GEOTECHNICAL REPORTS

GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

AACE FILE NO. 15-158

AACE

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.

573 SW Biltmore Street
Port St. Lucie, Florida 34983
Ph: 772-807-9191 Fx: 772-807-9192
www.aaceinc.com

Table of Contents

GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

AACE FILE NO. 15-158

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
Geotechnical Engineering
Construction Materials Testing
Environmental Consulting

AACE File No. 15-158
August 17, 2015

Carter Associates, Inc.
1708 21st Street
Vero Beach, FL 32960

Attn: Mr. Clint Rahjes, P.E.

GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

1.0 INTRODUCTION

In accordance with your request and authorization, Andersen Andre Consulting Engineers, Inc. (hereinafter referred to as AACE) has completed a subsurface exploration and geotechnical engineering analyses for the above referenced project. The purpose of performing this exploration was to explore shallow soil types and groundwater levels, and restrictions which these may place on the proposed stormwater quality and lake excavation project. Our work included one Standard Penetration Test (SPT) boring, auger borings, laboratory testing, and engineering analysis. This report documents our explorations and presents our findings, and summarizes our conclusions and recommendations.

2.0 SITE INFORMATION AND PROJECT UNDERSTANDING

2.1 Site Location and Project Description

The proposed Fellsmere South Regional Lake encompasses approximately 45 acres of vacant and mostly overgrown land located on the southwest corner of 89th Street and 130th Avenue in Fellsmere, Indian River County, Florida. The site is relatively open and accessible on the western portion, however, only limited access is available throughout the remainder of the site due to the presence of heavy vegetation. Further, existing lakes are present on the western and central portions of the site.

A Site Vicinity Map (2014 aerial photograph) which depicts the approximate boundaries of the study area is included on the attached Sheet No. 1. The site location is further shown superimposed on the "Fellsmere, Florida" USGS topographic quadrangle map (1992), also included on Sheet No. 1. The USGS map depicts the subject property as relatively level and having an approximate surface elevation of 25 feet relative to the National Geodetic Vertical Datum of 1929.

Based on our conversations and our review of the forwarded project-related information, we understand that the City of Fellsmere is considering constructing a water quality flow-through system that includes the excavation of four (4) "smaller" lakes, the expansion of one (1) existing "larger" (i.e., 10+ acres) lake, and the excavation of flow-through runnels that interconnect each of the aforementioned lakes. The existing ground surface elevation averages approximately 23-24 feet NAVD, and the planned lakes and runnels have a proposed bottom elevation of approximately 17 feet NAVD. Approximately 1-2 feet of water will be present in the bottom of the runnels and lakes, and lake bank slopes will range from 3H:1V to 6H:1V. A copy of the proposed site plan is included on Sheet No. 2.

As noted in our proposal for this project, no slope stability investigation, seepage analyses, or foundation design were requested as part of our services.

2.2 Review of USDA Soil Survey

According to the USDA NRCS Web Soil Survey, the predominant surficial soil types within the overall site area are as follows (listed in Map Unit numerical order):

- Map Unit 3 - EauGallie fine sand
- Map Unit 10 - Riviera fine sand
- Map Unit 13 - Wabasso fine sand
- Map Unit 16 - Pineda fine sand
- Map Unit 23 - Arents, 0 to 5 percent slopes
- Map Unit 47 - Holopaw fine sand, 0 to 2 percent slopes.

With the exception of the Arents soil type (Map Unit 23), these soil types are all noted to consist of sandy and loamy marine deposits, with surficial fine sands extending to depths of 23 to 47 inches and underlain by sandy loam, clay loam and loamy sands to depths in excess of 80 inches. Conversely, the Arents soil type is noted to consist of altered marine deposits with sands present to depths in excess of 60 inches.

The approximate location of the overall site is shown superimposed on a copy of the USDA Web Soil Survey aerial photograph, presented on Sheet No. 1. A brief comparison of the noted soil types (including their approximate percent coverage within the site) along with the summary report obtained from the USDA Web Soil Survey are included in Appendix I.

3.0 FIELD EXPLORATION PROGRAM

To explore subsurface conditions at the site relative to the proposed construction, the field exploration program summarized in Table 1 below was completed. The locations of the completed field work are graphically depicted on the Field Work Location Plan, presented on Sheet No. 2.

Table 1 - Field Exploration Program

Boring Type	Number	ASTM	Max. Depth below grade [feet]	Location
Standard Penetration Test (SPT)	1	D1586	16	Refer to Sheet No. 2
Solid-Stem Auger	3	D1452	10	Refer to Sheet No. 2
Hand Auger	6	D1452	3-3.5	Refer to Sheet No. 2

As discussed during the progress of our field work, the presence of a very shallow water table (see Section 4.2) necessitated a change to our field work as compared to the scope of work presented in our original proposal for the project.

Overall, our field work was performed on August 3 and 4, 2015. The soil boring locations shown on Sheet No. 2 were determined in the field by our field crew using a combination of hand-held GPS, the provided site plan, obtained aerial photographs and existing site features as references. The locations should be considered accurate only to the degree implied by the method of measurement used. We preliminarily anticipate that the actual locations are within 15 feet of those shown on Sheet No. 2.

Summaries of AACE's field procedures are included in Appendix II, and the individual boring profiles are presented on the attached Sheet No. 3. Samples obtained during performance of the borings were visually classified in the field, and representative portions of the samples were transported to our laboratory in sealed sample jars for further classification. The soil samples recovered from our explorations will be kept in our laboratory for 60 days, then discarded unless you specifically request otherwise.

4.0 OBSERVED SUBSURFACE CONDITIONS

4.1 General Soil Conditions

Detailed subsurface conditions are illustrated on the soil boring profiles presented on the attached Sheet No. 3. The stratification of the boring profiles represents our interpretation of the field boring logs and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

In brief, at the locations and depths explored, the majority of our borings encountered a few inches of topsoil followed fine sands to depths of about 2 to 4 feet. At this depth, our hand auger borings were terminated due to the presence of a shallow water table. Our borings TB-1, AB-1, AB-2 and AB-3 (completed with a truck-mounted drill rig) then encountered loose to moderately dense clayey fine sands (SC) and occasionally slightly clayey fine sands (SP-SC) to depths of about 10-13 feet below grade, in turn followed by dense fine sands (SP) with shell fragments (TB-1 only) to an approximate depth of 16 feet below grade.

Overall, the encountered soil conditions correlate well with those reported by the USDA, with surficial fine sands underlain by loamy (clayey) sands.

4.2 Measured Groundwater Level

The groundwater table was encountered at depths ranging from about 6 inches to about 2 feet below grade. In general, fluctuations in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the borings were conducted. It should further be expected that rainwater possibly could pond after periods of intense or prolonged rainfall events or, as a minimum, be present at depths shallower than the levels noted herein, possibly for extended periods of time.

5.0 LABORATORY TESTING PROGRAM

Our drillers observed the soil recovered from the borings, placed the recovered soil samples in moisture proof containers, and maintained a log for each boring. The recovered soil samples, along with the field boring logs, were transported to our Port St. Lucie soils laboratory where they were visually examined by AACE's project engineer to determine their engineering classification. The visual classification of the samples was performed in general accordance with the Unified Soil Classification System, USCS.

Additionally, Percent Fines tests (ASTM D1140) and Moisture Content tests (ASTM D2216) were performed on representative soil samples to aid in classification of the soils. The soil classifications and other pertinent data obtained from our explorations and laboratory examinations are reported on Sheet No. 3.

6.0 GEOTECHNICAL ENGINEERING EVALUATION

Based on the findings of our site exploration, our evaluation of subsurface conditions, and judgment based on our experience with similar projects, it is apparent that the this site is mantled by a thin (2-4 feet) stratum of fine sands, followed by mostly clayey fine sands (SC) to depths in excess of the proposed lake depths.

The encountered soils should be readily suitable for excavation using conventional earthmoving equipment. As such, no hard layers of limerock or soft layers of organics were encountered; rather, loose to medium dense granular soil conditions were encountered throughout the anticipated lake excavation depths. As a matter of practicality relative to the excavation process, it is noted that the groundwater table was encountered as shallow as 6 inches below grade.

Following are recommendations relative to fill suitability of the encountered soils.

- Organic topsoil and the encountered organic soils are not considered suitable for use as any type of fill, other than possibly in landscaped areas or other non-structural areas.
- Fine sands (SP) should be suitable to serve as fill soils and with proper moisture control should densify using conventional compaction equipment. Soils obtained from below the water table may require time to dry sufficiently. However, these materials should be suitable for relatively unrestricted use as fill and roadway embankment.
- Slightly clayey fine sand (SP-SC) is suitable for structural fill, but will likely be more difficult to compact due to its inherent nature to retain excess soil moisture. If the use of slightly clayey soils is desired, it may be necessary to stockpile these soils in order for them to drain. Thinner lifts (perhaps 6 to 8 inches in loose thickness) may be required for placement and compaction of these soils. Further, it may become necessary to mix these soils with drier, cleaner granular sands prior to placement to increase the "workability" of these soils.
- Clayey fine sand (SC) is generally considered unsuitable for use as structural fill because of the difficulty in conditioning and working the material due to its high fines content. However, clayey soils can possibly be mixed with the upper sands with less fines content (i.e. less than 5 percent passing the U.S. No. 200 sieve) and likely be used.

Based on the subsurface conditions encountered during this exploration and as presented in the soil boring profiles included on Sheet No. 3, it appears that the majority of the soils within the upper 4 feet (i.e. about half of the proposed excavation depth) consists mostly of fine sands (SP), while the lower portion of the lake excavations likely will encounter the more clayey sands (SP-SC/SC). As noted, the slightly clayey sands (SP-SC) and, specifically, the clayey sands (SC) could be mixed with the cleaner sands and likely produce a suitable fill/embankment source. If it is attempted to blend the more clayey soils with the sands containing less fines, we would recommend obtaining post-mix samples for laboratory determination of moisture contents and fines content (turnaround time typically less than 24 hours), in addition to optimum moisture contents/maximum density relationships (turnaround time typically 24 to 36 hours), so as to determine whether the soils were sufficiently mixed, and to provide guidelines for placement and compaction procedures.

Nevertheless, due to the potentially slightly elevated fines content in the mixed soils, it will likely be prudent to compact the soils within a few percent of the material's optimum moisture content. Once excavated we recommend that all soils be stockpiled as high as possible so as to increase the rate of drainage, prior to placement and compaction.

We note that it is not anticipated that the lake levels will vary substantially, other than in response to typical seasonal fluctuations. In other words, sudden in-rushes of water and rapid drawdown conditions requiring slope stability analysis and seepage considerations are not anticipated by AACE. As such, in general terms, we recommend using a slope no steeper than 3H:1V for excavations made below the ambient groundwater table within the encountered sandy soil formation. Some measure of compaction of any slope sections above the water table should be performed so that a dry density of 95 percent of the modified Proctor (ASTM D1557) maximum dry density of the compacted material is achieved to depths of 2 feet below the compacted surface.

7.0 CLOSURE

The geotechnical evaluation submitted herein is based on the data obtained from the soil borings presented on Sheet No. 3, and our understanding of the proposed project as previously described. Limitations and conditions to this report are presented in Appendix III.

This report has been prepared in accordance with generally accepted geotechnical engineering practices for the exclusive use of Carter Associates, Inc. and the City of Fellsmere for the subject project. No other warranty, expressed or implied, is made.

We are pleased to be of assistance to you on this phase of your project. When we may be of further service to you or should you have any questions, please contact us.

