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Village of Marvin

ADDENDUM No. 1

TO: Prospective Bidders

FROM: Village Manager, Christina Amos

DATE: July 24, 2025

PROJECT: Village Hall Park Phase 1, Village of Marvin

The following items are being issued herein for modification and clarification to the Bid Requirements for the project referenced above. All Bidders shall acknowledge this Addendum within their submittal.

MODIFICATIONS

QUESTIONS & ANSWERS

(Complete below)

1) Can you provide a copy of the Geotechnical report with the seasonal high water table results?

   Answer:
   See attached for the Geotechnical report, which includes the seasonal high water table results.

Attachments:

1. **Froehling & Robertson, Inc., "Report of Subsurface Exploration and Geotechnical Engineering Services: Village Hall Park – Phase 1" dated September 20, 2024.**

7/24/2025

Brian M. LaFranchi, PE NC Lic. # 40016

NORTH CAROLINA PROFESSIONAL SEAL 40016 ENGINEER BRIAN M. LaFRANCHI

END OF ADDENDUM NO. 1 of Bid

FROEHLING & ROBERTSON, INC.

Report of
Subsurface Exploration and Geotechnical Engineering Services

Village Hall Park – Phase I
Marvin, North Carolina

Prepared for:
Dewberry Engineers, Inc.
9300 Harris Corners Parkway, Suite 220
Charlotte, NC 28269

Prepared by:
Froehling & Robertson, Inc.
3300 International Airport Drive, Suite 600
Charlotte, North Carolina 28208

20 September 2024

F&R Project No. 63C-0045

F&R Project No.: 63C-0045 20 September 2024

Mr. Brian LaFranchi, P.E.
Senior Project Manager
Dewberry Engineers, Inc.
9300 Harris Corners Parkway, Suite 220
Charlotte, NC 28269-3797

Re: Report of Subsurface Exploration and Geotechnical Engineering Services
Village Hall Park – Phase I
Marvin, Union County, North Carolina

Mr. LaFranchi,

The enclosed report presents the results of the subsurface exploration program and geotechnical engineering evaluation undertaken by Froehling & Robertson, Inc. (F&R), in connection with the above referenced project. Our services were performed in general accordance with F&R Proposal No. 2463-00029 (Revision 1) dated 24 April 2024. This report presents our understanding of the project, reviews our subsurface exploration and laboratory testing procedures, describes the general subsurface conditions at the boring locations, and presents geotechnical engineering evaluations and recommendations.

We have enjoyed working with you on this project, and we are prepared to assist you with further geotechnical services as plans are further developed. We can also perform the recommended quality assurance monitoring and testing services during construction. Please contact us if you have any questions regarding this report or if we may be of further service.

Sincerely,
FROEHLING & ROBERTSON, INC.

NORTH CAROLINA PROFESSIONAL SEAL 048021 ENGINEER ALEXANDER T. KUCZERO

09/20/2024

Alexander T. Kuczero, P.E.
Geotechnical Engineer

Andrew R. Frank, P.E.
Regional Senior Geotechnical Engineer

Email Distribution: BLaFranchi@Dewberry.com

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APPENDICES

APPENDIX I

Site Vicinity Map (Figure No. 1)

Boring Location Plan (Figure No. 2)

APPENDIX II

Key to Soil Classification

Soil Classification Chart

Boring Logs (B-1 through B-10)

APPENDIX III

Laboratory Test Results

APPENDIX IV

Seasonal High Water Table Determination and Hydraulic Conductivity Testing Report

APPENDIX V

GBA Publication "Important Information about This Geotechnical Engineering Report"

EXECUTIVE SUMMARY

This Executive Summary is provided as a brief overview of our geotechnical engineering evaluation for the project and is not intended to replace more detailed information contained elsewhere in this report. As an overview, this summary inherently omits details that could be very important to the proper application of the provided geotechnical design recommendations. This report should be read in its entirety prior to implementation into design and construction. The Project Information section of this report should be particularly reviewed by project designers to confirm that the geotechnical engineer's understanding of the project concurs with the current project parameters at the time of project design.

- The site was explored by ten (10) soil test borings extended to depths ranging from 8 to 18.7 feet below the existing ground surface. The subsurface conditions generally consisted of surficial soils underlain by existing fill materials, residual soils, partially weathered rock (PWR) and auger refusal materials.
- The existing near-surface on-site soils appeared generally acceptable for reuse as controlled structural fill materials, although some moisture conditioning may be required.
- Based on the subsurface conditions encountered in borings B-1 through B-4 and the assumed foundation type and loads, the proposed pedestrian bridge and amphitheater canopy may be supported on a system of conventional shallow foundations designed for an allowable bearing pressure of 3,000 pounds per square foot (psf). Foundations should bear on residual soil or controlled structural fill placed in accordance with our recommendations.
- Groundwater was encountered in borings B-2 and B-5 upon completion of drilling operations at depths of 16 feet and 12 feet below existing grade, respectively. While groundwater was not encountered in borings B-6, B-8, B-9, and B-10 immediately following the completion of drilling, the split-spoon samples collected from 6.5 to 8 feet below existing grade in each boring was described as "wet" during manual classification. A SHWT was observed in hand auger borings SHWT-1 and SHWT-2 at depths of 71 inches and 22 inches below the existing ground surface, respectively. Additionally, a perched water table (PWT) was observed in boring SHWT-1 within a layer of low permeability soil from 11 to 23 inches below existing grade. Therefore, groundwater or perched groundwater could be encountered in excavations or areas of cut particularly in the southern portion of the project site.

1.0 PROJECT INFORMATION

Our understanding of this project is based on information provided to F&R via email correspondence from Mr. Tristan McMannis and Mr. Brian LaFranchi of Dewberry, which included a conceptual sketch of Marvin Village Hall Park (filename: *SCOPE EXHIBIT (ATTACHMENT C).pdf*) and a plan showing requested Seasonal High Water Table determination locations (*SHWT Locations EXH-Model.pdf*).

The 2.3-acre project site is located to the west of Marvin Village Hall, on the larger 4.3-acre parcel at 10006 Marvin School Road in Marvin, North Carolina. The approximate project location is shown on the attached Site Vicinity Map (Figure No. 1, Appendix I). The project will consist of Phase 1 improvements for the Village Hall Park, which will include construction of a recreation trail, an amphitheater with event lawn, a pedestrian bridge, and two stormwater BMPs. The area of the proposed park is currently undeveloped and primarily wooded with a stream running through the northwest corner of the site. Based on a limited review of historical aerial images, portions of the project site were previously used for agricultural purposes and a residence was located to the southwest of what is now Village Hall.

Grading information was not provided at the time of this report. Topographic information from Union County GIS indicates that existing site grades generally slope downward from about elevation 680 feet on the south side to about 662 feet at the northwest corner. Based on existing site grades, we anticipate that cuts and fills will generally be on the order of 4 feet or less. Several retaining walls are shown on the provided Conceptual Sketch. Information on retaining walls was not provided at the time of this report; however, we anticipate wall heights will also generally be on the order of 4 feet or less. Retaining wall design recommendations were not included in our scope of work for this project.

Limited preliminary information on the pedestrian bridge was provided at the time of this report. The pedestrian bridge will cross the stream on the northwest corner of the project site as part of a connection of park trails to existing trails. We understand that the bridge will be about 12 feet in length and primarily utilized by pedestrians, with occasional UTV/gator traffic. We anticipate the bridge will be a relatively low, swale-bridge type structure, supported by a shallow strip foundation on each side.

No information on the amphitheater stage was provided at the time of this report. In our experience, foundation loads for canopy structures can vary considerably based on size, configuration, and material type. Uplift loads will often enlarge foundations beyond that which is required to carry the design axial loading. For our preliminary analysis in this report, we have assumed a canopy supported on shallow spread foundations with a maximum axial load of 50 kips.

2.0 GEOTECHNICAL SCOPE OF SERVICES

The purposes of our involvement on this project were to 1) conduct a subsurface exploration program, 2) provide general descriptions of the encountered subsurface conditions at the locations explored, and 3) comment on the site development aspects of the proposed construction. In order to accomplish these objectives we undertook the following scope of services:

1) Visited the site to observe existing surface conditions and features and mark boring locations.
2) Coordinated NC-811 services to locate utilities around the planned boring locations.
3) Provided clearing with a forestry mulcher to create access trails to the boring locations.
4) Reviewed and summarized readily available geologic information relative to the project site.
5) Executed a subsurface exploration program consisting of ten (10) Standard Penetration Test (SPT) soil borings drilled to depths ranging from 8 to 18.7 feet below existing grade.
6) Performed a laboratory-testing program on selected split-spoon samples consisting of two (2) classification tests (Atterberg limits, wash #200, and natural moisture).
7) Performed Seasonal High Water Table (SHWT) determinations and hydraulic conductivity testing at two (2) locations.
8) Prepared this written report summarizing our work on the project, providing descriptions of the subsurface conditions encountered, commenting on the geotechnical related aspects of the proposed construction. Copies of the test boring logs and laboratory test results are included.

Our proposed scope of geotechnical services did not include survey services, quantity estimates, civil, environmental, stormwater, or structural engineering services, preparation of plans or specifications, formal slope stability analyses, pavement design, retaining wall design, evaluations of earthquake motions, or the identification and evaluation of wetland or other environmental aspects of the project site.

3.0 EXPLORATION PROCEDURES

3.1 Subsurface Exploration Methods

The subsurface exploration program consisted of ten (10) soil test borings (designated as B-1 through B-10) performed on 20 and 21 August 2024. The borings were extended to depths ranging from 8 to 18.7 feet below the existing ground surface. Boring locations are shown on the attached Boring Location Plan (Figure No. 2, Appendix I).

F&R personnel marked boring locations in the field using a handheld GPS device. Boring elevations were interpolated from Union County GIS topographic information. In consideration of the methods used in their determination, the boring locations shown on the attached Boring Location Plans and elevations shown on the attached Boring Logs should be considered approximate.

