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REPORT OF A GEOTECHNICAL EXPLORATION

Fennell Commercial Development
Roadway & Pond Exploration
Jacksonville, Florida

December 7, 2020

PROJECT NO. 0930.2000231.0000
REPORT NO. 1822576

Prepared for:

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December 7, 2020

RCBF Properties, LLC
3491 Pall Mall Road – Suite 204
Jacksonville, Florida 32257

Attention: Mr. Blair Fonda

Reference: **REPORT OF A GEOTECHNICAL EXPLORATION**
Fennell Commercial Development – Roadway & Pond Exploration
Jacksonville, Florida
UES Project No. 0930.2000231.0000 and Report No. 1822576

Dear Mr. Fonda:

Universal Engineering Sciences, Inc. has completed a subsurface exploration for the proposed roadways and ponds at the site of the proposed commercial development located in Jacksonville, Florida. This exploration was performed in accordance with Proposal No. 1809383, dated October 7, 2020. This report contains the results of our exploration, an engineering evaluation with respect to the project characteristics described to us, and recommendations for groundwater considerations, pavement design, stormwater management, and site preparation. A summary of our findings is as follows:

- The borings generally encountered loose fine sand and fine sand with silt (SP, SP-SM) with few medium dense zones in the upper 3.0 to 7.0 feet. Loose to medium dense clayey to very clayey fine sand (SC) with few very loose zones, firm to stiff clay (CL) and soft to stiff clay (CH) extended to the deepest boring termination depths of 25 feet below existing grade.

  As exceptions, boring A-1 encountered clayey fine sand from existing grade to a depth of 3 feet, underlain by clay (CL) to the termination depth of 6 feet; Boring LA-1 encountered very loose clayey fine sand from existing grade to a depth of 1.0 foot; Boring LA-4 encountered very loose fine sand with silt and some concrete fragments and few organics from existing grade to 2 feet; and borings LA-3 and LA-4 encountered fine sand and fine sand with clay from depths of 23 and 24 feet to the termination depths of 25 feet, respectively.

- We measured the groundwater level at the boring locations from depths between the existing ground surface to 5.1 feet below the existing grade. The variations in groundwater levels are likely attributed to topographical differentials and soil type. We estimate the seasonal high groundwater level will occur approximately between the existing grade and 1.5 feet below the existing grade with the exception of the area around A-4 which will have a seasonal high groundwater level of 3.5 feet below the existing grade.

- As previously mentioned, clayey soils were encountered relatively near the existing ground surface. We recommend a minimum 2-foot separation be maintained between the top of the clayey soils the bottom of a flexible pavement base course or bottom of a rigid concrete pavement. This separation can be achieved by either filling the site or undercutting the clayey material.

- A rigid or flexible pavement section could be used on this project. Flexible pavement combines the strength and durability of several layer components to produce an appropriate and cost-effective combination of available construction materials. Concrete pavement has the advantage of the ability to “bridge” over isolated soft areas, and it typically has a longer service life than asphalt pavement. Disadvantages of rigid pavement include an initial higher cost and more difficult patching of distressed areas than occurs with flexible pavement.

- Based on the borings performed in the stormwater management area, the soils described as fine sand (SP), fine sand with silt (SP-SM), and fine sand with clay (SP-SC) are considered suitable for use as structural fill. It should be understood that all soils excavated from below the water table may be excessively wet and may require stockpiling or spreading to dry prior to placement and compaction. The soils described as fine sand with silt and fine sand with clay (SP-SM, SP-SC) may be moisture sensitive and more difficult to dry than sand (SP) soils, depending on the weather conditions at the time of construction.

  Soils described as clayey fine sand (SC) in the range of 12 to 15 percent fines content are marginal for use as structural fill and their suitability will be highly dependent on the ability of the contractor to maintain proper moisture control and properly work this material. The depth ranges of suitable fill and marginal suitable fill for the associated borings are shown on Table 6, Section 4.4.1.

- We recommend only normal, good practice site preparation techniques to prepare the existing subgrade to support the proposed roadways. These techniques include clearing the construction areas, dewatering if warranted, removing any existing utilities, stripping topsoils and vegetation, over-excavating clayey soils as warranted, proof-rolling to aid in identifying soft zones or pumping conditions, compacting the subgrade and placing engineered fill to the desired grades.

We trust this report meets yours needs and addresses the geotechnical issues associated with the proposed construction. We appreciate the opportunity to have worked with you on this project and look forward to a continued association. Please do not hesitate to contact us if you should have any questions, or if we may further assist you as your plans proceed.

Respectfully submitted,

UNIVERSAL ENGINEERING SCIENCES, INC.
Certificate of Authorization No. 549

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1.0 INTRODUCTION

In this report, we present the results of the subsurface exploration of the site for the proposed roadways and ponds for the commercial development located in Jacksonville, Florida. We have divided this report into the following sections:

- SCOPE OF SERVICES - Defines what we did
- FINDINGS - Describes what we encountered
- RECOMMENDATIONS - Describes what we encourage you to do
- LIMITATIONS - Describes the restrictions inherent in this report
- APPENDICES - Presents support materials referenced in this report

2.0 SCOPE OF SERVICES

2.1 PROJECT DESCRIPTION

Project information was provided to us in a recent correspondence with you. We were provided with a copy of a Site Plan for the project prepared by Dominion Engineering Group, Inc. This plan shows the boundary limits for the property, the roadways located adjacent to the site, the layout of the proposed roadways and stormwater management facilities, and the requested boring locations.

We understand that the construction will consist of a new commercial center development adjacent to Ortega Hills Drive and Roosevelt Boulevard in Jacksonville, Florida. This portion of the project includes roadways which will provide access to the proposed commercial parcels and three retention areas for stormwater management. Detailed grading information has not been provided, therefore we have assumed elevating fill heights will not exceed two feet.

We note that since the applicability of geotechnical recommendations is very dependent upon project characteristics, most specifically: improvement locations, grade alterations, and actual structural loads applied, UES must review the preliminary and final site and grading plans to validate all recommendations rendered herein. Without such review our recommendations should not be relied upon for final design or construction of any site improvements.

2.2 PURPOSE

The purposes of this exploration were:

- to explore the general subsurface conditions at the site for the proposed roadway and pond construction;

- to interpret and evaluate the subsurface conditions with respect to the proposed roadway and pond construction; and

- to provide geotechnical engineering recommendations for groundwater considerations, pavement design, stormwater management, and site preparation.

This report presents an evaluation of site conditions on the basis of traditional geotechnical procedures for site characterization. The recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards. Universal Engineering Sciences would be pleased to perform these services, if you desire.

Our exploration was confined to the zone of soil likely to be stressed by the proposed construction. Our work did not address the potential for surface expression of deep geological conditions. This evaluation requires a more extensive range of field services than performed in this study. We will be pleased to conduct an investigation to evaluate the probable effect of the regional geology upon the proposed construction, if you desire.

