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Report of Geotechnical Exploration

**Proposed Three Oaks Pkwy. Extension Phase 2 -
Stormwater Management Areas**

Fort Myers, Lee County, Florida

**October 31, 2023
UES Project No.: 0530.2300329.0000**

Prepared For:

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Attention: Mr. Albert Martes-Rodriguez
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Prepared By:

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October 31, 2023

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**Site: Report of Findings
Proposed Three Oaks Parkway Extension Phase 2
Stormwater Management Areas
13230 North River Road
Fort Myers, Lee County, Florida
UES Project No.: 0530.2300046.0000**

Dear Mr. Albert Martes-Rodriguez:

UES has completed the subsurface exploration and geotechnical engineering evaluation for the above-referenced project in accordance with the geotechnical and engineering service agreement for this project. The scope of UES's exploration was planned in conjunction with and authorized by you. This exploration was performed in accordance with generally accepted soil and foundation engineering practices.

EXECUTIVE SUMMARY

The purpose of this subsurface exploration was to classify the nature of the subsurface soils and general geomorphic conditions and evaluate their impact upon the proposed construction. This report contains the results of the subsurface exploration at the site and UES's engineering interpretations of these, with respect to the project characteristics described to UES including providing recommendations for site preparation and the design of the foundation system.

UES understands that you would like to gain a better understanding of the subsurface soils located in the proposed lake/retention areas which are planned as a part of the Three Oaks Parkway Expansion Phase 2 in Fort Myers, Florida. You provided UES with a preliminary site plan and proposed boring depths. The recommendations provided herein are based upon the above considerations. If the project description has been revised, please inform UES so that UES may review the recommendations with respect to any modifications.

The following were completed for this study

- Six (6) Standard Penetration Test (SPT) borings advanced to depths of approximately 25 feet below ground surface (BGS).

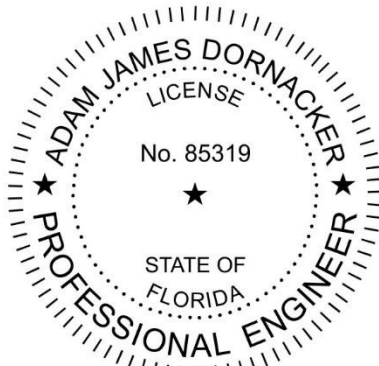
The subsurface soil conditions encountered at this site generally consists of very loose to medium dense sands (SP) with some (if any) wood fragments, medium dense slightly silty sands (SP-SM), very loose to dense silty sands (SM) with some (if any) weathered limestone fragments, soft silts (ML), medium dense slightly clayey sands (SP-SC), very loose clayey sands (SC) and soft weathered limestone (WLS) to the boring termination depths. Please refer to Appendix D: "Record of Test Borings" for a detailed account of each boring.

UES appreciates the opportunity to be of service to you on this project and look forward to a continued association. Please do not hesitate to contact UES if you have any questions or comments, or if UES may further assist you as your plans proceed.

Respectfully Submitted,
UES
Registry Number 4930



Ashok Neela
Staff Engineer



Adam J. Dornacker, P.E No. 85319
State of Florida
Geotechnical Department Manager

*This document has been digitally
signed and sealed by*

on the date adjacent to the seal.

*Printed copies of this document are not
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the signature must be verified on any electronic
copies.*



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1.0 INTRODUCTION

1.1 Scope of Services

The objective of these geotechnical services was to collect subsurface data for the subject project, summarize the test results, and discuss any apparent site conditions that may have geotechnical significance for retention areas. The following scope of service is provided within this report:

1. Conduct six (6) Standard Penetration Test (SPT) borings to determine the nature and condition of the subsurface soils and preparing record logs of these soil borings depicting the subsurface soil conditions encountered during the field exploration.
2. Review each soil sample obtained during the field exploration for classification and additional testing, if necessary.
3. Evaluate the existing soil conditions found during the exploration with respect to the design of stormwater management areas.
4. Prepare this report to document the results of the field exploration, and engineering recommendations for the design of stormwater management areas

1.2 Project Description

UES understands that you would like to gain a better understanding of the subsurface soils located in the proposed lake/retention areas which are planned as a part of the Three Oaks Parkway Expansion Phase 2 in Fort Myers, Florida. You provided UES with a preliminary site plan and proposed boring depths. The recommendations provided herein are based upon the above considerations. If the project description has been revised, please inform UES so that UES may review the recommendations with respect to any modifications.

2.0 OBSERVATIONS

2.1 Site Conditions

The recovered samples were not evaluated, either visually or analytically, for chemical composition or environmental hazards. UES would be pleased to perform these services for an additional fee, if required.

2.2 Field Exploration

The following were completed for this study

- Six (6) Standard Penetration Test (SPT) borings advanced to depths of approximately 25 feet below ground surface (BGS).

The locations of the borings performed are illustrated in Appendix B: "Test Location Plan". The Standard Penetration Test (SPT) boring method was used as the investigative tool within the borings. SPT tests were performed in substantial accordance with ASTM Procedure D-1586, "Penetration Test and Split-Barrel Sampling of Soils".



This test procedure consists of driving a 1.4-inch I.D. split-tube sampler into the soil profile using a 140-pound hammer falling 30 inches. The number of blows per foot, for the second and third 6-inch increment, is an indication of soil strength.

The soil samples recovered from the soil borings were visually classified and their stratification is illustrated in Appendix D: "Record of Test Borings". It should be noted that soil conditions might vary between the strata interfaces, which are shown. The soil boring data reflect information from a specific test location only. Site specific survey staking for the test locations was not provided for the field exploration. The indicated depth and location of each test was approximated based upon existing grade and estimated distances and relationships to obvious landmarks. The boring depths were selected based on UES's knowledge of vicinity soils and to include the zone of soil likely to be stressed by the proposed construction.

2.3 Visual Classification

Soil samples recovered from the field exploration were returned to UES's laboratory where they were visually classified in general accordance with ASTM D-2488. Samples were evaluated to obtain an accurate understanding of the soil properties and site geomorphic conditions. After performing a review of the recovered site soils, no laboratory testing was deemed necessary. Bag samples of the soil encountered during the field exploration will be held in UES's laboratory for your inspection for 45 days and then discarded unless UES is notified otherwise in writing.