The test borings were performed in accordance with generally accepted practice using an ATV-mounted CME-550X drill rig equipped with an automatic hammer. The borings were advanced using hollow-stem augers to pre-selected depths and representative soil samples were recovered with a standard split-spoon sampler (1 3/8 in. ID, 2 in. OD) in general accordance with ASTM D 1586, the Standard Penetration Test. In this test, a weight of 140 pounds is freely dropped from a height of 30 inches to drive the split-spoon sampler into the soil. The number of blows required to drive the split-spoon sampler three consecutive 6-inch increments is recorded, and the blows of the last two increments are summed to obtain the Standard Penetration Resistance (N-value). The N-value provides a general indication of in-situ soil conditions and has been correlated with certain engineering properties of soils.

Groundwater level readings were taken in each of the borings during drilling or immediately upon completion of the soil drilling process. Following groundwater readings, the boreholes were backfilled with auger cuttings (soil). Periodic observation and maintenance of the boreholes should be performed due to potential subsidence at the ground surface, as the borehole backfill could settle over time. By the nature of the work performed, our drilling activities resulted in disturbances to the site. Reasonable efforts were made to reduce disturbance. However, remediation of the site to a pre-explored condition was not included.

Representative portions of the split-spoon soil samples obtained throughout the exploration program were placed in airtight containers and transported to our laboratory. In the laboratory, the soil samples were classified by a member of our professional staff in general accordance with techniques outlined in the visual-manual identification procedure (ASTM D 2488) and the Unified Soil Classification System. The soil descriptions and classifications discussed in this report and shown on the attached Boring Logs are generally based on visual observation and should be considered approximate. Copies of the boring logs are provided and classification procedures are further explained in the attached Appendix II.

Split-spoon soil samples recovered on this project will be stored at F&R's office for a period of sixty days. After sixty days, the samples will be discarded unless prior notification is provided to us in writing.

3.2 Soil Laboratory Testing

Two (2) split-spoon soil samples were selected for additional laboratory classification testing. This testing included water content determination (ASTM D2216), Atterberg limits tests (ASTM D4318), and percent passing #200 sieve (ASTM D 1140).

Based on the results of these tests, the soils from these selected samples were then classified in general accordance with Unified Soil Classification System (ASTM D2487). The results of the laboratory testing program are summarized in *Section 4.3, Laboratory Test Results* of this report and presented in Appendix III.

3.3 Seasonal High Water Table Determination and Hydraulic Conductivity Testing

F&R subcontracted a North Carolina Licensed Soil Scientist to perform Seasonal High Water Table (SHWT) determinations for the project. The SHWT was evaluated at the two (2) requested boring locations (designated as SHWT-1 and SHWT-2) by Earthly Elements Soil Consulting (EESC) via hand auger borings. Additionally, infiltration testing (saturated hydraulic conductivity, K_{SAT}) was performed in the most restrictive soil horizon that was encountered within 2 feet of the SHWT at each location with a compact constant-head permeameter (Amoozemeter).

The results of the determinations and testing are summarized in *Section 4.2.5* of this report and the SHWT Determination and Hydraulic Conductivity Testing report is provided in Appendix IV.

4.0 SUBSURFACE CONDITIONS

4.1 Regional Geology

The project site is located in the Charlotte Belt of the Piedmont Physiographic Province. According to the Geologic Map of North Carolina (1985), the project site is primarily underlain by gabbro. The topography of the Piedmont Province generally consists gently rolling, well-rounded hills and long low ridges.

The soils resulting from in-situ weathering of the parent rock, without significant transportation, are called residual soils and may retain some of the structure of the rock from which they weathered. The residual soil profile generally grades downward gradually from fine-grained plastic soils near the ground surface to coarser-grained soils at greater depth. A transitional zone of "partially weathered rock" of varying thickness can occur between the coarser-grained residual soils and the underlying bedrock. Partially weathered rock is defined, for engineering purposes, as residual material with standard penetration resistances in excess of 100 blows per foot. Weathering of the parent bedrock is generally more rapid near fracture zones and therefore, the bedrock surface may be irregular. Irregular patterns of differential weathering may also result in zones of rock and partially weathered rock embedded within the more completely weathered coarse-grained soils.

4.2 Subsurface Conditions

The subsurface conditions discussed in the following paragraphs, and shown on the boring logs in Appendix II, represent an estimate of the subsurface conditions based on interpretation of the field and laboratory data using normally accepted geotechnical engineering judgments.

The strata breaks designated on the boring logs represent approximate boundaries between soil types. Actual transitions between soil strata are generally less distinct than the immediate transitions depicted on the boring logs and profile. Although individual soil test borings are representative of the subsurface conditions encountered at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times. Given the spacing between boring locations, it should be anticipated that subsurface conditions could vary between the borings.

Below the existing ground surface, the borings generally encountered surficial soils underlain by existing fill, residual soils, partially weathered rock, and auger refusal materials. These materials are discussed further below:

4.2.1 Surficial Soils

Surficial soils were encountered in each boring from the ground surface to depths of about 3 to 8 inches. Surficial soils are typically a dark-colored soil material containing roots, fibrous matter, and/or other organic components, and are generally unsuitable for engineering purposes. We note that no laboratory testing has been performed to determine the organic content or horticultural properties of the observed surficial soil materials. Therefore, the term "surficial soils" is not intended to indicate suitability for landscaping and/or other purposes. The surficial soil depths provided in this report are based on driller observations and should be considered approximate. Actual surficial soil depths should be expected to vary across the site.

4.2.2 Fill Materials

Fill materials include those materials deposited by man. Materials identified as existing fill were encountered in borings B-1, B-2, B-4, and B-5 to depths of about 2 feet below the existing surface. Sampled fill materials were described as silty sand (SM) with standard penetration resistances (N-values) ranging from 4 to 5 blows per foot (bpf).

4.2.3 Residual Soils

Residual soils, formed by the in-place weathering of the parent rock, were encountered in each boring below the surficial soils or existing fill. Sampled residual soils were described as silty sand (SM), clayey sand (SC), and sandy clay (CL). Standard penetration resistances within the sampled residuum ranged from 4 to 71 bpf.

4.2.4 Partially Weathered Rock

Partially weathered rock (PWR) is a transitional material between soil and rock, which retains the relic structure of the rock and has very hard or very dense consistencies. PWR was encountered in borings B-1 and B-2 at depths of 6 feet and 17 feet below existing grade, respectively. Sampled PWR was described as silty sand (SM) and exhibited penetration resistances ranging from 50 blows per 5 inches to 50 blows per 2 inches of split-spoon penetration (50/5 to 50/2).

4.2.5 Auger Refusal Materials

Auger refusal occurs when materials are encountered that cannot be penetrated by the soil auger and is normally indicative of a hard or very dense material, such as debris within fill, boulders, rock lenses, pinnacles, or the upper surface of bedrock. Auger refusal was encountered in boring B-1 at a depth of 12.6 feet below the existing ground surface.

Auger refusal discussed herein is based on conditions impenetrable the drilling equipment utilized on this project (CME-550X). Auger refusal conditions with the drilling rig utilized in this exploration do not necessarily indicate conditions impenetrable to other equipment. Auger refusal conditions may exist intermediate of the boring locations or in unexplored areas of the site.

4.2.6 Groundwater Data

Groundwater for the purposes of this report is defined as water encountered below the existing ground surface. Groundwater was encountered in borings B-2 and B-5 upon completion of drilling operations at depths of 16 feet and 12 feet below existing grade, respectively.

It should be noted that the groundwater levels fluctuate depending upon seasonal factors such as precipitation and temperature. As such, soil moisture and groundwater conditions at other times may vary from those described in this report.

4.3 Seasonal High Water Table and Hydraulic Conductivity

A SHWT was observed in hand auger borings SHWT-1 and SHWT-2 at depths of 71 inches and 22 inches below the existing ground surface, respectively. Additionally, a perched water table (PWT) was observed in boring SHWT-1 within a layer of low permeability soil from 11 to 23 inches below existing grade.

The infiltration rate was determined in each hand auger boring by measuring saturated hydraulic conductivity (KSAT) in the most restrictive soil horizon that was encountered within 2 feet of the SHWT. The SHWT Determination and Hydraulic Conductivity report is provided in Appendix IV. Results of the SHWT determinations and hydraulic conductivity testing are summarized in the following table:

SHWT and Hydraulic Conductivity Summary

Hand Auger Boring	SHWT Depth below Existing Ground Surface (inches)	PWT Depth below Existing Ground Surface (inches)	Hydraulic Conductivity	
			Test Depth (inches)	Measured K_{SAT} (inches/hour)
SHWT-1	71	11-23	62	0.705
SHWT-2	22	-	21	0.225

4.4 Laboratory Test Results

As outlined in *Section 3.2, Soil Laboratory Testing*, selected split-spoon samples were tested in general accordance with applicable ASTM International (ASTM) standards. The results of the soil laboratory testing program are summarized in the following tables and presented in Appendix III:

Soil Classification Test Summary

Boring No.	Sample Depth (ft)	Water Content (%)	% Finer than No. 200 Sieve	Atterberg Limits			USCS Classification
				LL	PL	PI	
B-2	3.5-6	10.0	48	23	14	9	SC
B-9	2-6	24.3	67	47	23	24	CL

Notes: * – Bulk Sample, LL – Liquid Limit, PL – Plastic Limit, PI – Plastic Index, NP – Non-Plastic

5.0 GEOTECHNCIAL DESIGN RECOMMENDATIONS

5.1 General

The following evaluations and recommendations are based on our observations at the site, interpretation of the field and laboratory data obtained during this exploration, provided project information and assumptions as outlined in Section 1.0 Project Information, and our experience with similar subsurface conditions and projects. Using established correlations, soil penetration data have been used to evaluate the site for applicable foundation support approaches. Subsurface conditions in unexplored locations may vary from those encountered.

Determination of an appropriate foundation system for a given structure is dependent on the proposed structural loads, soil conditions, settlement, and construction constraints. The subsurface exploration aids the geotechnical engineer in determining the soil stratum appropriate for structural support. This determination includes considerations with regard to both allowable bearing capacity and compressibility of the soil strata. In addition, since the method of construction greatly affects the soils intended for structural support, consideration must be given to the implementation of suitable methods of site preparation, fill compaction, and other aspects of construction. Please refer to the Construction Recommendations included in Section 6 of this report.