Sincerely,
ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
Certificate of Authorization No. 26794

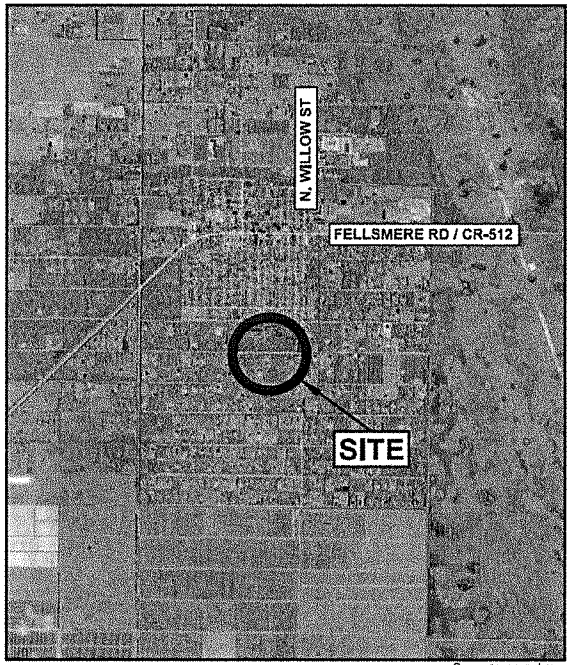
PETER GREGERS ANDERSEN
LICENSE
No. 57956
STATE OF
FLORIDA
PROFESSIONAL ENGINEER
8-17-2015

Peter G. Andersen, P.E.
Principal Engineer
Fla. Reg. No. 57956

David P. Andre, P.E.
Principal Engineer
Fla. Reg. No. 53969
8/17/15

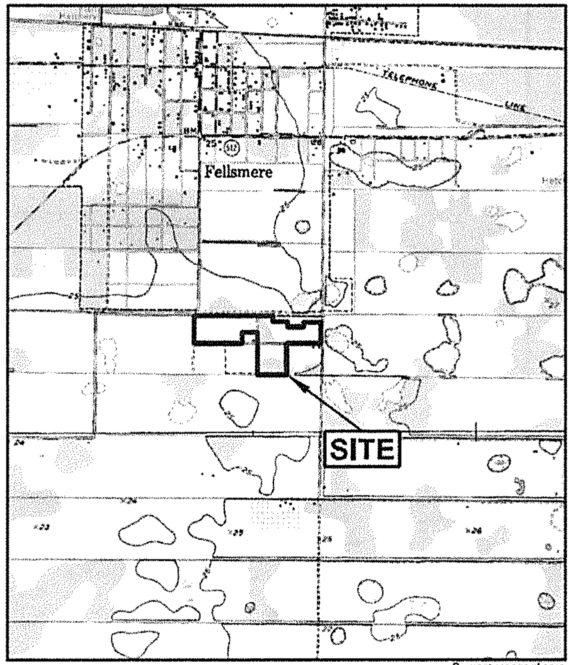
PGA/DPA:pa

2014 AERIAL PHOTOGRAPH



Source: mapcard.com

USGS TOPOGRAPHIC MAP
(1992 USGS Quadrangle Map of "Fellsmere, Florida")



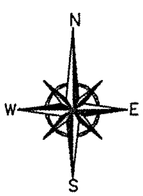
Source: mapcard.com

USDA SOIL SURVEY MAP

Source: USDA NRCS Web Soil Survey

USDA NRCS SOIL TYPES WITHIN SITE BOUNDARY

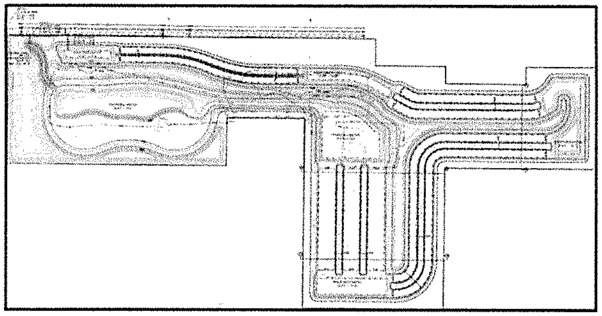
3: EauGallie fine sand
10: Riviera fine sand
13: Wabasso fine sand
16: Pineda sand
23: Arents, 0 to 5 percent slopes
47: Holopaw fine sand, 0 to 2 percent slopes



NOT TO SCALE

ANDERSEN ANDRE CONSULTING ENGINEERS, INC. 573 SW Biltmore Street, Port St. Lucie, FL 34983 772-807-9191 www.AACEinc.com Certificate of Authorization No. 26794	SITE VICINITY MAPS	GEOTECHNICAL ENGINEERING EVALUATION CITY OF FELLSMERE SOUTH REGIONAL LAKE FELLSMERE, INDIAN RIVER COUNTY, FLORIDA	Drawn by: PGA Checked by: DPA AACE File No: 15-158	Date: August 2015 Date: August 2015 **Sheet No. 1**

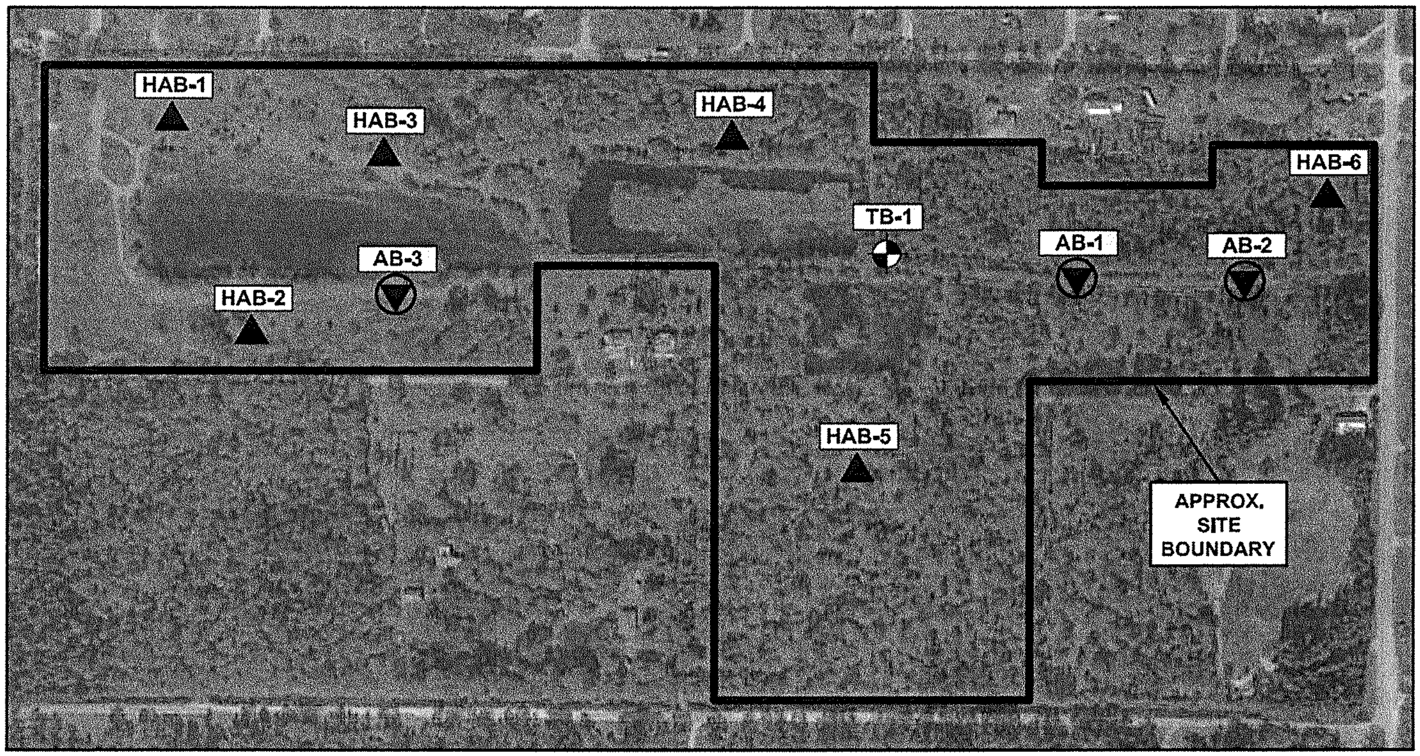
PROPOSED SITE PLAN (NOT TO SCALE)



Shown and noted field work locations are approximate. All field work locations were located using the provided site plan, obtained aerial photographs, existing site features, and WAAS-enabled GPS. The shown field work locations should be considered accurate only to the degree implied by the method of measurement used.

Sheet No. 2 Source: Site Plan by Carter Associates, Inc. and Google Earth Pro

CURRENT SITE CONDITIONS AND
BORING LOCATION PLAN

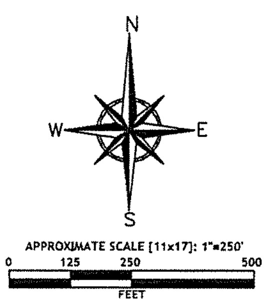


NOTES AND LEGEND

TB-# Standard Penetration Test Boring

AB-# Solid-Stem Auger Boring

HAB-# Hand Auger Boring

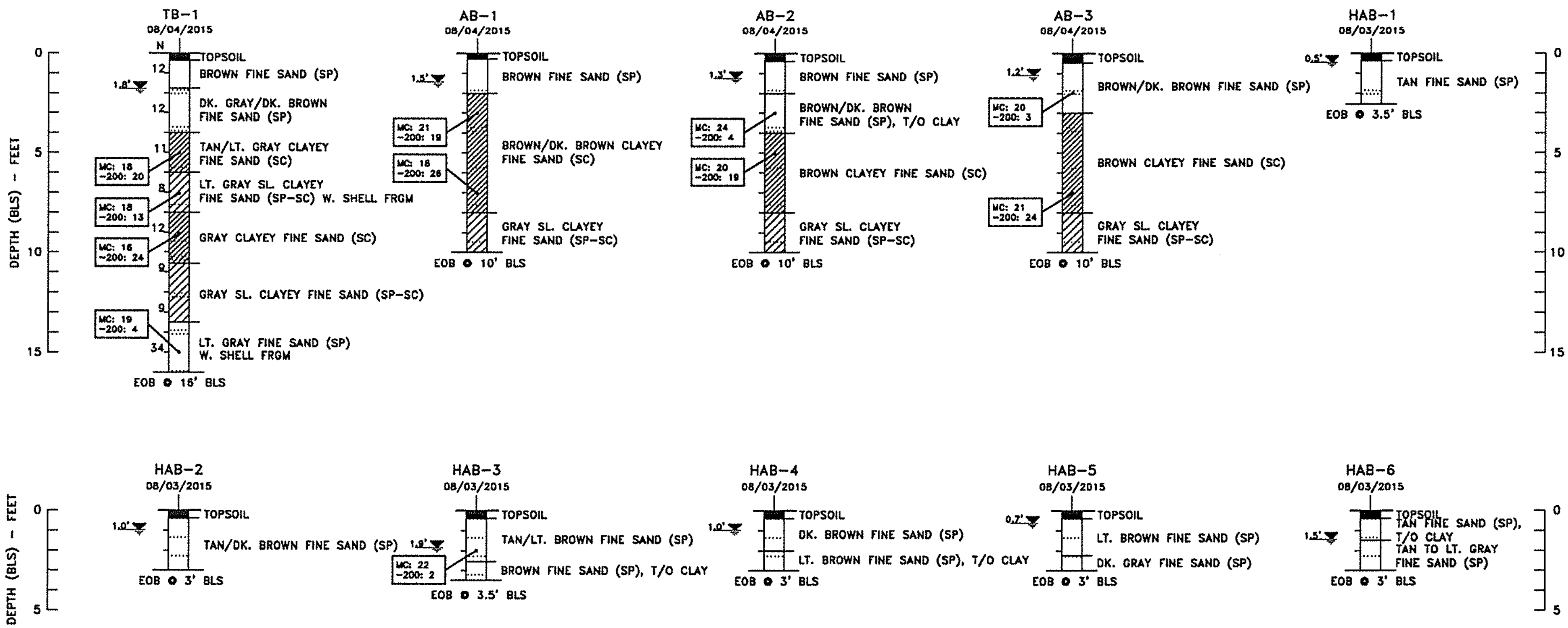


ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
573 SW Biltmore Street, Port St. Lucie, FL 34983 772-807-9191 www.AACEinc.com
Certificate of Authorization No. 26794

FIELD WORK LOCATION PLAN

GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE
SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

Drawn by: PGA	Date: August 2015
Checked by: DPA	Date: August 2015
AACE File No: 15-158	Sheet No. 2



LEGEND:

- TOPSOIL
- FINE SAND W. T/O SILT/CLAY (SP)
- SLIGHTLY CLAYEY FINE SAND (SP-SC)
- CLAYEY FINE SAND (SC)

NOTES:

TB-#	STANDARD PENETRATION TEST [SPT] BORING (ASTM D1586)
AB-#	SOLID-STEM AUGER BORING (ASTM D1452)
HAB-#	HAND AUGER BORING (ASTM D1452)
N	SPT RESISTANCE IN BLOWS PER FOOT
X.X' ▼	GROUNDWATER TABLE (FT BELOW EXIST. GRADE) AT TIME DRILLED
EOB	END OF BORING
BLS	BELOW LAND SURFACE
GWT N.E.	GROUNDWATER TABLE NOT ENCOUNTERED
SP, SP-SC, SC:	UNIFIED SOIL CLASSIFICATION SYSTEM [USCS] USCS GROUPS DETERMINED BY VISUAL CLASSIFICATION EXCEPT FOR NOTED LABORATORY TESTS
MC	NATURAL MOISTURE CONTENT IN PERCENT (ASTM D2216)
-200	PERCENT PASSING NO. 200 SIEVE SIZE [PERCENT FINES] (ASTM D1140)

DRILL CREW FIRM: AACE
DRILL CREW CHIEF: RL
DRILL RIG: DIEDRICH D-25
SPT DRILL METHOD: ROTARY-WASH/BENTONITE SLURRY
SPT HAMMER TYPE: AUTOMATIC

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
573 SW Biltmore Street, Port St. Lucie, FL 34983 772-807-9191 www.AACEinc.com
Certificate of Authorization No. 26794

SOIL BORING PROFILES

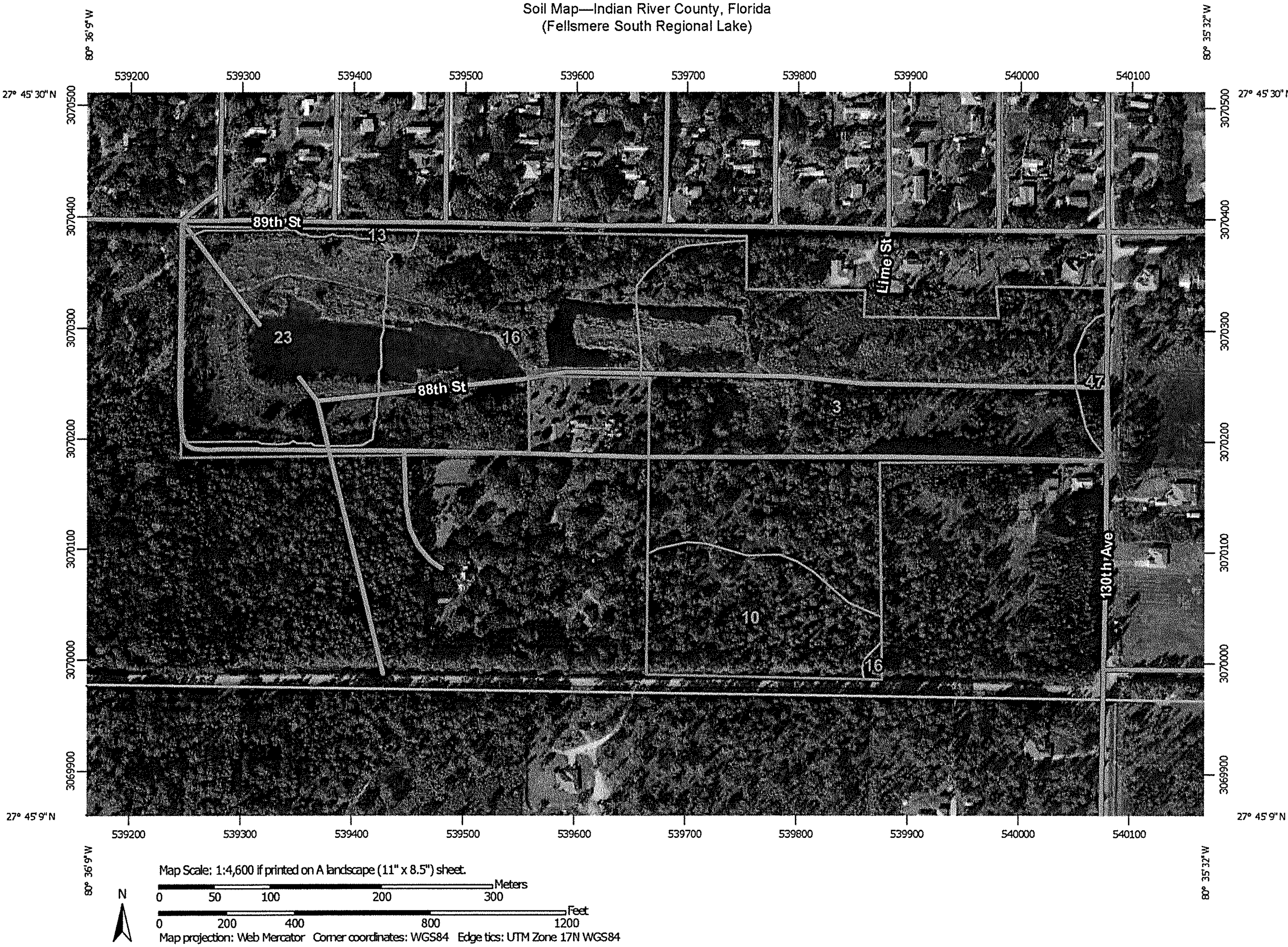
GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE
SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

Drawn by: PGA	Date: August 2015
Checked by: DPA	Date: August 2015
AACE File No: 15-158	Sheet No. 3

APPENDIX I

USDA Web Soil Survey Summary Report

Soil Map—Indian River County, Florida
(Fellsmere South Regional Lake)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 15, 2010—Mar 13, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Indian River County, Florida (FL061)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
3	EauGallie fine sand	20.4	44.8%
10	Riviera fine sand	5.2	11.3%
13	Wabasso fine sand	0.4	0.8%
16	Pineda fine sand	10.6	23.2%
23	Arents, 0 to 5 percent slopes	8.4	18.4%
47	Holopaw fine sand, 0 to 2 percent slopes	0.7	1.5%
Totals for Area of Interest		**45.6**	**100.0%**

Indian River County, Florida

3—EauGallie fine sand

Map Unit Setting

National map unit symbol: tdfl
Elevation: 20 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Eaugallie, non-hydric, and similar soils: 80 percent
Eaugallie, hydric, and similar soils: 10 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Eaugallie, Non-hydric

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 26 inches: fine sand
Bh - 26 to 42 inches: fine sand
BE - 42 to 47 inches: fine sand
Btg - 47 to 62 inches: sandy clay loam
Cg - 62 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Description of Eaugallie, Hydric

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 26 inches: fine sand
Bh - 26 to 42 inches: fine sand
BE - 42 to 47 inches: fine sand
Btg - 47 to 62 inches: sandy clay loam
Cg - 62 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Minor Components

Myakka, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces

Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Oldsmar, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Wabasso, non-hydric

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Pepper, non-hydric

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

10—Riviera fine sand

Map Unit Setting

National map unit symbol: tdft
Elevation: 10 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Riviera and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riviera

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 26 inches: fine sand
Btg1 - 26 to 31 inches: sandy loam
Btg2 - 31 to 40 inches: sandy loam
Cg - 40 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Cabbage Palm Flatwoods (R155XY005FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Minor Components

Floridana

Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Winder

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Other vegetative classification: Wetland Hardwood Hammock (R155XY012FL), Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)

Wabasso, hydric

Percent of map unit: 2 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Holopaw

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Slough (R155XY011FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Oldsmar, hydric

Percent of map unit: 2 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Manatee

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL), Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)

Pineda

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Slough (R155XY011FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

13—Wabasso fine sand

Map Unit Setting

National map unit symbol: tdfx
Elevation: 0 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Wabasso, non-hydric, and similar soils: 70 percent
Wabasso, hydric, and similar soils: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wabasso, Non-hydric

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 7 inches: fine sand
E - 7 to 24 inches: fine sand
Bh - 24 to 35 inches: fine sand
Bt - 35 to 48 inches: sandy clay loam
Cg - 48 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Description of Wabasso, Hydric

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 7 inches: fine sand
E - 7 to 24 inches: fine sand
Bh - 24 to 35 inches: fine sand
Bt - 35 to 48 inches: sandy clay loam
Cg - 48 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Minor Components

Eaugallie, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces

Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Boca, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Riviera

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Cabbage Palm Flatwoods (R155XY005FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Winder

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Other vegetative classification: Wetland Hardwood Hammock (R155XY012FL), Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

16—Pineda fine sand

Map Unit Setting

National map unit symbol: tdg0
Elevation: 20 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Pineda and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pineda

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 9 inches: fine sand
Bw - 9 to 23 inches: fine sand
Btg - 23 to 40 inches: sandy loam
Cg - 40 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Slough (R155XY011FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Minor Components

Eaugallie, non-hydric
Percent of map unit: 4 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Wabasso, hydric
Percent of map unit: 4 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Riviera
Percent of map unit: 4 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Cabbage Palm Flatwoods (R155XY005FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Winder
Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Other vegetative classification: Wetland Hardwood Hammock (R155XY012FL), Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

23—Arents, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: tdg6
Elevation: 20 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Arents and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arents

Setting

Landform: Rises on marine terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Altered marine deposits

Typical profile

C1 - 0 to 10 inches: sand
C2 - 10 to 32 inches: sand
C3 - 32 to 60 inches: sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A

Other vegetative classification: Forage suitability group not assigned (G156BC999FL)

Minor Components

Quartzipsamments

Percent of map unit: 5 percent
Landform: Rises on marine terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Forage suitability group not assigned (G156BC999FL)

Urban land

Percent of map unit: 5 percent
Landform: Marine terraces
Landform position (three-dimensional): Interfluve, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Forage suitability group not assigned (G156BC999FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

47—Holopaw fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2vbpd
Elevation: 0 to 130 feet
Mean annual precipitation: 37 to 62 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 300 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Holopaw and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw

Setting

Landform: — error in exists on —
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
Eg - 6 to 42 inches: fine sand
Btg - 42 to 60 inches: fine sandy loam
Cg - 60 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: A/D
Other vegetative classification: Slough (R155XY011FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Minor Components

Basinger

Percent of map unit: 6 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave

Oldsmar

Percent of map unit: 5 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex
Across-slope shape: Linear

Boca

Percent of map unit: 3 percent
Landform: — error in exists on —
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)

Riviera

Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

APPENDIX II

General Notes

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
SOIL BORING, SAMPLING AND TESTING METHODS

GENERAL

Andersen Andre Consulting Engineers, Inc. (AACE) borings describe subsurface conditions only at the locations drilled and at the time drilled. They provide no information about subsurface conditions below the bottom of the boreholes. At locations not explored, surface conditions that differ from those observed in the borings may exist and should be anticipated.

The information reported on our boring logs is based on our drillers' logs and on visual examination in our laboratory of disturbed soil samples recovered from the borings. The distinction shown on the logs between soil types is approximate only. The actual transition from one soil to another may be gradual and indistinct.

The groundwater depth shown on our boring logs is the water level the driller observed in the borehole when it was drilled. These water levels may have been influenced by the drilling procedures, especially in borings made by rotary drilling with bentonitic drilling mud. An accurate determination of groundwater level requires long-term observation of suitable monitoring wells. Fluctuations in groundwater levels throughout the year should be anticipated.

The absence of a groundwater level on certain logs indicates that no groundwater data is available. It does not mean that groundwater will not be encountered at that boring location at some other point in time.

STANDARD PENETRATION TEST

The Standard Penetration Test (SPT) is a widely accepted method of in situ testing of foundation soils (ASTM D-1586). A 2-foot (0.6m) long, 2-inch (50mm) O.D. split-barrell sampler attached to the end of a string of drilling rods is driven 24 inches (0.60m) into the ground by successive blows of a 140-pound (63.5 Kg) hammer freely dropping 30 inches (0.76m). The number of blows needed for each 6 inches (0.15m) increments penetration is recorded. The sum of the blows required for penetration of the middle two 6-inch (0.15m) increments of penetration constitutes the test result of N-value. After the test, the sampler is extracted from the ground and opened to allow visual description of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load. The following tables relate N-values to a qualitative description of soil density and, for cohesive soils, an approximate unconfined compressive strength (Qu):

Cohesionless Soils:	N-Value	Description
	0 to 4	Very loose
	4 to 10	Loose
	10 to 30	Medium dense
	30 to 50	Dense
	Above 50	Very dense

Cohesive Soils:	**N-Value**	**Description**	**Qu**
	0 to 2	Very soft	Below 0.25 tsf (25 kPa)
	2 to 4	Soft	0.25 to 0.50 tsf (25 to 50 kPa)
	4 to 8	Medium stiff	0.50 to 1.0 tsf (50 to 100 kPa)
	8 to 15	Stiff	1.0 to 2.0 tsf (100 to 200 kPa)
	15 to 30	Very stiff	2.0 to 4.0 tsf (200 to 400 kPa)
	Above 30	Hard	Above 4.0 tsf (400 kPa)

The tests are usually performed at 5 foot (1.5m) intervals. However, more frequent or continuous testing is done by AACE through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or prevent the loss of circulating fluid. After completion of a test borings, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed by backfilling, either with accumulated cuttings or lean cement.