2.4 Geomorphic Conditions

Boring logs derived from the field exploration are presented in Appendix D: "Record of Test Borings". The boring logs depict the observed soils in graphic detail. The Standard Penetration Test borings indicate the penetration resistance, or N-values, logged during the drilling and sampling activities. The classifications and descriptions shown on the logs are generally based upon visual characterizations of the recovered soil samples. All soil samples reviewed have been depicted and classified in general accordance with the Unified Soil Classification System, modified as necessary to describe typical southwest Florida conditions. See Appendix E: "Discussion of Soil Groups", for a detailed description of various soil groups.

The subsurface soil conditions encountered at this site generally consists of very loose to medium dense sands (SP) with some (if any) wood fragments, medium dense slightly silty sands (SP-SM), very loose to dense silty sands (SM) with some (if any) weathered limestone fragments, soft silts (ML), medium dense slightly clayey sands (SP-SC), very loose clayey sands (SC) and soft weathered limestone (WLS) to the boring termination depths. Please refer to Appendix D: "Record of Test Borings" for a detailed account of each boring.

2.5 Hydrogeological Conditions

On the dates of the field exploration, the groundwater table was encountered at approximately 2.0 to 3.5 feet below the existing ground surface at the test boring locations. The groundwater table will fluctuate seasonally depending upon local rainfall and other site specific and/or local influences such as tidal events.

No additional investigation was included in UES's scope of work in relation to the wet seasonal high groundwater table or any existing well fields in the vicinity. Well fields may influence water table levels and cause significant fluctuations. If a more comprehensive water table analysis is necessary, please contact UES for additional guidance.



3.0 ENGINEERING EVALUATION AND RECOMMENDATIONS

3.1 General

In this section of the report UES presents the geotechnical design recommendations and information pertaining to the construction related services UES can provide. UES's recommendations are made based upon a review of the attached soil test data, UES's understanding of the proposed construction as it was described to UES, and UES's stated assumptions. ***If UES is not informed of changes to the provided final design information, the recommendations contained herein are not considered valid as UES cannot be responsible for performance issues that may arise from design changes of which UES was unaware.*** Additionally, if subsurface conditions are encountered during construction that were not found in the test borings, report those conditions immediately to UES for observation and recommendations.

3.2 Stormwater Management Areas

No specific details regarding the stormwater management areas was provided to UES. The subsurface soil conditions encountered at this site generally consists of relatively free draining sands [SP] and somewhat poorly draining slightly clayey and silty sands [SP-SC, SP-SM] underlain at around 12 feet by poorly draining clayey and silty sands [SC, SM] and restrictive layers of weathered limestone and silts [WLS, ML] to the maximum depths explored of 25 feet below ground surface. The soil samples recovered from the soil borings were visually classified and their stratification is illustrated in "Appendix D - Record of Test Borings". It should be noted that soil conditions might vary between the strata interfaces shown on the logs. The soil boring data reflect information from a specific test location only.

FILL SUITABILITY

Based on the visual classifications, it is UES's opinion a majority of the soils within the site to depths of approximately 10 to 12 feet BGS are suitable for use as structural fill. UES typically recommends structural fill materials contain less than 12 percent fines passing the No. 200 sieve. Generally, sands (SP), slightly silty sands (SP-SM), and slightly clayey sands (SP-SC) meet this requirement. If some near surface soils are found to contain more than 12 percent fines passing the No. 200 sieve (SM or SC), these soils can be used by blending these soils with the clean surficial sands and using proper moisture control and compaction techniques, to obtain specified field densities with vibratory equipment. The degree of compaction will be dependent upon the utilization of the fill (roadway, structural, etc.). Large rocks may occasionally be encountered in the surficial strata and will require crushing prior to use as structural fill. The amount of rock crushing should be determined during the excavation program. If large amounts of roots are encountered in any of the near surface soils, UES recommends screening of these soils be completed to remove the roots prior to placement over the site.

As evidenced in the borings, possible structural sand fill material extends generally to depths of approximately 10 to 12 feet BGS. Some of these overburden soils mixed with shell or crushed rock may also be suitable for use as roadway stabilized subbase material. Additional laboratory testing would be necessary to verify the suitability of the soils for this purpose. This testing would consist of Limerock Bearing Ratio tests of bulk samples that could be obtained during excavation.



The weathered and/or fractured limestone (WLS), if encountered during excavation, can generally be used as structural fill material but should **not** be placed within the top 2 feet below finished grade. Any weathered limestone with a fines content over 12% should be mixed with clean sand to bring the fines content below 12%. Strict Moisture control may be required when silt contents are 5% or more. Depending on the silt and clay content, a sheepsfoot roller may be required to compact these soils to the required density. If it is desired to further evaluate utilizing this materials as structural fill, UES recommends UES be contacted to provide recommendations for supplemental work required to use the soils in this manner.

The true confining unit to the surficial aquifer in this area typically consists of a greenish-gray clayey sand or sandy clay. UES did not encounter clayey sand or sandy clay strata at the designated lake boring locations. If encountered, UES recommends the planned excavations be maintained at least 3 to 5 feet above these strata.

4.0 REPORT LIMITATIONS

This consulting report has been prepared for the exclusive use of the current project owners and other members of the design team for the proposed Three Oaks Parkway Extension Phase 2 located in Fort Myers, Lee County, Florida. This report has been prepared in accordance with generally accepted local geotechnical engineering practices; no other warranty is expressed or implied. The evaluation submitted in this report, is based in part upon the data collected during a field exploration, however, the nature and extent of variations throughout the subsurface profile may not become evident until further borings are completed at the subject site. If variations then appear evident, it may be necessary to reevaluate information and professional opinions as provided in this report.

UES is not responsible for damage caused by soil improvement and/or construction activity vibrations related to this project. UES is also not responsible for damage concerning drainage or moisture related issues for the proposed or nearby structures.

