Report of Roadway Soil Survey

I-95 INTERCHANGE AT PIONEER TRAIL
PROJECT DEVELOPMENT AND ENVIRONMENT (PD&E) STUDY

Volusia County, Florida

Financial Project ID. 436292-1-22-01

GEC Project No. 4162G

Final
August 2020

Geotechnical and Environmental Consultants, Inc.
At the very foundation of our community

August 12, 2020

Stantec Inc.
11315 Corporate Boulevard Suite 105
Orlando, Florida 32817

Attention: Mr. Luis Diaz, P.E.
Principal

Subject: Report of Roadway Soil Survey
I-95 INTERCHANGE AT PIONEER TRAIL
PROJECT DEVELOPMENT AND ENVIRONMENT (PD&E) STUDY
Volusia County, Florida
FPID No. 436292-1-22-01
GEC Project No. 4162G

Dear Mr. Diaz:

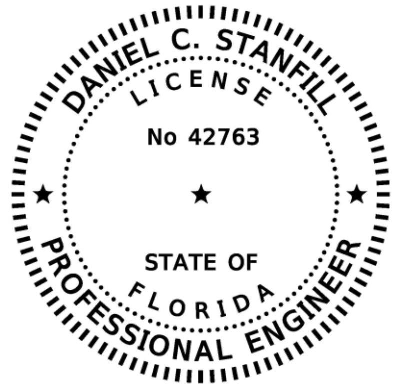
Geotechnical and Environmental Consultants, Inc. (GEC) is pleased to provide this Report of Roadway Soil Survey for the above-referenced project. This investigation was performed in general accordance with the scope of work presented in the FDOT Scope of Services for this project. The purpose of this investigation was to evaluate soil and groundwater conditions along project alignment of Pioneer Trail (CR 4118), I-95 (SR 9), stormwater ponds, floodplain compensation alternatives and use the information obtained to develop preliminary geotechnical engineering recommendations to guide design and construction of the proposed interchange improvements.

This report describes our exploration procedures, exhibits the data obtained, presents our preliminary conclusions and recommendations regarding the geotechnical engineering aspects of this project. The information in this report is subject to change as project plans develop.

GEC appreciates the opportunity to work with Stantec, and the Florida Department of Transportation (FDOT) District 5 on this project. Should there be any questions regarding the contents of this report, or if we may be of further assistance, please do not hesitate to contact us.

Very truly yours,

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
Certificate of Authorization No. 5882



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GPB/DCS/alc

cc: Mr. Victor Rivera, P.E. (FDOT District 5 – Geotechnical Engineer)

This Report has been digitally signed and sealed by Daniel C. Stanfill, P.E. on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

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1.0 SITE AND PROJECT DESCRIPTION

The project site is located in Volusia County at the I-95 (SR 9) and Pioneer Trail (CR 4118) interchange (MP. 19.032) in New Smyrna Beach, Florida. Pioneer Trail is a 2-lane, east-west, undivided roadway with 10 foot travel lanes and unpaved shoulders. The land use in the immediate project area is rural and transitions to residential at the eastern and western extents. The Pioneer Trail section extends from approximate Sta. 16+60 to 79+15, a distance of about 6,255 feet (or approximately 1.1 miles) and I-95 section that extends from Sta. 4676+81 to 4739+99, a distance of about 6,300 feet (or approximately 1.1 miles).

We understand the partial cloverleaf interchange plans include:

- Pioneer Trail – a four lane urban section, turn lanes for ramp access and improvements to the Turnbull Bay Road and Williamson Boulevard intersections
- Turnbull Bay Road – reconstruction of the roadway with signalization improvements
- Williamson Boulevard – milling and resurfacing of the intersection for pedestrian and signalization improvements
- I-95 (SR 9) – parallel acceleration/deceleration lanes and milling and resurfacing to accommodate ramp and bridge tie-in
- Signalization – two at the interchange ramps, one at Turnbull Bay Road and Williamson Boulevard
- Wet detention stormwater ponds (5 sites) and floodplain compensation areas (3 sites)

GEC's scope for this investigation was to evaluate soil and groundwater conditions along Pioneer Trail, ramps, I-95 acceleration/deceleration lanes, stormwater management areas and develop preliminary geotechnical engineering recommendations to guide design.