2.3 FIELD EXPLORATION

A field exploration was initiated on November 9 and completed on November 10, 2020. The approximate boring locations are shown on the attached Boring Location Plan in Appendix A. The approximate boring locations are shown on the attached Boring Location Plan in Appendix A. The approximate boring locations were determined in the field by our personnel using a hand-held GPS unit, and should be considered accurate only to the degree implied by the method of measurement used. Samples of the soils encountered will be held in our laboratory for your inspection for 60 days unless we are notified otherwise.

2.3.1 Standard Penetration Borings

To explore the subsurface conditions within the area of the proposed stormwater management facilities, we located and drilled four (4) Standard Penetration Test (SPT) borings to depths of 25 feet below the existing ground surface in general accordance with the methodology outlined in ASTM D 1586. A summary of this field procedure is included in Appendix A. 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.

2.3.2 Auger Borings

To determine the subsurface conditions within the proposed roadway areas, we located and drilled five (5) auger borings to depth of approximately six feet below the existing ground surface in general accordance with the methodology outlined in ASTM D 1452. A summary of this field procedure is included in Appendix A. Representative soil samples recovered from the auger borings were returned to our laboratory for further evaluation.

2.4 LABORATORY TESTING

Representative soil samples obtained during our field exploration were returned to our office and classified by a geotechnical engineer. The samples were visually classified in general accordance with ASTM D 2488 (Unified Soil Classification System).

Thirteen (13) fines content tests, thirteen (13) moisture content tests, and one (1) Atterberg Limits test were conducted in the laboratory on representative soil samples obtained from the borings. These tests were performed to aid in classifying the soils and to help quantify and correlate engineering properties. The results of these tests are presented on the Boring Logs in Appendix A. A brief description of the laboratory procedures used is also provided in Appendix A.

3.0 FINDINGS

3.1 SOIL SURVEY

Based on the Soil Survey for Duval County, Florida, as prepared by the US Department of Agriculture Soil Conservation Service, the predominant predevelopment soil types at the site are identified as Albany (2), Maurepas (40), Sapelo (63), Urban land (69), and Urban land-Leon-Boulogne (71).

A summary of characteristics of these soil series were obtained from the Soil Survey and is included in Table 1.

TABLE 1
Summary of Soil Survey Information

Soil Type	Constituents	Hydrologic Group	Natural Drainage	Soil Permeability (Inches/Hr)	Seasonal High Water Table
Albany (2)	0-50” Fine sand 50-63” Fine sandy loam 63-80” Sandy clay loam, fine sandy loam	C	Somewhat Poorly Drained	0-50” 6.0 – 20 50-63” 0.6 – 2.0 63-80” 0.2 – 2.0	1.0 – 2.5
Maurepas (40)	0-80” Muck	A/D	Very Poorly Drained	0-80” 6.0 – 20	0.0-0.5
Sapelo (63)	0-23” Fine sand 23-32” Fine sand, loamy fine sand 32-56” Fine sand 56-80” Fine sandy loam, sandy clay loam	D	Poorly Drained	0-23” 6.0 – 20 23-32” 0.6 – 2.0 32-56” 6.0 – 20 56-80” 0.2 – 2.0	0.5 – 1.5
Urban Land (69)	0-6” Variable	-	Variable	0-6” -	-

TABLE 1 Summary of Soil Survey Information					
Soil Type	Constituents	Hydrologic Group	Natural Drainage	Soil Permeability (Inches/Hr)	Seasonal High Water Table
Urban Land (71)	-	-	-	-	-
Leon (71)	0-18" Fine sand 18-37" Fine sand, loamy fine sand 37-80" Fine sand	A/D	Poorly Drained	0-18" 6.0 – 20 18-37" 0.6 – 6.0 37-45" 2.0 – 20 45-80" 0.2 – 2.0	0.5 – 1.5
Boulogne (71)	0-31" Fine sand 31-39" Fine sand, loamy fine sand 39-80" Fine sand	C/D	Poorly Drained	0-6" 6.0 – 20 6-16" 2.0 – 6.0 16-31" 6.0 – 20 31-39" 0.6 – 2.0 39-80" 0.06 – 0.2	0.5 – 1.5

3.2 SURFACE CONDITIONS

The site of the proposed commercial development is located west of Roosevelt Boulevard and north of Ortega Hills Drive in Jacksonville, Florida. The site is mostly heavily wooded with palmettos, pine, and oak trees. A transmission line easement splits the site oriented east to west and a portion of the site extends into an existing commercial development to the north. The site is bordered to the west by wetlands, the north by a commercial development, the south by single family residences, and to the east commercial developments, a retention pond, and drainage ditches were observed parallel along Roosevelt Boulevard. Standing water was observed at the northeast portion of the site at the existing commercial development in the maintained grassy area. Based on a visual inspection of the site, the topography appears to be sloping down from south to the north and from the east to west.

3.3 SUBSURFACE CONDITIONS

The boring locations and detailed subsurface conditions are illustrated in Appendix A: Boring Location Plan and Boring Logs. It should be noted that soil conditions will vary away from and between boring locations. The classifications and descriptions shown on the logs are generally based upon visual characterizations of the recovered soil samples and a limited number of laboratory tests. Also, see Appendix A: Key to Boring Logs, for further explanation of the symbols and placement of data on the Boring Logs. Table 2: General Soil Profile, summarizes the soil conditions encountered.

TABLE 2 General Soil Profile		
Typical depth (ft)		Soil Descriptions
From	To	
0.0	3.0-7.0	Loose fine sand and fine sand with silt (SP, SP-SM) few medium dense zones
3.0-7.0	25*	Loose to medium dense clayey to very clayey fine sand (SC) with few very loose zones, firm to stiff clay (CL), and soft to stiff clay (CH)
* Termination Depth of Deepest Boring ( ) Indicates Unified Soil Classification		

As exceptions, boring A-1 encountered clayey fine sand from existing grade to a depth of 3 feet, underlain by clay (CL) to the termination depth of 6 feet; Boring LA-1 encountered very loose clayey fine sand from existing grade to a depth of 1.0 foot; Boring LA-4 encountered very loose fine sand with silt and some concrete fragments and few organics from existing grade to 2 feet; and borings LA-3 and LA-4 encountered fine sand and fine sand with clay from depths of 23 and 24 feet to the termination depths of 25 feet, respectively.

The groundwater level was recorded at the boring locations from depths between the existing ground surface to 5.1 feet below the existing grade. The variations in groundwater levels are likely attributed to topographical differentials and soil type (i.e. clayey vs. sandy soils). It should be anticipated the groundwater level will fluctuate due to topography, seasonal climatic variations, surface water runoff patterns, construction operations, and other interrelated factors.

4.0 RECOMMENDATIONS

4.1 GENERAL

In this section of the report, we present our detailed recommendations for groundwater control, pavement design, stormwater management, site preparation, and construction related services. The following recommendations are made based upon a review of the attached soil test data, our understanding of the proposed construction, and experience with similar projects and subsurface conditions. We recommend that we be provided the opportunity to review the project plans and specifications to confirm that our recommendations have been properly interpreted and implemented. If the roadway or pond locations change significantly from those discussed previously, we request the opportunity to review and possibly amend our recommendations with respect to those changes. The discovery of any subsurface conditions during construction which deviate from those encountered in the borings should be reported to us immediately for observation, evaluation and recommendations.