UES should be provided the opportunity to review the pre foundation specifications and review foundation design drawings, in order to determine whether UES's recommendations have been properly interpreted, communicated and implemented. If UES is not afforded the opportunity to participate in construction related aspects of foundation installation as recommended in this report or any report addendum, UES will accept no responsibility for the interpretation of the recommendations made in this report or on a report addendum for foundation performance.



5.0 BASIS FOR RECOMMENDATIONS

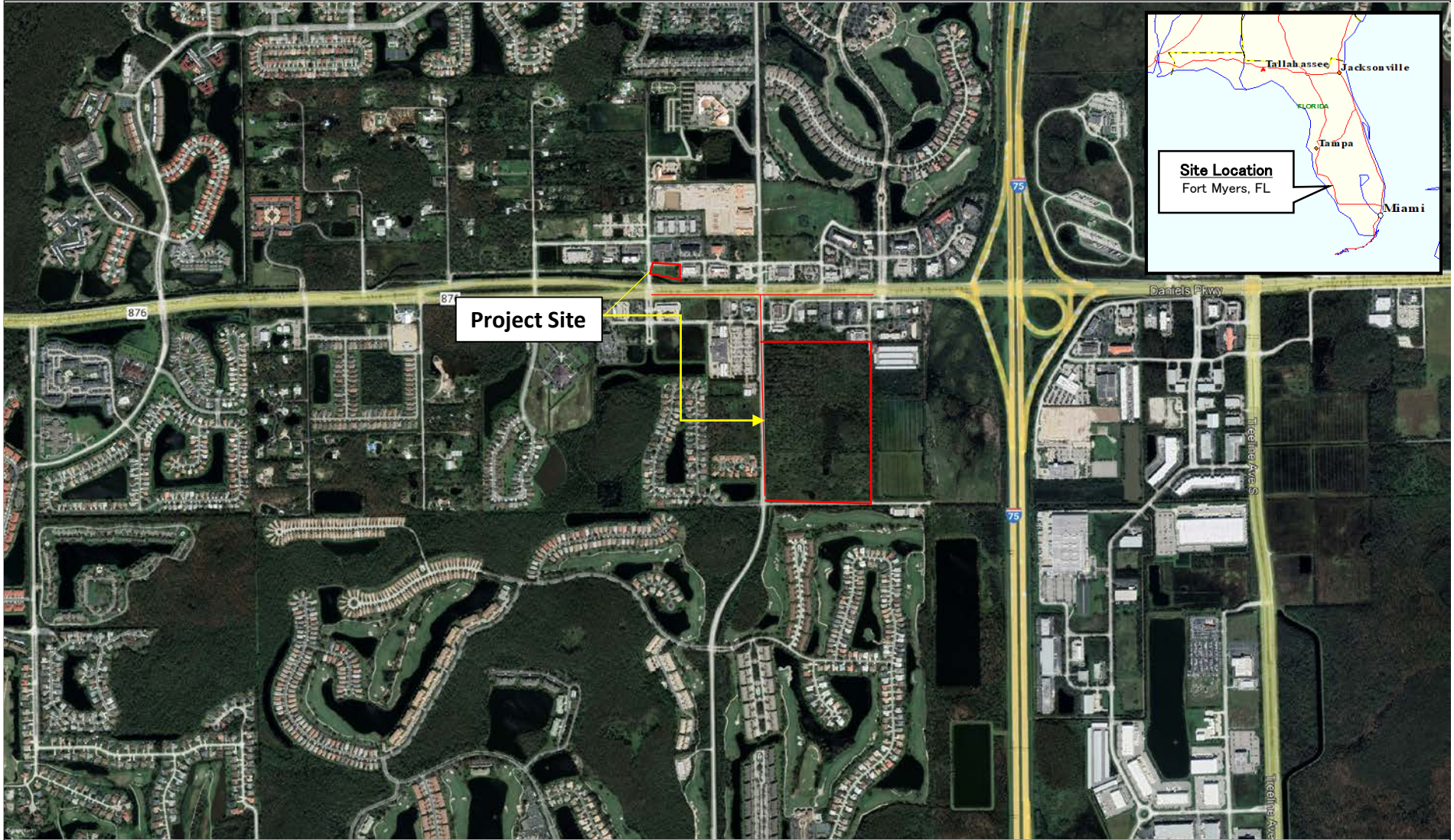
The analysis and recommendations submitted in this report are based on the data obtained from the tests performed at the locations indicated on the attached figure in Appendix B. This report does not reflect any variations, which may occur between borings. While the borings are representative of the subsurface conditions at their respective locations and for their vertical reaches, local variations characteristic of the subsurface soils of the region are anticipated and may be encountered. The delineation between soil types shown on the soil logs is approximate and the description represents UES's interpretation of the subsurface conditions at the designated boring locations on the particular date drilled.

Any third party reliance on this geotechnical report or parts thereof is strictly prohibited without the expressed written consent of UES. The methodology (ASTM D-1586) used in performing the borings and for determining penetration resistance is specific to the sampling tools utilized and does not reflect the ease or difficulty of advancing other tools or materials.