5.2 Foundations

5.2.1 Pedestrian Bridge Foundations

Limited preliminary information on the pedestrian bridge was provided at the time of this report. We understand that the bridge will be about 12 feet in length and primarily be utilized by pedestrians, with occasional UTV/gator traffic. We anticipate that the bridge will be a relatively low, swale-bridge type structure, supported by a shallow strip foundation on each side. We have assumed a maximum axial foundation load of 4 kips per linear foot (klf) on a shallow strip foundation.

Based on the subsurface conditions encountered in borings B-1 and B-2 and the assumed foundation type and loading, the pedestrian bridge may be supported on a system of conventional shallow foundations designed for an allowable bearing pressure of 3,000 pounds per square foot (psf). Foundations should bear on residual soil or controlled structural fill placed in accordance with our recommendations. We estimate foundation settlements of less than 1-inch, with differential settlement of about ½ of the estimated total settlement. To reduce the possibility of localized shear failures, strip footings should be a minimum of 2 feet wide. Foundations should be embedded a minimum of 12 inches below adjacent exterior grades for frost protection.

5.2.2 Amphitheatre Canopy Foundations

No information on the amphitheater stage was provided at the time of this report. In our experience, foundation loads for canopy structures can vary considerably based on size, configuration, and material type. For our preliminary analysis in this report, we have assumed a canopy supported on shallow spread foundations with a maximum axial load of 50 kips.

Based on the subsurface conditions encountered in borings B-3 and B-4 and the assumed foundation type and loading, the amphitheater canopy structure may be supported on a system of conventional shallow foundations designed for an allowable bearing pressure of 3,000 psf. Foundations should bear on residual soil or controlled structural fill placed in accordance with our recommendations. We estimate foundation settlements of less than 1-inch, with differential settlement of about ½ of the estimated total settlement. To reduce the possibility of localized shear failures, spread footings should be a minimum of 3 feet wide. Foundations should be embedded a minimum of 12 inches below adjacent exterior grades for frost protection.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 General

The principal purpose of this section is to comment in general on the items related to earthwork and associated geotechnical engineering aspects of construction that should be expected for this project. It is recommended that F&R's geotechnical engineer be retained to provide soil engineering services during the construction phases of the project and perform appropriate evaluations to help confirm that conditions encountered during construction are similar to conditions observed in the borings.

6.2 Site Preparation

Before proceeding with construction, any surficial soils, roots, and any other deleterious non-soil materials should be stripped or removed from the proposed construction area. During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water.

After stripping, areas intended to support new fill, pavements, floor slabs, and foundations should be carefully evaluated by a representative of the geotechnical engineer. At that time, the engineer may require proofrolling of the subgrade with a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. Proofrolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated. The purpose of the proofrolling is to locate soft, weak, or excessively wet soils present at the time of construction and to provide an opportunity for the geotechnical engineer to locate inconsistencies intermediate of our boring locations.

Any unsuitable materials observed during the evaluation and proofrolling operations should be undercut and replaced with compacted fill or stabilized in-place. Existing fill was encountered in borings B-1, B-2, B-4, and B-5 to depths of about 2 feet below the existing surface. Existing fill materials may be located in between the boring locations, and the composition and consistency of the fills may vary from those encountered in the borings. The actual extent of undercutting and/or in-place stabilization required can best be determined by a representative of the geotechnical engineer at the time of construction.

Undercutting or additional in-place compaction may be necessary if the exposed subgrade soils become unstable during construction. Any fill materials, aggregate, and or concrete should be placed as soon as possible over the approved subgrade in order to reduce exposure of the subgrade to weather and construction activity.

It is important to stress that if site preparation or construction are performed during the winter months, additional undercutting of the subgrade soils may be required if the subgrade is not properly prepared or protected.

6.3 Shallow Foundation Construction

All foundation subgrades should be observed, evaluated, and verified for the design bearing pressure by a representative of the geotechnical engineer after excavation and prior to reinforcement steel placement. The purpose of the observation is to determine that the foundations bear in suitable materials at the proper embedment depths, and that unsuitable soft or loose materials are undercut and backfilled with approved structural fill material at the direction of the geotechnical engineer.

Excavations for footings should be made in such a way as to provide bearing surfaces that are firm and free of loose, soft, wet, or otherwise disturbed soils. Foundation concrete should not be placed on frozen or saturated subgrades. If such materials are allowed to remain below foundations, settlements will increase. Foundation excavations should be concreted as soon as practical after they are excavated. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Water should not be allowed to pond in any excavation.

6.4 Controlled Structural Fill

The existing near-surface on-site soils appeared generally acceptable for reuse as controlled structural fill materials, although some moisture conditioning may be required. If encountered during construction, plastic clays (CH soils) or debris-laden existing fill soils should not be used as structural fill.

If an off-site borrow source is required to balance the site, the imported materials should have a classification of CL, ML, SC, or SM as defined by the Unified Soil Classification System. Other materials may be suitable for use as controlled structural fill material and should be individually evaluated by the geotechnical engineer. If encountered, plastic clays (CH) should not be used as structural fill. Controlled structural fill should be free of boulders, organic matter, debris, or other deleterious materials and should have a maximum particle size no greater than 3 inches. In addition, we recommend a minimum standard Proctor (ASTM D 698) maximum dry density of approximately 100 pounds per cubic feet for fill materials.

Fill materials should be placed in horizontal lifts with maximum height of 8 inches loose measure. New fill should be adequately keyed into stripped and scarified subgrade soils and should, where applicable, be benched into the existing slopes. During fill operations, positive surface drainage should be maintained to prevent the accumulation of water. We recommend that structural fill be compacted to at least 95 percent of the standard Proctor maximum dry density. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 to 4 inches may be required to achieve specified degrees of compaction. Each lift of fill should be tested in order to confirm that the recommended degree of compaction is attained.

In general, we recommend that the moisture content of fill materials be maintained within three percentage points of the optimum moisture content as determined from the standard Proctor density test. We recommend that the contractor have equipment on site during earthwork for both drying and wetting of fill soils. Moisture control may be especially difficult during winter months or extended periods of rain. Attempts to work the soils when wet can be expected to result in deterioration of otherwise suitable soil conditions or of previously placed and properly compacted fill. Where construction traffic or weather has disturbed the subgrade, the upper 8 inches of soils (or more if warranted) intended for structural support should be scarified and re-compacted.

6.5 Groundwater Conditions

Groundwater was encountered in borings B-2 and B-5 upon completion of drilling operations at depths of 16 feet and 12 feet below existing grade, respectively. While groundwater was not encountered in borings B-6, B-8, B-9, and B-10 immediately following the completion of drilling, the split-spoon samples collected from 6.5 to 8 feet in each boring were described as "wet" during manual classification. A SHWT was observed in hand auger borings SHWT-1 and SHWT-2 at depths of 71 inches and 22 inches below the existing ground surface, respectively. Additionally, a perched water table (PWT) was observed in boring SHWT-1 within a layer of low permeability from 11 to 23 inches below existing grade. Therefore, groundwater or perched groundwater could be encountered in excavations or areas of cut particularly in the southern portion of the project site.

Groundwater levels tend to fluctuate with seasonal and climatic variations as well as with some types of construction operations. Generally, the highest subsurface water levels occur in late winter and early spring and the lowest levels occur in late summer and early fall. In addition, groundwater readings in predominantly fine-grained soils are not necessarily indicative of the actual static groundwater levels due to the low-permeability of such soils. If encountered during construction, engineering personnel from our office should be notified immediately.

6.6 Excavation Conditions and Guidelines

Based on the subsurface conditions encountered in the borings and the assumed grading information, the need to employ difficult excavation techniques for removal of very dense or hard materials during mass grading is not expected at this time.

Mass excavations and other excavations required for this project must be performed in accordance with the United States Department of Labor, Occupational Safety and Health Administration (OSHA) guidelines (29 CFR 1926, Subpart P, Excavations) or other applicable jurisdictional codes for permissible temporary side-slope ratios and or shoring requirements. The OSHA guidelines require daily inspections of excavations, adjacent areas and protective systems by a "competent person" for evidence of situations that could result in cave-ins, indications of failure of a protective system, or other hazardous conditions.

Excavated soils, equipment, building supplies, etc., should be placed away from the edges of the excavation at a distance equaling or exceeding the depth of the excavation. F&R cautions that the actual excavation slopes will need to be evaluated frequently each day by the "competent person" and flatter slopes or the use of shoring may be required to maintain a safe excavation depending upon excavation specific circumstances. The contractor is responsible for providing the "competent person" and all aspects of site excavation safety.

7.0 CONTINUATION OF SERVICES

As previously discussed, a Geotechnical Engineer should be retained to monitor and test earthwork activities, and observe subgrade preparations for foundations, floor slabs, and pavements. It should be noted that the actual soil conditions at the various subgrade levels and footing bearing grades will vary across this site and thus the presence of the Geotechnical Engineer and/or his representative during construction will serve to validate the subsurface conditions and recommendations presented in this report. A geotechnical engineer should be employed to monitor the earthwork and foundation construction, and to report that the recommendations contained in this report are completed in a satisfactory manner. The continued geotechnical engineering involvement on the project will aid in the proper implementation of the recommendations discussed herein. The following is a recommended scope of services:

- Review of project plans and construction specifications prior to completion to verify that the recommendations presented in this report have been properly interpreted and implemented;
- Observe the earthwork process to document that subsurface conditions encountered during construction are consistent with the conditions anticipated in this report;
- Observe the subgrade conditions before placing structural fill including proofroll observations;
- Observe the placement and compaction of any structural fill and backfill, and perform laboratory and field compaction testing of the fill; and,
- Observe all foundation excavations and footing bearing grades for compliance with the recommended design soil bearing capacity. We also stress the importance of conducting hand auger and DCP testing at and extending several feet below the footing bearing grade in order to give an indication of the anticipated subsurface conditions

8.0 LIMITATIONS

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

This report has been prepared for the exclusive use of Dewberry for the specific application to the planned Village Hall Park (Phase I) in Marvin, North Carolina, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. Our recommendations are based on design information furnished to us at the time the work was performed; the data obtained from the previously described subsurface exploration program, and generally accepted geotechnical engineering practice. The findings and recommendations do not reflect variations in subsurface conditions, which could exist in unexplored areas of the site. In areas where variations from the available subsurface data become apparent during construction, it will be necessary to re-evaluate our recommendations based upon on-site observations of the conditions.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions in other areas will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, our experienced geotechnical engineers should evaluate foundation construction to verify that the conditions anticipated in design actually exist. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations. In the event that changes are made in the design or location of the proposed structures, the recommendations presented in this report shall not be considered valid unless the changes are reviewed by our firm and recommendations of this report modified or verified in writing. If this report is copied or transmitted to a third party, it must be copied or transmitted in its entirety, including text, attachments, and enclosures. Interpretations based on only a part of this report may not be valid.