4.2 GROUNDWATER CONSIDERATIONS

The groundwater table will fluctuate seasonally depending upon local rainfall. The rainy season in Northeast Florida is normally between June and September. Based upon our review of U.S.G.S. data, Duval County Soils Survey, and regional hydrogeology, it is our opinion the seasonal high groundwater at the site will occur approximately between the existing grade and 1.5 feet below the existing grade with the exception of the area surrounding A-4 which will have a seasonal high groundwater level of 3.5 feet below the existing grade.

Note, it is possible the estimated seasonal high groundwater levels will temporarily exceed these estimated levels during any given year in the future. Should impediments to surface water drainage exist on the site, or should rainfall intensity and duration, or total rainfall quantities exceed the normally anticipated rainfall quantities, groundwater levels may exceed our seasonal high estimates. We recommend positive drainage be established and maintained on the site during construction. We further recommend permanent measures be constructed to maintain positive drainage from the site throughout the life of the project. We recommend all foundation and pavement grade designs be based on the seasonal high groundwater conditions.

4.3 PAVEMENTS

4.3.1 General

A rigid or flexible pavement section could be used on this project. Flexible pavement combines the strength and durability of several layer components to produce an appropriate and cost-effective combination of available construction materials. Concrete pavement has the advantage of the ability to "bridge" over isolated soft areas, it requires less security lighting, and it typically has a longer service life than asphalt pavement. Disadvantages of rigid pavement include an initial higher cost and more difficult patching of distressed areas than occurs with flexible pavement.

4.3.2 Asphalt (Flexible) Pavements

We have recommended a flexible pavement section with a 20-year design life for use on this project. Because traffic loadings are commonly unavailable, we have generalized our pavement design into two groups. The group descriptions and the recommended component thicknesses are presented in Table 3: Summary of Pavement Component Recommendations. The thicknesses in Table 3 are based on a structural number analysis with the stated estimated daily traffic volume for a 20-year replacement design life. We have conservatively assumed a design subgrade LBR of 20 (Resilient Modulus of 7,500 psi) for this analysis and have additionally assumed a separation of at least 2 feet between the bottom of base and the seasonal high groundwater level.

TABLE 3
Summary of Pavement Component Recommendations

Traffic Group	Maximum Traffic Loading	Component Thickness (inches)		
		Stabilized Subgrade	Base Course	Surface Course
Automobile parking lots and driveways - **standard duty**	Up to 300,000 E_{18}SAL	12	6	1.5
Truck parking lots and driveways - **heavy duty**	Up to 800,000 E_{18}SAL	12	8	2.0

4.3.2.1 Stabilized Subgrade

We recommend that subgrade materials be compacted in place according to the requirements in the "Site Preparation" section of this report. Further, beneath limerock base course, stabilize the subgrade materials to a minimum Limerock Bearing Ratio (LBR) of 40, as specified by Florida Department of Transportation (FDOT) requirements for Type B Stabilized Subgrade. The subgrade material should be compacted to at least 98 percent of the Modified Proctor maximum dry density (ASTM D 1557, AASHTO T-180) value.

The stabilized subgrade can be a blend of existing soil and imported material such as limerock. If a blend is proposed, we recommend that the contractor perform a mix design to find the optimum mix proportions.

The primary function of stabilized subgrade beneath the base course is to provide a stable and firm subgrade so that the limerock can be properly and uniformly placed and compacted. Depending upon the soil type, the subgrade material may have sufficient stability to provide the needed support without additional stabilizing material. Generally, sands with silt or clay should have sufficient stability and may not require additional stabilizing material. Conversely, relatively "clean" sand will not provide sufficient stability to adequately construct the limerock base course. Universal Engineering Sciences should observe the soils exposed on the finish grades to evaluate whether or not additional stabilization will be required beneath the base course.

4.3.2.2 Base Course

We recommend the base course consist of locally available limerock complying with the requirements of the latest version of the FDOT Standard Specifications for Road and Bridge Construction (SSRBC), Section 200 and Section 911. The limerock should be mined or supplied from an FDOT approved source. Place the limerock in maximum 6-inch thick loose lifts and compact each lift to a minimum density of 98 percent of the Modified Proctor maximum dry density (ASTM D1557/AASHTO T-180).

Alternatively, we believe locally available crushed concrete base of equal thickness could be substituted for the limerock. Crushed concrete should be supplied by an FDOT approved plant with quality control procedures. Crushed concrete should meet the requirements for Recycled Concrete Aggregate (RCA) of the most recent version of FDOT SSRBC Sections 200 and 911.

The base shall have an average LBR of not less than 100 and should be compacted to at least 98 percent of the Modified Proctor maximum dry density (ASTM D 1557, AASHTO T-180) value. The LBR value of material produced at a particular source shall be determined in accordance with an approved quality control procedure.

Testing shall be performed at the following frequencies:

- Perform in-place density on the base at a frequency of 1 test per 300 linear foot of roadway or 5,000 square feet of pavement.
- Perform Limerock Bearing Ratio tests at a frequency of 1 test per visual change in material and a minimum of 1 test per 15,000 square feet of pavement.
- Engineer should perform a final visual base inspection prior to placement of prime or tack coat and paving.

4.3.2.3 Wearing Surface

For the roadways, we recommend that the surfacing consist of FDOT SuperPave (SP) asphaltic concrete. The surface course should consist of FDOT SP-9.5 fine mix for the proposed light-duty area. The heavy duty area can consist of a single 2-inch lift of SP-12.5 or 2 layers of SP-9.5 placed in 1-inch lifts. The asphalt concrete should be placed within the allowable lift thicknesses for fine Type SP mixes per the latest edition of FDOT, Standard Specifications for Road and Bridge Construction, Section 334-1.4 Thickness.

The asphaltic concrete should be compacted to an average field density of 93 percent of the laboratory maximum density determined from specific gravity (G_{mm}) methods, with an individual test tolerance of **+2 percent and -1.2% of the design G_{mm}**. Specific requirements for the SuperPave asphaltic concrete structural course are outlined in the latest edition of FDOT, Standard Specifications for Road and Bridge Construction, Section 334.

Please note, if the Designer (or Contract Documents) limits compaction to the static mode only or lifts are placed one-inch thick, then the average field density should be 92 percent, with an individual test tolerance of + 3 percent, and -1.2% of the design G_{mm}.

After placement and field compaction, the wearing surface should be cored to evaluate material thickness and density. Cores should be obtained at frequencies of at least one (1) core per 5,000 square feet of placed pavement, every 250 feet of lineal roadway, or a minimum of two (2) cores per day’s production.

4.3.3 Concrete (Rigid) Pavements

Concrete pavement is a rigid pavement that transfers much lighter wheel loads to the subgrade soils than a flexible asphalt pavement. For a concrete pavement subgrade, we recommend using the existing surficial sands or recommend clean fine sand fill (SP), densified to at least 98 percent of Modified Proctor test maximum dry density (ASTM D 1557) without additional stabilization, with the following stipulations:

1. Subgrade soils must be densified to at least 98 percent of Modified Proctor test maximum dry density (ASTM D 1557) to a depth of at least 2 feet prior to placement of concrete.