Appendix A: Vicinity Map





VICINITY MAP
 SOURCE: GOOGLE EARTH PRO©

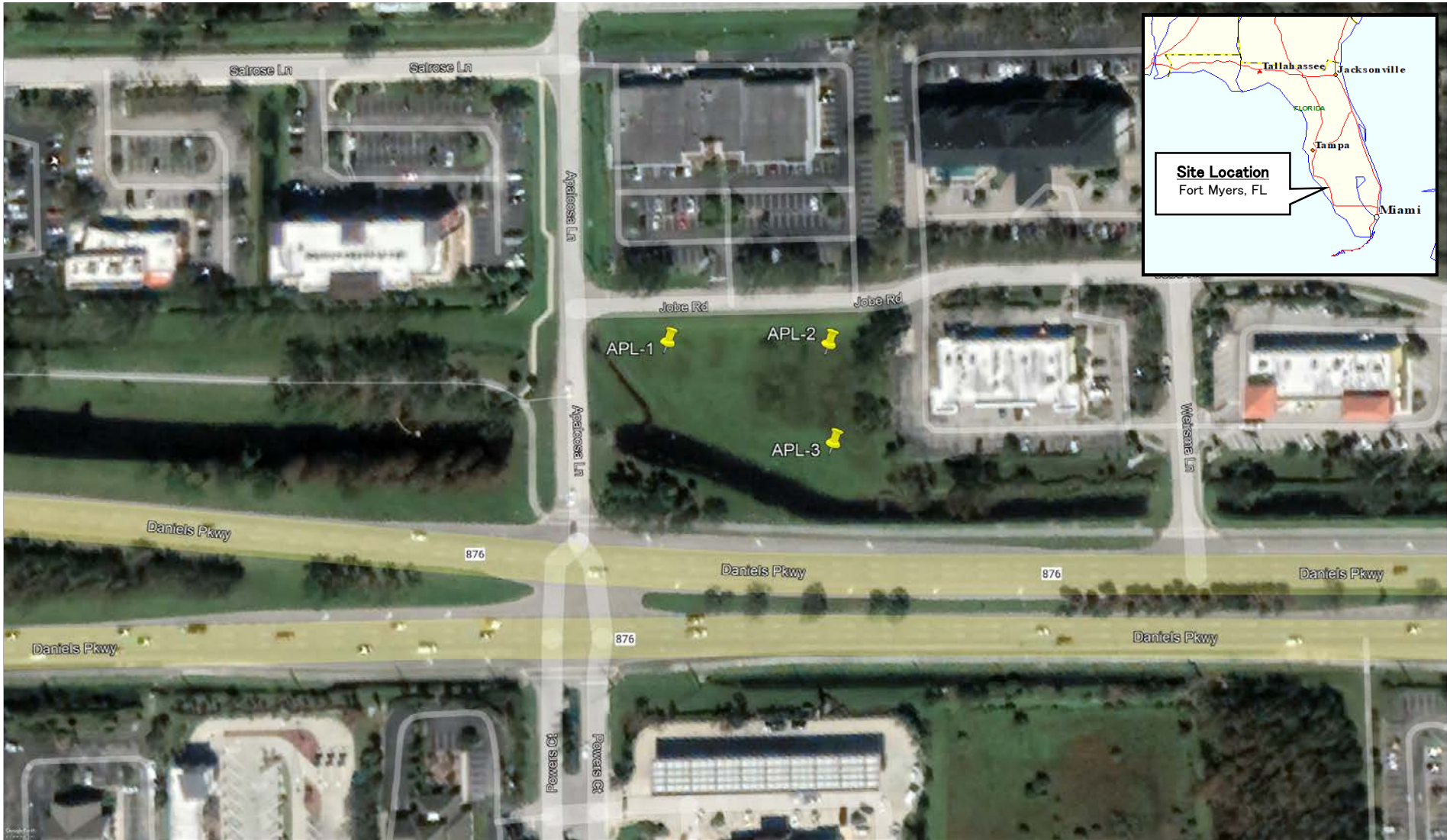


Three Oaks Parkway Extension
 Fort Myers, Lee County, FL

Drawn By: Ashok Neela	Checked By: AJD	Date: 10/03/2023
Project No.: 0530.2300329.0000	Approved By: Adam Dornacker, P.E.	

Appendix B: Test Location Plan





Boring locations are an approximation.