Representative split-spoon samples from each sampling interval and from different strata are brought to our laboratory in air-tight jars for classification and testing, if necessary. Afterwards, the samples are discarded unless prior arrangement have been made.

POWER AUGER BORINGS

Auger borings (ASTM D-1452) are used when a relatively large, continuous sampling of soil strata close to the ground surface is desired. A 4-inch (100 mm) diameter, continuous flight, helical auger with a cutting head at its end is screwed into the ground in 5-foot (1.5m) sections. It is powered by the rotary drill rig. The sample is recovered by withdrawing the auger our of the ground without rotating it. The soil sample so obtained, is classified in the field and representative samples placed in bags or jars and returned to the AACE soils laboratory for classification and testing, if necessary.

HAND AUGER BORINGS

Hand auger borings are used, if soil conditions are favorable, when the soil strata are to be determined within a shallow (approximately 5-foot [1.5m]) depth or when access is not available to power drilling equipment. A 3-inch (75mm) diameter hand bucket auger with a cutting head is simultaneously turned and pressed into the ground. The bucket auger is retrieved at approximately 6-inch (0.15m) interval and its contents emptied for inspection. On occasion post-hole diggers are used, especially in the upper 3 feet (1m) or so. Penetrometer probings can be used in the upper 5 feet (1.5m) to determine the relative density of the soils. The soil sample obtained is described and representative samples put in bags or jars and transported to the AACE soils laboratory for classification and testing, if necessary.

UNDISTURBED SAMPLING

Undisturbed sampling (ASTM D-1587) implies the recovery of soil samples in a state as close to their natural condition as possible. Complete preservation of in situ conditions cannot be realized; however, with careful handling and proper sampling techniques, disturbance during sampling can be minimized for most geotechnical engineering purposes. Testing of undisturbed samples gives a more accurate estimate of in situ behavior than is possible with disturbed samples.

Normally, we obtain undisturbed samples by pushing a 2.875-inch (73 mm) I.D., thin wall seamless steel tube 24 inches (0.6 m) into the soil with a single stoke of a hydraulic ram. The sampler, which is a Shelby tube, is 30 (0.8 m) inches long. After the sampler is retrieved, the ends are sealed in the field and it is transported to our laboratory for visual description and testing, as needed.

ROCK CORING

In case rock strata is encountered and rock strength/continuity/composition information is needed for foundation or mining purposes, the rock can be cored (ASTM D-2113) and 2-inch to 4-inch diameter rock core samples be obtained for further laboratory analyses. The rock coring is performed through flush-joint steel casing temporarily installed through the overburden soils above the rock formation and also installed into the rock. The double- or triple-tube core barrels are advanced into the rock typically in 5-foot intervals and then retrieved to the surface. The barrel is then opened so that the core sample can be extruded. Preliminary field measurements of the recovered rock cores include percent recovery and Rock Quality Designation (RQD) values. The rock cores are placed in secure core boxes and then transported to our laboratory for further inspection and testing, as needed.

SFWMD EXFILTRATION TESTS

In order to estimate the hydraulic conductivity of the upper soils, constant head or falling head exfiltration tests can be performed. These tests are performed in accordance with methods described in the South Florida Water Management District (SFWMD) Permit Information Manual, Volume IV. In brief, a 6 to 9 inch diameter hole is augered to depths of about 5 to 7 feet; the bottom one foot is filled with 57-stone; and a 6-foot long slotted PVC pipe is lowered into the hole. The distance from the groundwater table and to the ground surface is recordedand the hole is then saturated for 10 minutes with the water level maintained at the ground surface.

If a constant head test is performed, the rate of pumping will be recorded at fixed intervals of 1 minute for a total of 10 minutes, following the saturation period.

LABORATORY TEST METHODS

Soil samples returned to the AACE soils laboratory are visually observed by a geotechnical engineer or a trained technician to obtain more accurate description of the soil strata. Laboratory testing is performed on selected samples as deemed necessary to aid in soil classification and to help define engineering properties of the soils. The test results are presented on the soil boring logs at the depths at which the respective sample was recovered, except that grain size distributions or selected other test results may be presented on separate tables, figures or plates as discussed in this report.

THE PROJECT SOIL DESCRIPTION PROCEDURE FOR SOUTHEAST FLORIDA

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

The soil descriptions shown on the logs are based upon visual-manual procedures in accordance with local practice. Soil classification is performed in general accordance with the United Soil Classification System and is also based on visual-manual procedures.

BOULDERS (>12" [300 MM]) and COBBLES (3" [75 MM] TO 12" [300 MM]):

GRAVEL:

Coarse Gravel:	3/4" (19 mm) to 3" (75 mm)
Fine Gravel:	No. 4 (4.75 mm) Sieve to 3/4" (19 mm)

Descriptive adjectives:

0 - 5%	– no mention of gravel in description
5 - 15%	– trace
15 - 29%	– some
30 - 49%	– gravelly (shell, limerock, cemented sands)

SANDS:

COARSE SAND: No. 10 (2 mm) Sieve to No. 4 (4.75 mm) Sieve
MEDIUM SAND: No. 40 (425 μm) Sieve to No. 10 (2 mm) Sieve
FINE SAND: No. 200 (75 μm) Sieve to No. 40 (425 μm) Sieve

Descriptive adjectives:

0 - 5%	– no mention of sand in description
5 - 15%	– trace
15 - 29%	– some
30 - 49%	– sandy

SILT/CLAY: < #200 (75μM) Sieve

SILTY OR SILT: $PI < 4$
SILTY CLAYEY OR SILTY CLAY: $4 \leq PI \leq 7$
CLAYEY OR CLAY: $PI > 7$

Descriptive adjectives:

< - 5%	– clean (no mention of silt or clay in description)
5 - 15%	– slightly
16 - 35%	– clayey, silty, or silty clayey
36 - 49%	– very

ORGANIC SOILS:

Organic Content	**Descriptive Adjectives**	**Classification**
0 - 2.5%	Usually no mention of organics in description	See Above
2.6 - 5%	slightly organic	add "with organic fines" to group name
5 - 30%	organic	SM with organic fines
		Organic Silt (OL)
		Organic Clay (OL)
		Organic Silt (OH)

THE PROJECT SOIL DESCRIPTION PROCEDURE FOR SOUTHEAST FLORIDA

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

Organic Clay (OH)

HIGHLY ORGANIC SOILS AND MATTER:

Organic Content	Descriptive Adjectives	Classification
30 - 75%	sandy peat	Peat (PT)
	silty peat	Peat (PT)
> 75%	amorphous peat	Peat (PT)
	fibrous peat	Peat (PT)

STRATIFICATION AND STRUCTURE:

Descriptive Term		Thickness
with interbedded		
seam	--	less than ½ inch (13 mm) thick
layer	--	½ to 12-inches (300 mm) thick
stratum	--	more than 12-inches (300 mm) thick
pocket	--	small, erratic deposit, usually less than 1-foot
lens	--	lenticular deposits
occasional	--	one or less per foot of thickness
frequent	--	more than one per foot of thickness
calcareous	--	containing calcium carbonate (reaction to diluted HCL)
hardpan	--	spodic horizon usually medium dense
marl	--	mixture of carbonate clays, silts, shells and sands

ROCK CLASSIFICATION (FLORIDA) CHART:

Symbol	Typical Description
LS	Hard Bedded Limestone or Caprock
WLS	Fractured or Weathered Limestone
LR	Limerock (gravel, sand, silt and clay mixture)
SLS	Stratified Limestone and Soils

THE PROJECT SOIL DESCRIPTION PROCEDURE FOR SOUTHEAST FLORIDA

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

LEGEND FOR BORING LOGS

N:	Number of blows to drive a 2-inch OD split spoon sampler 12 inches using a 140-pound hammer dropped 30 inches
R:	Refusal (less than six inches advance of the split spoon after 50 hammer blows)
MC:	Moisture content (percent of dry weight)
OC:	Organic content (percent of dry weight)
PL:	Moisture content at the plastic limit
LL:	Moisture content at the liquid limit
PI:	Plasticity index (LL-PL)
qu:	Unconfined compressive strength (tons per square foot, unless otherwise noted)
-200:	Percent passing a No. 200 sieve (200 wash)
+40:	Percent retained above a No. 40 sieve
US:	Undisturbed sample obtained with a thin-wall Shelby tube
k:	Permeability (feet per minute, unless otherwise noted)
DD:	Dry density (pounds per cubic foot)
TW:	Total unit weight (pounds per cubic foot)

Appendix III

Project Limitations and Conditions

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
(revised January 24, 2007)

Project Limitations and Conditions

Andersen Andre Consulting Engineers, Inc. has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made herein. Further, the report, in all cases, is subject to the following limitations and conditions:

VARIABLE/UNANTICIPATED SUBSURFACE CONDITIONS

The engineering analysis, evaluation and subsequent recommendations presented herein are based on the data obtained from our field explorations, at the specific locations explored on the dates indicated in the report. This report does not reflect any subsurface variations (e.g. soil types, groundwater levels, etc.) which may occur adjacent or between borings.

The nature and extent of any such variations may not become evident until construction/excavation commences. In the event such variations are encountered, Andersen Andre Consulting Engineers, Inc. may find it necessary to (1) perform additional subsurface explorations, (2) conduct in-the-field observations of encountered variations, and/or re-evaluate the conclusions and recommendations presented herein.

We at Andersen Andre Consulting Engineers, Inc. recommend that the project specifications necessitate the contractor immediately notifying Andersen Andre Consulting Engineers, Inc., the owner and the design engineer (if applicable) if subsurface conditions are encountered that are different from those presented in this report.

No claim by the contractor for any conditions differing from those expected in the plans and specifications, or presented in this report, should be allowed unless the contractor notifies the owner and Andersen Andre Consulting Engineers, Inc. of such differing site conditions. Additionally, we recommend that all foundation work and site improvements be observed by an Andersen Andre Consulting Engineers, Inc. representative.

SOIL STRATA CHANGES

Soil strata changes are indicated by a horizontal line on the soil boring profiles (boring logs) presented within this report. However, the actual strata's changes may be more gradual and indistinct. Where changes occur between soil samples, the locations of the changes must be estimated using the available information and may not be at the exact depth indicated.

SINKHOLE POTENTIAL

Unless specifically requested in writing, a subsurface exploration performed by Andersen Andre Consulting Engineers, Inc. is not intended to be an evaluation for sinkhole potential.

MISINTERPRETATION OF SUBSURFACE SOIL EXPLORATION REPORT

Andersen Andre Consulting Engineers, Inc. is responsible for the conclusions and recommendations presented herein, based upon the subsurface data obtained during this project. If others render conclusions or opinions, or make recommendations based upon the data presented in this report, those conclusions, opinions and/or recommendations are not the responsibility of Andersen Andre Consulting Engineers, Inc.

CHANGED STRUCTURE OR LOCATION

This report was prepared to assist the owner, architect and/or civil engineer in the design of the subject project. If any changes in the construction, design and/or location of the structures as discussed in this report are planned, or if any structures are included or added that are not discussed in this report, the conclusions and recommendations contained in this report may not be valid. All such changes in the project plans should be made known to Andersen Andre Consulting Engineers, Inc. for our subsequent re-evaluation.

USE OF REPORT BY BIDDERS

Bidders who are reviewing this report prior to submission of a bid are cautioned that this report was prepared to assist the owners and project designers. Bidders should coordinate their own subsurface explorations (e.g.; soil borings, test pits, etc.) for the purpose of determining any conditions that may affect construction operations. Andersen Andre Consulting Engineers, Inc. cannot be held responsible for any interpretations made using this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which may affect construction operations.

IN-THE-FIELD OBSERVATIONS

Andersen Andre Consulting Engineers, Inc. attempts to identify subsurface conditions, including soil stratigraphy, water levels, zones of lost circulation, "hard" or "soft" drilling, subsurface obstructions, etc. However, lack of mention in the report does not preclude the presence of such conditions.