2. The surface of the subgrade soils must be smooth, and any disturbances or wheel rutting corrected prior to placement of concrete.

3. The subgrade soils must be moistened prior to placement of concrete.

4. Concrete pavement thickness should be uniform throughout, with exception to thickened edges (curb or footing).

5. The bottom of the pavement should be separated from the estimated typical wet season groundwater level by at least 18 inches.

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) equal to 200 pounds per cubic inch, c) a 20-year design life, and d) the previously stated traffic conditions in Section 4.3.2, we recommend using the design shown in Table 4 for standard duty concrete pavements.

TABLE 4
Standard Duty (Unreinforced) Concrete Pavement

Minimum Pavement Thickness	Maximum Control Joint Spacing	Recommended Sawcut Depth
5 Inches	10 Feet x 10 Feet	1¼ Inches

Our recommended design for heavy duty concrete pavement is shown in Table 5 below.

TABLE 5
Heavy Duty (Unreinforced) Concrete Pavement

Minimum Pavement Thickness	Maximum Control Joint Spacing	Recommended Sawcut Depth
6 Inches	12 Feet x 12 Feet	1½ Inches

We recommend using concrete with 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 sufficient strength to support workers and equipment. We recommend allowing Universal 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 on Non-Reinforced Concrete Pavements" published by the Florida Concrete and Products Associates, Inc., and "Building Quality Concrete Parking Areas", published by the Portland Cement Association.

4.3.4 Effects of Groundwater

One of the most critical factors influencing pavement performance in Northeast Florida is the relationship between the pavement subgrade and the seasonal high groundwater level. Many roadways and parking areas have been damaged as a result of deterioration of the base conditions and/or the base/surface course bond. We recommend that the seasonal high groundwater and the bottom of the flexible pavement limerock base course be separated by at least 24 inches. We recommend a separation of at least 18 inches below the bottom of a rigid concrete pavement or below a flexible pavement with a crushed concrete base. If this separation cannot be established and maintained by grading and surface drainage improvements, permanent groundwater control measures (underdrains) will be required.

4.3.5 Curbing

We recommend that curbing around the landscaped sections adjacent to the parking areas and driveways be constructed with full-depth curb sections. Using extruded curb sections which lie directly on top of the final asphalt level, or eliminating the curbing entirely, can allow migration of irrigation water from the landscape areas to the interface between the asphalt and the base. This migration often causes separation of the wearing surface from the base and subsequent rippling and pavement deterioration. Topsoil placed behind curbing in landscaped areas should be limited to 6-inch vertical thickness within five feet of flexible pavement.

4.3.6 Construction Traffic

Light duty roadways and incomplete pavement sections will not perform satisfactorily under construction traffic loadings. We recommend that construction traffic (construction equipment, concrete trucks, sod trucks, garbage trucks, dump trucks, etc.) be re-routed away from these roadways or that the pavement section be designed for these loadings.

4.4 RETENTION POND CONSIDERATIONS

4.4.1 Fill Suitability

Based on the borings performed in the stormwater management area, the soils described as fine sand (SP), fine sand with silt (SP-SM), and fine sand with clay (SP-SC) are considered suitable for use as structural fill. It should be understood that all soils excavated from below the water table may be excessively wet and may require stockpiling or spreading to dry prior to placement and compaction. The soils described as fine sand with silt and fine sand with clay (SP-SM, SP-SC) may be moisture sensitive and more difficult to dry than sand (SP) soils, depending on the weather conditions at the time of construction. Although not suitable for structural fill, due to excessive organic content, the topsoil materials and organic material may be used in landscape areas as long as positive drainage is maintained. **It should be noted that concrete debris was encountered from existing grade to a depth of two feet in boring LA-4. This material is not considered suitable for use as structural fill. If warranted, test pits could be performed to delineate the vertical and horizontal extents of this material.**

Soils described as clayey fine sand (SC) in the range of 12 to 15 percent fines content are marginal for use as structural fill and their suitability will be highly dependent on the ability of the contractor to maintain proper moisture control and properly work this material. This material may be suitable if stockpiled to allow it to dry and spread in thin lifts. **These soils will not be suitable as structural fill if the moisture contents are excessive.** In addition, it should be anticipated that layers of unsuitable more clayey material may be encountered within these stratums during construction. It is noted that soils with greater that 15 percent fines content are not considered suitable for the use of structural fill. If soil conditions deviate from our exploration, please notify us immediately for observation, evaluation and further recommendations. Table 6 shows the depths of suitable fill and marginal suitable fill for the pond borings.

TABLE 6
Depths of Suitable Fill

Boring (2)	Depth Ranges of Suitable Fill (ft) [SP, SP-SM, SP-SC]	Depth Ranges of Marginal Suitable Fill (1) (ft) [SC]
LA-1	1.0-3.5	14-18
LA-2	0.0-3.0	12-17
LA-3	0.0-7.0, 23-25 (3)	13-23
LA-4	3.5-5.0, 24-25 (3)	19-24

[ ] Indicates Unified Soil Classification
(1) Anticipate that layers of unsuitable more clayey material may be encountered within the stratum.
(2) It should be noted that normal clearing and grubbing operations will need to be performed in the pond areas and that the material removed will not be suitable for use as structural fill.
(3) Boring termination depth

4.4.2 Seasonal High Groundwater

We measured the groundwater level at the pond boring locations from the existing ground surface to a depth of 1.9 feet below the existing grade. We estimate the seasonal high groundwater level will be encountered within 1 foot of the existing ground surface.

4.5 SITE PREPARATION

We recommend normal, good practice site preparation procedures. These procedures include: removing the existing trees and vegetation, stripping the site of root zones and topsoil, over-excavating clayey soils as warranted, proof-rolling the surface to identify soft zones and pumping conditions dewatering as warranted, compacting the subgrade and placing necessary fill or backfill to grade with engineered fill. A more detailed synopsis of this work is as follows:

1. Prior to construction, the location of any existing underground utility lines within the construction area should be established. Provisions should then be made to relocate interfering utilities to appropriate locations. It should be noted that if underground pipes are not properly removed or plugged, they may serve as conduits for subsurface erosion which may subsequently lead to excessive settlement of the overlying structure(s).

- The groundwater level was recorded at the existing grade to a depth of 5.1 feet below the existing ground surface. We estimate the seasonal high groundwater level will occur approximately between the existing grade and 1.5 feet below the existing grade with the exception of the area around A-4 which will have a seasonal high groundwater level of 3.5 feet below the existing grade. The groundwater level should be maintained at least 2 feet below any excavations and the surface of any vibratory compaction procedures. If required, temporary groundwater control can probably be achieved by pumping from sumps located in perimeter ditches. Each sump should be located outside the bearing area to avoid loosening of the fine sandy bearing soils.