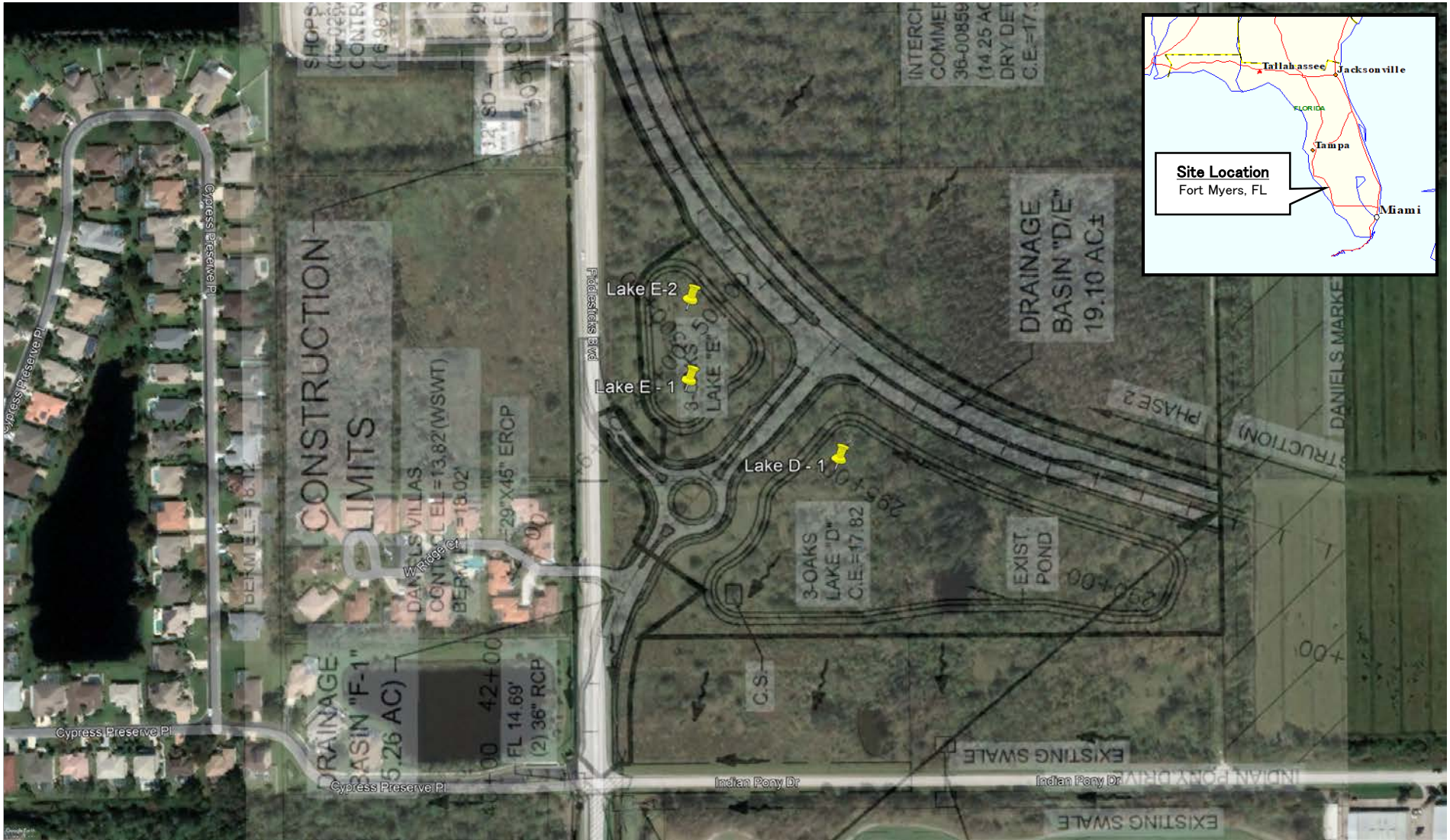
TEST LOCATION PLAN

SOURCE: GOOGLE EARTH PRO©



Three Oaks Parkway Extension
Fort Myers, Lee County, FL

Drawn By: Ashok Neela	Checked By: AJD	Date: 06/07/2023
Project No.: 0530.2300144.0000	Approved By: Adam Dornacker, P.E.	



Boring locations are an approximation.



TEST LOCATION PLAN

SOURCE: GOOGLE EARTH PRO©



Three Oaks Parkway Extension
Fort Myers, Lee County, FL

Drawn By: Ashok Neela	Checked By: AJD	Date: 06/07/2023
Project No.: 0530.2300144.0000	Approved By: Adam Dornacker, P.E.	

Appendix C: Notes Related to Borings



**NOTES RELATED TO
RECORDS OF TEST BORING AND
GENERALIZED SUBSURFACE PROFILE**

1. Groundwater level was encountered and recorded (if shown) following the completion of the soil test boring on the date indicated. Fluctuations in groundwater levels are common; consult report text for a discussion.
2. The boring location was identified in the field by offsetting from existing reference marks and using a cloth tape and survey wheel.
3. The borehole was backfilled to site grade following boring completion, and patched with asphalt cold patch mix when pavement was encountered.
4. The Record of Test Boring represents our interpretation of field conditions based on engineering examination of the soil samples.
5. The Record of Test Boring is subject to the limitations, conclusions and recommendations presented in the Report text.
6. "Field Test Data" shown on the Record of Test Boring indicated as 11/6 refers to the Standard Penetration Test (SPT) and means 11 hammer blows drove the sampler 6 inches. SPT uses a 140-pound hammer falling 30 inches.
7. The N-value from the SPT is the sum of the hammer blows required to drive the sampler the second and third 6-inch increments.
8. The soil/rock strata interfaces shown on the Records of Test Boring are approximate and may vary from those shown. The soil/rock conditions shown on the Records of Test Boring refer to conditions at the specific location tested; soil/rock conditions may vary between test locations.

9. Relative density for sands/gravels and consistency for silts/clays are described as follows:

SPT	CPT	SANDS/GRAVELS	SPT	CPT	SILTS/CLAYS
BLOWS/FOOT	KG/CM ²	RELATIVE DENSITY	BLOWS/FOOT	KG/CM ²	CONSISTENCY
0-3	0-16	Very loose	under 1	0-3	Very soft
4-10	17-40	Loose	1-4	4-9	Soft
11-30	41-120	Medium Dense	5-8	10-17	Firm
31-50	over 120	Dense	9-15	18-31	Stiff
over 50		Very Dense	16-30	32-60	Very stiff
			over 30	over 60	Hard

10. Grain size descriptions are as follows:

NAME	SIZE LIMITS	PROPORTION	ADJECTIVE
Boulder	12 Inches or more	Up to 10%	with a trace
Cobbles	3 to 12 Inches	10 to 30%	with some
Coarse Gravel	¾ to 3 Inches		
Fine Gravel	No. 4 sieve to ¾ inch		
Coarse Sand	No. 10 to No. 4 sieve		
Medium Sand	No. 40 to No. 10 sieve		
Fine Sand	No. 200 to No. 40 sieve		
Fines	Smaller than No. 200 sieve		