LOCATION OF BURIED OBJECTS

Users of this report are cautioned that there was no requirement for Andersen Andre Consulting Engineers, Inc. to attempt to locate any man-made, underground objects during the course of this exploration, and that no attempts to locate any such objects were performed. Andersen Andre Consulting Engineers, Inc. cannot be responsible for any buried man-made objects which are subsequently encountered during construction.

PASSAGE OF TIME

This report reflects subsurface conditions that were encountered at the time/date indicated in the report. Significant changes can occur at the site during the passage of time. The user of the report recognizes the inherent risk in using the information presented herein after a reasonable amount of time has passed. We recommend the user of the report contact Andersen Andre Consulting Engineers, Inc. with any questions or concerns regarding this issue.

Important Information about Your

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.

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

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

AACE FILE NO. 15-158

AACE

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.

573 SW Biltmore Street
Port St. Lucie, Florida 34983
Ph: 772-807-9191 Fx: 772-807-9192
www.aaceinc.com

TABLE OF CONTENTS

GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

AACE FILE NO. 15-158

PAGE #

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
Geotechnical Engineering
Construction Materials Testing
Environmental Consulting

AACE File No. 15-158
August 17, 2015

Carter Associates, Inc.
1708 21st Street
Vero Beach, FL 32960

Attn: Mr. Clint Rahjes, P.E.

GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

1.0 INTRODUCTION

In accordance with your request and authorization, Andersen Andre Consulting Engineers, Inc. (hereinafter referred to as AACE) has completed a subsurface exploration and geotechnical engineering analyses for the above referenced project. The purpose of performing this exploration was to explore shallow soil types and groundwater levels, and restrictions which these may place on the proposed stormwater quality and lake excavation project. Our work included one Standard Penetration Test (SPT) boring, auger borings, laboratory testing, and engineering analysis. This report documents our explorations and presents our findings, and summarizes our conclusions and recommendations.

2.0 SITE INFORMATION AND PROJECT UNDERSTANDING

2.1 Site Location and Project Description

The proposed Fellsmere South Regional Lake encompasses approximately 45 acres of vacant and mostly overgrown land located on the southwest corner of 89th Street and 130th Avenue in Fellsmere, Indian River County, Florida. The site is relatively open and accessible on the western portion, however, only limited access is available throughout the remainder of the site due to the presence of heavy vegetation. Further, existing lakes are present on the western and central portions of the site.

A Site Vicinity Map (2014 aerial photograph) which depicts the approximate boundaries of the study area is included on the attached Sheet No. 1. The site location is further shown superimposed on the "Fellsmere, Florida" USGS topographic quadrangle map (1992), also included on Sheet No. 1. The USGS map depicts the subject property as relatively level and having an approximate surface elevation of 25 feet relative to the National Geodetic Vertical Datum of 1929.

Based on our conversations and our review of the forwarded project-related information, we understand that the City of Fellsmere is considering constructing a water quality flow-through system that includes the excavation of four (4) "smaller" lakes, the expansion of one (1) existing "larger" (i.e., 10+ acres) lake, and the excavation of flow-through runnels that interconnect each of the aforementioned lakes. The existing ground surface elevation averages approximately 23-24 feet NAVD, and the planned lakes and runnels have a proposed bottom elevation of approximately 17 feet NAVD. Approximately 1-2 feet of water will be present in the bottom of the runnels and lakes, and lake bank slopes will range from 3H:1V to 6H:1V. A copy of the proposed site plan is included on Sheet No. 2.

As noted in our proposal for this project, no slope stability investigation, seepage analyses, or foundation design were requested as part of our services.

2.2 Review of USDA Soil Survey

According to the USDA NRCS Web Soil Survey, the predominant surficial soil types within the overall site area are as follows (listed in Map Unit numerical order):

- Map Unit 3 - EauGallie fine sand
- Map Unit 10 - Riviera fine sand
- Map Unit 13 - Wabasso fine sand
- Map Unit 16 - Pineda fine sand
- Map Unit 23 - Arents, 0 to 5 percent slopes
- Map Unit 47 - Holopaw fine sand, 0 to 2 percent slopes.

With the exception of the Arents soil type (Map Unit 23), these soil types are all noted to consist of sandy and loamy marine deposits, with surficial fine sands extending to depths of 23 to 47 inches and underlain by sandy loam, clay loam and loamy sands to depths in excess of 80 inches. Conversely, the Arents soil type is noted to consist of altered marine deposits with sands present to depths in excess of 60 inches.

The approximate location of the overall site is shown superimposed on a copy of the USDA Web Soil Survey aerial photograph, presented on Sheet No. 1. A brief comparison of the noted soil types (including their approximate percent coverage within the site) along with the summary report obtained from the USDA Web Soil Survey are included in Appendix I.

3.0 FIELD EXPLORATION PROGRAM

To explore subsurface conditions at the site relative to the proposed construction, the field exploration program summarized in Table 1 below was completed. The locations of the completed field work are graphically depicted on the Field Work Location Plan, presented on Sheet No. 2.

Table 1 - Field Exploration Program

Boring Type	Number	ASTM	Max. Depth below grade [feet]	Location
Standard Penetration Test (SPT)	1	D1586	16	Refer to Sheet No. 2
Solid-Stem Auger	3	D1452	10	Refer to Sheet No. 2
Hand Auger	6	D1452	3-3.5	Refer to Sheet No. 2

As discussed during the progress of our field work, the presence of a very shallow water table (see Section 4.2) necessitated a change to our field work as compared to the scope of work presented in our original proposal for the project.

Overall, our field work was performed on August 3 and 4, 2015. The soil boring locations shown on Sheet No. 2 were determined in the field by our field crew using a combination of hand-held GPS, the provided site plan, obtained aerial photographs and existing site features as references. The locations should be considered accurate only to the degree implied by the method of measurement used. We preliminarily anticipate that the actual locations are within 15 feet of those shown on Sheet No. 2.

Summaries of AACE's field procedures are included in Appendix II, and the individual boring profiles are presented on the attached Sheet No. 3. Samples obtained during performance of the borings were visually classified in the field, and representative portions of the samples were transported to our laboratory in sealed sample jars for further classification. The soil samples recovered from our explorations will be kept in our laboratory for 60 days, then discarded unless you specifically request otherwise.

4.0 OBSERVED SUBSURFACE CONDITIONS

4.1 General Soil Conditions

Detailed subsurface conditions are illustrated on the soil boring profiles presented on the attached Sheet No. 3. The stratification of the boring profiles represents our interpretation of the field boring logs and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

In brief, at the locations and depths explored, the majority of our borings encountered a few inches of topsoil followed fine sands to depths of about 2 to 4 feet. At this depth, our hand auger borings were terminated due to the presence of a shallow water table. Our borings TB-1, AB-1, AB-2 and AB-3 (completed with a truck-mounted drill rig) then encountered loose to moderately dense clayey fine sands (SC) and occasionally slightly clayey fine sands (SP-SC) to depths of about 10-13 feet below grade, in turn followed by dense fine sands (SP) with shell fragments (TB-1 only) to an approximate depth of 16 feet below grade.

Overall, the encountered soil conditions correlate well with those reported by the USDA, with surficial fine sands underlain by loamy (clayey) sands.

4.2 Measured Groundwater Level

The groundwater table was encountered at depths ranging from about 6 inches to about 2 feet below grade. In general, fluctuations in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the borings were conducted. It should further be expected that rainwater possibly could pond after periods of intense or prolonged rainfall events or, as a minimum, be present at depths shallower than the levels noted herein, possibly for extended periods of time.

5.0 LABORATORY TESTING PROGRAM

Our drillers observed the soil recovered from the borings, placed the recovered soil samples in moisture proof containers, and maintained a log for each boring. The recovered soil samples, along with the field boring logs, were transported to our Port St. Lucie soils laboratory where they were visually examined by AACE's project engineer to determine their engineering classification. The visual classification of the samples was performed in general accordance with the Unified Soil Classification System, USCS.

Additionally, Percent Fines tests (ASTM D1140) and Moisture Content tests (ASTM D2216) were performed on representative soil samples to aid in classification of the soils. The soil classifications and other pertinent data obtained from our explorations and laboratory examinations are reported on Sheet No. 3.

6.0 GEOTECHNICAL ENGINEERING EVALUATION

Based on the findings of our site exploration, our evaluation of subsurface conditions, and judgment based on our experience with similar projects, it is apparent that the this site is mantled by a thin (2-4 feet) stratum of fine sands, followed by mostly clayey fine sands (SC) to depths in excess of the proposed lake depths.

The encountered soils should be readily suitable for excavation using conventional earthmoving equipment. As such, no hard layers of limerock or soft layers of organics were encountered; rather, loose to medium dense granular soil conditions were encountered throughout the anticipated lake excavation depths. As a matter of practicality relative to the excavation process, it is noted that the groundwater table was encountered as shallow as 6 inches below grade.

Following are recommendations relative to fill suitability of the encountered soils.

- Organic topsoil and the encountered organic soils are not considered suitable for use as any type of fill, other than possibly in landscaped areas or other non-structural areas.

- Fine sands (SP) should be suitable to serve as fill soils and with proper moisture control should densify using conventional compaction equipment. Soils obtained from below the water table may require time to dry sufficiently. However, these materials should be suitable for relatively unrestricted use as fill and roadway embankment.

- Slightly clayey fine sand (SP-SC) is suitable for structural fill, but will likely be more difficult to compact due to its inherent nature to retain excess soil moisture. If the use of slightly clayey soils is desired, it may be necessary to stockpile these soils in order for them to drain. Thinner lifts (perhaps 6 to 8 inches in loose thickness) may be required for placement and compaction of these soils. Further, it may become necessary to mix these soils with drier, cleaner granular sands prior to placement to increase the "workability" of these soils.

- Clayey fine sand (SC) is generally considered unsuitable for use as structural fill because of the difficulty in conditioning and working the material due to its high fines content. However, clayey soils can possibly be mixed with the upper sands with less fines content (i.e. less than 5 percent passing the U.S. No. 200 sieve) and likely be used.

Based on the subsurface conditions encountered during this exploration and as presented in the soil boring profiles included on Sheet No. 3, it appears that the majority of the soils within the upper 4 feet (i.e. about half of the proposed excavation depth) consists mostly of fine sands (SP), while the lower portion of the lake excavations likely will encounter the more clayey sands (SP-SC/SC). As noted, the slightly clayey sands (SP-SC) and, specifically, the clayey sands (SC) could be mixed with the cleaner sands and likely produce a suitable fill/embankment source. If it is attempted to blend the more clayey soils with the sands containing less fines, we would recommend obtaining post-mix samples for laboratory determination of moisture contents and fines content (turnaround time typically less than 24 hours), in addition to optimum moisture contents/maximum density relationships (turnaround time typically 24 to 36 hours), so as to determine whether the soils were sufficiently mixed, and to provide guidelines for placement and compaction procedures.

Nevertheless, due to the potentially slightly elevated fines content in the mixed soils, it will likely be prudent to compact the soils within a few percent of the material's optimum moisture content. Once excavated we recommend that all soils be stockpiled as high as possible so as to increase the rate of drainage, prior to placement and compaction.

We note that it is not anticipated that the lake levels will vary substantially, other than in response to typical seasonal fluctuations. In other words, sudden in-rushes of water and rapid drawdown conditions requiring slope stability analysis and seepage considerations are not anticipated by AACE. As such, in general terms, we recommend using a slope no steeper than 3H:1V for excavations made below the ambient groundwater table within the encountered sandy soil formation. Some measure of compaction of any slope sections above the water table should be performed so that a dry density of 95 percent of the modified Proctor (ASTM D1557) maximum dry density of the compacted material is achieved to depths of 2 feet below the compacted surface.

7.0 CLOSURE

The geotechnical evaluation submitted herein is based on the data obtained from the soil borings presented on Sheet No. 3, and our understanding of the proposed project as previously described. Limitations and conditions to this report are presented in Appendix III.

This report has been prepared in accordance with generally accepted geotechnical engineering practices for the exclusive use of Carter Associates, Inc. and the City of Fellsmere for the subject project. No other warranty, expressed or implied, is made.

We are pleased to be of assistance to you on this phase of your project. When we may be of further service to you or should you have any questions, please contact us.