This preliminary report describes our exploration procedures, exhibits the data obtained and presents our preliminary conclusions and recommendations regarding the geotechnical engineering aspects of the roadway, ramps, and stormwater elements of this project. Geotechnical recommendations for bridge and retaining wall structures will be submitted under separate cover during final design.

2.0 REVIEW OF AVAILABLE DATA

To obtain general information on soil and groundwater conditions at the project site, GEC reviewed available data including the USGS Quadrangle Map, the Natural Resources Conservation Service (NRCS) Soil Survey of Volusia County and other published sources. A summary of this information is presented in the following report sections.

2.1 USGS Quadrangle Map

Based on review of the USGS Samsula, Florida Quadrangle map, the existing ground surface elevation at the project site ranges from +25 to +27 feet NGVD. The project site is predominately occupied by low-lying, marsh/swamp features. The project site is depicted on an excerpt of the U.S. Geological Survey (USGS) Samsula, Florida Quadrangle map (**Figure 1**) in the **Appendix**.

2.2 NRCS Soil Survey

The Natural Resources Conservation Service (NRCS) Soil Survey of Volusia County was reviewed to obtain near-surface soils information at the project site. The project site is shown on an excerpt of the NRCS Soil Survey map on **Figure 1** in the **Appendix**. The following NRCS Soil Survey soil types are identified at the project site.

Table 1
Volusia County NRCS Soil Units Summary

Unit No.	Soil Name	Depth (in)	Soil Description	AASHTO Classification Symbol	Depth to Seasonal High Groundwater (ft.)	Hydrologic Group
17	Daytona sand, 0 to 5 percent slopes	0 – 36 36 – 47 47 – 80	Sand Sand, fine sand, coarse sand Sand, fine sand, coarse sand	A-3 A-3, A-2-4 A-3	3.5 – 5.0	A
49	Pomona fine sand	0 – 5 5 – 50 50 – 60 60 – 70	Fine sand Sand, fine sand Fine sandy loam, sandy clay loam Fine sandy clay loam	A-3, A-2-4 A-3, A-2-4 A-2, A-4, A-6 A-2, A-4, A-6	0.0 – 1.0 (hydric) 0.5 – 1.5 (non-hydric)	A/D
51	Pomona – St. Johns complex	0 – 5 5 – 50 50 – 80	Fine sand Sand, fine sand Fine sandy loam, sandy clay loam	A-3, A-2-4 A-3, A-2-4 A-2, A-4, A-6	+2.0 – 0.0	A/D B/D
56	Samsula, frequently ponded, 0 to 1 percent slopes	0 – 32 32 – 80	Muck Sand, fine sand	A-3 A-3, A-2-4	+2.0 – 1.0	A/D
60	Smyrna-Smyrna, wet, fine sand, 0 to 2 percent slopes	0 – 17 17 – 27 27 – 80	Fine sand Loamy fine sand, fine sand Fine sand	A-3, A-2-4 A-2-4 A-3, A-2-4	0.0 – 0.5 (hydric) 0.5 – 3.5 (non-hydric)	A/D
62	St. Lucie sand, 0 to 5 percent slopes	0 – 80	Fine sand	A-3, A-2-4	> 6.0	A
63	Tavares fine sand, 0 to 5 percent slopes	0 – 6 6 – 80	Fine sand Fine sand, sand	A-3, A-2-4 A-3, A-2-4	3.5 – 5.0	A

NRCS Web Soil Survey referenced May 2019

In general, the soils at the project site are characterized as nearly level to sloping moderately drained to poorly drained sands. The soils classified as A-3 and A-2-4 can be treated as Select (S) soils for use as roadway embankment fill. However, the loamy soils classified as A-2, A-4, and A-6 will have limited suitability for use as fill material.

The NRCS soil survey predicts the seasonal high groundwater levels for these soil types to be 2 feet above the natural ground surface (ponded) to greater than 6 feet below the natural ground surface.