APPENDIX I

Site Vicinity Map (Figure No. 1)

Boring Location Plan (Figure No. 2)

Source: Union County GIS – 2023 Aerial

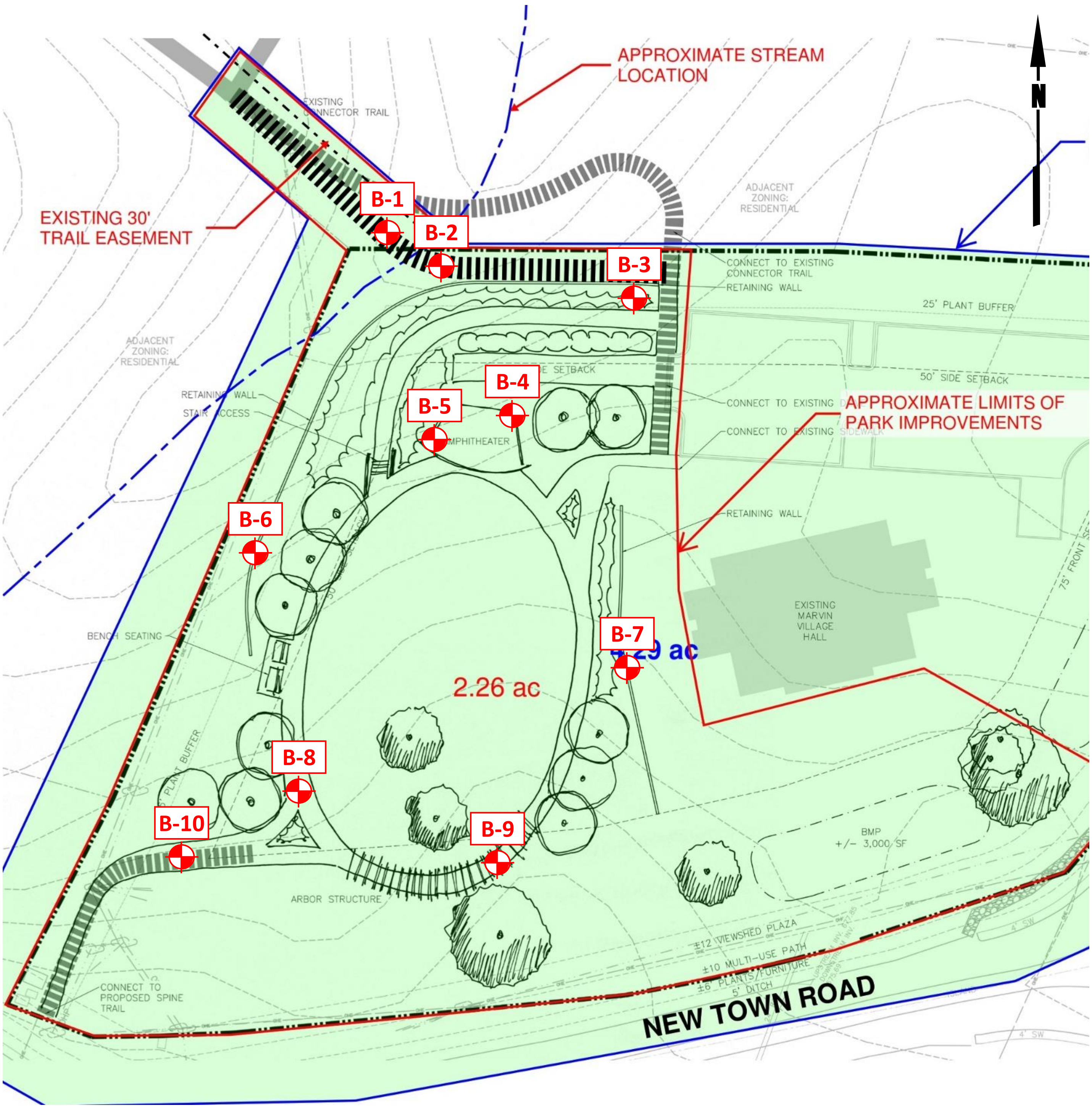
FROEHLING & ROBERTSON
Engineering Stability Since 1881

DATE:	September 2024
SCALE:	As Shown
DRAWN:	ATK — 63C-0045

Dewberry
Village Hall Park Phase I
Marvin, North Carolina

SITE VICINITY MAP

FIGURE NO.
1



Source: Conceptual Sketch prepared by McAdams (undated)

0' 40' 80'

F&R Soil Test Boring Locations

FROEHLING & ROBERTSON
Engineering Stability Since 1881

DATE:	September 2024
SCALE:	As Shown
DRAWN:	ATK — 63C-0045

Dewberry
Village Hall Park Phase I
Marvin, North Carolina

BORING LOCATION PLAN

FIGURE NO.
2

APPENDIX II

Key to Soil Classification

Soil Classification Chart

Boring Logs (B-1 through B-10)

KEY TO BORING LOG SOIL CLASSIFICATION

Particle Size and Proportion

Visual descriptions are assigned to each soil sample or stratum based on estimates of the particle size of each component of the soil and the percentage of each component of the soil.

Particle Size Descriptive Terms		Proportion Descriptive Terms		
Soil Component	Particle Size	Component	Term	Percentage
Boulder	> 12 inch	Major	Uppercase Letters	> 50%
Cobble	3 - 12 inch		(e.g., SAND, CLAY)	
Gravel-Coarse	3/4 - 3 inch			
-Fine	#4 - 3/4 inch	Secondary	Adjective	20% - 50%
Sand-Coarse	#10 - #4		(e.g., sandy, clayey)	
-Medium	#40 - #10			
-Fine	#200 - #40	Minor	Some	15% - 25%
Silt (non-cohesive)	< #200		Little	5% - 15%
Clay (cohesive)	< #200		Trace	0% - 5%

Notes:
1. Particle size is designated by U.S. Standard Sieve Sizes
2. Because of the small size of the split-spoon sampler relative to the size of gravel, the true percentage of gravel may not be accurately estimated.

Density or Consistency

The standard penetration resistance values (N-values) are used to describe the density of coarse-grained soils (GRAVEL, SAND) or the consistency of fine-grained soils (SILT, CLAY). Sandy silts of very low plasticity may be assigned a density instead of a consistency.

DENSITY		CONSISTENCY	
Term	N-Value	Term	N-Value
Very Loose	0 - 4	Very Soft	0 - 1
Loose	5 - 10	Soft	2 - 4
Medium Dense	11 - 30	Firm	5 - 8
Dense	31 - 50	Stiff	9 - 15
Very Dense	> 50	Very Stiff	16 - 30
		Hard	> 30

Notes:
1. The N-value is the number of blows of a 140 lb. Hammer freely falling 30 inches required to drive a standard split-spoon sampler (2.0 in. O.D., 1-3/8 in. I.D.) 12 inches into the soil after properly seating the sampler 6 inches.
2. When encountered, gravel may increase the N-value of the standard penetration test and may not accurately represent the in-situ density or consistency of the soil sampled.

SOIL CLASSIFICATION CHART

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BORING LOG

Boring: B-1 (1 of 1)

FROEHLING & ROBERTSON

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 662 ±
Total Depth: 12.6'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/21/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
661.8	0.3	**SURFICIAL SOIL:** 3 inches	2-2-2	0.0 1.5	4	**Groundwater Data:** 0 HR: DRY 0 HR CAVE: 11.0 feet
660.0	2.0	**FILL:** Sampled as loose, dark brown, silty fine to coarse SAND (SM) with trace organics, moist	10-28-43	2.0 3.5	71	
658.5	3.5	**RESIDUUM:** Very dense, mottled brown, orange, and white, silty fine to coarse SAND (SM), moist	16-22-17	3.5 5.0	39	
656.0	6.0	Dense, gray and white, silty fine to coarse SAND (SM), dry				
		PARTIALLY WEATHERED ROCK: Sampled as very dense, gray, silty fine to coarse SAND (SM) with trace mica, dry	40-50/5	6.5 7.4	100+	
			50/5	8.5	100+	
649.4	12.6	**Auger Refusal at 12.6 feet**	50/1	12.6	100+	

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

BORING LOG

Boring: B-2 (1 of 1)

FROEHLING & ROBERTSON

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 662 ±
Total Depth: 18.7'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/21/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
661.8	0.3	**SURFICIAL SOIL:** 3 inches	2-2-2	0.0	4	**Groundwater Data:** 0 HR: 15.8 feet 0 HR CAVE: 16.0 feet
				1.5		
660.0	2.0	**FILL:** Sampled as loose, dark brown, silty fine to coarse SAND (SM) with trace organics, moist	3-4-4	2.0	8	
				3.5		
658.5	3.5	**RESIDUUM:** Loose, mottled brown, orange, and gray, silty fine to coarse SAND (SM) with trace organics, dry	5-12-12	3.5	24	
		Medium dense, gray and white, clayey fine to coarse SAND (SC) with trace rock fragments, dry		5.0		
656.0	6.0	Dense to medium dense, brown and tan, clayey fine to coarse SAND (SC) with trace mica, moist	7-11-20	6.5	31	
				8.0		
			7-12-10	8.5	22	
				10.0		
			8-9-15	13.5	24	
				15.0		
645.0	17.0	**PARTIALLY WEATHERED ROCK:** Sampled as very dense, gray, silty fine to coarse SAND (SM) with trace rock fragments, moist	50/2	18.7	100+	
643.3	18.7	**Boring Terminated at 18.7 feet**				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

