ECS Florida, LLC

Geotechnical Engineering Report

Fire Station 90 - Sampson City

13641 SW County Road 227
Starke, Bradford County, Florida

ECS Project Number 35:35722

July 10, 2024

ECS FLORIDA, LLC

"One Firm. One Mission."

Geotechnical • Construction Materials • Environmental • Facilities

July 10, 2024

Cody Cash, P.E.
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Jacksonville, FL 32222

ECS Project No. 35:35722
Client ID: 35:JW16-0C

Reference: Geotechnical Engineering Report
Fire Station 90 - Sampson City
13641 SW County Road 227
Starke, Bradford County, Florida

Dear Cody:

ECS Florida, LLC (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our Proposal No. 35:21700 Rev. 1, dated May 29, 2024. This report presents our understanding of the geotechnical aspects of the project, the results of the field exploration and laboratory testing conducted, and our recommendations to assist with foundation design and earthwork construction.

It has been our pleasure to be of service to CHW an NV5 Company during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the assumptions of subsurface conditions made for this report. Should you have questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,
ECS Florida, LLC.

This item has been digitally signed and sealed by Corey Alan Dunlap on the date adjacent to the seal.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

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Distribution: Addressee 1 pdf

TABLE OF CONTENTS

APPENDICES

EXECUTIVE SUMMARY

The following summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Please refer to the complete report for more detailed discussion.

ECS Florida, LLC (ECS) has completed the subsurface exploration for the proposed sleeping quarters and truck bay expansion located at 13641 SW County Road 227, Starke, Bradford County, Florida. The project information summarized below is based exclusively on the information made available to us by Robert Walpole and Cody Cash with CHW an NV5 Company at the time of this report. Our findings, conclusion and recommendations are summarized below.

PROJECT INFORMATION:

Site Location:	13641 SW County Road 227, Starke, Bradford County, Florida
Building Scope:	One-story sleeping quarters and truck bay expansion
Building Type:	Sleeping Quarters: CMU Construction Truck Bay Expansion: Pre-engineered Metal Building
Assumed Loads:	Sleeping Quarters: Max. column loads = 50 kips, Max. wall loads = 4 klf Truck Bay Expansion: Max. column loads = 25 kips, Max. wall loads = 2 klf
Earthwork:	Estimated cuts/fills of up to 2 feet

SUBSURFACE CONDITIONS:

- Field Exploration: Three (3) SPT Borings drilled to 20 feet below existing grade for the proposed buildings and one (1) SPT Boring drilled to 6 feet below existing grade for the proposed pavements.
- Site Conditions: Site conditions include three (3) existing structures and pavement associated with the Fire Station located on site. Surface cover consists of scattered trees and manicured grass.
- Probable Fill: Not encountered within the depths of borings. Based on aerial photographs a structure was constructed on the southern portion of the property in 2004 and demolished in 2009. A single-story manufactured building was constructed on the northeast portion of the site between August 2006 and November of 2006, and is currently present on the property. A single-story metal frame building was constructed on the central portion of the site between April 2009 and January 2010, and is currently present on the property. A single-story manufactured building was constructed on the western portion of the site between March 2018 and April 2021, and is currently present on the property. The extent of the grading operations and specific date of construction for the existing buildings is unknown at the time of this report. It appears no further construction has taken place since 2021. Fill may be encountered in unexplored areas.
- Natural Soils: FINE SAND (SP), SAND WITH SILT (SP-SM), SAND WITH CLAY (SP-SC), CLAYEY SAND (SC), and CLAYEY SAND/SANDY FAT CLAY (SC/CH).

- Groundwater: Not recorded in the SPT Borings and boring P-01. Based on the borings performed at the site and the Soil Survey information, we estimate the seasonal high groundwater table will range between 12 to 30 inches beneath existing ground surface.

GEOTECHNICAL & CONSTRUCTABILITY CONSIDERATION:

- **Loose Soils:** Loose soils were encountered in the building borings at various depths ranging from ground surface to 6 feet below existing grades. During construction, we recommend careful proof rolling and if stable bearing conditions are not encountered, compaction or undercuts may be required in some areas.

DESIGN & CONSTRUCTION RECOMMENDATIONS:

- Shallow foundations:

Max. Net Allow. Bearing Pressure	= 2,500 psf
Min. Exterior Embedment:	= 12 inches
Min. Column/Strip Footing Width	= 24 inches/18 inches

- Slab Subgrade Modulus: = 150 pci

1.0 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide geotechnical information to assist with building foundation and pavement. This report contains the results of our subsurface explorations and laboratory testing programs, site characterization, engineering analyses, and project recommendations.

The recommendations developed for this report are based on project information supplied by Robert Walpole and Cody Cash with CHW an NV5 Company.

1.2 SCOPE OF SERVICES

To obtain the necessary geotechnical information required for design:

- Three (3) Standard Penetration Test (SPT) borings were performed to depths of 20 feet beneath grade in the area of the planned structures.
- One (1) SPT boring was performed to depths of 6 feet beneath grade in the area of the planned pavements.

A laboratory-testing program was also implemented to characterize the physical and engineering properties of the subsurface soils.

This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following.

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil stratigraphy with pertinent available physical properties.
- Final copies of our test boring logs.
- Recommended foundation support parameters and type(s).
- General recommendations for pavement design.
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills and delineation of potentially inadequate soils and/or soils exhibiting excessive moisture at the time of sampling.

1.3 AUTHORIZATION

Our services were provided in accordance with our Proposal No. 35:21700 Rev. 1, dated May 29, 2024, as authorized by Monique Heathcock on June 3, 2024, and includes the Terms and Conditions of Service in the Subconsultant Agreement.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION

The project site is located at the northeast corner of the SW County Road 227 and SW County Road 225 intersection in Starke, Bradford County, Florida. The site is bordered to the north and east by residential property, to the south by SW County Road 227, and to the west by SW County Road 225. The general site location is shown on the Site Location Diagram in Appendix A.

2.2 SITE CONDITIONS

At the time of our exploration, the site was developed with three existing structures and pavement associated with the Fire Station located on site. Surface cover consists of scattered trees and manicured grass. Surface water was not observed near planned structural areas at the time of our exploration. A concept plan with topography, prepared by CHW was provided on May 28, 2024. We understand that the site generally slopes downward to the south. Review of the concept plan indicates the existing ground surface grades generally range from El. +149 to +151 feet (unknown datum).

2.3 PROJECT DESCRIPTION

Project information was provided by Robert Walpole and Cody Cash with CHW an NV5 Company via several discussions and an email dated May 23, 2024. We were provided with a copy of a site plan for the subject site, prepared by CHW, provided on May 28, 2024. This plan indicated the boundary limits for the property, the existing roadways adjacent to the site, and the layout of the proposed construction. We understand the project includes proposed sleeping quarters and future truck bay expansion. The proposed sleeping quarters is one-story, CMU construction and is approximately 46 feet by 47 feet in plan dimensions. The proposed truck bay expansion is one-story, pre-engineered metal building construction, approximately 35 feet by 40 feet in plan dimensions. The following information explains our understanding of the structures and their loads:

Table 2.3.1 Design Values

SUBJECT	DESIGN INFORMATION / EXPECTATIONS	
Usage	Sleeping Quarters	Truck Bay Expansion
Building Footprint	Approximately 2,300 square feet in plan view	Approximately 1,400 square feet in plan view
# of Stories	One-story	
Framing	CMU Construction	Pre-engineered metal buildings
Column Loads	Estimated at 50 kips maximum	Estimated at 25 kips maximum
Wall Loads	Estimated at 4 kips per linear foot (klf) maximum	Estimated at 2 kips per linear foot (klf) maximum
Fill/Cuts	Estimated at less than 2 feet of fill (and only nominal cuts) will likely be required to achieve final grades in structural areas.	

Parking lots and driveways are generally located south and west of the proposed structures. If actual building loads and other estimated project information varies from these conditions, then the recommendations in this report may need to be re-evaluated. We should be contacted if the above project information is incorrect so that we may reevaluate our recommendations.

3.0 FIELD EXPLORATION

3.1 FIELD EXPLORATION PROGRAM

We performed a field exploration on June 12, 2024. The approximate boring locations are indicated on the attached Boring Location Diagram in Appendix A. Our personnel established the boring locations using readily available aerial photographs and handheld GPS capable devices. The boring locations on the referenced Boring Location Diagram should be considered accurate only to the degree implied by the method of measurement used.