11. Definition of Descriptive Terms of Fines:

11. Definitions related to adjectives used in soil/rock descriptions:

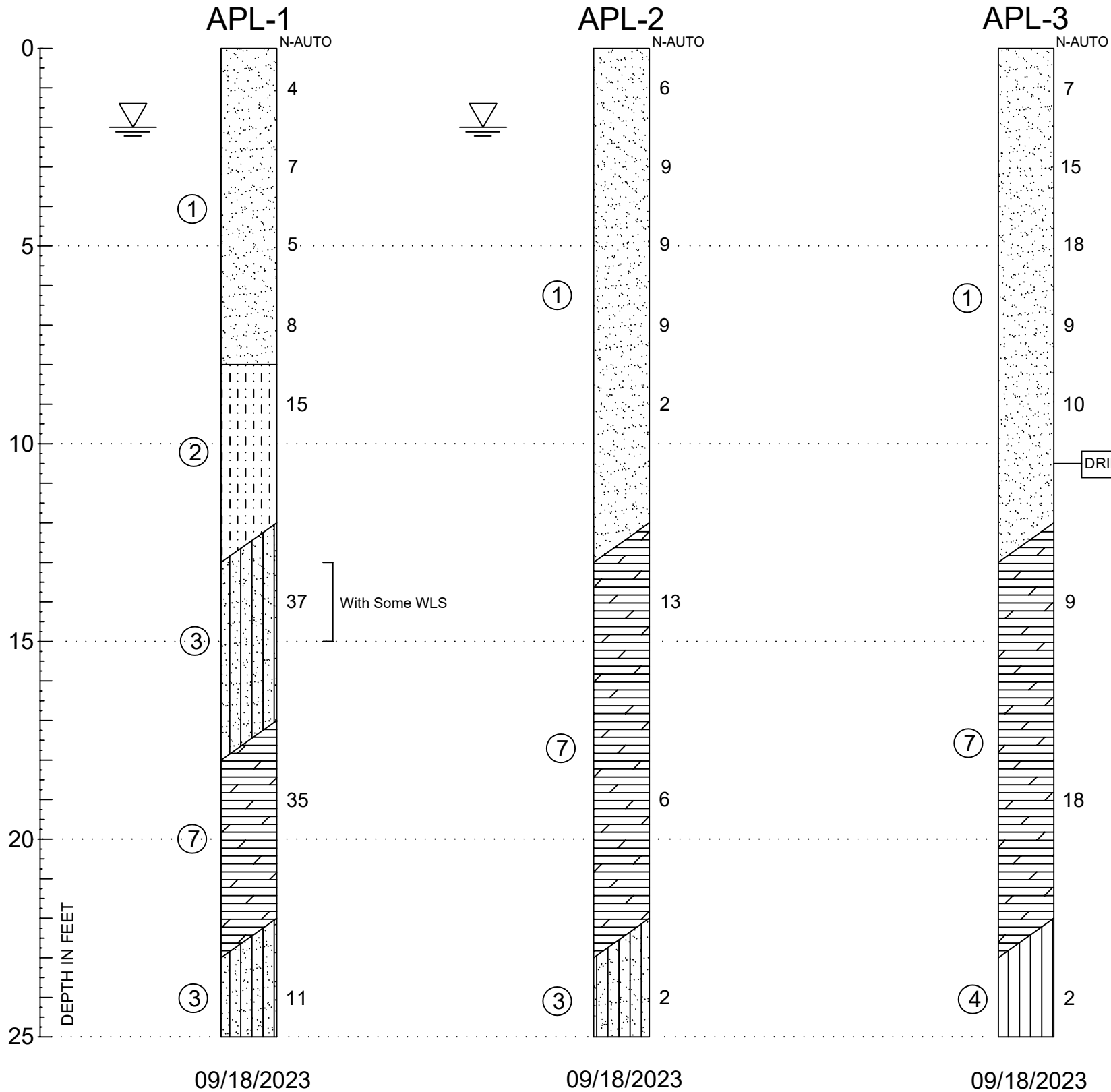
PROPORTION	ADJECTIVE	APPROXIMATE ROOT DIAMETER	ADJECTIVE
Up to 10%	with a trace	Less than 1/32"	Fine roots
10 to 30%	with some	1/32" to ¼"	Small roots
30 to 50%	with	¼" to 1"	Medium roots
		Greater than 1"	Large roots



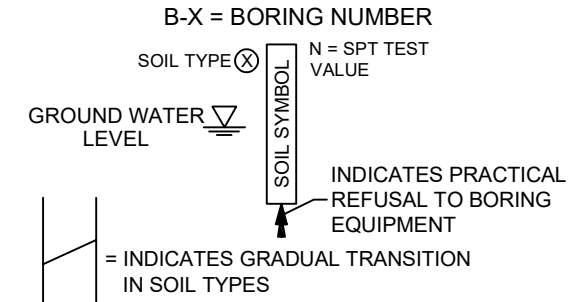
Appendix D: Record of Test Borings



SOIL PROFILES



SOIL PROFILE LEGEND



NOTES:

N - STANDARD PENETRATION RESISTANCE TEST (SPT) VALUE. NUMBERS TO THE RIGHT OF BORINGS INDICATE SPT VALUE FOR 12-INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).

WOH - BORING INTERVAL ADVANCED UNDER WEIGHT OF HAMMER.

WOR - BORING INTERVAL ADVANCED UNDER WEIGHT OF ROD.

LFC - LOSS OF DRILLING FLUID CIRCULATION.

WLS - WEATHERED LIMESTONE

HD - HARD DRILLING

SOIL LEGEND

- ① Dark to Light Brown, Gray SAND (SP) Very Loose to Medium Dense
- ② Gray Slightly Silty SAND (SP-SM) Medium Dense
- ③ Gray, Light Brown Silty SAND (SM) Very Loose to Dense
- ④ Light Gray SILT (ML) Soft
- ⑤ Brown, Gray Slightly Clayey SAND (SP-SC) Medium Dense
- ⑥ Gray Clayey SAND (SC) Very Loose
- ⑦ Gray, WEATHERED LIMESTONE (WLS) Soft

SOIL CLASSIFICATION

CORRELATION OF N - VALUES WITH RELATIVE DENSITY AND CONSISTENCY

COHESIONLESS SOIL			SILTS AND CLAYS		
N - VALUE (SAFETY)	N - VALUE (AUTO)	RELATIVE DENSITY	N - VALUE (SAFETY)	N - VALUE (AUTO)	CONSISTENCY
0 - 4	0 - 3	VERY LOOSE	0 - 2	0 - 1	VERY SOFT
5 - 10	4 - 8	LOOSE	3 - 5	2 - 4	SOFT
11 - 30	9 - 24	MEDIUM DENSE	6 - 7	5 - 6	FIRM
31 - 50	25 - 40	DENSE	8 - 15	7 - 12	STIFF
OVER 50	OVER 40	VERY DENSE	16 - 30	13 - 24	VERY STIFF
			OVER 30	OVER 24	HARD

CORRELATION OF N - VALUES WITH HARDNESS DESCRIPTION

N - VALUE	RELATIVE DENSITY
0 - 50	SOFT
51 - 50 FOR 0"	HARD

APPROXIMATE FINES CONTENT

PERCENTAGE OF MODIFIER MATERIAL	MODIFIERS
5% TO 12%	SLIGHTLY SILTY OR SLIGHTLY CLAYEY
12% TO 25%	SILTY OR CLAYEY
26% TO 49%	VERY SILTY OR VERY CLAYEY

APPROXIMATE SHELL CONTENT

PERCENTAGE OF MODIFIER MATERIAL	MODIFIERS
0% TO 5%	NO MENTION
5% TO 12%	SLIGHTLY SHELLY
13% TO 30%	SHELLY
31% TO 50%	VERY SHELLY

