and Grubbing

Site preparation should include the removal of all unsuitable surface materials (topsoil, vegetation, surface soils containing organic matter or other deleterious materials) from within the proposed building, and pavement areas. Deleterious materials should be disposed of offsite or in areas of the site that will not be developed. Topsoil and organic soils may be stockpiled for later use in areas to be landscaped.

10.2 Groundwater Control

Groundwater was not encountered during this investigation. It should be noted that groundwater levels may fluctuate several feet with seasonal and rainfall variations and with changes in the water level in adjacent drainage features. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall.

10.3 Proofroll

After stripping and rough excavation grading, we recommend that areas to provide support for the foundations, floor slab, engineered fill, and pavement be carefully inspected for soft surficial soils and proofrolled with a 25 to 35-ton, four-wheeled, rubber-tired roller or similar approved equipment. The proofroller should make at least four passes over each location, with the last two passes perpendicular to the first two where practical.

Any areas which wave, rut, or deflect excessively and continue to do so after several passes of the proofroller should be stabilized in accordance with section 10.4 of this report. The excavated areas should be backfilled in thin lifts with engineered fill. The proofrolling and excavating operations should be carefully monitored by an experienced engineering technician working under the direction of the geotechnical engineer. Proofrolling should not be performed when the ground is frozen or wet from recent precipitation.

10.4 Subgrade Stabilization

The subgrade condition will be highly influenced by prevailing weather conditions at the time of construction. It is expected that significant portions of the subgrade, particularly nearer to the creek, will be unstable after inspection, and remedial activities will be necessary. Such remedial activities may include partial undercutting and replacement, or stabilization with geo-synthetics and crushed stone, or a combination of these methods. Appropriate recommendations may be provided at the time of construction by BLE. Stabilization measures will vary with location and will also be dependent on the weather conditions during construction.

10.5 Excavation

Based on information available at the time of this report's preparation and the soil data collected, it is assumed that excavation will extend through soft to moderate consistency alluvial and residual soils. Based on the test pits and previous soil borings, and our experience, the existing fill and residual soil should be excavatable using conventional earthmoving equipment.

10.6 Engineered Fill

All fill used for raising site grade or for replacement of material that is undercut should be uniformly compacted in 8-inch loose lifts to at least 95 percent of the standard Proctor maximum dry density (ASTM D

698). Beneath floor slabs and on-grade parking, the compaction requirement should be raised to 98 percent in the upper 12 inches. The soils to be used in the engineered fill should contain no more than 3 percent organic matter by weight and should be free of roots, limbs, other deleterious material and should generally preclude rocks larger than 6 inches in diameter (see "Mixed Fill" section below for additional detail). In addition, the moisture content of the compacted soil fill should be maintained to within plus or minus 3 percent of the optimum moisture content as determined from the standard Proctor compaction test during placement and compaction. This provision may require the contractor to dry soils during periods of wet weather or to wet soils during dry periods. The fill soils should have a Plasticity Index (PI) of less than 30, and a standard Proctor maximum dry density of no less than 90 pounds per cubic foot (pcf).

10.7 Assessment of Onsite Material for use as Structural Fill

Based on our correspondence with Tribute Construction, BLE understands that the northern and western areas of the site (Test Pits TP-1, TP-3, TP-5, TP-6, and TP-7) are under consideration for use as a structural fill in other areas of the site. The dry unit weights of the bulk samples were tested as 92.5 pcf, 107.3 pcf, and 98.9 pcf respectively, which are above the recommended dry unit weight of 90 pcf. However, the in-situ moisture of the residual soils is above the optimum moisture content for re-compaction; moderate to significant drying will be needed to prepare soils for use as a structural fill. As such, we recommend that an allowance be budgeted to perform remedial processing of the existing soils before re-use as structural fill. The dark gray alluvial soils should not be used as structural fill material. The residual soils and terraced alluvium are suitable for re-use, provided they are appropriately moisture conditioned as described above.

If offsite soil is required at the time of construction, BLE can assist in testing the borrow source when identified. The offsite material will be required to meet the criteria for structural fill, as described in section 10.6.