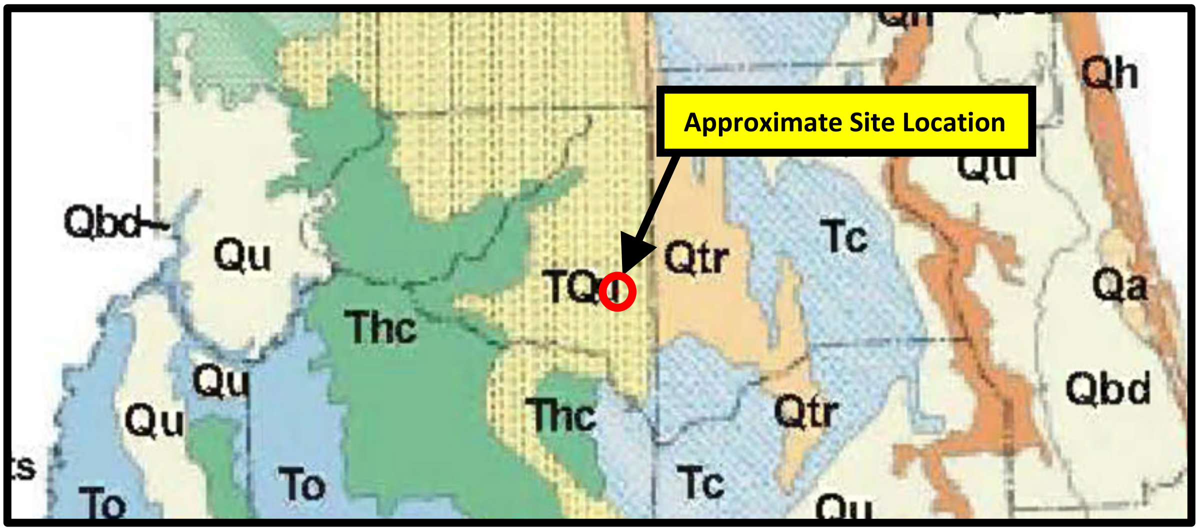
3.1.1 SPT Borings

The SPT borings were performed in general accordance with the methodology outlined in ASTM D 1586. Split-spoon soil samples recovered during performance of the borings were visually classified in the field and representative portions of the samples were transported to our laboratory for further evaluation.

3.2 REGIONAL/SITE GEOLOGY

The site is located near the east-central portion of Bradford County. This area of Bradford County maps as the Undifferentiated Tertiary-Quaternary Sediments geological region[1]. The following description is from the Geological Survey.

Figure 3.2.1 Regional Geology



TQu – Undifferentiated Tertiary-Quaternary Sediments – These sediments are siliciclastics that are separated from undifferentiated Quaternary sediments solely on the basis of elevation. Based on the suggestion that the Pleistocene sea levels reached a maximum of approximately 100 feet (30 meters) msl (Colquhoun, 1969), these sediments, which occur above 100 feet (30 meters) msl, are predominantly older than Pleistocene but contain some sediments reworked during the

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[1] Open-File Report 80, Thomas M. Scott, P.G. No. 99, Text to Accompany the Geological Map of Florida, Florida Geological Survey, 2001.

Pleistocene. This unit may include fluvial and aeolian deposits. The undifferentiated Tertiary-Quaternary sediments occur in a band extending from the Georgia-Florida state line in Baker and Columbia Counties southward to Alachua County.

These sediments are gray to blue green, unconsolidated to poorly consolidated, fine to coarse grained, clean to clayey, unfossiliferous sands, sandy clays and clays. Organic debris and disseminated organics are present in these sediments.

The undifferentiated Tertiary-Quaternary sediments are part of the surficial aquifer system.

3.3 SOIL SURVEY MAPPING

Based on the Web Soil Survey for Bradford County, Florida, as prepared by the U.S. Department of Agriculture Natural Resource Conservation Service[2], the predominant soil types existing within the site area are described in the following table. The site area is illustrated superimposed on the USDA-NRCS Soil Survey Map included as Figure 3.3.1:

Figure 3.3.1 Soil Survey Map

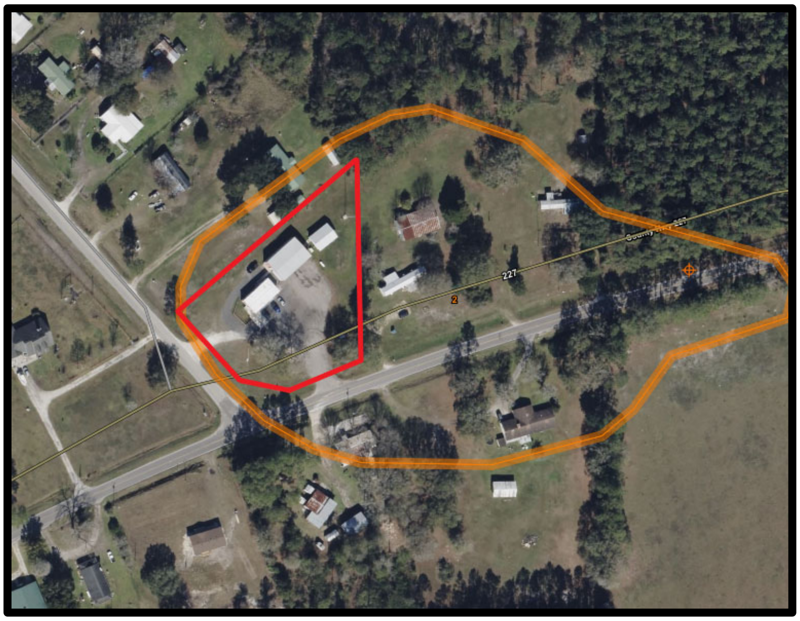

Table 3.3.1 Soil Survey Data

Soil ID	Soil Type	Typical Profile	Hydrology	Hydrologic Soil Classification	Estimated Seasonal High Groundwater Level⁽¹⁾
2	Albany fine sand, 0 to 5 percent slopes	0 to 50 inches: fine sand 50 to 60 inches: sandy loam 60 to 80 inches: sandy clay loam	Somewhat poorly drained	A/D	12 to 30

(1) Inches below ground surface at time of survey.

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[2] Soil Survey of Bradford County, Florida. Soil Conservation Service, U.S. Department of Agriculture.

3.4 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published soil survey information and geological mapping. Detailed boring records are included in Appendix B. It should be understood that the soil conditions will likely vary between the boring locations. The following table summarizes the soil conditions encountered.

Table 3.4.1 Subsurface Stratigraphy – Building

Approximate Depth Range (ft)	Stratum	Description	Ranges of SPT(1) N-values (bpf)
0 to 0.38	N/A	Topsoil – 4 to 4.5 inches Deeper topsoil or organic laden soils are most likely present in wet, poorly drained areas and potentially unexplored areas of the site.	N/A
0.33 to 8	I	Loose to Medium Dense SAND WITH SILT and SAND WITH CLAY (SP-SM, SP-SC), Moist, with phosphates	5 to 25
2 to 20	II	Loose to Medium Dense CLAYEY SAND (SC), Moist	9 to 20
6 to 17	III	Medium Dense CLAYEY FINE SAND/SANDY FAT CLAY (SC/CH), Moist	11 to 22

Notes: (1) Standard Penetration Test

The SPT borings encountered phosphate at various depths ranging between approximately 2 to 8 feet beneath grade. Boring B-03 encountered clay nodules at a depth ranging between approximately 2 to 4 feet below existing grade.

Table 3.4.2 Subsurface Stratigraphy – Pavement

Approximate Depth Range (ft)	Stratum	Description	Ranges of SPT(1) N-values (bpf)
0 to 0.33	N/A	Topsoil – 4 inches Deeper topsoil or organic laden soils are most likely present in wet, poorly drained areas and potentially unexplored areas of the site.	N/A
0.33 to 6	I	Loose to Dense FINE SAND and FINE SAND WITH SILT (SP, SP-SM), Moist	10 to 31

Notes: (1) Standard Penetration Test

3.5 GROUNDWATER LEVEL

Measured Groundwater: Groundwater was not recorded in borings B-01 through B-03 at the time of drilling. Groundwater was not recorded in boring P-01 to depths explored. We note that groundwater levels will likely fluctuate due to seasonal climatic variations, surface water runoff patterns, construction operations, and other interrelated factors. The groundwater depth at each boring location is noted on the Generalized Subsurface Profiles and on the Soil Boring Logs.

Estimated Seasonal High Groundwater: The normal seasonal high groundwater level is affected by a number of factors. The drainage characteristics of the soils, land surface elevation, relief points such as drainage ditches, lakes, rivers, swamp areas, etc., and distance to relief points are some of the more important factors influencing the seasonal high groundwater level.

Based on our interpretation of the site conditions, including the boring logs and Soil Survey information, we estimate the seasonal high groundwater table will be a perched condition that will temporarily develop on top of the clayey soils after periods of intense or sustained seasonal rainfall. Based on the borings performed at the site and the Soil Survey information, we estimate the seasonal high groundwater table will range between 12 to 30 inches beneath existing ground surface. It is possible that groundwater levels may exceed the estimated normal seasonal high groundwater level as a result of significant or prolonged rains.

4.0 LABORATORY TESTING

The laboratory testing performed by ECS for this project consisted of selected tests performed on samples obtained during our field exploration operations. The following paragraphs briefly discuss the results of the completed laboratory testing program.

The samples from the test borings were visually classified on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Additionally, the following laboratory tests were performed to aid in classifying the soils and to further evaluate their engineering properties:

- Three (3) percent soil fines passing the No. 200 sieve determinations (ASTM D 1140)
- Three (3) natural moisture content determinations (ASTM D 2216)

The laboratory tests indicate the tested soils consist of sand with silt, sand with clay, silty sand, clayey sand.