Sincerely,
ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
Certificate of Authorization No. 26794

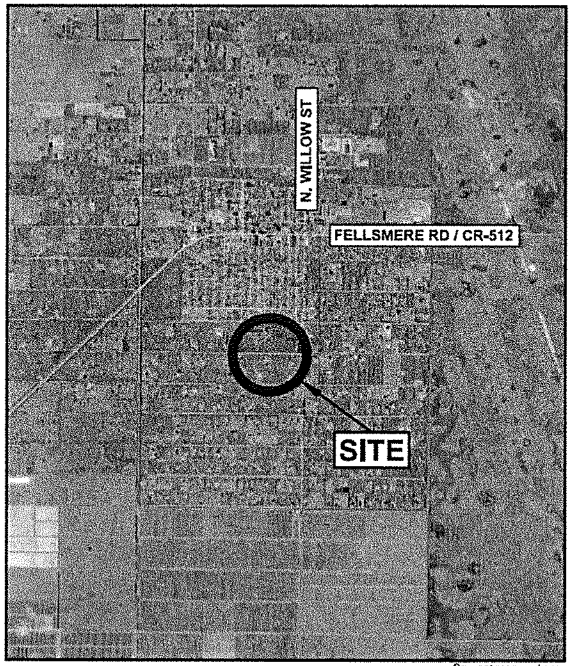
PETER GREGERS ANDERSEN
LICENSE
No. 57956
STATE OF FLORIDA
PROFESSIONAL ENGINEER
8-17-2015

Peter G. Andersen, P.E.
Principal Engineer
Fla. Reg. No. 57956

David P. Andre, P.E.
Principal Engineer
Fla. Reg. No. 53969
8/17/15

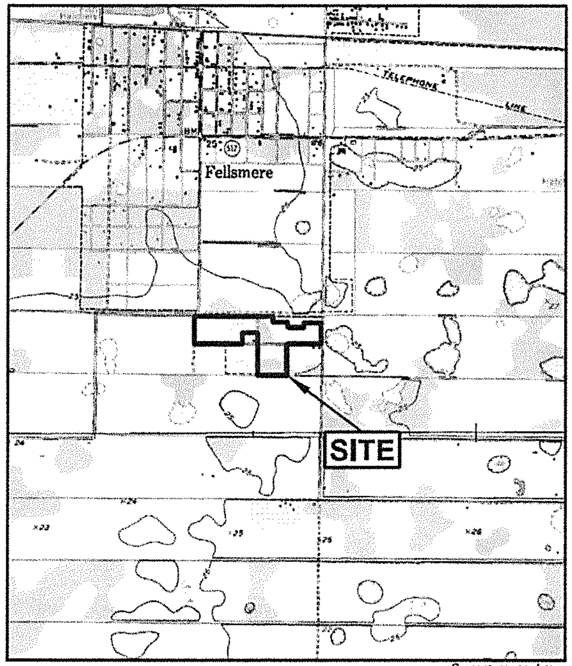
PGA/DPA:pa

2014 AERIAL PHOTOGRAPH



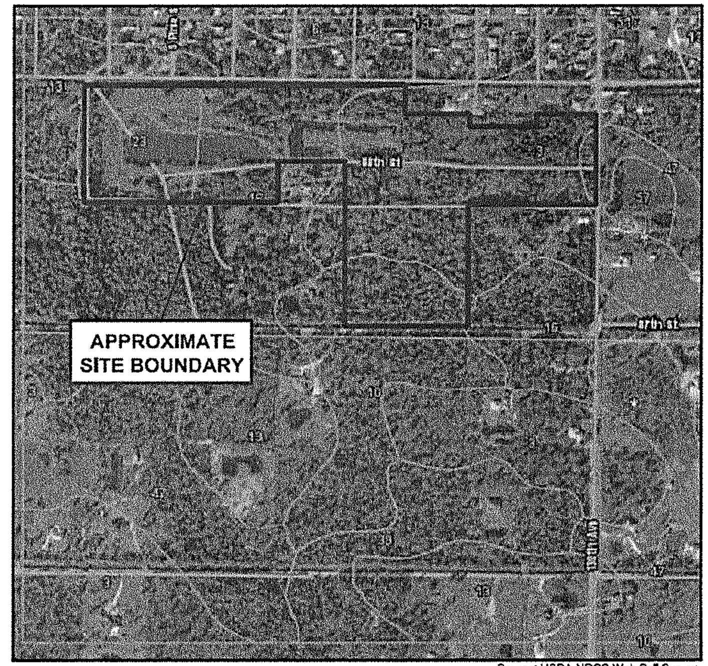
Source: mapcard.com

USGS TOPOGRAPHIC MAP
(1992 USGS Quadrangle Map of "Fellsmere, Florida")



Source: mapcard.com

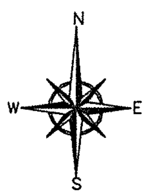
USDA SOIL SURVEY MAP



Source: USDA NRCS Web Soil Survey

USDA NRCS SOIL TYPES WITHIN SITE BOUNDARY

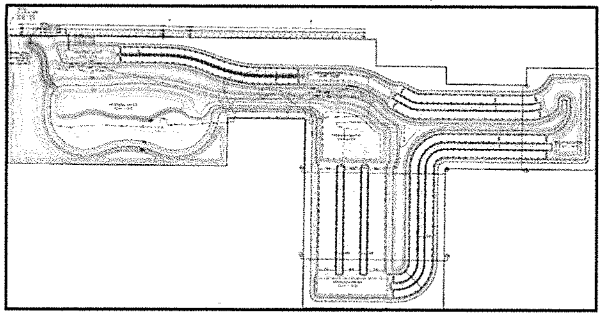
3: EauGallie fine sand
10: Riviera fine sand
13: Wabasso fine sand
16: Pineda sand
23: Arents, 0 to 5 percent slopes
47: Holopaw fine sand, 0 to 2 percent slopes



NOT TO SCALE

ANDERSEN ANDRE CONSULTING ENGINEERS, INC. 573 SW Biltmore Street, Port St. Lucie, FL 34983 772-807-9191 www.AACEInc.com Certificate of Authorization No. 26794	SITE VICINITY MAPS	GEOTECHNICAL ENGINEERING EVALUATION CITY OF FELLSMERE SOUTH REGIONAL LAKE FELLSMERE, INDIAN RIVER COUNTY, FLORIDA	Drawn by: PGA Checked by: DPA AACE File No: 15-158	Date: August 2015 Date: August 2015 Sheet No. 1

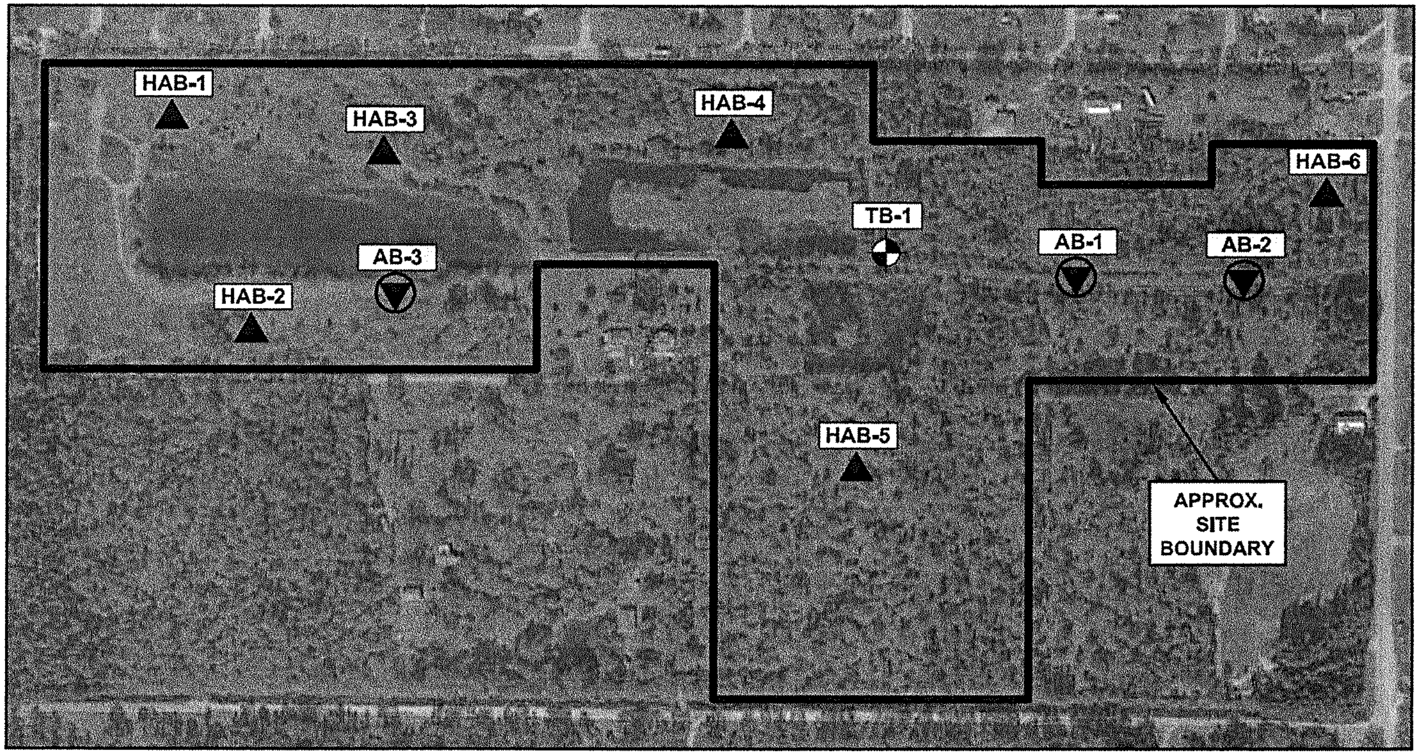
PROPOSED SITE PLAN (NOT TO SCALE)



Shown and noted field work locations are approximate. All field work locations were located using the provided site plan, obtained aerial photographs, existing site features, and WAAS-enabled GPS. The shown field work locations should be considered accurate only to the degree implied by the method of measurement used.

Sheet No. 2 Source: Site Plan by Carter Associates, Inc. and Google Earth Pro

CURRENT SITE CONDITIONS AND BORING LOCATION PLAN

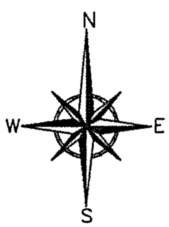


NOTES AND LEGEND

TB-# Standard Penetration Test Boring

AB-# Solid-Stem Auger Boring

HAB-# Hand Auger Boring

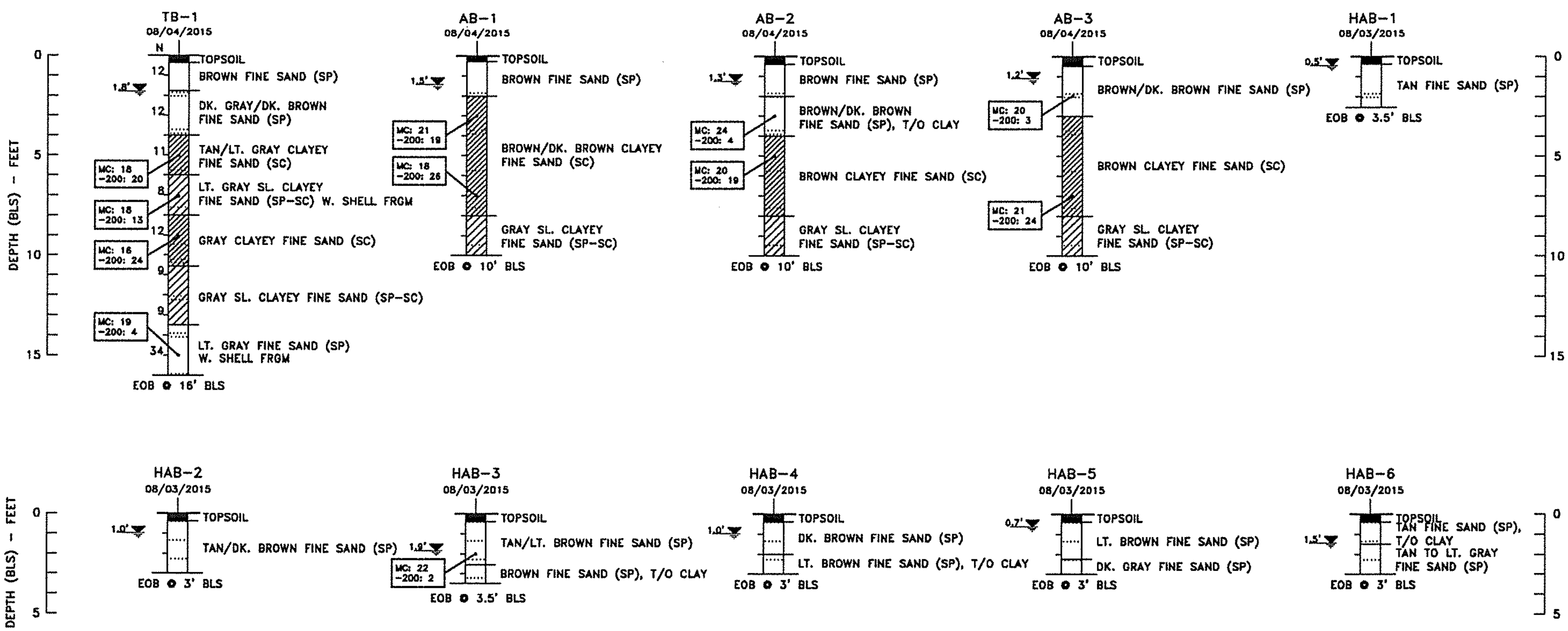


APPROXIMATE SCALE [11x17]: 1"=250'