The NRCS Soil Survey also identifies Samsula, frequently ponded, 0 to 1 percent slopes (Soil Unit no. 56) near Ramp E, at approximate station 516+00 to 521+00. This soil type may contain high organic content soils (A-8), which can have severe limitations for roadway construction if left untreated.

Information contained in the NRCS Soil Survey is very general and may be outdated. It may not therefore be reflective of actual soil and groundwater conditions, particularly if recent development in the site vicinity has modified soil conditions or surface/subsurface drainage. The information obtained from the soil borings provides a better characterization of actual site conditions.

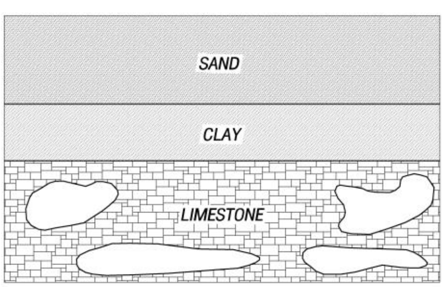
3.0 FDEP POTENTIOMETRIC MAP DATA

…the potentiometric surface of the Floridan Aquifer along the project site is approximately +8 feet NGVD.

According to the FDEP September, 2017 Potentiometric Contours map titled, "Upper Floridan Aquifer Potentiometric Surface", the potentiometric surface of the Floridan Aquifer at the project site is approximately +8 feet NGVD.

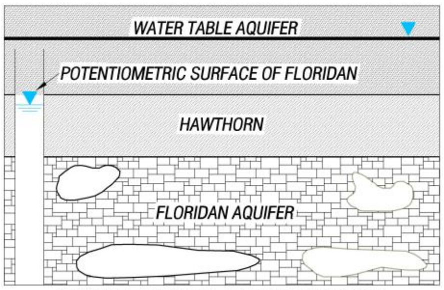
Since ground surface elevations at the project site ranges from approximately +25 to +27 feet NGVD, artesian flow conditions are not anticipated at the project site. Artesian flow conditions were not encountered in any of our borings during the field exploration program.

3.1 Regional Geology



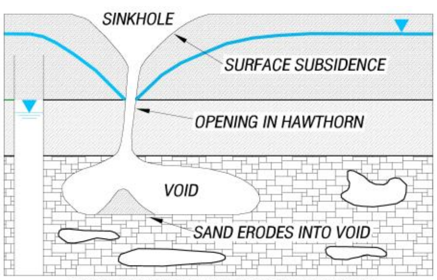
KARST GEOLOGY OF CENTRAL FLORIDA

Due to its prevalent geology, referred to as karst, Central Florida is prone to the formation of sinkholes, or large, circular depressions created by local subsidence of the ground surface. The nature and relationship of the three sedimentary layers typical of Central Florida geology cause sinkholes. The deepest, or basement, layer is a massive cavernous limestone formation known as the Floridan aquifer. The Floridan aquifer limestone is overlain by a silty or clayey sand, clay, phosphate, and limestone aquitard (or flow-retarding layer) ranging in thickness from nearly absent to greater than 100 feet and locally referred to as the Hawthorn formation. The Hawthorn formation is in turn overlain by a 40 to 70-foot thick surficial layer of sand, bearing the water table aquifer. The likelihood of sinkhole occurrence at a given site within the region is determined by the relationship among these three layers, specifically by the water (and soil)-transmitting capacity of the Hawthorn formation at that location.



CENTRAL FLORIDA AQUIFER SYSTEMS

The water table aquifer is comprised of Recent and Pleistocene sands and is separated from the Eocene limestone of the Floridan aquifer by the Miocene sands, clays and limestone of the Hawthorn formation. Since the thickness and consistency of the Hawthorn layer is variable across Central Florida, the likelihood of groundwater flow from the upper to the lower aquifer (known as aquifer recharge) will also vary by geographical location. In areas where the Hawthorn formation is absent, water table groundwater (and associated sands) can flow downward to cavities within the limestone aquifer, like sand through an hourglass, recharging the Floridan aquifer, and sometimes causing the formation of surface sinkholes. This process of subsurface erosion associated with recharging the Floridan aquifer is known as raveling. Thus, in Central Florida, areas of effective groundwater recharge to the Floridan aquifer have a higher potential for the formation of surface sinkholes.