FROEHLING & ROBERTSON

BORING LOG

Boring: B-3 (1 of 1)

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 666 ±
Total Depth: 8.0'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/20/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
665.8	0.3	**SURFICIAL SOIL:** 3 inches	5-5-6	0.0	11	**Groundwater Data:** 0 HR: DRY
		RESIDUUM: Medium dense, mottled brown, tan, and white, silty fine to coarse SAND (SM) with trace organics, dry	7-9-20	1.5 2.0	29	
662.5	3.5	Very dense to medium dense, white and tan, silty fine to coarse SAND (SM) with trace mica and rock fragments, dry	12-28-34	3.5 5.0	62	
			6-10-15	6.5 8.0	25	
658.0	8.0	**Boring Terminated at 8 feet**				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

BORING LOG

Boring: B-4 (1 of 1)

FROEHLING & ROBERTSON

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 669 ±
Total Depth: 15.0'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/20/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
668.6	0.4	**SURFICIAL SOIL:** 5 inches	2-3-2	0.0 - 1.5	5	**Groundwater Data:** 0 HR: DRY; 0 HR CAVE: 12.4 feet
667.0	2.0	**FILL:** Sampled as loose, dark brown, silty fine to coarse SAND (SM) with trace organics, dry	5-5-8	2.0 - 3.5	13	
665.5	3.5	**RESIDUUM:** Medium dense, mottled brown, tan, and gray, clayey fine to coarse SAND (SC), dry	6-12-14	3.5 - 5.0	26	
		Medium dense to loose, brown and tan, clayey fine to coarse SAND (SC), moist	4-7-9	6.5 - 8.0	16	
			4-4-6	8.5 - 10.0	10	
657.0	12.0	Dense, dark brown, silty fine to coarse SAND (SM) with trace mica and rock fragments, dry	9-15-21	13.5 - 15.0	36	
654.0	15.0	**Boring Terminated at 15 feet**				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

BORING LOG

Boring: B-5 (1 of 1)

FROEHLING & ROBERTSON

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 668 ±
Total Depth: 15.0'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/20/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
667.3	0.7	**SURFICIAL SOIL:** 8 inches	1-2-3	0.0 – 1.5	5	**Groundwater Data:** 0 HR: 12.0 feet; 0 HR CAVE: 12.0 feet
666.0	2.0	**FILL:** Sampled as loose, dark brown, silty fine to coarse SAND (SM) with trace organics, dry	4-6-7	2.0 – 3.5	13	
		RESIDUUM: Medium dense to loose, brown and tan, clayey fine to coarse SAND (SC) with trace mica, moist	6-10-12	3.5 – 5.0	22	
			7-8-11	6.5 – 8.0	19	
			4-3-4	8.5 – 10.0	7	
656.0	▽12.0	Hard, sandy LEAN CLAY (CL) with trace mica and rock fragments, moist	10-12-20	13.5 – 15.0	32	
653.0	15.0	**Boring Terminated at 15 feet**				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

BORING LOG

Boring: B-6 (1 of 1)

FROEHLING & ROBERTSON

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 670 ±
Total Depth: 8.0'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/20/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
669.6	0.4	**SURFICIAL SOIL:** 5 inches	6-11-12	0.0 - 1.5	23	**Groundwater Data:** 0 HR: DRY
668.0	2.0	**RESIDUUM:** Medium dense, brown, silty fine to coarse SAND (SM) with trace organics, dry	5-7-16	2.0 - 3.5	23	
664.0	6.0	Medium dense, tan and brown, clayey fine to coarse SAND (SC), dry	8-9-7	3.5 - 5.0	16	
662.0	8.0	Very loose, brown and orange, silty fine to medium SAND (SM), wet	1-2-2	6.5 - 8.0	4	

Boring Terminated at 8 feet

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

BORING LOG

Boring: B-7 (1 of 1)

FROEHLING & ROBERTSON

Project No: 63C-0045	**Elevation:** 674 ±	**Drilling Method:** HSA
Client: Dewberry Engineers Inc.	**Total Depth:** 15.0'	**Hammer Type:** Automatic
Project: Village Hall Park (Phase I)	**Boring Location:** See Boring Location Plan	**Date Drilled:** 8/20/24
City/State: Marvin, NC		**Driller:** HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
673.7	0.3	**SURFICIAL SOIL:** 4 inches	3-4-7	0.0 – 1.5	11	**Groundwater Data:** 0 HR: DRY 0 HR CAVE: 13.0 feet
		RESIDUUM: Stiff, orange and brown, sandy LEAN CLAY (CL) with trace organics, dry				
672.0	2.0	Medium dense, mottled orange, brown, and tan, clayey fine to coarse SAND (SC), dry	5-7-9	2.0 – 3.5	16	
			7-9-10	3.5 – 5.0	19	
668.0	6.0	Loose to very loose, mottled orange, brown, and tan, clayey fine to coarse SAND (SC), moist	2-3-3	6.5 – 8.0	6	
			2-2-2	8.5 – 10.0	4	
662.0	12.0	Medium dense, orange and tan, silty fine to coarse SAND (SM) with trace rock fragments, moist	9-12-15	13.5 – 15.0	27	
659.0	15.0	**Boring Terminated at 15 feet**				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

BORING LOG

Boring: B-8 (1 of 1)

FROEHLING & ROBERTSON

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 675 ±
Total Depth: 8.0'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/20/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
674.4	0.6	**SURFICIAL SOIL:** 7 inches	5-5-5	0.0 - 1.5	10	**Groundwater Data:** 0 HR: DRY
673.0	2.0	**RESIDUUM:** Loose, brown and red, clayey fine to coarse SAND (SC) with trace organics, moist	3-4-6	2.0 - 3.5	10	
		Stiff to firm, red and tan, sandy LEAN CLAY (CL), moist	3-3-4	3.5 - 5.0	7	
669.0	6.0					
667.0	8.0	Very loose, mottled orange, tan, and black, clayey fine to coarse SAND (SC) with trace mica, wet	1-2-2	6.5 - 8.0	4	
		Boring Terminated at 8 feet				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

FROEHLING & ROBERTSON

BORING LOG

Boring: B-9

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 679 ±
Total Depth: 8.0'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/20/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
678.5	0.5	**SURFICIAL SOIL:** 6 inches	2-2-4	0.0 - 1.5	6	**Groundwater Data:** 0 HR: DRY
677.0	2.0	**RESIDUUM:** Loose, brown, silty fine to coarse SAND (SM) with trace organics, dry	2-6-7	2.0 - 3.5	13	
673.0	6.0	Stiff, red and tan, sandy LEAN CLAY (CL), moist	3-5-5	3.5 - 5.0	10	
671.0	8.0	Loose, orange and tan, clayey fine to coarse SAND (SC) with trace mica, wet	2-3-3	6.5 - 8.0	6	
		Boring Terminated at 8 feet				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

FROEHLING & ROBERTSON

BORING LOG

Boring: B-10 (1 of 1)

Project No: 63C-0045
Client: Dewberry Engineers Inc.
Project: Village Hall Park (Phase I)
City/State: Marvin, NC

Elevation: 676 ±
Total Depth: 8.0'
Boring Location: See Boring Location Plan

Drilling Method: HSA
Hammer Type: Automatic
Date Drilled: 8/20/24
Driller: HPC: J. Cain

Elevation	Depth	Description of Materials (Classification)	* Sample Blows	Sample Depth (feet)	N-Value (blows/ft)	Remarks
675.6	0.4	**SURFICIAL SOIL:** 5 inches	4-5-8	0.0	13	**Groundwater Data:** 0 HR: DRY
		RESIDUUM: Stiff to firm, mottled red, tan, and brown, sandy LEAN CLAY (CL), moist		1.5		
			3-5-5	2.0	10	
			3-3-3	3.5	6	
				5.0		
670.0	6.0	Loose, orange and tan, silty fine to medium SAND (SM), wet	2-2-2	6.5	4	
668.0	8.0	**Boring Terminated at 8 feet**		8.0		

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N-Value.

APPENDIX III

Material Test Report

Froehling & Robertson, Inc.
Charlotte Office
3300 International Airport Drive, Suite 600
Charlotte, NC 28208
Phone: 704.596.2889 www.FandR.com

Material Test Report

Client: Dewberry Engineers, Inc. - Charlotte
9300 Harris Corners Parkway
Charlotte, NC 28269

CC:

Project: 63C0045
Village Hall Park Phase 1 - Village of Marvin, NC
10006 Marvin School Road
Village of Marvin, NC 28173

Report No: ASM:6324-03239

Review Date:

Material Details

Source

Sampled From on-site excavation

Sample Details

Sample ID	6324-03239-S01	6324-03239-S02
Field Sample ID		
Date Sampled	8/28/2024	
Boring No	B-2	B-9
Depth	3.5-6'	2-6'

Other Test Results

Description	Method	Results		Limits
Passing No. 200 (75 µm) (%)	ASTM D1140	48	67	
Procedure		A	A	
Soaking Period (min)		120	120	
Initial Dry Mass (g)		272.9	241.3	
Tested By		Usery David B	Usery David B	
Water Content (%)	ASTM D2216	10	24.3	
Date Tested		8/28/2024	8/28/2024	
Tested By		Usery David B	Usery David B	
Group Code	ASTM D2487	SC	CL	
Group Name		Clayey sand	Sandy lean clay	
Sand (%)		52	33	
Fines (%)		48	67	
Tested By	ASTM D2487	Usery David B	Usery David B	
Liquid Limit	ASTM D4318	23	47	
Plastic Limit		14	23	
Plasticity Index		9	24	
As-Received Water Content (%)		10.0	24.3	
Tested By		Usery David B	Usery David B	
Date Tested		8/28/2024	8/28/2024	

Comments

Legend

APPENDIX IV

Seasonal High Water Table Determination and Hydraulic Conductivity Testing Report

SEASONAL HIGH WATER TABLE DETERMINATION AND HYDRAULIC CONDUCTIVITY TESTING

10006 New Town Road
Waxhaw, Union County, NC
Earthly Elements Job Number: 24-100

Prepared For:

Froehling & Robertson
3300 International Airport Drive, Suite 600
Charlotte, NC 28208

Prepared By:

Earthly Elements Soil Consulting, PLLC
PO Box 12131
Durham, NC 27709

August 23, 2024

Evan T. Morgan, LSS

INTRODUCTION & SITE DESCRIPTION

Froehling and Robertson (F&R) is investigating the construction of stormwater control measures (SCMs) for the Village of Marvin Loop Park project site at 10006 New Town Road in Union County, NC. The SCMs are being proposed to collect and treat runoff from impervious surfaces. As part of the design process a soils investigation detailing soil type and depth to the SHWT and saturated hydraulic conductivity (K_{SAT}) testing is required. Earthly Elements Soil Consulting, PLLC (Earthly Elements) has been retained to perform the soils investigation.