- The tested sand with silt (SP-SM) contains approximately 8.3 percent soil fines and a natural moisture content of about 6.4 percent.
- The tested clayey sand (SC) contains approximately 13 percent soil fines and a natural moisture content of about 15 percent.
- The tested sand with clay (SP-SC) contains approximately 7.7 percent soil fines and a natural moisture content of about 14 percent.

The results of the laboratory testing are shown in the Summary of Laboratory Test Data included in Appendix C.

5.0 DESIGN RECOMMENDATIONS

5.1 GENERAL

Our geotechnical engineering evaluation of the site and subsurface conditions at the property, with respect to the planned construction and our recommendations for site preparation and foundation support, are based on (1) our site observations, (2) the field and laboratory test data obtained, (3) our understanding of the project information and structural conditions as presented in this report, and (4) our experience with similar soil and loading conditions.

If the stated structural or grading conditions are incorrect, or should the location of the structure or pavement areas be changed, please contact us so that we can review our recommendations. Also, the discovery of site or subsurface conditions during construction that deviate from the data obtained during this geotechnical exploration should also be reported to us for our evaluation.

The recommendations in the subsequent sections of this report present design and construction techniques that are appropriate for the planned construction. We recommend that ECS be provided the opportunity to review the foundation plans and earthwork specifications to verify that our recommendations have been properly interpreted and implemented.

5.2 FOUNDATION DESIGN RECOMMENDATIONS

Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed structure on a properly designed conventional shallow foundation system. Provided the site preparation and earthwork construction recommendations outlined in Section 6.0 of this report are performed, the following parameters may be used for foundation design.

It is our understanding that the maximum loading of 50 kips is anticipated, and we have assumed a FFE of EL. 150 feet. ECS requests final loading conditions, finished floor elevations, and foundation layout be provided to review and update our recommendations as appropriate. Our current bearing and settlement analysis is contingent on these assumptions.

Loose soils were encountered in building borings to depths ranging from ground surface to 6 feet below existing grades. The N-values of the loose soils range from 5 to 9 blows per foot. The existing loose soils should be carefully evaluated during construction, we recommend careful proof rolling and if stable bearing conditions are not encountered, compaction or undercuts may be required in some areas in accordance to Section 5.2.3.

5.2.1 Foundations

Provided subgrades and structural fills are prepared as discussed herein, the proposed structure can be supported by conventional shallow foundations: individual column footings and continuous wall footings. The design of the foundation should utilize the following parameters:

Table 5.2.1.1 Foundation Design

Design Parameter	Column Footing	Wall Footing
Minimum Width	24 inches	18 inches
Minimum Footing Embedment Depth (below slab and finished grade)	12 inches	12 inches
Estimated Maximum Total Settlement	1 inch	1 inch
Estimated Maximum Differential Settlement	Less than 0.5 inches between columns	Less than 0.5 inches over 50 feet
Net Allowable Bearing Pressure[1]	2,500 psf	
Acceptable Bearing Soil Material	Stratum I, II or Structural Fill	

1. Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.

Depending on the final floor elevations of the buildings, we anticipate that most of the soils at the foundation bearing elevation are anticipated to be adequate for support of the proposed structure, after prepared in accordance with Section 6.0 of this report. The bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the Modified Proctor maximum dry density (ASTM D 1557) to a depth of at least one foot below foundation bearing levels.

Should the foundations bear on the clayey sand (SC) soils (i.e. soils with greater than 20 percent fines), these soils should be visually observed and probed in lieu of density testing. The bearing surface of the clayey soils should be found to be in a firm and unyielding condition in the upper 12 inches. Foundation excavations in clayey soils should be performed in a manner that reduces disturbance of the soil. Clayey sands that are disturbed should be re-compacted to a minimum 98 percent of the Standard Proctor maximum dry density (ASTM D698).

5.2.2 Floor Slabs

The floor slabs can be constructed as a slab-on-ground, provided the site is prepared as outlined in Section 6.0. A minimum clearance of 2 feet is recommended between the estimated seasonal high groundwater table and the bottom of the floor slab. It is recommended the floor slab bearing soils be covered with an impervious membrane to reduce moisture entry and floor dampness. A 6-mil thick plastic membrane is commonly used for this purpose. Care should be exercised not to tear large sections of the membrane during placement of reinforcing steel and concrete. In addition, we recommend that a minimum separation of two feet be maintained between the finished floor levels and the top of clayey soils (SC, CL, or CH). We also recommend that densities of at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557) be obtained within the upper one foot of the materials immediately below the floor slab.

Subgrade Modulus: Provided the placement of Structural Fill per the recommendations discussed herein, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 150 pci (lbs/cu. inch). The modulus of subgrade reaction value is based on a 1 ft by 1 ft plate load test equivalence.

Slab Isolation: Ground-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will likely not induce excessive shear and bending stresses in the floor slab. Where the structural configuration is not favorable for use of a free-floating slab, the slab should be designed with adequate reinforcement and load transfer devices to reduce the risk of overstressing of the slab.

5.2.3 Undercutting

Selective undercutting of the foundation limits is recommended where loose soils are encountered. During construction, we recommend careful proof rolling and if stable bearing conditions are not encountered, compaction or undercuts may be required in some areas. Methods of repair of soft subgrade, such as undercutting or moisture conditioning, should be discussed with ECS to determine the appropriate procedure with regard to the existing conditions causing the pumping/yielding. However, we anticipate undercutting to be an appropriate method of repairing soft subgrades. Our typical undercutting recommendations are below.

Where loose materials are encountered beneath the structures, we recommend these soils be undercut to a depth such that the loose materials are removed and firm and unyielding conditions are encountered. The undercuts can be backfilled and recompacted with imported structural fill (as described in Section 6.1) or with native soils (as described 5.3.2).

The backfill should be placed in maximum 12-inch loose lifts and compacted to a minimum 95 percent of the Modified Proctor maximum dry density (ASTM D-1557). If required, we recommend the undercutting and backfilling be performed under the observation of the geotechnical engineer. The geotechnical engineer should meet with the earthwork contractor to confirm the locations of the recommended undercutting prior to commencing work. The geotechnical engineer should inspect the bottom of the undercuts prior to the contractor placing the backfill. Field density tests should be performed on the backfill at a minimum of one test per 2,500 square feet of undercut area for each 1-foot lift of fill material.

5.3 SITE DESIGN CONSIDERATIONS

5.3.1 Pavement Sections

Typical Asphalt Section: Based on the results of our exploration, we consider the subsurface conditions at the site favorable for support of a flexible pavement section when constructed on properly prepared subgrade soils as outlined in Section 6.0 of this report. Typical pavement sections used in North Central Florida are shown on the following table. If requested, we can prepare a project-specific pavement design if specific traffic data is provided.

Table 5.3.1.1: Typical Flexible Pavement Section

Pavement Layer	Auto Parking & Traffic Lanes	Truck Areas
Asphaltic Concrete Wearing Surface	1.5 inches	2.0 inches
Limerock Base	6.0 inches	8.0 inches
Stabilized Subgrade	12.0 inches	12.0 inches

Wearing Surface: The wearing surface should consist of Florida Department of Transportation (FDOT) Type S asphaltic concrete having a minimum Marshall Stability of 1,500 lbs. Specific requirements for Type S asphaltic concrete wearing surface are outlined in the 2000 edition of the *Florida Department of Transportation, Standard Specifications for Road and Bridge Construction*. As an alternative, the wearing surface may consist of a Type SP-9.5 asphaltic concrete as outlined in the current edition of the *Standard Specifications.*

Base and Subgrade: The limerock base course should have a minimum Limerock Bearing Ratio (LBR) of 100 and should be compacted to 98 percent of the Modified Proctor maximum dry density (ASTM D 1557) value.

The subgrade material should have a minimum LBR of 40 and be compacted to 98 percent of the modified Proctor maximum dry density (ASTM D 1557) value.

Rigid Concrete Pavements: For Typical concrete pavement sections used in north central Florida are shown on the tables below. If requested, we can prepare a project specific pavement design if specific traffic data is provided. Our recommendations for slab thickness for standard duty and heavy duty concrete pavements are based on a) subgrade soils densified to 98 percent of the modified Proctor maximum dry density (ASTM D 1557) b) modulus of subgrade reaction (k) equivalent to 200 pounds per cubic inch, c) a 20 year design life.

Table 5.3.1.2: Typical Standard Duty Concrete Pavement Section

Minimum Pavement Thickness	Maximum Control Joint Spacing	Recommended Sawcut Depth
5 Inches	10 Feet x 10 Feet	1-1/4 Inches

Table 5.3.1.3: Typical Heavy Duty Concrete Pavement Section

Minimum Pavement Thickness	Maximum Control Joint Spacing	Recommended Sawcut Depth
6 Inches	12 Feet x 12 Feet	1-1/2 Inches

We recommend using concrete with a minimum 28-day compressive strength of 4,000 psi and a minimum 28-day flexural strength (modulus of rupture) of at least 600 pounds per square inch, based on 3rd point loading of concrete beam test samples. Layout of the sawcut control joints should form square panels, and the depth of sawcut joint should be at least ¼ of the concrete slab thickness. The joints should be sawed within six hours of concrete placement or as soon as the concrete has developed adequate strength to support workers and equipment. We recommend allowing ECS Florida, LLC. to review and comment on the final concrete pavement design, including section and joint details (type of joints, joint spacing, etc.), prior to the start of construction.