SINKHOLE FORMATION MECHANISM

No method of geological, geotechnical, or geophysical exploration is known that can accurately predict the occurrence of sinkholes. It is common geotechnical practice in Central Florida to make a qualitative prediction of sinkhole risk on the basis of local geological conditions in the vicinity of a particular site.

> …the project site is located in an area where the relative risk of sinkhole formation is low to moderate…

Based on our review of the U.S. Geological Survey Map entitled "Recharge and Discharge Areas of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida," 1984, the project site lies in an area of low to moderate recharge and, therefore, we can conclude based solely on this data that the project site is located in an area where the relative risk of sinkhole formation is low to moderate compared to the overall risk across Central Florida.

4.0 SUBSURFACE EXPLORATION

In addition to consulting the sources of information previously discussed for regional and site-specific soils data, GEC conducted a subsurface exploration to evaluate soil and groundwater conditions at the project site.

4.1 Roadway and Ramps

Subsurface conditions along the Pioneer Trail and Ramp sections were typically evaluated by performing auger borings to a depth of 5 feet at 100-foot intervals and extended to a depth of 20 feet at 500-foot intervals along each respective alignment.

Sections of Ramp E and F were converted from auger borings to Standard Penetration Test (SPT) borings due to standing water. The boreholes were advanced by the rotary wash method with bentonite-based mud used as the circulating fluid to stabilize the borehole. These locations were performed to typical depths ranging 10 to 25 feet.

Locations near the bridge site that are expected to be placed in high fill were precluded at this time and will be explored as project plans progress with deeper Standard Penetration Test (SPT) high fill borings.

Manual muck probes were performed at two boring locations at Ramp H to evaluate the presence of surficial organic compressible soils. This area was inaccessible to amphibious mounted drill rig due to the extent of the very dense vegetation.

GEC also obtained 12 representative soil samples along the Pioneer Trail and Ramp alignments for Resilient Modulus (R_m) Testing.

4.2 Stormwater Ponds and Floodplain Compensation Alternatives

Subsurface conditions at stormwater pond sites and floodplain compensation areas were typically evaluated by performing auger borings to depths ranging from 10 to 20 feet.

4.3 Manual Auger Borings

GEC's engineering technician performed standard barrel manual auger borings, ASTM D-1452, by manually turning a 3-inch diameter, 6-inch long sampler into the soil until it was full. He then retrieved the sampler and visually examined and classified the soil. This procedure was repeated until the desired termination depth was achieved. Our technician collected representative samples for further visual examination and classification in our laboratory.

4.4 Machine Auger Borings

Machine auger borings were performed in general accordance with ASTM Procedure D-1452. Machine auger borings were performed by hydraulically turning a 4-inch wide continuous flight, solid-stem, auger into the ground in 5-foot increments until the desired boring termination depth was achieved. The auger flights were retrieved in 5-foot increments without further rotation and the soils retained on the auger were examined by our technician prior to collection of representative soil samples. The samples were placed in sealed jars and transported to GEC's laboratory for further examination and limited laboratory testing.

4.5 Groundwater Measurement

A GEC engineering technician measured the depth to the groundwater in the boreholes at the time of drilling and again after approximately 24 hours. Once the groundwater measurements were recorded, the boreholes were backfilled with soil cuttings to prevailing ground surface.

4.6 Boring Locations

Boring locations were established in the field using project plans provided by Stantec, and a handheld, sub-meter accuracy, Global Positioning Satellite (GPS) unit.

5.0 LABORATORY TESTING

Selected soil samples obtained from the borings were tested in accordance with Florida Standard Testing Methods (FM), American Association of State Highway Transportation Officials (AASHTO) testing methods and American Society for Testing and Materials (ASTM) testing methods. Our laboratory testing program is summarized in the following table:

Table 2
Laboratory Testing Program

Type of Test	ID No.
Grain Size Analysis	(AASHTO-T88)
Organic Content	(FM 1 – T267)
Natural Moisture Content	(AASHTO-T265)
Atterberg Limits	(AASHTO-T 89/90)
Corrosion Series	(FM 5-550/551/552/553)

The results of our laboratory testing for the roadway, ramps, stormwater ponds and floodplain compensation alternative borings are summarized on the Roadway Soil Survey sheet (**Figure 2**) and Summary of Laboratory Test Results table (**Table 7**) in the **Appendix**.