APPROXIMATE ORGANIC CONTENT

PERCENTAGE OF MODIFIER MATERIAL	MODIFIERS
0% TO 2.5%	NO MENTION
2.5% TO 5%	WITH A TRACE
5% TO 20%	WITH ORGANICS
20% TO 75%	HIGHLY ORGANIC
75% TO 100%	PEAT

DEFINITION OF DESCRIPTIVE TERMS OF MODIFIERS FOR SILTS/CLAYS/SHELLS/GRAVELS ARE DESCRIBED AS FOLLOWS:

PERCENTAGE OF MODIFIER MATERIAL	FIRST QUALIFIER	SECOND QUALIFIER
5 - 12	SLIGHTLY + MODIFIER + Y	WITH A LITTLE
12 - 30	MODIFIER + Y	WITH SOME
30 - 50	VERY + MODIFIER + Y	AND

RECORD OF TEST BORINGS

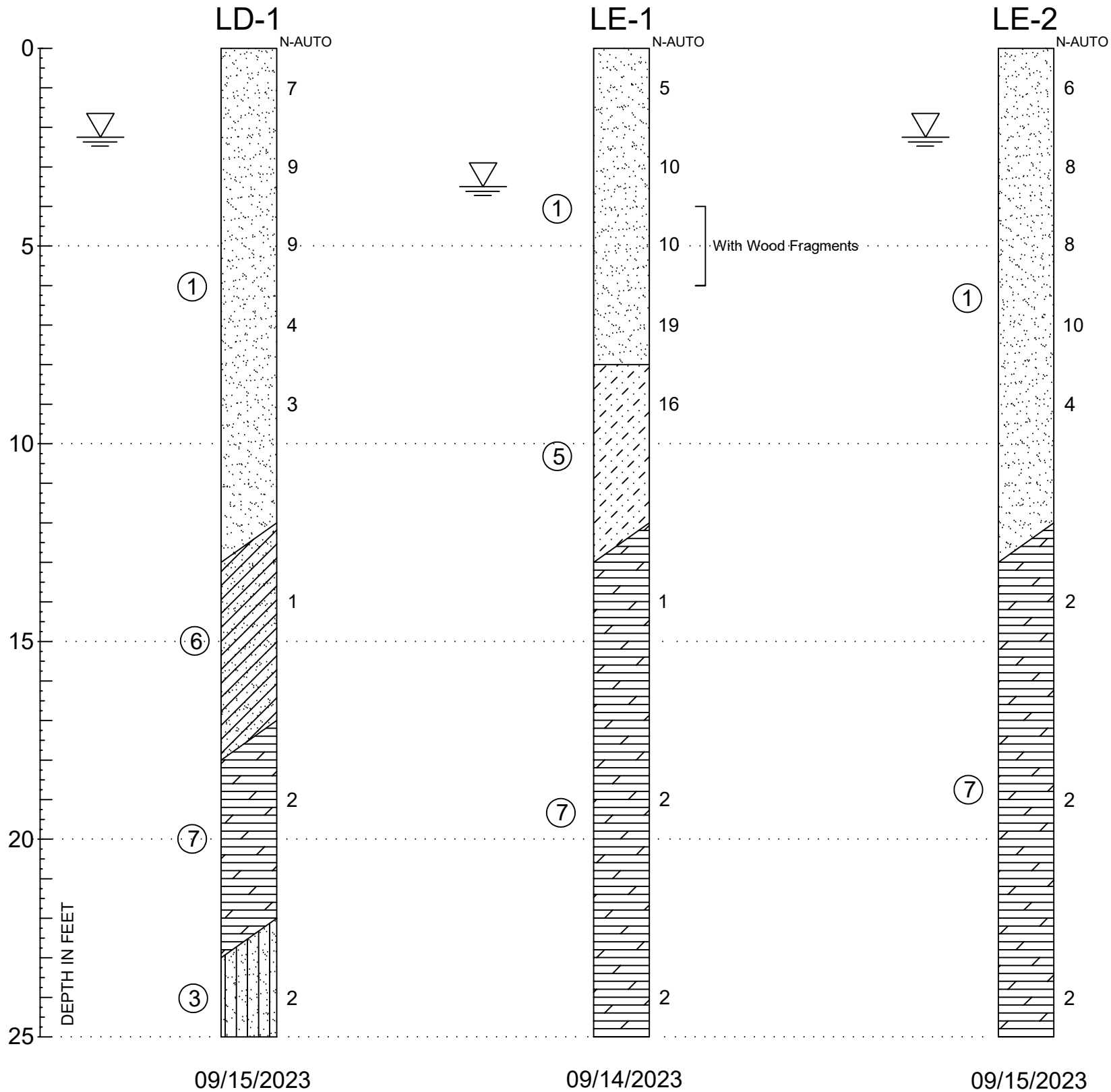


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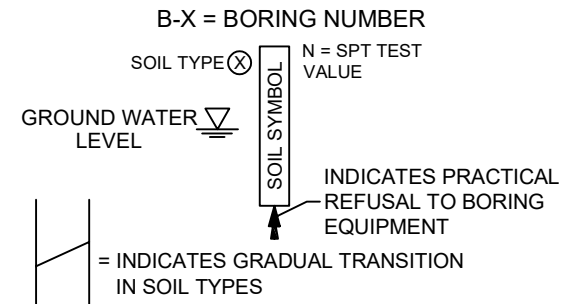
Client: Avalon Engineering
Project No: 0530.2300329.0000
Project: Three Oaks Parkway Extension
 Lee County, Florida

Date: 10/03/2023
RIG: CME-45
Drilled By: LSJ
Drawn By: AN
Approved By: AJD

SOIL PROFILES



SOIL PROFILE LEGEND



NOTES:

N - STANDARD PENETRATION RESISTANCE TEST (SPT) VALUE. NUMBERS TO THE RIGHT OF BORINGS INDICATE SPT VALUE FOR 12-INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).

WOH - BORING INTERVAL ADVANCED UNDER WEIGHT OF HAMMER.