10.8 Fill Placement over Sloping Ground

Where the existing ground is steeper than 6:1 (horizontal to vertical), newly placed fill should be tied into the existing ground to reduce the potential for a preferential shearing plane at the fill/ground surface interface. This can be accomplished by benching or stepping into the natural ground. The height of each bench should not exceed 2 feet, and all fill should be compacted on a level plane.

10.9 Subgrade Protection During Construction

The surface of compacted subgrade soils can deteriorate and lose its support capabilities when exposed to environmental changes and construction activity. Deterioration can occur in the form of freezing, formation of erosion gullies, extreme drying, exposure for a long period of time or rutting by construction traffic. We recommend that the surfaces of floor slab subgrades that have deteriorated or softened be recompacted prior to construction of the floor slab. Additionally, any excavations through the subgrade soils (such as utility trenches) should be properly backfilled in compacted lifts. Recompaction of subgrade surfaces and compaction of backfill should be checked with a sufficient number of density tests to determine if adequate compaction is being achieved.

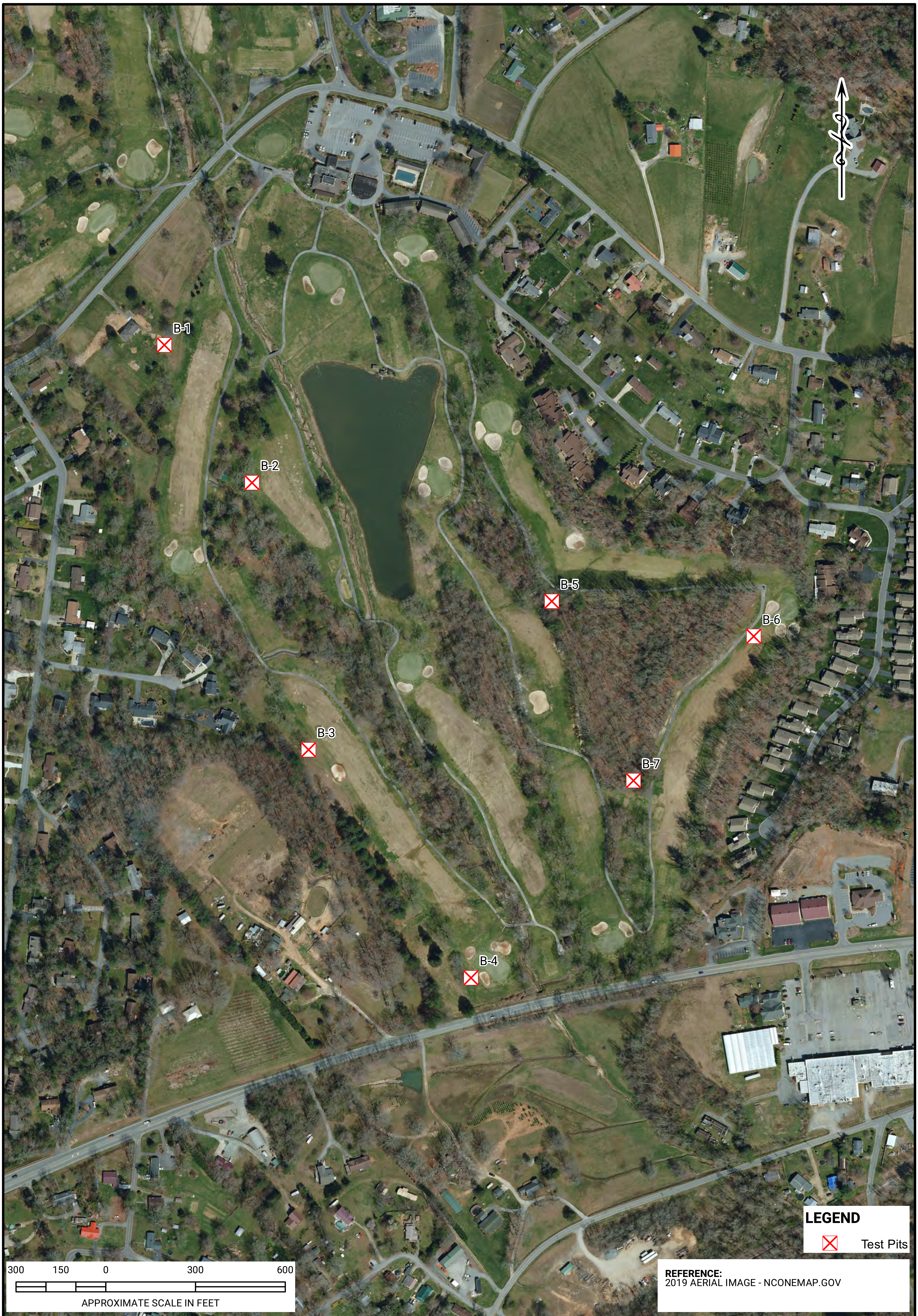
11.0 SPECIFICATIONS REVIEW

It is recommended that Bunnell-Lammons Engineering be retained to make a general review of the foundation and earthwork plans and specifications prepared from the recommendations presented in this report. We would then suggest any modifications so that our recommendations are properly interpreted and implemented.

12.0 BASIS OF RECOMMENDATIONS

Our evaluation of foundation support conditions has been based on our understanding of the project information and data obtained in our exploration as well as our experience on similar projects. The general subsurface conditions utilized in our foundation evaluation have been based on interpolation of the subsurface data between the widely spaced borings. Subsurface conditions between the test pit locations may differ. If the project information