For further details on concrete pavement construction, please reference the “Guide to Jointing Unreinforced Pavements”, published by the America Concrete Pavement Association, and “Building Quality Concrete Parking Areas”, published by the Portland Cement Association.

5.3.2 Borrow Suitability

Based on the boring results and classification of the soil samples, soils ranging from sands to clayey sands/sandy clays are expected to be excavated from the site. A description of each soil type that could be excavated from the site with respect to fill suitability is presented below:

- The sands (SP), sands with silt (SP-SM), and sands with clay (SP-SC) are considered acceptable for use as fill soil. These soils were encountered in the borings from near ground surface to 8 feet beneath the existing ground surface. The soils containing surficial organic material will likely require removal and are inadequate as structural fill. The organic soils could be used in landscape berms.

- The clayey sands (SC) having a maximum of 30 percent soil fines may also be used as structural fill; however, we note that these soils will likely be more difficult to compact due to their tendency to retain soil moisture and they will likely require drying. Depending on the anticipated time for completing the site work portion of the project and the drying time required to reduce the potential for pumping and yielding of these soils during placement and compaction operations, these soils may not be feasible for use as fill material. Soils containing surficial organic material (topsoil) will likely require removal, and are considered inadequate for use as embankment fill. The organic soils may be used in landscape berms.

  Clayey sands with greater than 30 percent soil fines are especially moisture sensitive. We do not recommend using clayey soils with greater than 30 percent soil fines as structural fill unless these materials are carefully mixed with sandy soils. We can provide soil mixing recommendations to engineer more adequate fill materials at your request.

- Although not encountered, we do not recommend reuse of sandy clays to clays (CL or CH) as structural fill material because of their high plasticity and high affinity for moisture.

It should be anticipated that the soils excavated from below the groundwater level will likely have moisture contents in excess of the Modified Proctor optimum moisture content. Reuse of these materials will likely require stockpiling or spreading to drain the excess moisture. Generally, the wet soils should be dried to bring the soil moisture content within ±2 percent of the soil's optimum moisture content (ASTM D1557) to facilitate placement and compaction.

5.4 GENERAL DESIGN CONSIDERATIONS

Gutters: Roof gutters should be considered to divert discharge away from the structure. We recommend, if possible, gutter downspouts discharge a minimum of 10 feet from the structure to reduce the amount of water collecting around the foundations.

Landscaping: Existing and planted trees and large “tree-like” shrubbery with potential for developing large root systems should be located a minimum distance of half their final height away from the structure. The purpose of this is to reduce the potential for foundation or slab movements from the growth of root systems as the landscaping matures. Consideration should also be given to using landscaping that has a low water demand, so that excessive irrigation is not conducted around the structures.

6.0 SITE CONSTRUCTION RECOMMENDATIONS

6.1 SUBGRADE PREPARATION

Site preparation as outlined in this section should be performed to provide more consistent foundation bearing conditions, to reduce the potential for post-construction settlements of the planned structure(s) and to maintain the integrity of a flexible pavement section.

6.1.1 Stripping and Grubbing

Prior to construction, the location of existing underground utilities within the construction area should be established. Provisions should then be made to relocate interfering utilities to appropriate locations. Underground pipes that are not properly removed or plugged may serve as conduits for subsurface erosion, which may subsequently lead to excessive settlement of overlying structures.

The "footprint" of the proposed building plus a minimum additional margin of 5 feet, and of the hardscape areas (parking/driveway) plus a minimum additional margin of 3 feet, should be stripped of surface vegetation, stumps, foundations and demolition debris from the existing building, organic topsoil, or other deleterious materials. During grubbing operations, roots with a diameter greater than 0.5-inch, stumps, or small roots in a concentrated state, should be grubbed and removed.

Based on the results of our field exploration, it should be anticipated that 4 inches to 4.5 inches of topsoil and soils containing significant amounts of organic materials may be encountered across the site. The actual depths of inadequate soils and materials should be established by ECS using visual observation and judgment during earthwork operations. Topsoil removed from the building and parking/drive areas can be stockpiled and used subsequently in non-structural areas.

6.1.2 Proofrolling

After removing inadequate surface materials, cutting to the proposed grade, and prior to the placement of structural fill or other construction materials, the exposed subgrade should be observed by ECS. The exposed subgrade should be carefully proofrolled with previously approved construction equipment having a minimum axle load of 10 tons (e.g. amply loaded tandem-axle dump truck). The areas subject to proofrolling should be traversed by the equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle under the observation of ECS. This procedure is intended to assist in identifying localized yielding materials. In the event that yielding or “pumping” subgrade is identified by the proofrolling, those areas should be repaired prior to the placement of subsequent structural fill or other construction materials.

Methods of repair of soft subgrade, such as undercutting or moisture conditioning, should be discussed with ECS to determine the appropriate procedure with regard to the existing conditions causing the pumping/yielding. A test pit(s) may be excavated to explore the shallow subsurface materials in the area of the yielding conditions to help in establishing the cause and to assist in the evaluation of the appropriate remedial action to create a firm and unyielding subgrade.

6.1.3 Temporary Groundwater Control

Because of the need for densification of the soils within the upper 12 inches below the stripped surface, temporary groundwater control measures may be required if the groundwater level is within 2 feet below the stripped and grubbed surface at the time of construction. Should groundwater control measures become necessary, dewatering methods should be established by the contractor. We recommend temporary groundwater control measures, if necessary; remain in place until compaction of the existing soils is completed. The dewatering method should be maintained until backfilling has reached a height of 2 feet above the groundwater level at the time of construction. The site should be graded to direct surface water runoff from the construction area.

Note that discharge of produced groundwater to surface waters of the state from dewatering operations or other site activities is regulated and requires a permit from the State of Florida Department of Environmental Protection (FDEP). This permit is termed a Generic Permit for the Discharge of Produced Groundwater From Any Non-Contaminated Site Activity. If discharge of produced groundwater is anticipated, we recommend sampling and testing of the groundwater early in the site design phase to reduce project delays during construction. ECS can provide the sampling, testing, and professional consulting related to compliance with the regulations.

6.1.4 Subgrade Compaction

Subgrade Compaction: After completing the clearing and stripping operations and installing the temporary groundwater control measures (if required), the exposed surface should be compacted with a vibratory drum roller having a minimum static, at-drum weight 4 tons to 6 tons. Typically, the material should exhibit moisture contents within ±2 percentage points of the modified Proctor optimum moisture content (ASTM D 1557) during the compaction operations. Compaction should continue until densities of at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557) have been achieved within the upper 2 feet of the compacted natural soils at the site.

Should the bearing level soils experience pumping and soil strength loss during the compaction operations, compaction work should be immediately terminated, and (1) the disturbed soils should be removed and backfilled with compacted structural fill, or (2) the excess moisture content within the disturbed soils should be allowed to dissipate before recompacting.

Care should be exercised to avoid damaging nearby structures while the compaction operation is underway. Prior to commencing compaction, occupants of adjacent structures should be notified, and the existing conditions of the structures should be documented with photographs and survey (if deemed necessary). Compaction should cease if deemed detrimental to adjacent structures, and ECS should be contacted immediately. We recommend the vibratory roller remain a minimum of 50 feet from existing structures. Within this zone, use of a track-mounted bulldozer, or a vibratory roller operating in the static mode, is recommended.

6.1.5 Structural Backfill and Fill Soils

Structural backfill or fill required for site development should be placed in loose lifts not exceeding 12 inches in thickness when compacted by the use of the vibratory drum roller described in Section 6.1.4. The lift thickness should be reduced to 8 inches if the roller operates in the static mode or if track-mounted compaction equipment is used. If hand-held compaction equipment is used, the lift thickness should be further reduced to 6 inches.

Structural fill is defined as a non-plastic, inorganic, granular soil having less than 10 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The fine sand and fine sand with silt or fine sand with clay, without roots, as encountered in the borings, are adequate as fill materials and, with proper moisture control, should densify using conventional compaction methods.

Soils with more than 10 to 12 percent passing the No. 200 sieve will likely be more difficult to compact, due to their nature to retain soil moisture, and such materials may require drying. Typically, the material should exhibit moisture contents within ±2 percent of the modified Proctor optimum moisture content (ASTM D 1557) during the compaction operations. Compaction should continue until densities of at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557) have been achieved within each lift of the compacted structural fill.

Fill materials should not be placed on excessively wet soils. Excessively wet soils should be scarified, aerated, and moisture conditioned. Proper drainage should be maintained during the earthwork phases of construction to reduce ponding of water which has a tendency to degrade subgrade soils. The contractor should control dusting or implement dust control measures, as required.