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LFC - LOSS OF DRILLING FLUID CIRCULATION.

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HD - HARD DRILLING

SOIL LEGEND

- ① Dark to Light Brown, Gray SAND (SP) Very Loose to Medium Dense
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- ③ Gray, Light Brown Silty SAND (SM) Very Loose to Dense
- ④ Light Gray SILT (ML) Soft
- ⑤ Brown, Gray Slightly Clayey SAND (SP-SC) Medium Dense
- ⑥ Gray Clayey SAND (SC) Very Loose
- ⑦ Gray, WEATHERED LIMESTONE (WLS) Soft

SOIL CLASSIFICATION

CORRELATION OF N - VALUES WITH RELATIVE DENSITY AND CONSISTENCY			CORRELATION OF N - VALUES WITH HARDNESS DESCRIPTION				
COHESIONLESS SOIL			SILTS AND CLAYS			LIMEROCK	
N - VALUE (SAFETY)	N - VALUE (AUTO)	RELATIVE DENSITY	N - VALUE (SAFETY)	N - VALUE (AUTO)	CONSISTENCY	N - VALUE	RELATIVE DENSITY
0 - 4	0 - 3	VERY LOOSE	0 - 2	0 - 1	VERY SOFT	0 - 50	SOFT
5 - 10	4 - 8	LOOSE	3 - 5	2 - 4	SOFT	51 - 50 FOR 0"	HARD
11 - 30	9 - 24	MEDIUM DENSE	6 - 7	5 - 6	FIRM		
31 - 50	25 - 40	DENSE	8 - 15	7 - 12	STIFF		
OVER 50	OVER 40	VERY DENSE	16 - 30	13 - 24	VERY STIFF		
			OVER 30	OVER 24	HARD		

APPROXIMATE FINES CONTENT		APPROXIMATE SHELL CONTENT		APPROXIMATE ORGANIC CONTENT	
MODIFIERS	MODIFIERS	MODIFIERS	MODIFIERS	MODIFIERS	MODIFIERS
5% TO 12%	SLIGHTLY SILTY OR SLIGHTLY CLAYEY	0% TO 5%	NO MENTION	0% TO 2.5%	NO MENTION
12% TO 25%	SILTY OR CLAYEY	5% TO 12%	SLIGHTLY SHELLY	2.5% TO 5%	WITH A TRACE
26% TO 49%	VERY SILTY OR VERY CLAYEY	13% TO 30%	SHELLY	5% TO 20%	WITH ORGANICS
		31% TO 50%	VERY SHELLY	20% TO 75%	HIGHLY ORGANIC
				75% TO 100%	PEAT

DEFINITION OF DESCRIPTIVE TERMS OF MODIFIERS FOR SILTS/CLAYS/SHELLS/GRAVELS ARE DESCRIBED AS FOLLOWS:

PERCENTAGE OF MODIFIER MATERIAL	FIRST QUALIFIER	SECOND QUALIFIER
5 - 12	SLIGHTLY + MODIFIER + Y	WITH A LITTLE
12 - 30	MODIFIER + Y	WITH SOME
30 - 50	VERY + MODIFIER + Y	AND

RECORD OF TEST BORINGS



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Client: Avalon Engineering
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Project: Three Oaks Parkway Extension
 Lee County, Florida

Date: 10/03/2023
RIG: CME-45
Drilled By: LSJ
Drawn By: AN
Approved By: AJD

Appendix E: Discussion of Soil Groups



DISCUSSION OF SOIL GROUPS

COARSE GRAINED SOILS

GW and SW GROUPS. These groups comprise well-graded gravelly and sandy soils having little or no plastic fines (less than 5 percent passing the No. 200 sieve). The presence of the fines must not noticeably change the strength characteristics of the coarse-grained fraction and must not interface with its free-draining characteristics.

GP and SP GROUPS. Poorly graded gravels and sands containing little or no plastic fines (less than 5 percent passing the No. 200 sieve) are classed in GP and SP groups. The materials may be called uniform gravels, uniform sands or non-uniform mixtures of very coarse material and very fine sands, with intermediate sizes lacking (sometimes called skip-graded, gap-graded or step-graded). This last group often results from borrow pit excavation in which gravel and sand layers are mixed.

GM and SM GROUPS. In general, the GM and SM groups comprise gravels or sands with fines (more than 12 percent passing the No. 200 sieve) having low or no plasticity. The plasticity index and liquid limit of soils in the group should plot below the "A" line on the plasticity chart. The gradation of the material is not considered significant and both well and poorly graded materials are included.

GC and SC GROUPS. In general, the GC and SC groups comprise gravelly or sandy soils with fines (more than 12 percent passing the No. 200 sieve), which have a fairly high plasticity. The liquid limit and plasticity index should plot above the "A" line on the plasticity chart.

FINE GRAINED SOILS

ML and MH GROUPS. In these groups, the symbol M has been used to designate predominantly silty material. The symbols L and H represent low and high liquid limits, respectively, and an arbitrary dividing line between the two is set at a liquid limit of 50. The soils in the ML and MH groups are sandy silts, clayey silts or inorganic silts with relatively low plasticity. Also included are loess type soils and rock flours.

CL and CH GROUPS. In these groups the symbol C stands for clay, with L and H denoting low or high liquid limits, with the dividing line again set at a liquid limit of 50. The soils are primarily inorganic clays. Low plasticity clays are classified as CL and are usually lean clays, sandy clays or silty clays. The medium and high plasticity clays are classified as CH. These include the fat clays, gumbo clays and some volcanic clays.



OL and OH GROUPS. The soil in the OL and OH groups are characterized by the presence of organic odor or color, hence the symbol O. Organic silts and clays are classified in these groups. The materials have a plasticity range that corresponds with the ML and MH groups.

HIGHLY ORGANIC SOILS

The highly organic soils are usually very soft and compressible and have undesirable construction characteristics. Particles of leaves, grasses, branches, or other fibrous vegetable matter are common components of these soils. They are not subdivided and are classified into one group with the symbol PT. Peat humus and swamp soils with a highly organic texture are typical soils of the group.