is incorrect or the structure location (horizontal or vertical) and/or dimensions are changed, please contact us so that our recommendations can be reviewed. The discovery of any site or subsurface conditions during construction which deviate from the data obtained in this exploration should be reported to us for our evaluation. The assessment of site environmental conditions for presence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this exploration. Soil cuttings used as backfill in boreholes will settle over time resulting in a depression at the surface. It is beyond the scope of our services to return to the site to repair boreholes that have exhibited settlement of the backfill soils.

APPENDIX A
Figures



DRAWN BY:	KLC	DATE:	9-18-23	**TEST PIT LOCATION MAP** GEOTECHNICAL INVESTIGATION ETOWAH GOLF COURSE, ETOWAH HENDERSON COUNTY, NORTH CAROLINA	FIGURE 1
CHECKED BY:	TCW	FILE NAME:	TPLM.MXD		
APPROVED BY:	TCW	JOB NO:	17210-04		

PROJECT SITE DATA:

PROJECT ACREAGE	±83.5 AC.	
DISTURBED ACREAGE	±50 AC.	
EXISTING ZONING	R-1	
TOTAL LOTS	200	
BULK REQUIREMENTS		
	REQUIRED	PROVIDED
SETBACKS		
FRONT (EXTERIOR)	50 FT (US 64/ BRICKYARD)	
FRONT (INTERIOR)	20 FT. (COLL) 15 FT. (LOCAL)	
SIDE	10 FT	
REAR	10 FT	
COMMON AREA	(25%) ±20.9 AC	40.0 AC
MIN. LOT SIZE	6,000 SF	6,000 SF
INTERMEDIATE DENSITY MAX:	6 UNITS / ACRE	2.4 UNITS/ACRE

UNIT SUMMARY

LOTS = 200 LOTS

(MIN LOT SIZE: 60'x100' = 6000 SF)

Civil Design Concepts, PA

NCBELS #: C-2184

ETOWAH RESIDENTIAL
CUT AREAS EXHIBIT
SEPTEMBER 2023

APPENDIX B
Field Exploration Procedures

Field Exploration Procedures

The borings were made by mechanically twisting a continuous flight steel auger into the soil. Soil sampling and penetration testing were performed in general accordance with ASTM D 1586. At assigned intervals, soil samples were obtained with a standard 1.4-inch I. D., 2-inch O. D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches was recorded and is designated the "standard penetration resistance." The penetration resistance, when properly evaluated, is an index to the strength of the soil and foundation supporting capability.

Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined by a geotechnical engineer to verify the field classifications of the driller. Boring Logs are attached, showing the soil descriptions and penetration resistance.

APPENDIX C
Test Pit Logs

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TEST PIT LOG

Job Name: Etowah Golf Course		**Location**: TP-1
Job Number: J22-17210-04		**Date Logged**: 8/31/23
Approximate Elevation: Unknown		**Logged By**: Jesse Jacobson
Depth (Feet)		**Stratum Description**
From	**To**	
0’	2”	4” Topsoil
2”	18”’	Firm, dry, Lt brown, clayey SILT (ML) (Fill)
18”	4’	Firm, moist, orange to brown, silty CLAY (CL) (Alluvium or Fill)

Remarks and Notes:
Test pit terminated at 4 feet.
No groundwater was encountered at time of excavation or two hours after excavation.
Test pit backfilled with excavated material.

TEST PIT LOG

Job Name: Etowah Golf Course		**Location**: TP-2
Job Number: J22-17210-04		**Date Logged**: 8/31/23
Approximate Elevation: Unknown		**Logged By**: Jesse Jacobson
Depth (Feet)		**Stratum Description**
From	**To**	
0’	2”	2” Topsoil
2”	4’	Softy to firm, very moist, dark gray and black silty CLAY(CL) with organics (Alluvium)

Remarks and Notes:
Test pit terminated at 4 feet.
No groundwater was encountered at time of excavation or two hours after excavation.
Test pit backfilled with excavated material.

TEST PIT LOG

Job Name: Etowah Golf Course	**Location**: TP-3
Job Number: J22-17210-04	**Date Logged**: 8/31/23
Approximate Elevation: Unknown	**Logged By**: Jesse Jacobson

Depth (Feet)		Stratum Description
From	To	
0’	1”	1” Topsoil
1”	4’	Firm, moist brownish red clayey SILT (ML) (Residum)

Remarks and Notes:
Test pit terminated at 4 feet.
No groundwater was encountered at excavation of digging or two hours after excavation.
Test pit backfilled with excavated material.

TEST PIT LOG

Job Name: Etowah Golf Course	**Location**: TP-4
Job Number: J22-17210-04	**Date Logged**: 8/31/23
Approximate Elevation: Unknown	**Logged By**: Jesse Jacobson

Depth (Feet)		Stratum Description
From	To	
0’	2”	2” Topsoil
2”	2.5’	Loose to firm, moist, orange to white sandy SILT (ML) (Alluvium / Fill)
2.5’	5.5’	Firm, moist, gray to brown silty SAND (SM) (Residuum)

Remarks and Notes:
Test pit terminated at 5.5 feet.
No groundwater was encountered at time of excavation.
Test pit backfilled with excavated material.

TEST PIT LOG

Job Name: Etowah Golf Course		Location: TP-5
Job Number: J22-17210-04		**Date Logged**: 9/1/23
Approximate Elevation: Unknown		**Logged By**: Jimmy Bartlett
Depth (Feet)		**Stratum Description**
From	**To**	
0’	4”	4” Topsoil
4”	4’	Loose, moist, orange to light red clayey SILT (MH) – (Residuum)
4’	6’	Loose to firm, moist, light brown to orange sandy SILT(MLS) – (Residuum)

Remarks and Notes:
Test pit terminated at 6 feet.
No groundwater was encountered at time of excavation or two hours after excavation.
Test pit backfilled with excavated material.

TEST PIT LOG

Job Name: Etowah Golf Course		Location: TP-6
Job Number: J22-17210-04		**Date Logged**: 9/1/23
Approximate Elevation: Unknown		**Logged By**: Jimmy Bartlett
Depth (Feet)		**Stratum Description**
From	**To**	
0’	6”	6” Topsoil
6”	1.5’	Loose to firm, moist, brown to gray SILT (ML) (Residuum)
1.5’	3.5’	Loose to firm, moist, light orange, SILT (ML) (Residuum)

Remarks and Notes:
Test pit terminated at 3.5 feet.
No groundwater was encountered at time of excavation or two hours after excavation.
Test pit backfilled with excavated material.