2. Strip the proposed construction limits of all grass, roots, topsoil, existing construction and associated foundations and utilities, and other deleterious materials within and 3 feet beyond the perimeter of the proposed paved areas. Root rake the exposed subgrade (in perpendicular directions) to a depth of at least 12 inches to help locate and remove large near surface roots, debris and concentrated root zones. Some isolated areas may require deeper undercutting to remove the root systems of large trees.

3. Clayey soils were encountered relatively near the existing ground surface across the site. It is recommended a minimum 2-foot separation be maintained between the top of the clayey materials and the bottom of the flexible pavement base or bottom of a rigid concrete pavement. This separation can be achieved by either filling the site or undercutting the clayey materials.

4. We recommend the subgrade be proof-rolled with a heavily loaded, rubber-tired vehicle under the observation of a geotechnical engineer or his/her representative. Proof-rolling will help delineate areas of especially loose or soft soils not encountered in the soil test borings. We recommend the areas that experience pumping or otherwise appear unstable be undercut to firm soils. Placement and compaction of backfill in undercut areas and preparation of the subgrade and base should be placed and compacted in accordance with the recommendations below.

5. Compact the subgrade from the surface with a medium weight vibratory roller operating until you obtain a minimum density of at least 95 percent of the Modified Proctor maximum dry density (ASTM D-1557), to a depth of 2 feet below the compacted surface. A minimum of eight (8) complete coverages (in perpendicular directions) should be made in the structure construction area with the roller to improve the uniformity and increase the density of the underlying sandy soils. Typically, the soils should exhibit moisture contents within ±2.0% of the Modified Proctor optimum moisture content during compaction.

   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 removed and backfilled with dry structural fill soils which are then compacted, or (2) the excess pore pressures within the disturbed soils allowed to dissipate before recompaction.

6. Care should be exercised to avoid damaging any 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 be documented with photographs and survey (if deemed necessary). Compaction should cease if deemed detrimental to adjacent structures. Universal Engineering Sciences can provide vibration monitoring services to help document and evaluate the effects of the surface compaction operation on existing structures. In the absence of vibration monitoring it is recommended the vibratory roller remain a minimum of 50 feet from existing structures. Within this zone, use of a bulldozer or a vibratory roller operating in the static mode is recommended.

7. Care should be exercised in performing the site preparation procedures due to the presence of clayey soils near the existing ground surface. Excessive vibrations could result in pumping conditions which may result in the need for over-excavation and replacement.

To avoid pumping of the underlying clayey soils, we recommend self-propelled vibrating equipment remain a minimum of 2 feet above the clayey soils. The sandy soils within 2 feet of the clayey soils could be compacted with a vibratory roller operating in the static mode or with a track-mounted dozer to avoid disturbing the clayey soils. We further recommend a minimum of 18 inches of sand overlying the clayey soils prior to operation of any construction equipment. Excess disturbance of the clayey soils will degrade the strength characteristics of the soil and may result in an unsuitable soil which will require over-excavation and subsequent backfilling with clean fine sand fill material.

8. In the paved areas, perform compliance tests on the subgrade at a frequency of not less than one test per 10,000 square feet per lift, or at a minimum of two test locations, whichever is greater.

9. Place fill material, as required. The fill should consist of "clean," fine sand with less than 5 percent soil fines. You may use fill materials with soil fines between 5 and 12 percent, but strict moisture control may be required. Typically, the soils should exhibit moisture contents within ± 2 percent of the Modified Proctor optimum moisture content during compaction. Place fill in uniform 10- to 12-inch loose lifts and compact each lift to a minimum density of at least 95 percent of the Modified Proctor maximum dry density.

   The top 12 inches of fill beneath flexible pavement or the top 24 inches of fill beneath rigid pavement areas should be compacted to 98 percent of the Modified Proctor maximum dry density. For flexible pavement areas, stabilize this zone as necessary as recommended in Section 4.4.2, to obtain a minimum LBR of 40.

10. In paved areas, perform compliance tests at a frequency of not less than one test per 10,000 square feet per lift, or at a minimum of two test locations, whichever is greater.

4.6 CONSTRUCTION RELATED SERVICES

We recommend the owner retain Universal Engineering Sciences to perform construction materials tests and observations on this project. Field tests and observations include verification of foundation and pavement subgrades by performing quality assurance tests on the placement of compacted structural fill and pavement courses. We can also provide concrete testing, pavement section testing, structural steel testing, and general construction observation services.

The geotechnical engineering design does not end with the advertisement of the construction documents. The design is an on-going process throughout construction. Because of our familiarity with the site conditions and the intent of the engineering design, we are most qualified to address problems that might arise during construction in a timely and cost-effective manner.