Corrosion series tests were performed on representative soil samples to evaluate the soil substructure and environmental classification. The corrosion series test results and the associated environmental classification are summarized on the Summary of Corrosion Series Test Results (**Table 8**) in the **Appendix**.

6.0 DESCRIPTION OF SUBSURFACE CONDITIONS

The results of our borings are presented on the Soil Boring Results sheets (**Figures 3 through 11**) in the **Appendix**. The soils encountered in the soil borings were classified in accordance with the American Association of State Highway and Transportation Officials (AASHTO) Soil Classification System (A-3, A-2-4, etc.). Soils were described using the ASTM soil descriptions (e.g., sand with silt). We based our classifications on visual examination and the limited laboratory testing performed.

The boring logs indicate subsurface conditions only at the specific boring locations at the time of our field exploration. Subsurface conditions, including groundwater levels, at other locations of the project site may differ from conditions we encountered at the boring locations. Moreover, conditions at the boring locations can change over time. Groundwater levels fluctuate seasonally, and soil conditions can be altered by earthmoving operations.

The depths and thicknesses of the subsurface strata indicated on the boring logs were interpolated between samples obtained at different depths in the borings. The actual transition between soil layers may be different than indicated. *These stratification lines were used for our analytical purposes and actual earthwork quantities measured during construction should be expected to vary from quantities calculated based on the information in this report.*

6.1 Soil Stratigraphy

The descriptions and stratum numbers used for the encountered soils are summarized as follows:

Table 3
Soil Stratigraphy

Stratum No.	Soil Description	AASHTO Classification
1	Brown to light brown to dark brown to gray fine sand to fine sand with silt, occasional trace organic material, trace to some roots, limerock, asphalt fragments, shell and cemented sand	A-3

Stratum No.	Soil Description	AASHTO Classification
2	Light brown to brown to light gray to gray fine sand with silt to silty fine sand, occasional trace organic material, trace to some roots, limerock, asphalt fragments and shell	A-2-4
3	Brown to gray clayey fine sand	A-2-6
4	Dark brown mucky fine sand to sandy muck	A-8
5	Brown to light brown to gray cemented fine sand to fine sand with silt (hardpan)	A-3
6	Brown to light brown to gray shelly fine sand to fine sand with silt	A-1-a, A-1-b

Soil strata shown on the roadway cross sections may vary from those in this soil survey report. Laboratory testing was in progress at the time of cross section development and will be updated accordingly for the next phase submittal.

For detailed results of the borings, please refer to the Soil Boring Results sheets (**Figures 3 through 11**) in the **Appendix**.

6.2 Roadway and Ramp Boring Results

In general, the roadway and ramps typically encountered fine sand with variable silt content (A-3, A-2-4) (Strata 1 and 2) to depths ranging from 3 to 20 feet below the existing ground surface. Auger borings converted to SPT borings ranged from loose to dense soil density (N-values ranged from 4 to 48 bpf). Dense materials were generally encountered between approximate depths of 8 to 15 feet with fine sands mixed with cemented sand (hardpan) and shelly material.

Occasional layers of trace organic material, trace to some roots, limerock, asphalt fragments, shell and cemented sand interbedded with sand soils were encountered at the project site.

An isolated layer of clayey fine sand (A-2-6) (Stratum 3) was encountered in boring RE-16 at a depth ranging from 4 to 6 feet.

Intermittent layers of organic (muck) soils (Stratum 4) were encountered as follows:

- Along Pioneer Trail in borings AB-3, AB-16, AB-19, AB-27 at depths ranging from 0 to 5 feet
- Along Ramps E, G, H and I in borings RE-18, RG2-12 to RG2-14, RG2-16 to RG2-19, RH2-2 to RH2-7 and RI-8 at depths ranging from 0 to 5 feet
- Borings RH2-8 and RH2-9 at Ramp H were manually probed to depths ranging from 1 to 1.5 feet

A cemented sand (hardpan) layer (Stratum 5) was encountered in borings AB-37, AB-38, AB-40 and AB-44 (approximate Sta. 66+00 to 70+00) along Pioneer Trail at depths ranging from 0 to 4 feet.