TEST PIT LOG

Job Name: Etowah Golf Course	Location: TP-7

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Job Number: J22-17210-04		**Date Logged**: 9/1/23
Approximate Elevation: Unknown		**Logged By**: Jimmy Bartlett
Depth (Feet)		**Stratum Description**
From	**To**	
0’	4”	3” Topsoil
6”	1.5’	Loose to firm, moist, brown to gray SILT (ML) (Residuum)
1.5’	3.5’	Loose to firm, moist to wet, light orange, SILT (ML) (Residuum)

Remarks and Notes:
Test pit terminated at 3.5 feet.
No groundwater was encountered at time of excavation or two hours after excavation.
Test pit backfilled with excavated material.

APPENDIX D
A Key to Soil Classification

KEY TO SOIL CLASSIFICATIONS AND CONSISTENCY DESCRIPTIONS

BUNNELL-LAMMONS ENGINEERING, INC.
GREENVILLE, SOUTH CAROLINA

SANDS

Penetration Resistance* Blows per Foot	Relative Density
0 to 4	Very Loose
5 to 10	Loose
11 to 20	Firm
21 to 30	Very Firm
31 to 50	Dense
over 50	Very Dense

SILTS and CLAYS

Penetration Resistance* Blows per Foot	Consistency
0 to 2	Very Soft
3 to 4	Soft
5 to 8	Firm
9 to 15	Stiff
16 to 30	Very Stiff
31 to 50	Hard
over 50	Very Hard

*ASTM D 1586

Particle Size Identification

Boulder: Greater than 300 mm
Cobble: 75 to 300 mm
Gravel:
  Coarse - 19 to 75 mm
  Fine - 4.75 to 19 mm
Sand:
  Coarse - 2 to 4.75 mm
  Medium - 0.425 to 2 mm
  Fine - 0.075 to 0.425 mm
Silt & Clay: Less than 0.075 mm

KEY TO DRILLING SYMBOLS

Grab Sample

Split Spoon Sample

Undisturbed Sample

NR = No reaction to HCL

NA = Not applicable

NS = No sample

Groundwater Table at Time of Drilling

Groundwater Table 24 Hours after Completion of Drilling

KEY TO SOIL CLASSIFICATIONS

Well-graded Gravel
GW

Low Plasticity Clay
CL

Clayey Silt
MH

Silty Sand
SM

Poorly-graded Gravel
GP

Sandy Clay
CLS

Sandy Silt
MLS

Topsoil
TOPSOIL

Partially Weathered Rock
BLDRCBBL

Silty Clay
CL-ML

Sand
SW

Liquid Sludge
SLUDGE

High Plasticity Clay
CH

Silt
ML

Clayey Sand
SC

Fill
FILL

Poorly Graded Sand
SP

Bedrock
BEDROCK

Waste
WOOD

APPENDIX E
Laboratory Test Results

Standard proctor (ASTM D698 / AASHTO T99)

Report #: 001-L1

Client:	Tribute Construction, Inc.	**Report Date:**	09/20/2023
Project:	Etowah Golf Course	**Project #:**	17210-04
Location:	Etowah, NC		