We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. Moisture control may be difficult during extended periods of rain. The control of moisture content of soils containing more than 10 percent fines may be difficult when these soils become wet. Further, such soils are easily degraded by construction traffic when the moisture content is elevated.

6.1.6 Foundation Areas

After proper placement and compaction of the required structural fill, the foundation areas may be excavated to the planned bearing levels. The foundation bearing level soils, after compaction, should exhibit densities of at least 95 percent of the Modified Proctor maximum dry density (ASTM D 1557) to a depth of one foot below the bearing level. For confined areas, such as the footing excavations, compactive effort should be provided by a lightweight vibratory sled or roller having a total weight of 500 to 2,000 pounds.

Should the foundations bear on the clayey sand (SC) soils (i.e. soils with greater than 20 percent fines), these soils should be visually observed and probed in lieu of density testing. The bearing surface of the clayey soils should be found to be in a firm and unyielding condition in the upper 12 inches. Foundation excavations in clayey soils should be performed in a manner that reduces disturbance of the soil. Clayey sands that are disturbed should be re-compacted to a minimum 98 percent of the Standard Proctor maximum dry density (ASTM D698).

6.1.7 Pavement Areas

After completing the clearing/stripping operations in the pavement areas, underlying clayey sands and sandy clays that are within 2 feet of the bottom of the pavement base should be over-excavated from within the pavement areas. Structural backfill and fill required to achieve the finish pavement grades then can be placed and compacted as described in Sections 6.1.4 and 6.1.5 above. As an exception, densities of at least 98 percent of the modified Proctor maximum dry density (ASTM D1557) should be obtained within the upper one foot of the materials immediately below the proposed base course.

For a concrete pavement subgrade, we recommend using clean fine sand (SP), compacted to at least 98 percent of the Modified Proctor maximum dry density (ASTM D1557) without additional stabilization, with the following stipulations:

- Subgrade soils must be compacted to at least 98 percent of the Modified Proctor maximum dry density (ASTM D1557) to a depth of at least 2 feet prior to placement of concrete.
- The surface of the subgrade soils must be smooth, and disturbances or wheel rutting corrected prior to placement of concrete.
- The subgrade soils must be moistened prior to placement of concrete.
- Concrete pavement thickness should be even throughout, with exception to thickened edges (curb or footing).

6.2 UTILITY INSTALLATIONS

Utility Subgrades: It is our opinion that the fine sands and fine sand with silt (SP, SP-SM) soils will likely be adequate bedding soils for pipes and utility structures. The silty fine sand (SM) soils may also be adequate if they can be compacted to the required minimum density (typically 95 percent of the soil's Modified Proctor (AASHTO T-180) maximum dry density). If the SM soils cannot be compacted to the required density, and if clayey or clay soils (SC or CH) are encountered, then we recommend these soils be overexcavated a minimum of 12 inches below the pipe invert elevation (24 inches below the manhole base elevation) and replaced with compacted structural fill as described in Section 6.1.5 above.

Alternatively, a medium-duty woven geotextile, such as Mirafi 600X or equivalent, may be used as a separation barrier between the compacted backfill and the underlying silty/clayey soils. If a woven geotextile is used, then no overexcavation is necessary for the pipe, and the depth of overexcavation for the utility manholes may be reduced to 12 inches. The geotextile should be placed in the excavation bottom and along the sides above the silty/clayey soils creating a barrier between these soils and the sand backfill to reduce contamination of the backfill.

Utility Backfilling: Backfill placed around the pipe, and to a height of 2 feet above the top of pipe, should be placed in 6-inch lifts. Each lift should be compacted with hand-held equipment to at least 95 percent of the soil's Modified Proctor (ASTM D 1557) maximum dry density. Backfill placed above the 2-foot zone above the top of pipe elevation may be placed in 12-inch lifts and compacted with heavier equipment. Typically, the backfill soil should exhibit moisture contents within ±2 percent of the soil's optimum moisture content as revealed from the Proctor test. Care should be taken to avoid damaging the pipe during compaction operations.

Backfill placed around utility structures should be placed in 6-inch thick lifts, and compacted with hand-held equipment to the minimum in-place soil density stated above. Heavy equipment should not be used within 5 feet of the structures to reduce the risk of overstressing of the structure walls.

Utility Excavation Dewatering: Based on the groundwater depths encountered in our borings, groundwater will likely be encountered by utility excavations which extend much below existing grades. It is expected that removal of groundwater may be required, especially for deeper utility excavations. The contractor should submit a dewatering plan prior to installing the site utilities.

6.3 GENERAL CONSTRUCTION CONSIDERATIONS

Moisture Conditioning: We anticipate that typical moisture conditioning for soils in this area will likely be needed. The sandy surface soils may require wetting during dry periods or periods of high heat. Drying of soils containing more than 10 percent fines or excavated from below the water table may be required to be within ±2 percentage points of the modified Proctor optimum moisture content (ASTM D 1557).

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to reduce construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with an additional thickness of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to limit infiltration of surface water.

Excavation Safety: Excavations and slopes should be made and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing and constructing durable, temporary excavations and slopes and should shore, slope, or bench the sides of the excavations and slopes as required to maintain stability of both the excavation sides and bottom. The contractor’s responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor’s safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor’s activities; such responsibility is not being implied and should not be inferred.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. Erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

7.0 QUALITY CONTROL TESTING

ECS should be retained to perform the construction material testing and observations required for this project, to document that our recommendations have been satisfied. We are the most qualified party to address problems that may arise during construction, since we are familiar with the intent of our engineering design.

A representative number of field in-place density tests should be made in the upper 2 feet of compacted natural soils, in each lift of compacted backfill and fill, and in the upper 12 inches below the bearing levels in the footing excavations. Density tests are recommended to verify that proper compaction operations have been performed. We recommend density testing be performed at frequencies presented in the table below.

Table 7.0.1 Frequency of Compaction Testing

Location	Frequency of Tests
Expanded Building Limits	1 test per 2,500 sq. ft.
Continuous Wall Footing	1 test per 50 linear ft. of footing
Isolated Column Footings	1 test at 50% of footings
Pavement Areas	1 test per 10,000 sq. ft.

8.0 CLOSING

Our geotechnical exploration has been performed, our findings obtained, and our recommendations prepared, in accordance with generally accepted geotechnical engineering principles and practices. ECS is not responsible for independent conclusions, interpretation, opinions, or recommendations made by others based on the data contained in this report.

Our scope of services was intended to evaluate the soil conditions within the zone of soil influenced by the foundation system. Our scope of services does not address geologic conditions, such as sinkholes or soil conditions existing below the depth of the soil borings.

This report does not reflect variations that may occur adjacent to or between soil borings. The discovery of site or subsurface condition during construction that deviates from the data obtained during this geotechnical exploration should be reported to us for our evaluation.

If the project description information discussed in this report is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted immediately so we can review the report in light of the changes and provide additional or alternate recommendations as may be required to reflect the proposed construction.

We recommend that ECS be allowed to review the project’s plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report.

Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of and integral to the geotechnical design recommendation. We recommend that the owner retain these quality assurance services and that ECS be allowed to continue our involvement throughout these important phases of construction to provide general consultation as issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Figures

Site Location Diagram
Boring Location Diagram
Subsurface Cross-Section(s)