INVESTIGATION METHODOLOGY

The field survey was conducted on August 20, 2024, by Evan T. Morgan, LSS. Soil borings were advanced via hand-auger to a target depth of 12-feet (SHWT-1) and 7-feet (SHWT-2). Infiltration tests were conducted in the most limiting soil horizon within 2 feet of the SCM bottom or SHWT, whichever is shallower. Soil boring locations were provided by the client. Soil color was determined using a Munsell Soil Color Chart. Observations of the soil properties (depth, texture, structure, soil wetness, restrictive horizons, etc.) were recorded. Soil borings were described per the USDA-NRCS, *Field Book for Describing and Sampling Soils, Version 3.0.*

The USDA-NRCS Web Soil Survey was referenced prior to the site visit. The Appling and Helena soil series are mapped in the vicinity of the proposed SCMs. Information for these series is listed in Table 1 below.

Table 1: Soil Series, Map Unit Symbol and Taxonomic Class

Soil Series	*Map Unit Symbol*	*Taxonomic Class*
Appling	ApB	Fine, kaolinitic, thermic Typic Kanhapludults
Helena	HeB	Fine, mixed, semiactive, thermic Aquic Hapludults

The infiltration rate of the soil, or saturated hydraulic conductivity (K_{SAT}) rate, was measured with a compact constant-head permeameter (Amoozemeter). K_{SAT} test values were generated using the published calculations and formulas found in the corresponding User's Manual. The Glover solution was chosen as the most appropriate method for calculating K_{SAT}. The Glover solution is recommended when the distance between the bottom of the auger hole and any impermeable layer(s) is greater than 2 times the head (H), or constant water level in the hole.

The Glover solution is given by: $K_{SAT} = AQ$

Where: A= {sinh-1(H/r)-[(r/H)2+1] 1/2+r/H} / (2πH2)

And: Q is the steady-state rate of water flow from the Amoozemeter into the auger hole.

To solve for A: H is the head in the hole (i.e. total water depth) and r is the radius of the hole. Values for H and r can be found on the attached K_{SAT} data sheets.

RESULTS

Soil Series and SHWT Determination

Soil boring descriptions were compared to the USDA-NRCS Official Soil Series Descriptions (OSDs), and a soil series determination was made and listed in Table 2.

Soil characteristics indicative of a SHWT were observed at borings SHWT-1 and SHWT-2 prior to the target depth. A perched water table (PWT) was observed at boring SHWT-1 within an expansive clay horizon. Detailed depths are listed in Table 2. Full soil profile descriptions are attached. The NRCS OSD for the Helena soil series is appended.

Table 2: Soil Boring, Soil Series Determination, SHWT Depth and PWT Depth

Soil Boring	Soil Series Determination	SHWT Depth (in. below surface)	PWT Depth (in. below surface)
SHWT-1	Helena	71	11-23
SHWT-2	Helena	22	-

Hydraulic Conductivity Measurements

A K_{SAT} test was completed within the most limiting soil horizon within 2-feet of the target depth or auger refusal and the results are listed in Table 3 below. It should be noted that K_{SAT} values only represent the infiltration rate within the tested soil horizon and cannot be applied to other soil horizons with differing soil properties (texture, structure, consistency, mineralogy, etc.).

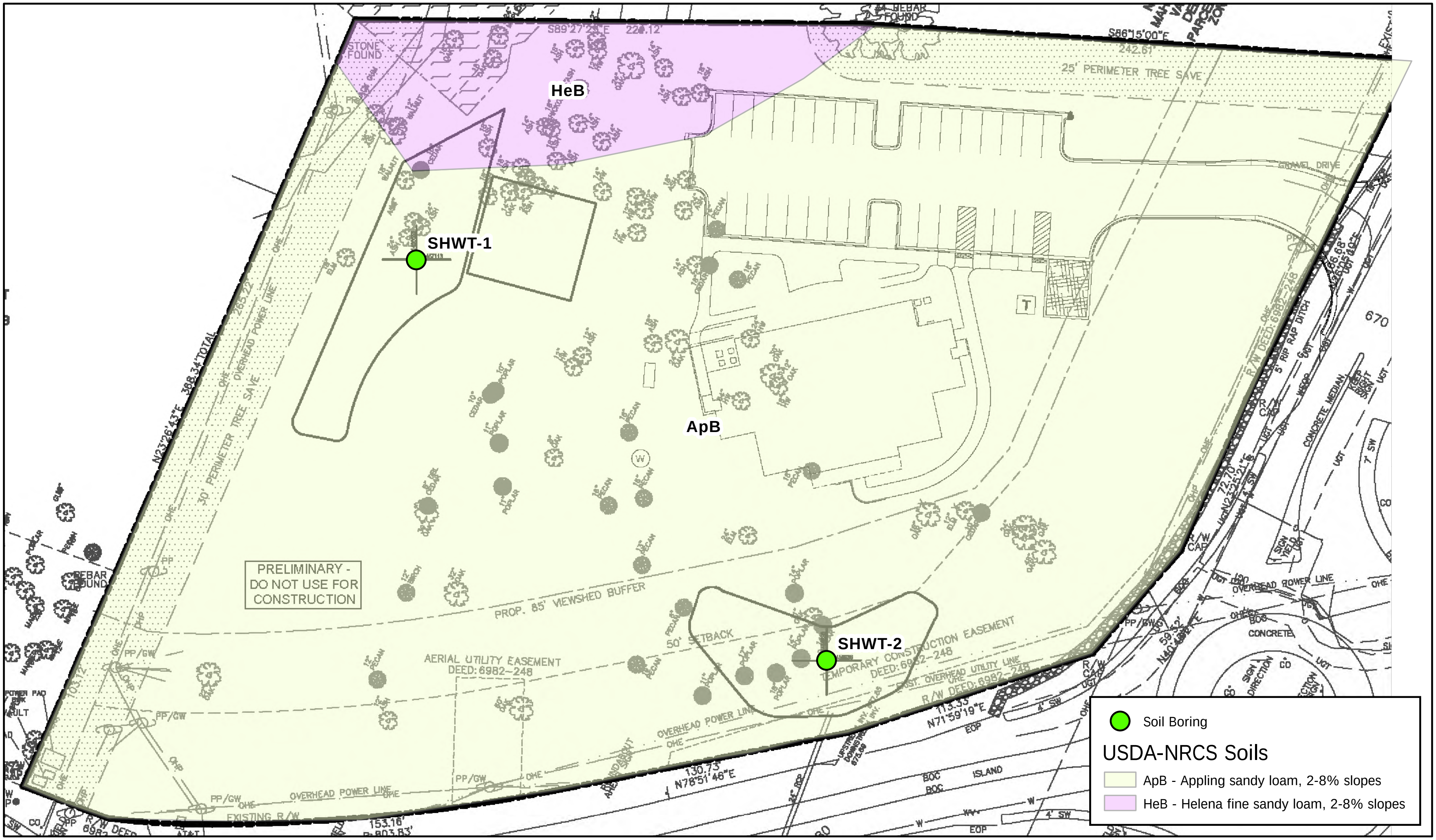
Table 3: Hydraulic conductivity tests results and parameters.

Test #	Soil Boring	Horizon/Texture	Test Depth (in)	Measured K_{SAT} (in/hr)
K1	SHWT-1	BC / CL	62	0.705
K2	SHWT-2	Bt / SCL	21	0.225

CONCLUSIONS

The findings presented herein represent Earthly Elements' professional opinion based on our soil evaluation. A SHWT was observed at each boring location prior to the target depth. A PWT was observed at boring SHWT-1. An infiltration test was conducted at each boring within the most limiting soil horizon within 2-feet of the SHWT.

Due to the inherent variability of soils to change over short distances, the soil profile descriptions presented in this report may not be representative of the entire soil system of the SCM footprint. This report is provided to assist in the design of the SCM by providing soil information.



EES
Earthly Elements
Soil Consulting

SHWT Determination &
Hydraulic Conductivity Testing

Village of Marvin Loop Park
USDA-NRCS Soils Map

Union County, North Carolina

Licensed Soil Scientist
Evan T. Morgan
1340
State of North Carolina

Date: August 2024

Job #: 24-100

1 inch = 60 feet

0 30 60 Feet

Figure

1

SOIL EVALUATION FORM

Earthly Elements Soil Consulting, PLLC
PO Box 12131
Durham, NC 27709
919-417-0509

Job: Village of Marvin Loop Park
County: Union
Date: 8-20-24
Sheet: 1 of 1

Profile #	Horizon	Horizon Depth (In)	Structure / Texture	Consistence / Mineralogy	Matrix Color	Mottle Colors (Quantity, Size, Contrast, Color)
SHWT-1	A	0-11	1mGR / SL	VFR / SO,PO	10YR5/4	
	Btss	11-23	2mABK / C	FI / S,VP	7.5YR6/6	C,2,P 10YR 6/2; C,1,D 10YR 6/4
	BC	23-71	1mABK / CL	FI / SS,SP	10YR6/4	C,1,D 10YR 7/3; C,1,D 2.5Y 6/4
	C	71-112	OM / SL	FR / SO,PO	7.5YR6/4	C,2,P 10YR 7/1; C,1,P 10YR6/2; C,1,D 10YR5/6
	Cr	112+	Auger Refusal			
			PWT 11-23"			
			AR 112"			
			SHWT at 71"			
SHWT-2	A	0-3	1mGR / LS	VFR / SO,PO	10YR3/2	
	E	3-14	1mGR / SL	FR / SO,PO	10YR6/4	
	Bt	14-22	1mSBK / SCL	FR / SS,SP	2.5Y6/4	
	BCg	22-84	2mABK / C	VFI / SP	10YR 6/2	C,2,D 2.5Y 6/4
			SHWT at 22"			