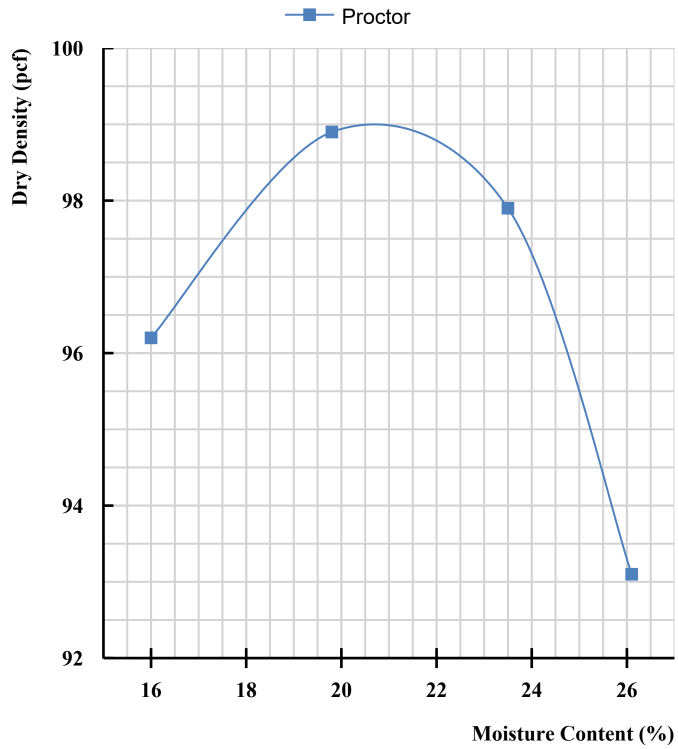
SAMPLE AND PROCTOR / SATURATION CURVE (MOISTURE DENSITY)

Sample Location /No:
Proctor #: L1 **Sample Date:** 09/06/2023
Sample Source: #7,#6,#5
Visual Classification: Light brown silty clay with a red hue

Test Procedure: ASTM D-698 (Proctor)
Test Method: A

TEST RESULTS

Max Dry Density (pcf): 98.9
Optimum Moisture (%): 19.8 %
Saturation Results
Specific Gravity: 0
% Retained **Rock Correction:**
3/4" Sieve: **3/8" Sieve:** **No. 4:**



Remarks:
Report Copied to: Mr. Kent Tanner

Lab Representative: BLEAE Labtech

Tim Woodcock

Bunnell-Lammons Engineering, Inc.

Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

BUNNELL LAMMONS ENGINEERING

Standard proctor (ASTM D698 / AASHTO T99)

Report #: 002-L1

Client: Tribute Construction, Inc.
Project: Etowah Golf Course
Location: Etowah, NC

Report Date: 09/20/2023
Project #: 17210-04

SAMPLE AND PROCTOR / SATURATION CURVE (MOISTURE DENSITY)

Sample Location /No:
Sample Source: B3
Test Procedure: ASTM D-698 (Proctor)

Proctor #: L1 **Sample Date:** 09/13/2023
Visual Classification: Tan Silty clay
Test Method: A

TEST RESULTS

Max Dry Density (pcf): 107.3

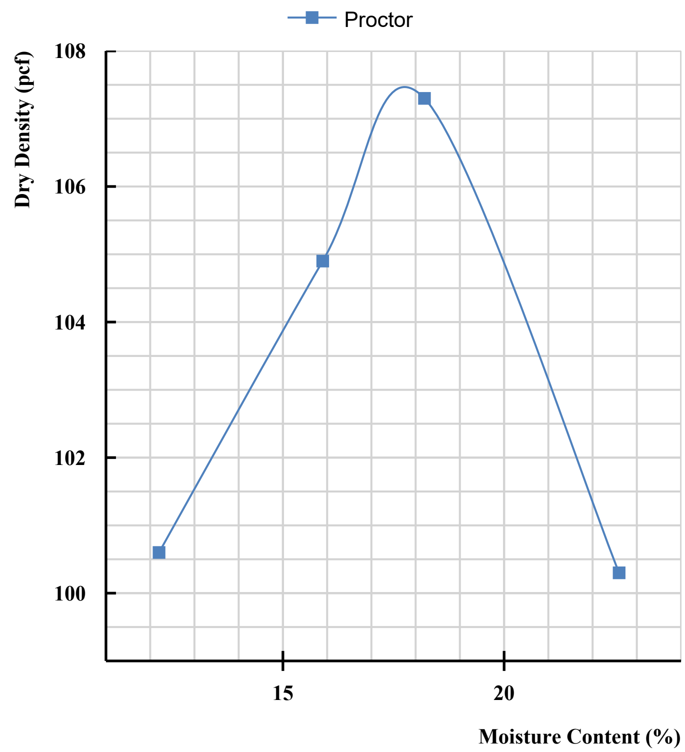
Optimum Moisture (%): 18.2 %

Saturation Results

Specific Gravity: 0

% Retained **Rock Correction:**

3/4" Sieve: **3/8" Sieve:** **No. 4:**



Remarks:

Report Copied to: Mr. Kent Tanner

Lab Representative: BLEAE Labtech

Tim Woodcock

Bunnell-Lammons Engineering, Inc.