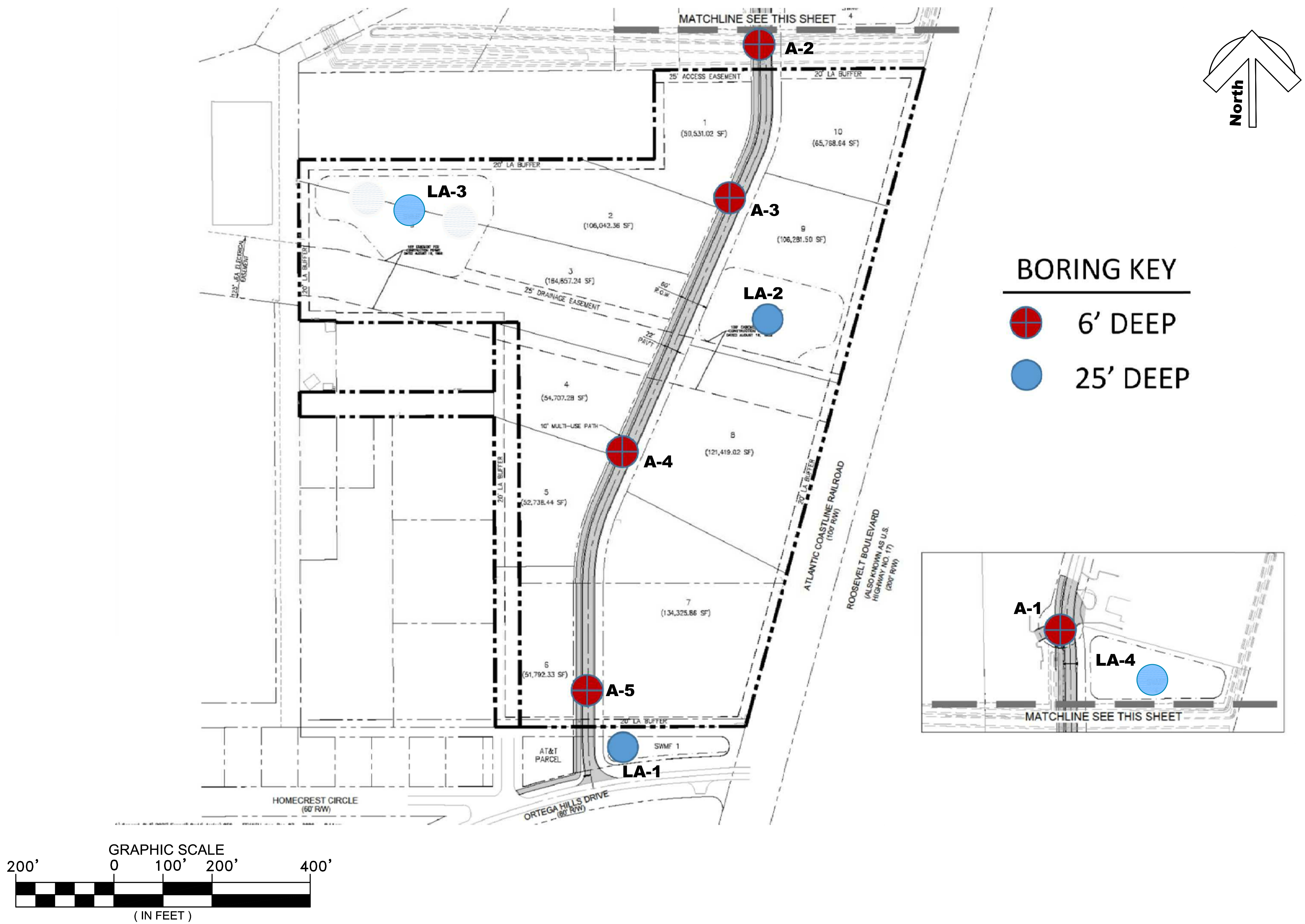
5.0 LIMITATIONS

During the early stages of most construction projects, geotechnical issues not addressed in this report may arise. Because of the natural limitations inherent in working with the subsurface, it is not possible for a geotechnical engineer to predict and address all possible problems. A Geotechnical Business Council (GBC) publication, "Important Information About This Geotechnical Engineering Report" appears in Appendix B, and will help explain the nature of geotechnical issues.

Further, we present documents in Appendix B: Constraints and Restrictions, to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

APPENDIX A

BORING LOCATION PLAN
BORING PROFILES
BORING LOGS
KEY TO BORING LOGS
FIELD EXPLORATION PROCEDURES
LABORATORY TESTING PROCEDURES



CLIENT: RCBF PROPERTIES, LLC

DRAWN BY: TW | DATE: 11/25/20
CHECKED BY: PM | DATE: 11/25/20
SCALE: 1"= 200'
PROJECT NO: 0930.2000231.0000 | REPORT NO: 1822576

GEOTECHNICAL EXPLORATION
FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

BORING LOCATION PLAN

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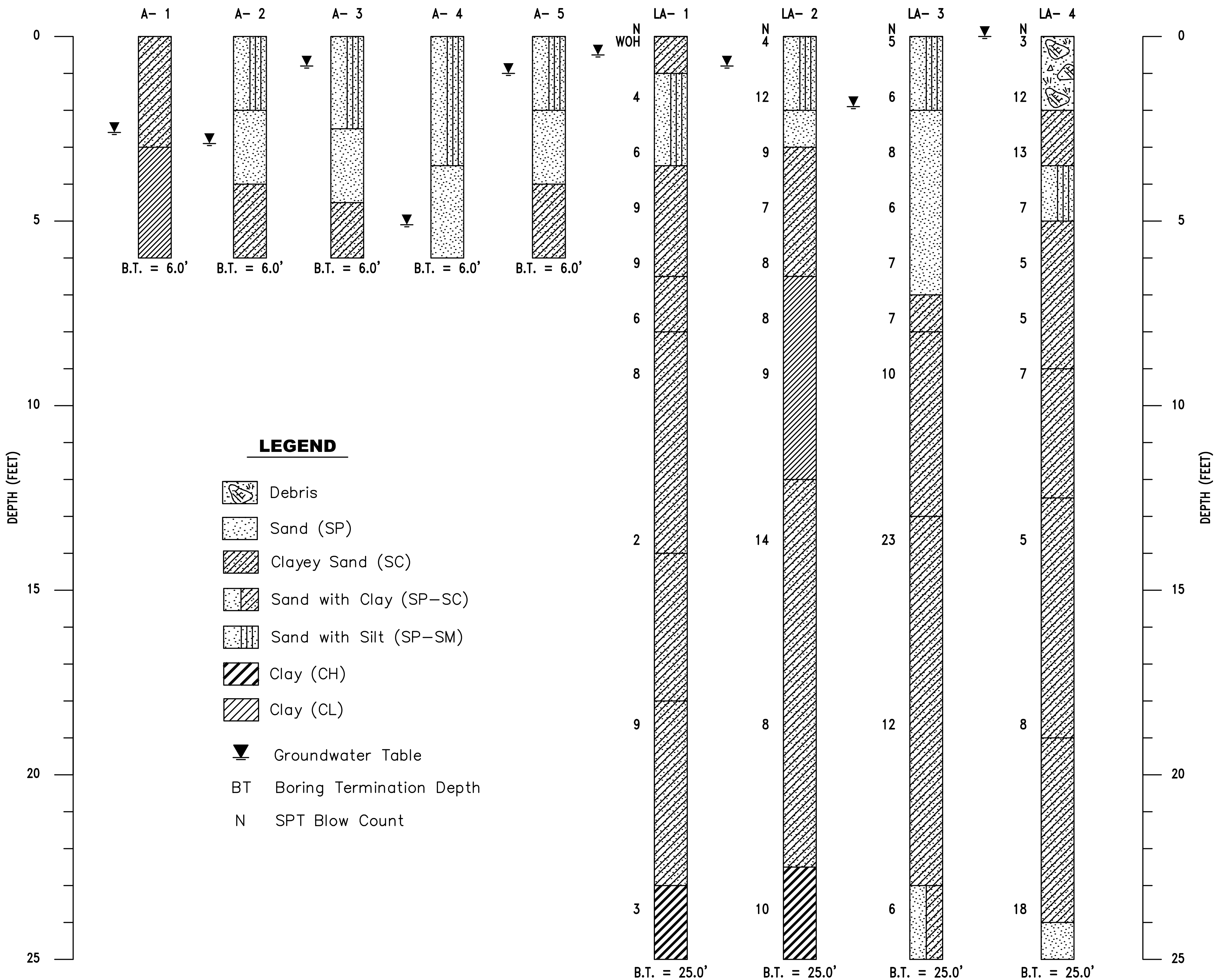
PAGE NO:
FIGURE A-1



CLIENT: RCBF PROPERTIES, LLC

DRAWN BY: TW | DATE: 11/25/20

CHECKED BY: PM | DATE: 11/25/20

SCALE: AS SHOWN

PROJECT NO: 0930.2000231.0000 | REPORT NO: 1822576

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FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

SOIL BORING PROFILES

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BORING LOG

PROJECT NO.:	0930.2000231.0000
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PROJECT: GEOTECHNICAL EXPLORATION
FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

BORING DESIGNATION: **A- 1** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS: PP - UNCONFINED COMPRESSIVE STRENGTH MEASURED WITH POCKET PENETROMETER