0 125 250 500

FEET

ANDERSEN ANDRE CONSULTING ENGINEERS, INC. 573 SW Biltmore Street, Port St. Lucie, FL 34983 772-807-9191 www.AACEinc.com Certificate of Authorization No. 26794	FIELD WORK LOCATION PLAN	GEOTECHNICAL ENGINEERING EVALUATION CITY OF FELLSMERE SOUTH REGIONAL LAKE FELLSMERE, INDIAN RIVER COUNTY, FLORIDA	Drawn by: PGA Checked by: DPA AACE File No: 15-158	Date: August 2015 Date: August 2015 Sheet No. 2



LEGEND:

- TOPSOIL
- FINE SAND W. T/O SILT/CLAY (SP)
- SLIGHTLY CLAYEY FINE SAND (SP-SC)
- CLAYEY FINE SAND (SC)

NOTES:

TB-#	STANDARD PENETRATION TEST [SPT] BORING (ASTM D1586)
AB-#	SOLID-STEM AUGER BORING (ASTM D1452)
HAB-#	HAND AUGER BORING (ASTM D1452)
N	SPT RESISTANCE IN BLOWS PER FOOT
X.X'	GROUNDWATER TABLE (FT BELOW EXIST. GRADE) AT TIME DRILLED
EOB	END OF BORING
BLS	BELOW LAND SURFACE
GWT N.E.	GROUNDWATER TABLE NOT ENCOUNTERED
SP, SP-SC, SC:	UNIFIED SOIL CLASSIFICATION SYSTEM [USCS] USCS GROUPS DETERMINED BY VISUAL CLASSIFICATION EXCEPT FOR NOTED LABORATORY TESTS
MC	NATURAL MOISTURE CONTENT IN PERCENT (ASTM D2216)
-200	PERCENT PASSING NO. 200 SIEVE SIZE [PERCENT FINES] (ASTM D1140)

DRILL CREW FIRM: AACE
DRILL CREW CHIEF: RL
DRILL RIG: DIEDRICH D-25
SPT DRILL METHOD: ROTARY-WASH/BENTONITE SLURRY
SPT HAMMER TYPE: AUTOMATIC

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
573 SW Biltmore Street, Port St. Lucie, FL 34983 772-807-9191 www.AACEinc.com
Certificate of Authorization No. 26794

SOIL BORING PROFILES

GEOTECHNICAL ENGINEERING EVALUATION
CITY OF FELLSMERE
SOUTH REGIONAL LAKE
FELLSMERE, INDIAN RIVER COUNTY, FLORIDA

Drawn by: PGA	Date: August 2015
Checked by: DPA	Date: August 2015
AACE File No: 15-158	Sheet No. 3

APPENDIX I

USDA Web Soil Survey Summary Report

Soil Map—Indian River County, Florida
(Fellsmere South Regional Lake)

Map Scale: 1:4,600 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 15, 2010—Mar 13, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Indian River County, Florida (FL061)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
3	EauGallie fine sand	20.4	44.8%
10	Riviera fine sand	5.2	11.3%
13	Wabasso fine sand	0.4	0.8%
16	Pineda fine sand	10.6	23.2%
23	Arents, 0 to 5 percent slopes	8.4	18.4%
47	Holopaw fine sand, 0 to 2 percent slopes	0.7	1.5%
Totals for Area of Interest		**45.6**	**100.0%**

Indian River County, Florida

3—EauGallie fine sand

Map Unit Setting

National map unit symbol: tdfl
Elevation: 20 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Eaugallie, non-hydric, and similar soils: 80 percent
Eaugallie, hydric, and similar soils: 10 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Eaugallie, Non-hydric

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 26 inches: fine sand
Bh - 26 to 42 inches: fine sand
BE - 42 to 47 inches: fine sand
Btg - 47 to 62 inches: sandy clay loam
Cg - 62 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Description of Eaugallie, Hydric

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 26 inches: fine sand
Bh - 26 to 42 inches: fine sand
BE - 42 to 47 inches: fine sand
Btg - 47 to 62 inches: sandy clay loam
Cg - 62 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Minor Components

Myakka, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces

Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Oldsmar, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Wabasso, non-hydric

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Pepper, non-hydric

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

10—Riviera fine sand

Map Unit Setting

National map unit symbol: tdft
Elevation: 10 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Riviera and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riviera

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 26 inches: fine sand
Btg1 - 26 to 31 inches: sandy loam
Btg2 - 31 to 40 inches: sandy loam
Cg - 40 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Cabbage Palm Flatwoods (R155XY005FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Minor Components

Floridana

Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Winder

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Other vegetative classification: Wetland Hardwood Hammock (R155XY012FL), Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)

Wabasso, hydric

Percent of map unit: 2 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Holopaw

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Slough (R155XY011FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Oldsmar, hydric

Percent of map unit: 2 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Manatee

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL), Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)

Pineda

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Slough (R155XY011FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

13—Wabasso fine sand

Map Unit Setting

National map unit symbol: tdfx
Elevation: 0 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Wabasso, non-hydric, and similar soils: 70 percent
Wabasso, hydric, and similar soils: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wabasso, Non-hydric

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 7 inches: fine sand
E - 7 to 24 inches: fine sand
Bh - 24 to 35 inches: fine sand
Bt - 35 to 48 inches: sandy clay loam
Cg - 48 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Description of Wabasso, Hydric

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 7 inches: fine sand
E - 7 to 24 inches: fine sand
Bh - 24 to 35 inches: fine sand
Bt - 35 to 48 inches: sandy clay loam
Cg - 48 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Minor Components

Eaugallie, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces

Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Boca, non-hydric

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Riviera

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Cabbage Palm Flatwoods (R155XY005FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Winder

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Other vegetative classification: Wetland Hardwood Hammock (R155XY012FL), Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

16—Pineda fine sand

Map Unit Setting

National map unit symbol: tdg0
Elevation: 20 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Pineda and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pineda

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 9 inches: fine sand
Bw - 9 to 23 inches: fine sand
Btg - 23 to 40 inches: sandy loam
Cg - 40 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Slough (R155XY011FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Minor Components

Eaugallie, non-hydric
Percent of map unit: 4 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Wabasso, hydric
Percent of map unit: 4 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)

Riviera
Percent of map unit: 4 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Cabbage Palm Flatwoods (R155XY005FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL)

Winder
Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Other vegetative classification: Wetland Hardwood Hammock (R155XY012FL), Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

23—Arents, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: tdg6
Elevation: 20 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Arents and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arents

Setting

Landform: Rises on marine terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Altered marine deposits

Typical profile

C1 - 0 to 10 inches: sand
C2 - 10 to 32 inches: sand
C3 - 32 to 60 inches: sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A

Other vegetative classification: Forage suitability group not assigned (G156BC999FL)

Minor Components

Quartzipsamments

Percent of map unit: 5 percent
Landform: Rises on marine terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Forage suitability group not assigned (G156BC999FL)

Urban land

Percent of map unit: 5 percent
Landform: Marine terraces
Landform position (three-dimensional): Interfluve, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Forage suitability group not assigned (G156BC999FL)

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

Indian River County, Florida

47—Holopaw fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2vbpd
Elevation: 0 to 130 feet
Mean annual precipitation: 37 to 62 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 300 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Holopaw and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw

Setting

Landform: — error in exists on —
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
Eg - 6 to 42 inches: fine sand
Btg - 42 to 60 inches: fine sandy loam
Cg - 60 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w

Hydrologic Soil Group: A/D
Other vegetative classification: Slough (R155XY011FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)

Minor Components

Basinger

Percent of map unit: 6 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave

Oldsmar

Percent of map unit: 5 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex
Across-slope shape: Linear

Boca

Percent of map unit: 3 percent
Landform: — error in exists on —
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)

Riviera

Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave

Data Source Information

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 12, Sep 10, 2014

APPENDIX II

General Notes

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
SOIL BORING, SAMPLING AND TESTING METHODS

GENERAL

Andersen Andre Consulting Engineers, Inc. (AACE) borings describe subsurface conditions only at the locations drilled and at the time drilled. They provide no information about subsurface conditions below the bottom of the boreholes. At locations not explored, surface conditions that differ from those observed in the borings may exist and should be anticipated.

The information reported on our boring logs is based on our drillers' logs and on visual examination in our laboratory of disturbed soil samples recovered from the borings. The distinction shown on the logs between soil types is approximate only. The actual transition from one soil to another may be gradual and indistinct.

The groundwater depth shown on our boring logs is the water level the driller observed in the borehole when it was drilled. These water levels may have been influenced by the drilling procedures, especially in borings made by rotary drilling with bentonitic drilling mud. An accurate determination of groundwater level requires long-term observation of suitable monitoring wells. Fluctuations in groundwater levels throughout the year should be anticipated.

The absence of a groundwater level on certain logs indicates that no groundwater data is available. It does not mean that groundwater will not be encountered at that boring location at some other point in time.

STANDARD PENETRATION TEST

The Standard Penetration Test (SPT) is a widely accepted method of in situ testing of foundation soils (ASTM D-1586). A 2-foot (0.6m) long, 2-inch (50mm) O.D. split-barrell sampler attached to the end of a string of drilling rods is driven 24 inches (0.60m) into the ground by successive blows of a 140-pound (63.5 Kg) hammer freely dropping 30 inches (0.76m). The number of blows needed for each 6 inches (0.15m) increments penetration is recorded. The sum of the blows required for penetration of the middle two 6-inch (0.15m) increments of penetration constitutes the test result of N-value. After the test, the sampler is extracted from the ground and opened to allow visual description of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load. The following tables relate N-values to a qualitative description of soil density and, for cohesive soils, an approximate unconfined compressive strength (Qu):

Cohesionless Soils:	N-Value	Description
	0 to 4	Very loose
	4 to 10	Loose
	10 to 30	Medium dense
	30 to 50	Dense
	Above 50	Very dense

Cohesive Soils:	N-Value	Description	Qu
	0 to 2	Very soft	Below 0.25 tsf (25 kPa)
	2 to 4	Soft	0.25 to 0.50 tsf (25 to 50 kPa)
	4 to 8	Medium stiff	0.50 to 1.0 tsf (50 to 100 kPa)
	8 to 15	Stiff	1.0 to 2.0 tsf (100 to 200 kPa)
	15 to 30	Very stiff	2.0 to 4.0 tsf (200 to 400 kPa)
	Above 30	Hard	Above 4.0 tsf (400 kPa)

The tests are usually performed at 5 foot (1.5m) intervals. However, more frequent or continuous testing is done by AACE through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or prevent the loss of circulating fluid. After completion of a test borings, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed by backfilling, either with accumulated cuttings or lean cement.

Representative split-spoon samples from each sampling interval and from different strata are brought to our laboratory in air-tight jars for classification and testing, if necessary. Afterwards, the samples are discarded unless prior arrangement have been made.