Evaluated by: E. Morgan

SATURATED HYDRAULIC CONDUCTIVITY STUDY
Village of Marvin Loop Park

Date: 8/20/2024
Location: SHWT-1
Number: 1
Horizon: BC
Depth(inches): 62.0

Weather Condition: Sunny
Temperature (F): 80

	cm	in
Target Water Level:	15.2	6.0
Beginning Water Level:	15.2	6.0
Ending Water Level:	15.2	6.0

SET UP

		cm	in
Hole Depth:		157.5	62.0
Reference:	+	10.2	4.0
Head:	-	15.2	6.0
CHT Tube(s) setting:	=	152.4	60.0

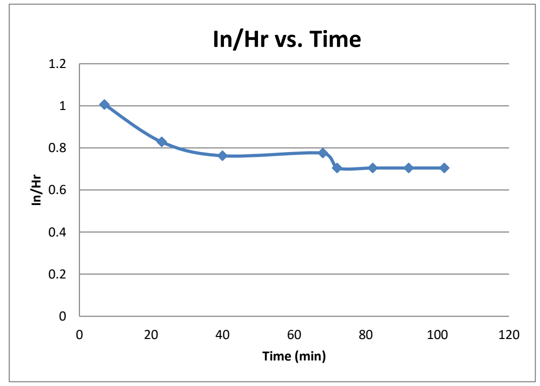
Hole diameter (d): 5.0 cm
Hole radius (r): 2.5 cm
coefficient A: 0.001136

Valve Setting:		x
	1-ON	2-ON

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 105.0

Water Reading	Change in Water Level	Chamber C.F.	Clock Time (min)	Elapsed Time (min)	Flow Volume (cm3)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
35	0.0	105.0	0.0					
32.5	2.5	105.0	7.0	7.00	262.500	2250.0	2.5565	1.0065
27.8	4.7	105.0	23.0	16.00	493.500	1850.6	2.1027	0.8278
23.2	4.6	105.0	40.0	17.00	483.000	1704.7	1.9369	0.7626
15.5	7.7	105.0	68.0	28.00	808.500	1732.5	1.9685	0.7750
14.5	1.0	105.0	72.0	4.00	105.000	1575.0	1.7896	0.7046
12	2.5	105.0	82.0	10.00	262.500	1575.0	1.7896	0.7046
9.5	2.5	105.0	92.0	10.00	262.500	1575.0	1.7896	0.7046
7	2.5	105.0	102.0	10.00	262.500	1575.0	1.7896	0.7046
						Final Ksat	**1.790**	**0.705**



SATURATED HYDRAULIC CONDUCTIVITY STUDY
Village of Marvin Loop Park

Date: 8/20/2024
Location: SHWT-2
Number: 2
Horizon: Bt
Depth(inches): 21.0

Weather Condition: Sunny
Temperature (F): 80

	cm	in
Target Water Level:	15.2	6.0
Beginning Water Level:	15.2	6.0
Ending Water Level:	15.2	6.0

SET UP

		cm	in
Hole Depth:		53.3	21.0
Reference:	+	10.2	4.0
Head:	-	15.2	6.0
CHT Tube(s) setting:	=	48.3	19.0

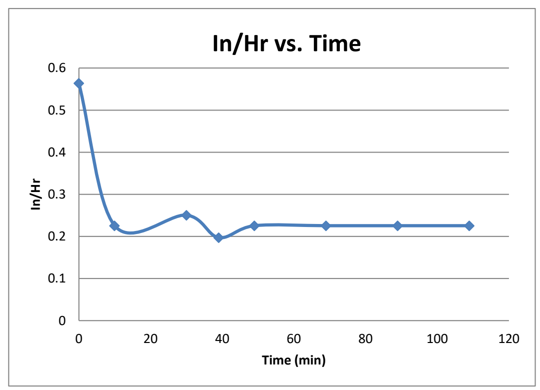
Hole diameter (d): 5.0 cm
Hole radius (r): 2.5 cm
coefficient A: 0.001136

Valve Setting:		x
	1-ON	2-ON

NOTE: Readings based on Ending Water Level

Coversion Factor (C.F.): 105.0

Water Reading	Change in Water Level	Chamber C.F.	Clock Time (min)	Elapsed Time (min)	Flow Volume (cm3)	Q (cm3/hr)	K (cm/hr)	K (in/hr)
35	0.0	105.0	0.0					
33	2.0	105.0	10.0	10.00	210.000	1260.0	1.4316	0.5636
31.4	1.6	105.0	30.0	20.00	168.000	504.0	0.5727	0.2255
30.6	0.8	105.0	39.0	9.00	84.000	560.0	0.6363	0.2505
29.9	0.7	105.0	49.0	10.00	73.500	441.0	0.5011	0.1973
28.3	1.6	105.0	69.0	20.00	168.000	504.0	0.5727	0.2255
26.7	1.6	105.0	89.0	20.00	168.000	504.0	0.5727	0.2255
25.1	1.6	105.0	109.0	20.00	168.000	504.0	0.5727	0.2255
23.5	1.6	105.0	129.0	20.00	168.000	504.0	0.5727	0.2255
						Final Ksat	**0.573**	**0.225**



LOCATION HELENA NC+AL GA SC VA

Established Series
Rev. AG, MDJ
11/2017

HELENA SERIES

MLRA(s): 136
Soil Survey Regional Office (SSRO) Responsible: Raleigh, North Carolina
Depth Class: Very deep
Agricultural Drainage Class: Moderately well drained
Permeability: Slow
Surface Runoff: Moderate to rapid
Parent Material: Residuum weathered from a mixture of felsic, intermediate, or mafic igneous or high-grade metamorphic rocks
Shrink-Swell Potential: High
Slope: 0 to 15 percent

TAXONOMIC CLASS: Fine, mixed, semiactive, thermic Aquic Hapludults

TYPICAL PEDON: Helena sandy loam - on a 4 percent slope in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; grayish brown (10YR 5/2) sandy loam; weak, medium, and coarse granular structure; very friable; many fine roots; moderately acid; abrupt smooth boundary. (4 to 10 inches thick)

E--8 to 12 inches; light yellowish brown (10YR 6/4) sandy loam; weak medium granular structure; very friable; few fine roots; few fine black concretions; strongly acid; clear wavy boundary. (0 to 10 inches thick)

BE--12 to 19 inches; brownish yellow (10YR 6/6) sandy clay loam; moderate medium prismatic structure that parts to moderate medium angular blocky; friable; sticky, plastic; few fine roots; few fine pores; few faint clay films on faces of peds; few medium quartz gravel; common fine faint pale brown (10YR 6/3) iron depletions; very strongly acid; clear wavy boundary. (0 to 7 inches thick)

Bt1--19 to 24 inches; yellowish brown (10YR 5/8) clay; weak coarse angular blocky structure; firm; sticky, plastic; few fine roots; few fine pores; few faint clay films on faces of peds; few fine prominent light brownish gray (10YR 6/2) iron depletions; very strongly acid; clear wavy boundary.

Bt2--24 to 39 inches; yellowish brown (10YR 5/8) clay; weak coarse subangular blocky and angular blocky structure; very firm, sticky, very plastic; few fine roots; few fine pores; common distinct clay films on faces of peds; many medium prominent gray (10YR 6/1) iron depletions; very strongly acid; clear wavy boundary.

Bt3--39 to 43 inches; light yellowish brown (10YR 6/4) clay loam; weak medium subangular blocky structure; extremely firm, sticky, very plastic; common distinct clay films on faces of peds; few brown concretions; common medium distinct light gray (10YR 7/1) iron depletions; very strongly acid; clear wavy boundary. (Combined thickness of the Bt horizons is 17 to 42 inches.)

BCg--43 to 46 inches; light gray (10YR 7/1) clay loam; weak coarse subangular blocky structure; friable, sticky, plastic; many coarse prominent strong brown (7.5YR 5/6) soft masses of iron accumulation; very strongly acid;

clear wavy boundary. (0 to 14 inches thick)

C--46 to 60 inches; strong brown (7.5YR 5/8) sandy loam saprolite; many coarse prominent light gray (10YR 7/1) streaks; massive; friable; few coarse veins of gray clay; common fragments of granitic rock; very strongly acid.

TYPE LOCATION: Durham County, North Carolina; 0.4 mile west of Mangum Store on Secondary Road 1603; 400 feet north on a farm road; 400 feet east in a cultivated field. USGS Durham North topographic quadrangle; lat. 36 degrees 11 minutes, and 45 seconds N. and long. 78 degrees 49 minutes 59 seconds W.

RANGE IN CHARACTERISTICS:
Depth to top of argillic horizon: 4 to 18 inches
Solum thickness: 40 to more than 60 inches
Depth to bedrock: Greater than 60 inches
Depth to seasonal high water table: 18 to 30 inches, January to April
Soil reaction: Extremely acid to moderately acid, except where limed.
Rock fragment content: 0 to 35 percent, by volume, throughout the profile; mostly gravel
Other features: Some pedons may have few to common dark concretions in the upper part of the profile

Range of Individual Horizons:
A or Ap horizon:
Color--hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 4
Texture--(fine-earth fraction) loamy sand, loamy coarse sand, coarse sandy loam, fine sandy loam, sandy loam, or loam
In eroded phases, the Ap horizon is clay loam or sandy clay loam

E horizon:
Color--hue of 10YR to 5Y, value of 5 to 8, and chroma of 2 to 4
Texture--(fine-earth fraction) loamy sand, loamy coarse sand, coarse sandy loam, fine sandy loam, sandy loam, or loam

BE or BA horizon:
Color--hue of 7.5YR to 5Y, value of 5 to 8, and chroma of 3 to 8
Texture--(fine-earth fraction) coarse sandy loam, sandy loam, sandy clay loam or clay loam

Bt horizon:
Color--hue of 7.5YR to 5Y, value of 5 to 8, and chroma of 3 to 8. In some pedons, the lower Bt horizon has 5YR hues or is multicolored in shades of yellow, brown, gray, or red.
Texture--(fine-earth fraction) clay loam, sandy clay, or clay. Some pedons have thin subhorizons of sandy clay loam.
Redoximorphic features--iron depletions with chroma of 2 or less occur within 24 inches of the upper boundary of the Bt horizon. Iron accumulations in shades of yellow, brown, or red may also be present.