BUNNELL LAMMONS ENGINEERING

Standard proctor (ASTM D698 / AASHTO T99)

Report #: 003-L1

Client: Tribute Construction, Inc.
Project: Etowah Golf Course
Location: Etowah, NC

Report Date: 09/19/2023
Project #: 17210-04

SAMPLE AND PROCTOR / SATURATION CURVE (MOISTURE DENSITY)

Sample Location /No:
Sample Source: TP-1
Test Procedure: ASTM D-698 (Proctor)

Proctor #: L1 **Sample Date:** 09/13/2023
Visual Classification: Tan silty clay
Test Method: A

TEST RESULTS

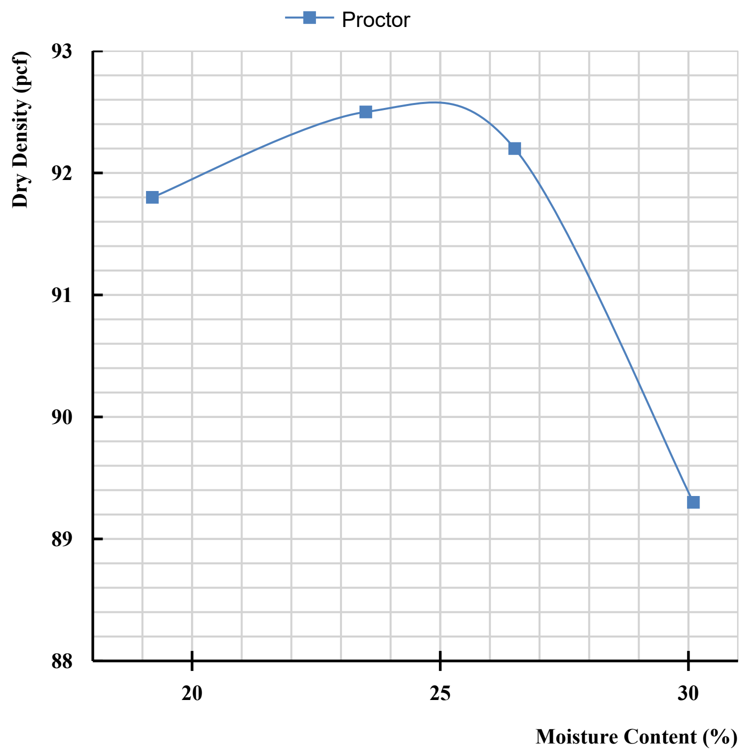
Max Dry Density (pcf): 92.5
Optimum Moisture (%): 23.5 %

<u>Saturation Results</u>

Specific Gravity: 0

<u>% Retained</u> **Rock Correction:**

3/4" Sieve: **3/8" Sieve:** **No. 4:**



Remarks:

Report Copied to: Mr. Kent Tanner

Lab Representative: BLEAE Labtech

Tim Woodcock

Bunnell-Lammons Engineering, Inc.

Notes: The results above apply only to the specific samples noted using the aforementioned test method(s) and do not represent any other sample. Reports may not be reproduced except in full without permission.

APPENDIX F
Important Information about
This Geotechnical Engineering Report

Important Information about This

Geotechnical-Engineering Report

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

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

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

Understand the Geotechnical-Engineering Services Provided for this Report

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

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

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific imes

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

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

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

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

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

Read this Report in Full

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

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

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

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

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

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

This Report's Recommendations Are Confirmation-Dependen

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance to Deal with Moisture Infiltration and Mol

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

GEOPROFESSIONAL BUSINESS ASSOCIATION

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