POWER AUGER BORINGS

Auger borings (ASTM D-1452) are used when a relatively large, continuous sampling of soil strata close to the ground surface is desired. A 4-inch (100 mm) diameter, continuous flight, helical auger with a cutting head at its end is screwed into the ground in 5-foot (1.5m) sections. It is powered by the rotary drill rig. The sample is recovered by withdrawing the auger our of the ground without rotating it. The soil sample so obtained, is classified in the field and representative samples placed in bags or jars and returned to the AACE soils laboratory for classification and testing, if necessary.

HAND AUGER BORINGS

Hand auger borings are used, if soil conditions are favorable, when the soil strata are to be determined within a shallow (approximately 5-foot [1.5m]) depth or when access is not available to power drilling equipment. A 3-inch (75mm) diameter hand bucket auger with a cutting head is simultaneously turned and pressed into the ground. The bucket auger is retrieved at approximately 6-inch (0.15m) interval and its contents emptied for inspection. On occasion post-hole diggers are used, especially in the upper 3 feet (1m) or so. Penetrometer probings can be used in the upper 5 feet (1.5m) to determine the relative density of the soils. The soil sample obtained is described and representative samples put in bags or jars and transported to the AACE soils laboratory for classification and testing, if necessary.

UNDISTURBED SAMPLING

Undisturbed sampling (ASTM D-1587) implies the recovery of soil samples in a state as close to their natural condition as possible. Complete preservation of in situ conditions cannot be realized; however, with careful handling and proper sampling techniques, disturbance during sampling can be minimized for most geotechnical engineering purposes. Testing of undisturbed samples gives a more accurate estimate of in situ behavior than is possible with disturbed samples.

Normally, we obtain undisturbed samples by pushing a 2.875-inch (73 mm) I.D., thin wall seamless steel tube 24 inches (0.6 m) into the soil with a single stoke of a hydraulic ram. The sampler, which is a Shelby tube, is 30 (0.8 m) inches long. After the sampler is retrieved, the ends are sealed in the field and it is transported to our laboratory for visual description and testing, as needed.

ROCK CORING

In case rock strata is encountered and rock strength/continuity/composition information is needed for foundation or mining purposes, the rock can be cored (ASTM D-2113) and 2-inch to 4-inch diameter rock core samples be obtained for further laboratory analyses. The rock coring is performed through flush-joint steel casing temporarily installed through the overburden soils above the rock formation and also installed into the rock. The double- or triple-tube core barrels are advanced into the rock typically in 5-foot intervals and then retrieved to the surface. The barrel is then opened so that the core sample can be extruded. Preliminary field measurements of the recovered rock cores include percent recovery and Rock Quality Designation (RQD) values. The rock cores are placed in secure core boxes and then transported to our laboratory for further inspection and testing, as needed.

SFWMD EXFILTRATION TESTS

In order to estimate the hydraulic conductivity of the upper soils, constant head or falling head exfiltration tests can be performed. These tests are performed in accordance with methods described in the South Florida Water Management District (SFWMD) Permit Information Manual, Volume IV. In brief, a 6 to 9 inch diameter hole is augered to depths of about 5 to 7 feet; the bottom one foot is filled with 57-stone; and a 6-foot long slotted PVC pipe is lowered into the hole. The distance from the groundwater table and to the ground surface is recordedand the hole is then saturated for 10 minutes with the water level maintained at the ground surface.

If a constant head test is performed, the rate of pumping will be recorded at fixed intervals of 1 minute for a total of 10 minutes, following the saturation period.

LABORATORY TEST METHODS

Soil samples returned to the AACE soils laboratory are visually observed by a geotechnical engineer or a trained technician to obtain more accurate description of the soil strata. Laboratory testing is performed on selected samples as deemed necessary to aid in soil classification and to help define engineering properties of the soils. The test results are presented on the soil boring logs at the depths at which the respective sample was recovered, except that grain size distributions or selected other test results may be presented on separate tables, figures or plates as discussed in this report.

THE PROJECT SOIL DESCRIPTION PROCEDURE FOR SOUTHEAST FLORIDA

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

The soil descriptions shown on the logs are based upon visual-manual procedures in accordance with local practice. Soil classification is performed in general accordance with the United Soil Classification System and is also based on visual-manual procedures.

BOULDERS (>12" [300 MM]) and COBBLES (3" [75 MM] TO 12" [300 MM]):

GRAVEL:

Coarse Gravel:	3/4" (19 mm) to 3" (75 mm)
Fine Gravel:	No. 4 (4.75 mm) Sieve to 3/4" (19 mm)

Descriptive adjectives:

0 - 5%	– no mention of gravel in description
5 - 15%	– trace
15 - 29%	– some
30 - 49%	– gravelly (shell, limerock, cemented sands)

SANDS:

COARSE SAND: No. 10 (2 mm) Sieve to No. 4 (4.75 mm) Sieve
MEDIUM SAND: No. 40 (425 μm) Sieve to No. 10 (2 mm) Sieve
FINE SAND: No. 200 (75 μm) Sieve to No. 40 (425 μm) Sieve

Descriptive adjectives:

0 - 5%	– no mention of sand in description
5 - 15%	– trace
15 - 29%	– some
30 - 49%	– sandy

SILT/CLAY: < #200 (75μM) Sieve

SILTY OR SILT: PI $<$ 4
SILTY CLAYEY OR SILTY CLAY: $4 \leq$ PI ≤ 7
CLAYEY OR CLAY: PI $>$ 7

Descriptive adjectives:

< - 5%	– clean (no mention of silt or clay in description)
5 - 15%	– slightly
16 - 35%	– clayey, silty, or silty clayey
36 - 49%	– very

ORGANIC SOILS:

Organic Content	Descriptive Adjectives	Classification
0 - 2.5%	Usually no mention of organics in description	See Above
2.6 - 5%	slightly organic	add "with organic fines" to group name
5 - 30%	organic	SM with organic fines
		Organic Silt (OL)
		Organic Clay (OL)
		Organic Silt (OH)

THE PROJECT SOIL DESCRIPTION PROCEDURE FOR SOUTHEAST FLORIDA

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

Organic Clay (OH)

HIGHLY ORGANIC SOILS AND MATTER:

Organic Content	Descriptive Adjectives	Classification
30 - 75%	sandy peat	Peat (PT)
	silty peat	Peat (PT)
> 75%	amorphous peat	Peat (PT)
	fibrous peat	Peat (PT)

STRATIFICATION AND STRUCTURE:

Descriptive Term		Thickness
with interbedded		
seam	--	less than ½ inch (13 mm) thick
layer	--	½ to 12-inches (300 mm) thick
stratum	--	more than 12-inches (300 mm) thick
pocket	--	small, erratic deposit, usually less than 1-foot
lens	--	lenticular deposits
occasional	--	one or less per foot of thickness
frequent	--	more than one per foot of thickness
calcareous	--	containing calcium carbonate (reaction to diluted HCL)
hardpan	--	spodic horizon usually medium dense
marl	--	mixture of carbonate clays, silts, shells and sands

ROCK CLASSIFICATION (FLORIDA) CHART:

Symbol	Typical Description
LS	Hard Bedded Limestone or Caprock
WLS	Fractured or Weathered Limestone
LR	Limerock (gravel, sand, silt and clay mixture)
SLS	Stratified Limestone and Soils

THE PROJECT SOIL DESCRIPTION PROCEDURE FOR SOUTHEAST FLORIDA

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

LEGEND FOR BORING LOGS

N:	Number of blows to drive a 2-inch OD split spoon sampler 12 inches using a 140-pound hammer dropped 30 inches
R:	Refusal (less than six inches advance of the split spoon after 50 hammer blows)
MC:	Moisture content (percent of dry weight)
OC:	Organic content (percent of dry weight)
PL:	Moisture content at the plastic limit
LL:	Moisture content at the liquid limit
PI:	Plasticity index (LL-PL)
qu:	Unconfined compressive strength (tons per square foot, unless otherwise noted)
-200:	Percent passing a No. 200 sieve (200 wash)
+40:	Percent retained above a No. 40 sieve
US:	Undisturbed sample obtained with a thin-wall Shelby tube
k:	Permeability (feet per minute, unless otherwise noted)
DD:	Dry density (pounds per cubic foot)
TW:	Total unit weight (pounds per cubic foot)

APPENDIX III

Project Limitations and Conditions

ANDERSEN ANDRE CONSULTING ENGINEERS, INC.
(revised January 24, 2007)

Project Limitations and Conditions

Andersen Andre Consulting Engineers, Inc. has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made herein. Further, the report, in all cases, is subject to the following limitations and conditions:

VARIABLE/UNANTICIPATED SUBSURFACE CONDITIONS

The engineering analysis, evaluation and subsequent recommendations presented herein are based on the data obtained from our field explorations, at the specific locations explored on the dates indicated in the report. This report does not reflect any subsurface variations (e.g. soil types, groundwater levels, etc.) which may occur adjacent or between borings.

The nature and extent of any such variations may not become evident until construction/excavation commences. In the event such variations are encountered, Andersen Andre Consulting Engineers, Inc. may find it necessary to (1) perform additional subsurface explorations, (2) conduct in-the-field observations of encountered variations, and/or re-evaluate the conclusions and recommendations presented herein.

We at Andersen Andre Consulting Engineers, Inc. recommend that the project specifications necessitate the contractor immediately notifying Andersen Andre Consulting Engineers, Inc., the owner and the design engineer (if applicable) if subsurface conditions are encountered that are different from those presented in this report.

No claim by the contractor for any conditions differing from those expected in the plans and specifications, or presented in this report, should be allowed unless the contractor notifies the owner and Andersen Andre Consulting Engineers, Inc. of such differing site conditions. Additionally, we recommend that all foundation work and site improvements be observed by an Andersen Andre Consulting Engineers, Inc. representative.

SOIL STRATA CHANGES

Soil strata changes are indicated by a horizontal line on the soil boring profiles (boring logs) presented within this report. However, the actual strata's changes may be more gradual and indistinct. Where changes occur between soil samples, the locations of the changes must be estimated using the available information and may not be at the exact depth indicated.

SINKHOLE POTENTIAL

Unless specifically requested in writing, a subsurface exploration performed by Andersen Andre Consulting Engineers, Inc. is not intended to be an evaluation for sinkhole potential.

MISINTERPRETATION OF SUBSURFACE SOIL EXPLORATION REPORT

Andersen Andre Consulting Engineers, Inc. is responsible for the conclusions and recommendations presented herein, based upon the subsurface data obtained during this project. If others render conclusions or opinions, or make recommendations based upon the data presented in this report, those conclusions, opinions and/or recommendations are not the responsibility of Andersen Andre Consulting Engineers, Inc.

CHANGED STRUCTURE OR LOCATION

This report was prepared to assist the owner, architect and/or civil engineer in the design of the subject project. If any changes in the construction, design and/or location of the structures as discussed in this report are planned, or if any structures are included or added that are not discussed in this report, the conclusions and recommendations contained in this report may not be valid. All such changes in the project plans should be made known to Andersen Andre Consulting Engineers, Inc. for our subsequent re-evaluation.

USE OF REPORT BY BIDDERS

Bidders who are reviewing this report prior to submission of a bid are cautioned that this report was prepared to assist the owners and project designers. Bidders should coordinate their own subsurface explorations (e.g.; soil borings, test pits, etc.) for the purpose of determining any conditions that may affect construction operations. Andersen Andre Consulting Engineers, Inc. cannot be held responsible for any interpretations made using this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which may affect construction operations.

IN-THE-FIELD OBSERVATIONS

Andersen Andre Consulting Engineers, Inc. attempts to identify subsurface conditions, including soil stratigraphy, water levels, zones of lost circulation, "hard" or "soft" drilling, subsurface obstructions, etc. However, lack of mention in the report does not preclude the presence of such conditions.

LOCATION OF BURIED OBJECTS

Users of this report are cautioned that there was no requirement for Andersen Andre Consulting Engineers, Inc. to attempt to locate any man-made, underground objects during the course of this exploration, and that no attempts to locate any such objects were performed. Andersen Andre Consulting Engineers, Inc. cannot be responsible for any buried man-made objects which are subsequently encountered during construction.

PASSAGE OF TIME

This report reflects subsurface conditions that were encountered at the time/date indicated in the report. Significant changes can occur at the site during the passage of time. The user of the report recognizes the inherent risk in using the information presented herein after a reasonable amount of time has passed. We recommend the user of the report contact Andersen Andre Consulting Engineers, Inc. with any questions or concerns regarding this issue.

Important Information about Your

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.

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

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org