G.S. ELEVATION (ft):
WATER TABLE (ft): 2.6
DATE OF READING: 11/10/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/9/20
DATE FINISHED: 11/9/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1452

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0				▼ (2.6)		Brown to orange-brown Clayey fine SAND (SC)	16.1	14.1				
						Light gray CLAY (CL) PP=1.25 tsf	57.1	27.2	47	30		
5												

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FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

BORING DESIGNATION: **A- 2** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): 2.9
DATE OF READING: 11/10/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/20
DATE FINISHED: 11/10/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1452

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Brown fine SAND with Silt and trace cemented Sand (SP-SM)						
				▼		Light gray fine SAND (SP)						
5						Light gray mottled orange-brown very Clayey fine SAND (SC)						

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JACKSONVILLE, FLORIDA

BORING DESIGNATION: **A- 3** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): 0.8
DATE OF READING: 11/9/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/9/20
DATE FINISHED: 11/9/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1452

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0				▼		Dark gray to brown fine SAND with Silt (SP-SM)	11.4	26.6				
						Light gray fine SAND (SP)						
5						Light gray-brown mottled orange-brown very Clayey fine SAND (SC)	29.6	22.6				

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JACKSONVILLE, FLORIDA

BORING DESIGNATION: **A- 4** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC

LOCATION: SEE BORING LOCATION PLAN

REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): 5.1
DATE OF READING: 11/9/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/9/20
DATE FINISHED: 11/9/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1452

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Brown fine SAND with Silt (SP-SM)	9.5	5.8				
						Light brown to light gray fine SAND (SP)						
5				▼								

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BORING LOG

PROJECT NO.: 0930.2000231.0000
REPORT NO.: 1822576
PAGE: A-5

PROJECT: GEOTECHNICAL EXPLORATION
FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

BORING DESIGNATION: **A- 5** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): 1.0
DATE OF READING: 11/9/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/9/20
DATE FINISHED: 11/9/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1452

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS		K (FT./ DAY)	ORG. CONT. (%)
									LL	PI		
0				▼ (1.0)		Dark brown fine SAND with Silt (SP-SM)						
						Light brown fine SAND (SP)						
5						Light brown mottled orange-brown Clayey fine SAND (SC)						

BORING_LOG 0930.2000231.0000-FENNEL COMMERCIAL DEVELOPMENT.GPJ UNIENGSC.GDT 12/3/20

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BORING LOG

PROJECT NO.:	0930.2000231.0000
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PROJECT: GEOTECHNICAL EXPLORATION
FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

BORING DESIGNATION: **LA- 1** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS: PP - UNCONFINED COMPRESSIVE STRENGTH MEASURED WITH POCKET PENETROMETER

G.S. ELEVATION (ft):
WATER TABLE (ft): 0.5
DATE OF READING: 11/9/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/9/20
DATE FINISHED: 11/9/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
0				▼		Very loose dark gray to gray Clayey fine SAND (SC)						
		1/18"	WOH			Very loose to loose light brown fine SAND with Silt (SP-SM)						
		1-1-3	4									
		3-3-3	6			Loose light brown to gray-brown Clayey fine SAND (SC)						
5		3-4-5	9									
		4-4-5	9			Loose gray very Clayey fine SAND (SC) PP=1.25 tsf	34.5	21.7				
		3-3-3	6			Loose gray Clayey fine SAND (SC)	17.5	25.7				
10		3-4-4	8									
15		1-1-1	2			Very loose gray Clayey fine SAND (SC)						
20		4-4-5	9			Loose gray-brown Clayey fine SAND (SC)						
25		1-2-1	3			Soft gray CLAY (CH) PP=0.75 tsf						

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FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

BORING DESIGNATION: **LA- 2** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS: PP - UNCONFINED COMPRESSIVE STRENGTH MEASURED WITH POCKET PENETROMETER

G.S. ELEVATION (ft):
WATER TABLE (ft): 0.8
DATE OF READING: 11/9/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/9/20
DATE FINISHED: 11/9/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
0				▼		Loose dark brown fine SAND with Silt (SP-SM)						
	X	1-1-3	4									
						Medium dense light gray fine SAND (SP)						
	X	5-6-6	12			Loose gray mottled orange-brown very Clayey fine SAND (SC)						
	X	3-4-5	9									
5	X	3-4-3	7			PP=1.5-2.0 tsf						
						Firm to stiff gray CLAY (CL)						
	X	3-3-5	8				60.7	33.1				
	X	3-4-4	8									
10	X	3-4-5	9			PP=1.5 tsf						
						Medium dense to loose light gray to light orange-brown Clayey fine SAND (SC)						
							12.8	25.1				
15	X	6-7-7	14									
20	X	4-4-4	8									
						Stiff gray CLAY (CH)						
						PP=1.0 tsf						
25	X	3-4-6	10									

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FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

BORING DESIGNATION: **LA- 3** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): 1.9
DATE OF READING: 11/10/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/10/20
DATE FINISHED: 11/10/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	K (FT./ DAY)	ORG. CONT. (%)
0						Loose gray-brown fine SAND with Silt (SP-SM)						
	X	1-2-3	5	▼								
	X	3-3-3	6			Loose light gray fine SAND (SP)						
	X	3-4-4	8									
5	X	3-3-3	6									
	X	3-4-3	7			Loose light gray Clayey fine SAND (SC)						
	X	3-3-4	7			Loose gray mottled orange-red very Clayey fine SAND (SC)						
10	X	3-4-6	10									
						Medium dense red-orange to light brown Clayey fine SAND (SC)						
15	X	8-10-13	23				12.2	27.1				
20	X	3-6-6	12				15.2	28.0				
						Loose light brown fine SAND with Clay (SP-SC)						
25	X	3-3-3	6									

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PROJECT: GEOTECHNICAL EXPLORATION
FENNELL COMMERCIAL DEVELOPMENT
JACKSONVILLE, FLORIDA

BORING DESIGNATION: **LA- 4** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: RCBF PROPERTIES, LLC
LOCATION: SEE BORING LOCATION PLAN
REMARKS: PP - UNCONFINED COMPRESSIVE STRENGTH MEASURED WITH POCKET PENETROMETER

G.S. ELEVATION (ft):
WATER TABLE (ft): 0.0
DATE OF READING: 11/9/20
EST. W.S.W.T. (ft):

DATE STARTED: 11/9/20
DATE FINISHED: 11/9/20
DRILLED BY: SV/MC
TYPE OF SAMPLING: ASTM D 1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	PI	K (FT./ DAY)	ORG. CONT. (%)
0				▼		Very loose gray-brown fine SAND with Silt and some Concrete fragments and few Organics (SP-SM, Debris)						
	X	1-1-2	3									
						Medium dense dark gray-brown Clayey fine SAND with trace Concrete fragments (SC)						
	X	5-6-6	12									
						Loose gray fine SAND with Silt (SP-SM)						
	X	6-6-7	13									
5						Loose gray-brown Clayey fine SAND (SC)						
	X	5-4-3	7									
							28.0	21.6				
	X	3-3-2	5									
	X	2-3-2	5									
						Loose gray very Clayey fine SAND (SC)						
10	X	3-3-4	7			PP=1.5 tsf						
						Loose dark brown to brown Clayey fine SAND (SC)						
15	X	2-3-2	5									
						Loose gray-brown Clayey fine SAND with interbedded fine Sand with Clay (SC)						
20	X	3-4-4	8				14.1	25.8				
						Medium dense light gray fine SAND (SP)						
25	X	5-7-11	18									