An isolated layer of shelly material (Stratum 6) was encountered in boring RE-16 along Ramp E at depths ranging from 13 to 23.5 feet.

The boring results are presented on the Soil Boring Results sheets (**Figures 3 through 11**) in the **Appendix**.

6.3 Stormwater Pond and Floodplain Compensation Alternatives

In general, the stormwater ponds and floodplain compensation alternatives typically encountered fine sand with variable silt content (A-3, A-2-4) (Strata 1 and 2) to depths ranging from 10 to 20 feet below the existing ground surface.

Occasional layers of trace organic material, trace to some roots, limerock, asphalt fragments shell and cemented sand interbedded with sand soils were encountered at the project site.

An isolated layer of clayey fine sand (A-2-6) (Stratum 3) was encountered within Floodplain Compensation Alternative 2 in boring FPC2-2 at depths ranging from 4 to 5 feet.

Intermittent layers of organic (muck) soils (Stratum 4) were encountered in borings PB-2 (Existing Pond), P3.3-9 and P3.3-10 (Pond 3.3) at depths ranging from 0 to 5 feet.

Shelly material (Stratum 5) was encountered within Pond 3.1 in boring P3.1-8 at depths ranging from 11 to 23 feet.

6.4 Groundwater Levels

The groundwater levels encountered at the project site are summarized in the table below:

Table 4
Summary of Groundwater Levels

Location	Measured Groundwater Levels (2/2020 – 4/2020) (feet)	[1]Groundwater Not Encountered (GNE)
Pioneer Trail	0 – 4.8	5 out of 54 locations
Ramps (E, F, G, H, I) and Acceleration/Deceleration Lanes	+0.5 – 7.4	13 out of 114 locations
Ponds/Floodplain Compensation	+1.0 – 4.4	---
1. Borings that did not encounter groundwater were performed to a depth of 5 feet.		

Groundwater levels can vary seasonally and with changes in subsurface conditions between boring locations. Alterations in surface and/or subsurface drainage brought about by site development can also affect groundwater levels. *Therefore, groundwater depths measured at different times or at different locations on the site can be expected to vary from those measured by GEC during this investigation.*

For purposes of this report, estimated seasonal high groundwater levels are defined as groundwater levels that are anticipated at the end of the wet season during a "normal rainfall" year under pre-development site conditions. We define a "normal rainfall" year as a year in which rainfall quantity and distribution were at or near historical averages.

Seasonal high groundwater levels are estimated to range from Above Ground Surface (AGS) to 4 feet…

Seasonal high groundwater levels are estimated to range from Above Ground Surface (AGS) to 4 feet below grade. Our encountered and estimated seasonal high groundwater levels are presented on the Soil Boring Results sheets (**Figures 3 through 11**) in the **Appendix**.

7.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

The preliminary conclusions and recommendations contained in this report are based in part on the data obtained from a limited number of widely-spaced borings. The investigation methods used indicate subsurface conditions only at the specific boring locations, only at the time they were performed, and only to the depths penetrated. Borings cannot be relied upon to accurately reflect the variations that usually exist between locations and these variations may not become evident until construction. If variations from the conditions described in this report do become evident during construction, or if project characteristics described in this report change, GEC should be retained so that we can reevaluate this report's conclusions and recommendations in light of such changes. We recommend that GEC be allowed to review the construction plans prior to bidding so that we can verify that our recommendations were properly interpreted.

7.1 Standard Roadway Embankment Construction

The results of our preliminary geotechnical investigation indicate that the majority of the near-surface soils at the project site are generally suitable for support of the roadway embankment construction. The soils encountered on this project should be utilized as follows:

Table 5
Embankment Soil Utilization

Stratum No.	AASHTO Classification	Embankment Soil Utilization (FDOT Index 120-001)
1	A-3	Select (S)
2	A-2-4	Select (S)
3	A-2-6	Plastic (P)
4	A-8	Muck (M)
5	A-3	Select (S)
6	A-1-a, A-1-b	Select (S)

The soils encountered in the borings performed at the project site classified as fine sand, fine sand with silt and silty fine sand (A-3, A-2-4) (Strata 1, 2, 5 and 6) should be treated as Select (S) material. Strata 2 and 5 material may retain excess moisture and may be difficult to dry and compact. Therefore, the contractor should be prepared to manipulate the moisture content of unstable subsoil as necessary to achieve stability and compaction requirements.