BORING LOCATION DIAGRAM

Fire Station 90 - Sampson City

13641 SW County Road 227, Starke, Florida
CHW Professional Consultants

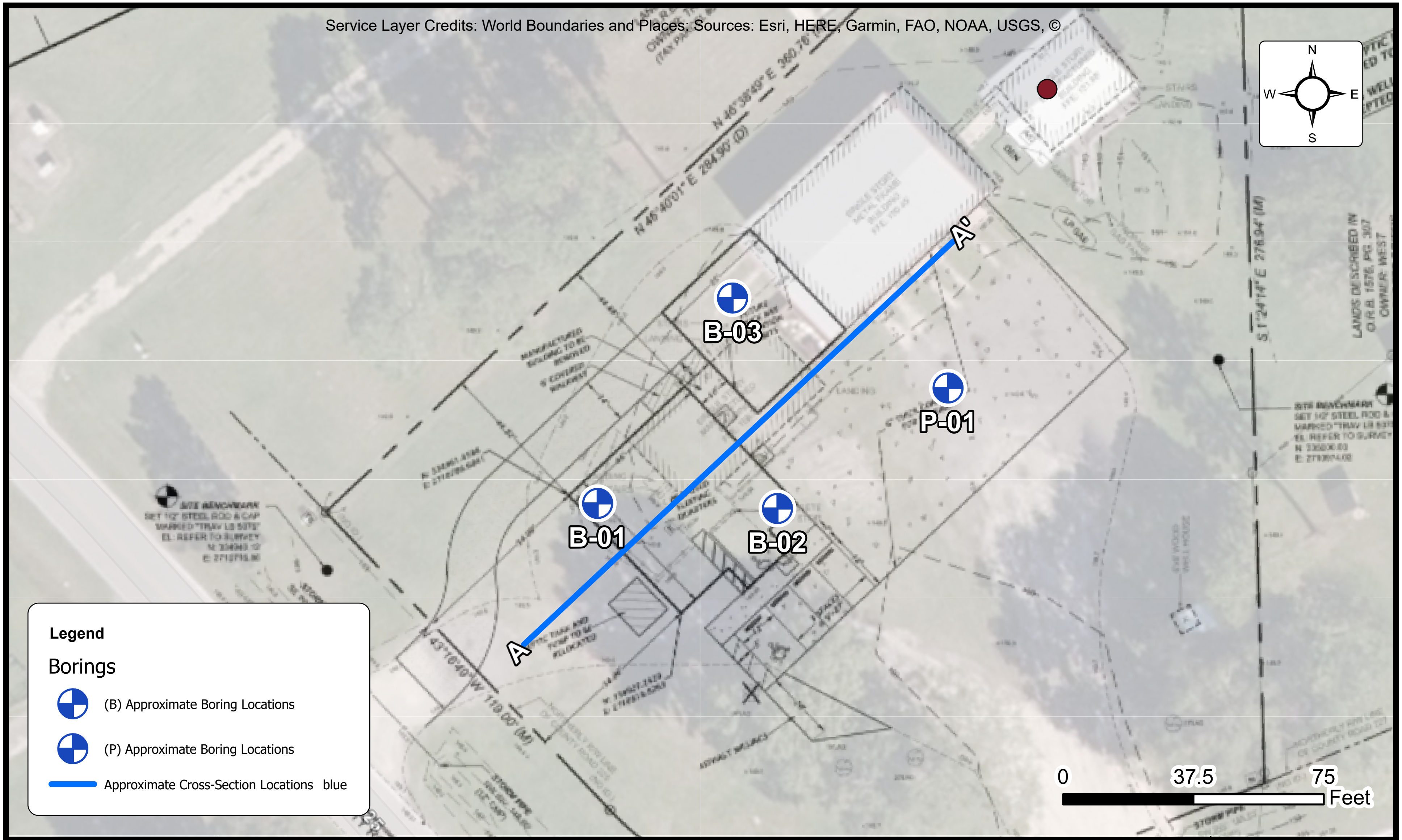
ENGINEER
GNV

SCALE
AS NOTED

PROJECT NO.
35:35722

SHEET
1

DATE
6/28/2024



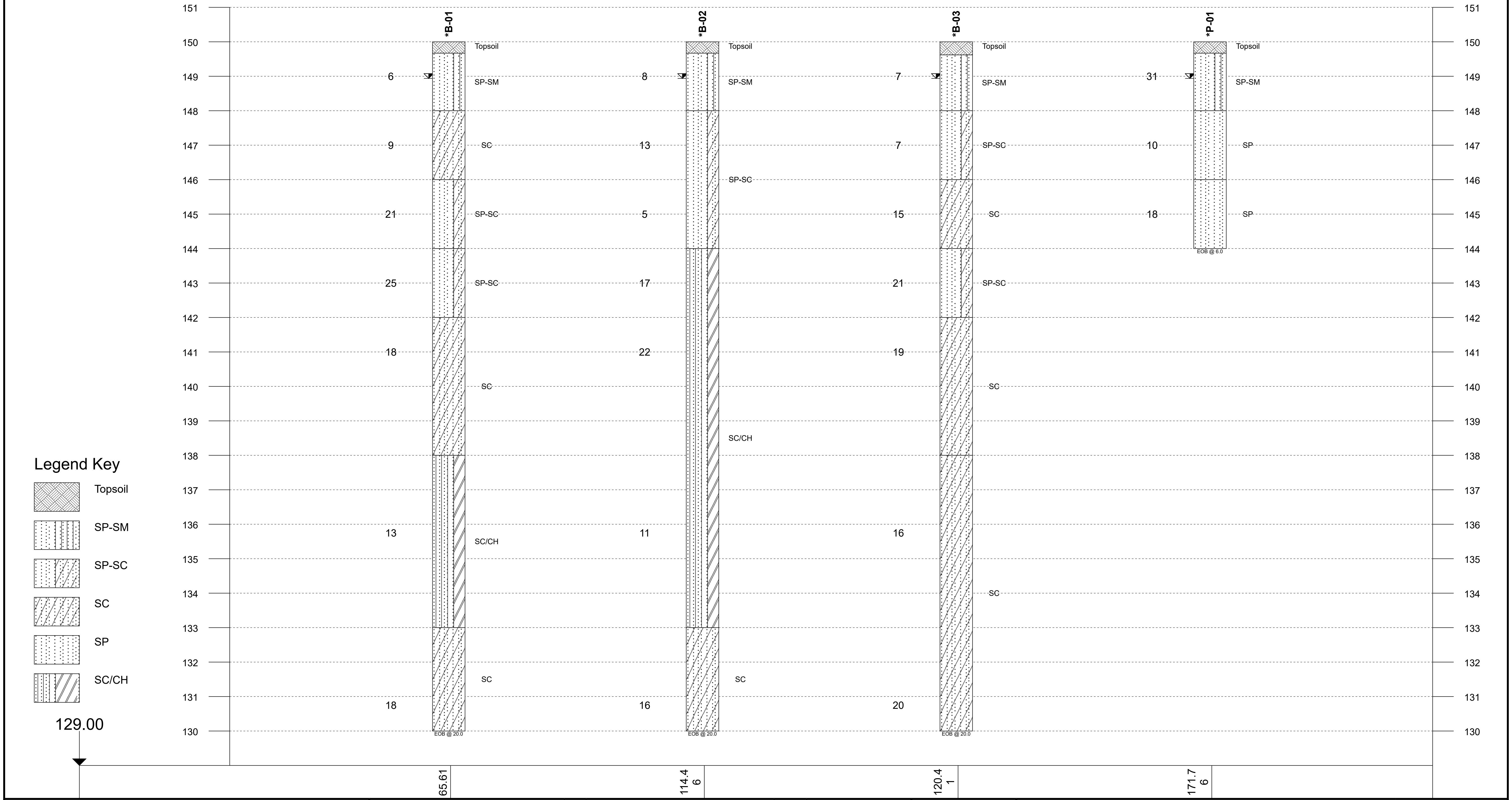
Service Layer Credits: World Boundaries and Places: Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, ©

BORING LOCATION DIAGRAM

Fire Station 90 - Sampson City

13641 SW County Road 227, Starke, Florida
CHW Professional Consultants

ENGINEER	GNV
SCALE	AS NOTED
PROJECT NO.	35:35722
SHEET	2
DATE	7/5/2024



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit
X———●———△
[FINES CONTENT %]
BOTTOM OF CASING
LOSS OF CIRCULATION

▽ WL (First Encountered)
▼ WL (Completion)
▽ WL (Seasonal High Water)
▽ WL (Stabilized)

🟥 Fill
🟪 Possible Fill
▨ Probable Fill
🟩 Rock

GENERALIZED SUBSURFACE PROFILE Section line 1

Fire Station 90 - Sampson City

CHW Professional Consultants

13641 SW County Road 227, Starke, Florida, 32091

Project No: 35:35722
Date: 07/10/2024

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Subsurface Exploration Procedure: Standard Penetration Testing (SPT)
Boring Logs

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]

■		**ASPHALT**
⁘		**CONCRETE**
⁂		**GRAVEL**
▨		**TOPSOIL**
□		**VOID**
▦		**BRICK**
○		**AGGREGATE BASE COURSE**
●	**GW**	**WELL-GRADED GRAVEL** **gravel-sand mixtures, little or no fines**
○	**GP**	**POORLY-GRADED GRAVEL** **gravel-sand mixtures, little or no fines**
▥	**GM**	**SILTY GRAVEL** **gravel-sand-silt mixtures**
▨	**GC**	**CLAYEY GRAVEL** **gravel-sand-clay mixtures**
▲	**SW**	**WELL-GRADED SAND** **gravelly sand, little or no fines**
⁘	**SP**	**POORLY-GRADED SAND** **gravelly sand, little or no fines**
▥	**SM**	**SILTY SAND** **sand-silt mixtures**
▨	**SC**	**CLAYEY SAND** **sand-clay mixtures**
▥	**ML**	**SILT** **non-plastic to medium plasticity**
▯	**MH**	**ELASTIC SILT** **high plasticity**
▨	**CL**	**LEAN CLAY** **low to medium plasticity**
▨	**CH**	**FAT CLAY** **high plasticity**
≀	**OL**	**ORGANIC SILT or CLAY** **non-plastic to low plasticity**
≀	**OH**	**ORGANIC SILT or CLAY** **high plasticity**
ѱ	**PT**	**PEAT** **highly organic soils**

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, QP[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<2	Very Soft
0.25 - <0.50	2 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS[6]

▽	WL (First Encountered)
▼	WL (Completion)
⧨	WL (Seasonal High Water)
▽	WL (Stabilized)

FILL AND ROCK

🟥	🟪	⬜	🟩
FILL	**POSSIBLE FILL**	**PROBABLE FILL**	**ROCK**

---

[1] Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2] To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3] Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4] Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5] Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6] The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7] Minor deviation from ASTM D 2488-17 Note 14.

[8] Percentages are estimated to the nearest 5% per ASTM D 2488-17.