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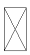
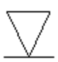
KEY TO BORING LOGS

SYMBOLS AND ABBREVIATIONS

SYMBOL	DESCRIPTION
N-Value	No. of Blows of a 140-lb. Weight Falling 30 Inches Required to Drive a Standard Spoon 1 Foot
WOR	Weight of Drill Rods
WOH	Weight of Drill Rods and Hammer
	Sample from Auger Cuttings
	Standard Penetration Test Sample
	Thin-wall Shelby Tube Sample (Undisturbed Sampler Used)
% REC	Percent Core Recovery from Rock Core Drilling
RQD	Rock Quality Designation
	Stabilized Groundwater Level
	Seasonal High Groundwater Level (also referred to as the W.S.W.T.)
NE	Not Encountered
GNE	Groundwater Not Encountered
BT	Boring Terminated
-200 (%)	Fines Content or % Passing No. 200 Sieve
MC (%)	Moisture Content
LL	Liquid Limit (Atterberg Limits Test)
PI	Plasticity Index (Atterberg Limits Test)
K	Coefficient of Permeability
Org. Cont.	Organic Content
G.S. Elevation	Ground Surface Elevation

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS More than 50% retained on the No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS 5% or less passing No. 200 sieve	SW**	Well-graded sands and gravelly sands, little or no fines
			SP**	Poorly graded sands and gravelly sands, little or no fines
		SANDS with 12% or more passing No. 200 sieve	SM**	Silty sands, sand-silt mixtures
			SC**	Clayey sands, sand-clay mixtures
FINE-GRAINED SIOLS 50% or more passes the No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy 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 diamicaceous fine sands or silts, elastic silts
			CH	Inorganic clays or clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
			PT	Peat, muck and other highly organic soils

*Based on the material passing the 3-inch (75 mm) sieve
** Use dual symbol (such as SP-SM and SP-SC) for soils with more than 5% but less than 12% passing the No. 200 sieve

RELATIVE DENSITY

(Sands and Gravels)
Very loose – Less than 4 Blow/Foot
Loose – 4 to 10 Blows/Foot
Medium Dense – 11 to 30 Blows/Foot
Dense – 31 to 50 Blows/Foot
Very Dense – More than 50 Blows/Foot

CONSISTENCY

(Silts and Clays)
Very Soft – Less than 2 Blows/Foot
Soft – 2 to 4 Blows/Foot
Firm – 5 to 8 Blows/Foot
Stiff – 9 to 15 Blows/Foot
Very Stiff – 16 to 30 Blows/Foot
Hard – More than 30 Blows/Foot

RELATIVE HARDNESS

(Limestone)
Soft – 100 Blows for more than 2 Inches
Hard – 100 Blows for less than 2 Inches

MODIFIERS

These modifiers Provide Our Estimate of the Amount of Minor Constituents (Silt or Clay Size Particles) in the Soil Sample
Trace – 5% or less
With Silt or With Clay – 6% to 11%
Silty or Clayey – 12% to 30%
Very Silty or Very Clayey – 31% to 50%

These Modifiers Provide Our Estimate of the Amount of Organic Components in the Soil Sample
Trace – Less than 3%
Few – 3% to 4%
Some – 5% to 8%
Many – Greater than 8%

These Modifiers Provide Our Estimate of the Amount of Other Components (Shell, Gravel, Etc.) in the Soil Sample
Trace – 5% or less
Few – 6% to 12%
Some – 13% to 30%
Many – 31% to 50%

FIELD EXPLORATION PROCEDURES

Standard Penetration Test Boring

The penetration boring was made in general accordance with the latest revision of ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils". The boring was advanced by rotary drilling techniques using a circulating bentonite fluid for borehole flushing and stability. At 2 ½ to 5 foot intervals, the drilling tools were removed from the borehole and a split-barrel sampler inserted to the borehole bottom and driven 18 inches into the soil using a 140-pound hammer falling on the average 30 inches per hammer blow. The number of blows for the final 12 inches of penetration is termed the "penetration resistance, blow count, or N-value". This value is an index to several in-place geotechnical properties of the material tested, such as relative density and Young's Modulus.

After driving the sampler 18 inches (or less if in hard rock-like material), the sampler was retrieved from the borehole and representative samples of the material within the split-barrel were placed in glass jars and sealed. After completing the drilling operations, the samples for each boring were transported to our laboratory where they were examined by our engineer in order to verify the driller's field classification.

Auger Boring

The auger boring was performed mechanically by the use of a continuous-flight auger attached to the drill rig and in general accordance with the latest revision of ASTM D 1452, "Soil Investigation and Sampling by Auger Borings". Representative samples of the soils brought to the ground surface by the augering process were placed in glass jars, sealed and transported to our laboratory where they were examined by our engineer to verify the driller's field classification.

LABORATORY TESTING PROCEDURES

Natural Moisture Content

The water content of the sample tested was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ratio of “pore” or “free” water in a given mass of material to the mass of solid material particles.

Percent Fines Content

The percent fines or material passing the No. 200 mesh sieve of the sample tested was determined in general accordance with the latest revision of ASTM D 1140. The percent fines are the soil particles in the silt and clay size range.

Atterberg Limits

The Atterberg Limits consist of the Liquid Limit (LL) and the Plastic Limit (PL). The LL and PL were determined in general accordance with the latest revision of ASTM D 4318. The LL is the water content of the material denoting the boundary between the liquid and plastic states. The PL is the water content denoting the boundary between the plastic and semi-solid states. The Plasticity Index (PI) is the range of water content over which a soil behaves plastically and is denoted numerically by as the difference between the LL and the PL. The water content of the sample tested was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ratio of “pore” or “free” water in a given mass of material to the mass of solid material particles.

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT

CONSTRAINTS AND RESTRICTIONS

Important Information about This

Geotechnical-Engineering Report

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

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

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

Understand the Geotechnical-Engineering Services Provided for this Report

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

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

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

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

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

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

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

Read this Report in Full

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

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

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

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are <u>Not</u> Covered

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

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> 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 <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

CONSTRAINTS & RESTRICTIONS

The intent of this document is to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

WARRANTY

Universal Engineering Sciences has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until excavation begins. If variations appear, we may have to re-evaluate our recommendations after performing on-site observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Universal Engineering Sciences, as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Universal Engineering Sciences of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Universal Engineering Sciences to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Universal Engineering Sciences is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Universal Engineering Sciences.

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Universal Engineering Sciences.

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations to determine those conditions that may affect construction operations. Universal Engineering Sciences cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Universal Engineering Sciences to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Universal Engineering Sciences to locate any such buried objects. Universal Engineering Sciences cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of exploration. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.

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