Btg horizon, where present:
Color--hue of 10YR or 2.5Y, value of 4 to 7, and chroma of 1 or 2.
Texture--(fine-earth fraction) clay loam, sandy clay, or clay. Some pedons have thin subhorizons of sandy clay loam.
Redoximorphic features--iron accumulations in shades of yellow, brown, or red are commonly present

BC horizon, where present:
Color--hue of 7.5YR to 5Y, value of 5 to 8, and chroma of 3 to 8. Some pedons may have 5YR hues or are multicolored in shades of yellow, brown, gray, or red.
Texture--(fine-earth fraction) clay loam, sandy clay loam, loam, fine sandy loam, or sandy loam
Redoximorphic features--iron depletions in shades of brown, olive, or gray and iron accumulations in shades of

yellow, brown, or red may also be present.

BCg horizon:
Color--hue of 10YR or 2.5Y, value of 4 to 7, and chroma of 1 or 2
Texture--(fine-earth fraction) clay loam, sandy clay loam, loam, fine sandy loam, or sandy loam
Redoximorphic features--iron accumulations in shades of yellow, brown, or red are commonly present

C horizon:
Color--hue of 5YR to 5Y, value of 5 to 8, and chroma of 3 to 8, or is multicolored in shades of gray, yellow, brown, red or white
Texture--(fine-earth fraction) sandy loam, fine sandy loam, sandy clay loam, or loam saprolite. Some pedons may have bodies or seams of clay loam or clay.
Redoximorphic features--iron depletions in shades of brown, olive, or gray and iron accumulations in shades of yellow, brown, or red.

Cg horizon, where present:
Color--hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 or 2 and is typically multicolored in shades of yellow or brown.
Texture--(fine-earth fraction) sandy loam, fine sandy loam, sandy clay loam, or loam saprolite. Some pedons may have bodies or seams of clay loam or clay.
Redoximorphic features--iron accumulations in shades of yellow, brown, or red

COMPETING SERIES:
Annemaine soils--have a redder hue and form from lower Coastal Plain sediments
Beason soils--have a higher silt content and have sediments from sedimentary rock origin
Buckatunna soils--form from Coastal Plain sediments
Bush River soils--have a paralithic contact at a depth of 40 to 60 inches
Chickasawhay soils--form in marine and Coastal Plain sediments
Cid soils--have a lithic contact at a depth of 20 and 40 inches
Craven soils--formed from Coastal Plain sediments and have a higher silt content
Creedmoor soils--have a very high shrink swell potential, more exchangeable aluminum and form from Triassic parent material
Dogue soils--have a higher silt content and form from Coastal Plain sediments
Dorian soils--have a moderate shrink-swell potential and form from fluvial sediments on stream terraces
Gritney soils--form from Coastal Plain sediments
Lignum soils--have a paralithic contact at a depth of 40 to 60 inches
Nemours soils--have a redder hue and form from Coastal Plain sediments
Newco soils--have a redder hue and form from Coastal Plain sediments
Prosperity soils--have a paralithic contact at a depth of 40 and 60 inches
Telfair soils--have a thinner solum and have a paralithic contact at a depth of 20 to 40 inches

GEOGRAPHIC SETTING:
Landscape: Piedmont
Landform: Ridges and hill slopes
Geomorphic Component: Interfluves and side slopes
Hillslope Profile Position: Toe slope, summits, and heads of drains
Parent Material: Residuum from aplitic granite or granite gneiss that is cut by dykes of gabbro and diorite, or mixed with hornblende schist or hornblende gneiss
Slope: 0 to 15 percent
Elevation: 350 to 900 feet
Frost-Free Period: 185 to 240 days
Mean Annual Air Temperature: 58 to 65 degrees F
Mean Annual Precipitation: 37 to 55 inches

GEOGRAPHICALLY ASSOCIATED SOILS:
Appling soils--are well drained and have a low shrink-swell potential
Cecil soils--are well drained, have a red subsoil, and have a low shrink-swell potential
Cullen soils--are well drained, have a red subsoil, and have a low shrink-swell potential
Durham soils--have less clay in the subsoil
Enon soils--are well-drained and have a higher base saturation
Hard Labor--soils have a moderate shrink-swell potential
Iredell soils--have a higher base saturation
Louisburg soils--are well drained and have less clay in the subsoil
Mecklenburg soils--are well drained, have a red subsoil, and have a higher base saturation
Pacolet soils--are well drained, have a red subsoil, and have a low shrink-swell potential
Rion soils--are well drained and have less clay in the subsoil
Santuc soils--have less clay in the subsoil
Sedgefield soils--have a higher base saturation
Vance soils--are well drained.
Wedowee soils--are well drained and have a low shrink-swell potential
Wilkes soils--are well drained, have a higher base saturation, and have a depth to paralithic contact of less than 20 inches
Worsham soils--are poorly drained

DRAINAGE AND PERMEABILITY:
Drainage Class (Agricultural): Moderately well drained
Internal Free Water Occurrence: Moderately deep, common
Saturated Hydraulic Conductivity Class: Moderately low to moderately high

USE AND VEGETATION:
Major Uses: Mostly cultivated
Dominant Vegetation: Where cultivated--tobacco, corn, soybean, small grain, and vegetables. Dominant forest vegetation includes a mix of hardwood and pine. Native species include loblolly pine, shortleaf pine, Virginia pine, sweetgum, willow oak, red oak, white oak, yellow-poplar, and American elm. Understory species include sourwood, flowering dogwood, winged elm, eastern cedar, hophornbean, eastern redbud, and sassafras.

DISTRIBUTION AND EXTENT:
Distribution: Alabama, Georgia, North Carolina, South Carolina, and Virginia.
Extent: Large.

SOIL SURVEY REGIONAL OFFICE (SSRO) RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: Person County, North Carolina, 1928.

REMARKS:
12/2012 Revision updates the format and added latitude and longitude.
8/1991 Revision changed depth to bedrock from "more than 48 inches to more than 60 inches" to be consistent with one depth to bedrock class as shown on the Soil Interpretation Records for Helena.

Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon--the zone from the surface to 12 inches (Ap and E horizons)
Argillic horizon--the zone from 12 to 46 inches (BE, Bt1, Bt2, Bt3 and BCg horizons)
Aquic conditions--periodic episaturation and reduction in a zone within the upper 24 inches of the argillic horizon

MLRA = 136

ADDITIONAL DATA:

TABULAR SERIES DATA:

SOI-5	Soil Name	Slope	Airtemp	FrFr/Seas	Precip	Elevation
NC0058	HELENA	0-15	58-65	185-240	37-55	350-900
NC0176	HELENA	0-15	58-65	185-240	37-55	350-900
NC0266	HELENA	0-15	58-65	185-240	37-55	350-900

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
NC0058	NONE		1.5-2.5	PERCHED	JAN-APR	>60	
NC0176	NONE		1.5-2.5	PERCHED	JAN-APR	>60	
NC0266	NONE		1.5-2.5	PERCHED	JAN-APR	>60	

SOI-5	Depth	Texture	3-Inch	No-10	Clay%	-CEC-
NC0058	0-12	SL FSL L	0-5	90-100	5-20	1- 6
NC0058	0-12	SCL CL	0-5	95-100	20-35	4- 8
NC0058	12-19	SCL CL	0-5	95-100	20-35	4- 7
NC0058	19-43	CL SC C	0-5	95-100	35-60	7-13
NC0058	43-60	VAR	-	-	-	-
NC0176	0-12	GR-FSL GR-L GR-COSL	0-5	50- 75	5-20	1- 6
NC0176	0-12	GR-LCOS GR-LS GR-S	0-5	50- 75	3-12	1- 4
NC0176	0-12	GR-CL GR-SCL	0-5	50- 75	20-35	4- 8
NC0176	12-19	SCL CL SL	0-5	95-100	20-35	4- 7
NC0176	19-43	CL SC C	0-5	95-100	35-60	7-13
NC0176	43-60	VAR	-	-	-	-
NC0266	0-12	LS LCOS	0-5	90-100	3-12	1- 4
NC0266	12-19	SCL CL	0-5	95-100	20-35	4- 7
NC0266	19-43	CL SC C	0-5	95-100	35-60	7-13
NC0266	43-60	VAR	-	-	-	-

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
NC0058	0-12	3.5-6.5	.5-2.	0-0	2.0-6.0	LOW
NC0058	0-12	3.5-6.5	.5-1.	0-0	0.2-0.6	LOW
NC0058	12-19	3.5-5.5	0.-.5	0-0	0.2-0.6	MODERATE
NC0058	19-43	3.5-5.5	0.-.5	0-0	0.06-0.2	HIGH
NC0058	43-60	-	-	-	-	
NC0176	0-12	4.5-6.5	.5-2.	0-0	2.0-6.0	LOW
NC0176	0-12	4.5-6.5	.5-2.	0-0	6.0- 20	LOW
NC0176	0-12	4.5-6.5	.5-1.	0-0	0.2-0.6	LOW
NC0176	12-19	4.5-5.5	0.-.5	0-0	0.2-0.6	MODERATE
NC0176	19-43	4.5-5.5	0.-.5	0-0	0.06-0.2	HIGH
NC0176	43-60	-	-	-	-	
NC0266	0-12	3.5-6.5	.5-2.	0-0	6.0- 20	LOW
NC0266	12-19	3.5-5.5	0.-.5	0-0	0.2-0.6	MODERATE
NC0266	19-43	3.5-5.5	0.-.5	0-0	0.06-0.2	HIGH
NC0266	43-60	-	-	-	-	

APPENDIX V

GBA Publication "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, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

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

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

Read this Report in Full

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

You Need to Inform Your Geotechnical Engineer about Change

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

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

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

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

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

This Report May Not Be Reliable

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

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

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

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

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