SUBSURFACE EXPLORATION PROCEDURE:
STANDARD PENETRATION TESTING (SPT)
ASTM D 1586
Split-Barrel Sampling

Standard Penetration Testing, or **SPT**, is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The N-Value, or blow counts, when corrected and correlated, can approximate engineering properties of soils used for geotechnical design and engineering purposes.

SPT Procedure:

- Involves driving a hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30-inches at desired depth

- Recording the number of hammer blows required to drive split-spoon a distance of 12 inches (in 3 or 4 Increments of 6 inches each)

- Auger is advanced* and an additional SPT is performed

- One SPT test is typically performed for every two to five feet

- Obtain two-inch diameter soil sample

**Drilling Methods May Vary—* The predominant drilling methods used for SPT are open hole fluid rotary drilling and hollow-stem auger drilling.

CLIENT: **CHW Professional Consultants**

PROJECT NO.: **35:35722**

BORING NO.: **B-01**

SHEET: **1 of 1**

PROJECT NAME: **Fire Station 90 - Sampson City**

DRILLER/CONTRACTOR: **ECS**

SITE LOCATION: **13641 SW County Road 227, Starke, Florida, 32091**

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

LATITUDE: **29.900092**

LONGITUDE: **-82.157181**

STATION:

SURFACE ELEVATION: **150.0**

⊕ STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

ROCK QUALITY DESIGNATION & RECOVERY 20 40 60 80 100

🟥 RQD

— REC

☒ MC SAMPLER BLOWS/FT 10 20 30 40 50

▼ TEXAS CONE PENETRATION BLOWS/FT

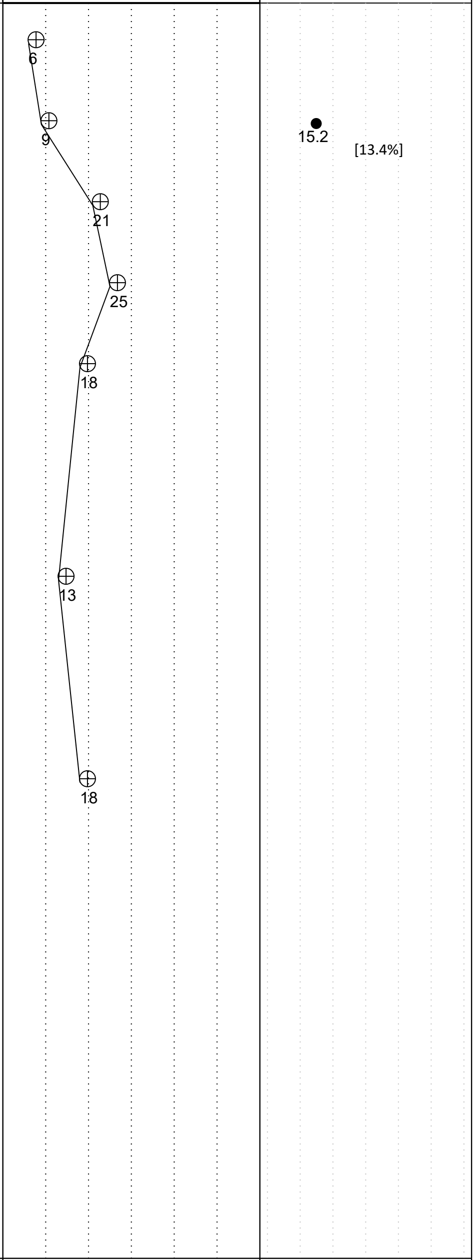
△ LIQUID LIMIT

× PLASTIC LIMIT

○ CALIBRATED PENETROMETER TSF 1 2 3 4 5

● WATER CONTENT % [FINES CONTENT] % 10 20 30 40 50

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
	S-1	SS	24	24	Topsoil Thickness[4.00"] (SP-SM) FINE SAND WITH SILT, gray, moist, loose	⧩		5-3-3-4 (6)
	S-2	SS	24	24	(SC) CLAYEY SAND, light gray and orange, moist, loose, contains phosphate			4-4-5-6 (9)
5	S-3	SS	24	24	(SP-SC) FINE SAND WITH CLAY, orangish tan and gray, moist, medium dense		145	6-9-12-15 (21)
	S-4	SS	24	24	(SP-SC) FINE SAND WITH CLAY, light brown, moist, medium dense			8-11-14-17 (25)
	S-5	SS	24	24	(SC) CLAYEY FINE SAND, light gray and red, moist, medium dense			5-8-10-12 (18)
10							140	
					(SC/CH) CLAYEY FINE SAND/SANDY FAT CLAY, light gray, moist, medium dense			
	S-6	SS	18	18				4-6-7 (13)
15							135	
					(SC) CLAYEY FINE SAND, gray, moist, medium dense			
	S-7	SS	18	18				6-8-10 (18)
20					**END OF BORING AT 20.0 FT**		130	
25							125	
30							120	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	
▼ WL (Completion)	**Not recorded**
⧩ WL (Seasonal High Water)	**1.00**
⧩ WL (Stabilized)	

BORING STARTED: **Jun 17 2024**

CAVE IN DEPTH: **Not Encountered**

BORING COMPLETED: **Jun 17 2024**

HAMMER TYPE: **Auto**

EQUIPMENT: **Buck Rogers 2500**

LOGGED BY: **GNV**

DRILLING METHOD: **Fluid Rotary**

GEOTECHNICAL BOREHOLE LOG

CLIENT:
CHW Professional Consultants

PROJECT NO.:
35:35722

BORING NO.:
B-02

SHEET:
1 of 1

PROJECT NAME:
Fire Station 90 - Sampson City

DRILLER/CONTRACTOR:
ECS

SITE LOCATION:
13641 SW County Road 227, Starke, Florida, 32091

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

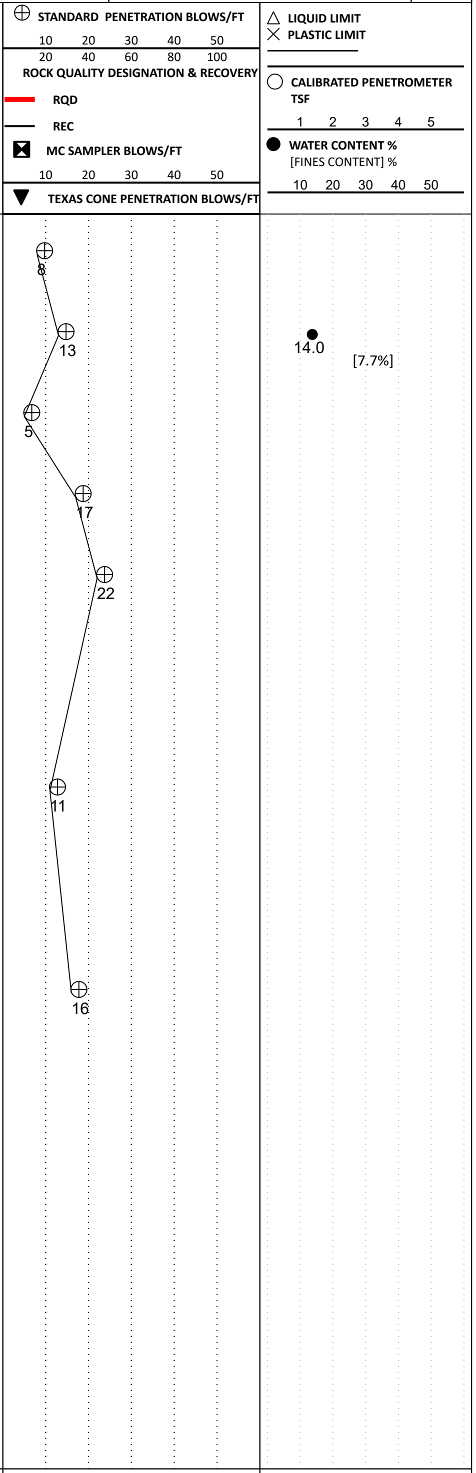
LATITUDE:
29.900085

LONGITUDE:
-82.157018

STATION:

SURFACE ELEVATION:
150.0

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
	S-1	SS	24	24	Topsoil Thickness[4.00"] (SP-SM) FINE SAND WITH SILT, gray, moist, loose	▼		7-4-4-6 (8)
	S-2	SS	24	24	(SP-SC) FINE SAND WITH CLAY, light brown, moist, loose to medium dense, contains phosphate			4-6-7-8 (13)
5	S-3	SS	24	24			145	5-3-2-6 (5)
	S-4	SS	24	24	(SC/CH) CLAYEY FINE SAND/SANDY FAT CLAY, gray and orange, moist, medium dense			4-7-10-12 (17)
	S-5	SS	24	24				7-9-13-17 (22)
10							140	
	S-6	SS	18	18				3-5-6 (11)
15							135	
					(SC) CLAYEY FINE SAND, light brown, moist, medium dense			
	S-7	SS	18	18				5-7-9 (16)
20					**END OF BORING AT 20.0 FT**		130	
25							125	
30							120	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	
▼ WL (Completion)	**Not recorded**
▼ WL (Seasonal High Water)	**1.00**
▽ WL (Stabilized)	

BORING STARTED: **Jun 17 2024**

BORING COMPLETED: **Jun 17 2024**

EQUIPMENT: **Buck Rogers 2500**

LOGGED BY: **GNV**

CAVE IN DEPTH: **Not Encountered**

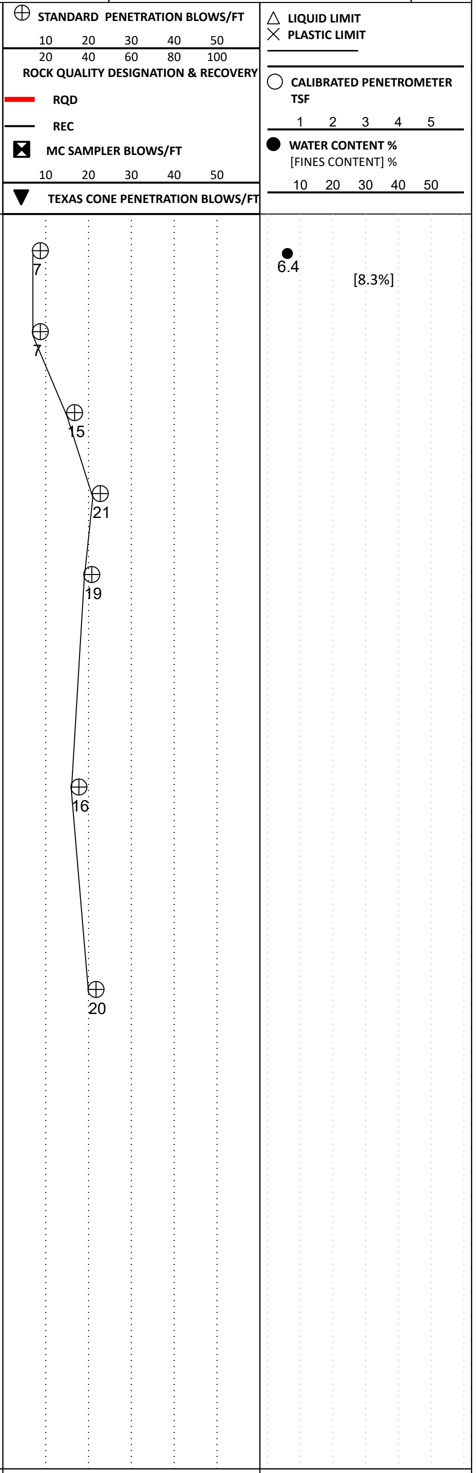
HAMMER TYPE: **Auto**

DRILLING METHOD: **Fluid Rotary**

GEOTECHNICAL BOREHOLE LOG

CLIENT: **CHW Professional Consultants**	PROJECT NO.: **35:35722**	BORING NO.: **B-03**	SHEET: **1 of 1**
PROJECT NAME: **Fire Station 90 - Sampson City**	DRILLER/CONTRACTOR: **ECS**		
SITE LOCATION: **13641 SW County Road 227, Starke, Florida, 32091**		LOSS OF CIRCULATION	100%
LATITUDE: **29.900252**	LONGITUDE: **-82.157055**	STATION:	SURFACE ELEVATION: **150.0**
		BOTTOM OF CASING	

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
					Topsoil Thickness[4.50"]			
	S-1	SS	24	24	(SP-SM) FINE SAND WITH SILT, gray, moist, loose	▽		7-4-3-3 (7)
	S-2	SS	24	24	(SP-SC) FINE SAND WITH CLAY, light brown and orange, loose, contains clay nodules			3-3-4-5 (7)
5	S-3	SS	24	24	(SC) CLAYEY FINE SAND, gray and orange, moist, medium dense		145	4-6-9-10 (15)
	S-4	SS	24	24	(SP-SC) FINE SAND WITH CLAY, gray, moist, medium dense, contains phosphate			7-9-12-13 (21)
	S-5	SS	24	24	(SC) CLAYEY FINE SAND, light gray and red, moist, medium dense			6-8-11-11 (19)
10							140	
					(SC) CLAYEY FINE SAND, gray, moist, medium dense			
	S-6	SS	18	18				5-7-9 (16)
15							135	
	S-7	SS	18	18				7-9-11 (20)
20					**END OF BORING AT 20.0 FT**		130	
25							125	
30							120	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)		BORING STARTED: **Jun 17 2024**	CAVE IN DEPTH: **Not Encountered**
▼ WL (Completion)	**Not recorded**	BORING COMPLETED: **Jun 17 2024**	HAMMER TYPE: **Auto**
▽ WL (Seasonal High Water)	**1.00**	EQUIPMENT: **Buck Rogers 2500** / LOGGED BY: **GNV**	DRILLING METHOD: **Fluid Rotary**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:
CHW Professional Consultants

PROJECT NO.:
35:35722

BORING NO.:
P-01

SHEET:
1 of 1

PROJECT NAME:
Fire Station 90 - Sampson City

DRILLER/CONTRACTOR:
ECS

SITE LOCATION:
13641 SW County Road 227, Starke, Florida, 32091

LOSS OF CIRCULATION ⟩100%⟩

BOTTOM OF CASING ▶

LATITUDE:
29.900177

LONGITUDE:
-82.156861

STATION:

SURFACE ELEVATION:
150.0

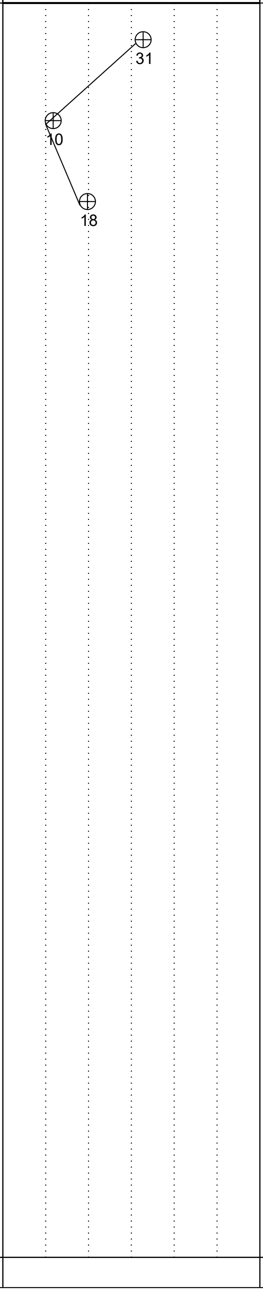
⊕ STANDARD PENETRATION BLOWS/FT
10 20 30 40 50
20 40 60 80 100
ROCK QUALITY DESIGNATION & RECOVERY
🟥 RQD
— REC
☒ MC SAMPLER BLOWS/FT
10 20 30 40 50
▼ TEXAS CONE PENETRATION BLOWS/FT

△ LIQUID LIMIT
✕ PLASTIC LIMIT

○ CALIBRATED PENETROMETER TSF
1 2 3 4 5

● WATER CONTENT %
[FINES CONTENT] %
10 20 30 40 50

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6" (TCP/MC/SPT-N value)*
	S-1	SS	24	24	Topsoil Thickness[4.00"] (SP-SM) FINE SAND WITH SILT, gray, moist, dense	▽		23-21-10-8 (31)
	S-2	SS	24	24	(SP) FINE SAND, brown, moist, loose			4-5-5-6 (10)
5	S-3	SS	24	24	(SP) FINE SAND, light brown, moist, medium dense		145	6-8-10-10 (18)
					END OF BORING AT 6.0 FT			
10							140	
15							135	
20							130	
25							125	
30							120	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Jun 17 2024**	CAVE IN DEPTH: **Not Encountered**
▼ WL (Completion) **Not recorded**	BORING COMPLETED: **Jun 17 2024**	HAMMER TYPE: **Auto**
▽ WL (Seasonal High Water) **1.00**	EQUIPMENT: **Buck Rogers 2500** / LOGGED BY: **GNV**	DRILLING METHOD: **Fluid Rotary**
▽ WL (Stabilized)		

GEOTECHNICAL BOREHOLE LOG

APPENDIX C – Laboratory Testing

Laboratory Test Results Summary

Laboratory Testing Summary

Sample Location	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		@ LBR (%)	#Organic Content (%)
					LL	PL	PI		<Maximum Density (pcf)	<Optimum Moisture (%)		
B-01	S-2	2-4	15.2	SC				13.4				
B-02	S-2	2-4	14.0	SP-SC				7.7				
B-03	S-1	0-2	6.4	SP-SM				8.3				

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, @FM 5-515, #ASTM D2974-20e1 < See test report for D4718 corrected values

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: Fire Station 90 - Sampson City
Client: CHW Professional Consultants

Project No.: 35:35722
Date Reported: 7/2/2024

Office / Lab	Address	Office Number / Fax
ECS Florida LLC - Gainesville	6342 NW 18th Drive, Unit 10 Gainesville, Florida 32653	352-221-9221

Tested by	Checked by	Approved by	Date Received
DMSpencer	DMSpencer	DMSpencer	6/27/2024