The soil layers classified as clayey fine sand (Stratum 3) should be considered Plastic (P). Where encountered during roadway embankment construction, these soils should be removed in accordance with the project plans and the FDOT Standard Plans, Index 120-002.

Organic soils (A-8) (Stratum 4) encountered along the roadway alignment should not be used in embankment construction. These organic soils should be excavated as indicated in Index 120-002 of the FDOT Design Standards unless shown as “To Remain” in the plans. **Delineation of organic soils and development of excavation limits on roadway plan cross-sections shall be performed during final design.**

Very dense, cemented and relatively impervious soils (locally referred to as hardpan) are present at the site. These soils are generally difficult to identify in auger borings and are often difficult to identify in SPT borings. Sometimes, their presence can be inferred from high N-values (often greater than 30 bpf) in SPT borings. However, cementation can also be present in layers with blow counts less than 30 bpf. The cemented sands (Stratum 5) can be treated as Select (S) but may be difficult to dewater, excavate and/or penetrate. Stratum 6 is shelly in nature, and can be treated as Select (S). Strata 5 and 6 may need to be pulverized prior to use as fill.

All fill soils placed for roadway construction should be selected in accordance with the FDOT Design Standards and FDOT Standard Plans Detail 120-001. In-place density tests should be performed on fill soils to verify the specified degree of compaction. The minimum test frequency should be in accordance with the FDOT Materials, Sampling, Testing and Reporting Guide.

7.2 Pavement Design

Twelve bulk soil samples obtained at the project site were delivered to the State Materials Office (SMO) for determination of an embankment resilient modulus (M_R) for pavement design. The samples were taken from Strata Nos. 1 (A-3) and 2 (A-2-4) which are the predominant shallow soil type encountered at our boring locations.

> The M_R test results… were combined to provide a single design embankment M_R value of 9,800 psi.

To obtain a design embankment resilient modulus for the embankment material, the SMO used the 90 Percent Method as outlined in both the Flexible Pavement Design Manual and Soils and Foundations Handbook. The M_R test results from the samples obtained along the roadway alignments were combined to provide a single design embankment M_R value of 9,800 psi. The results of the SMO analyses are included in **Appendix 1**.

Pavement design should be performed in accordance with the FDOT Design Manual (FDM) Section 224.17.1. Vertical clearance between the pavement base and the seasonal high groundwater levels should meet the minimum requirements detailed in the FDM Section 210.10.3.

After proper subsoil preparation, the pavement subgrade, base and surface courses should be constructed in accordance with current FDOT Standard Specifications for Road and Bridge Construction.

7.3 Stormwater Ponds and Floodplain Compensation Alternatives

In general, the stormwater pond and floodplain compensation borings typically encountered fine sand with variable silt content (A-3, A-2-4) (Strata 1, 2) to the maximum boring termination depth of 20 feet. However, plastic (A-2-6) (Stratum 3) and organic soils (A-8) (Stratum 4) were encountered at the following locations:

Table 6
Summary of Plastic and Organic Soils
At Pond and Floodplain Compensation Sites

Pond / FPC	Soil Utilization	Depth Range (feet)
Existing Pond	Muck (M)	3.0 – 5.0
Pond 3.3	Muck (M)	0.0 – 1.5
FPC 2	Plastic (P)	4.0 – 5.0

Plastic (Stratum 3) and organic (Stratum 4) soils are not suitable for use as fill and the cost associated with removal of these unsuitable fill materials should be considered in the selection of the preferred pond/FPC alternatives.

Based on the results of our subsurface exploration, **Figures 10 and 11** illustrate the encountered and estimated seasonal high groundwater levels for the borings performed within the proposed stormwater pond and floodplain compensation sites.

8.0 USE OF THIS REPORT

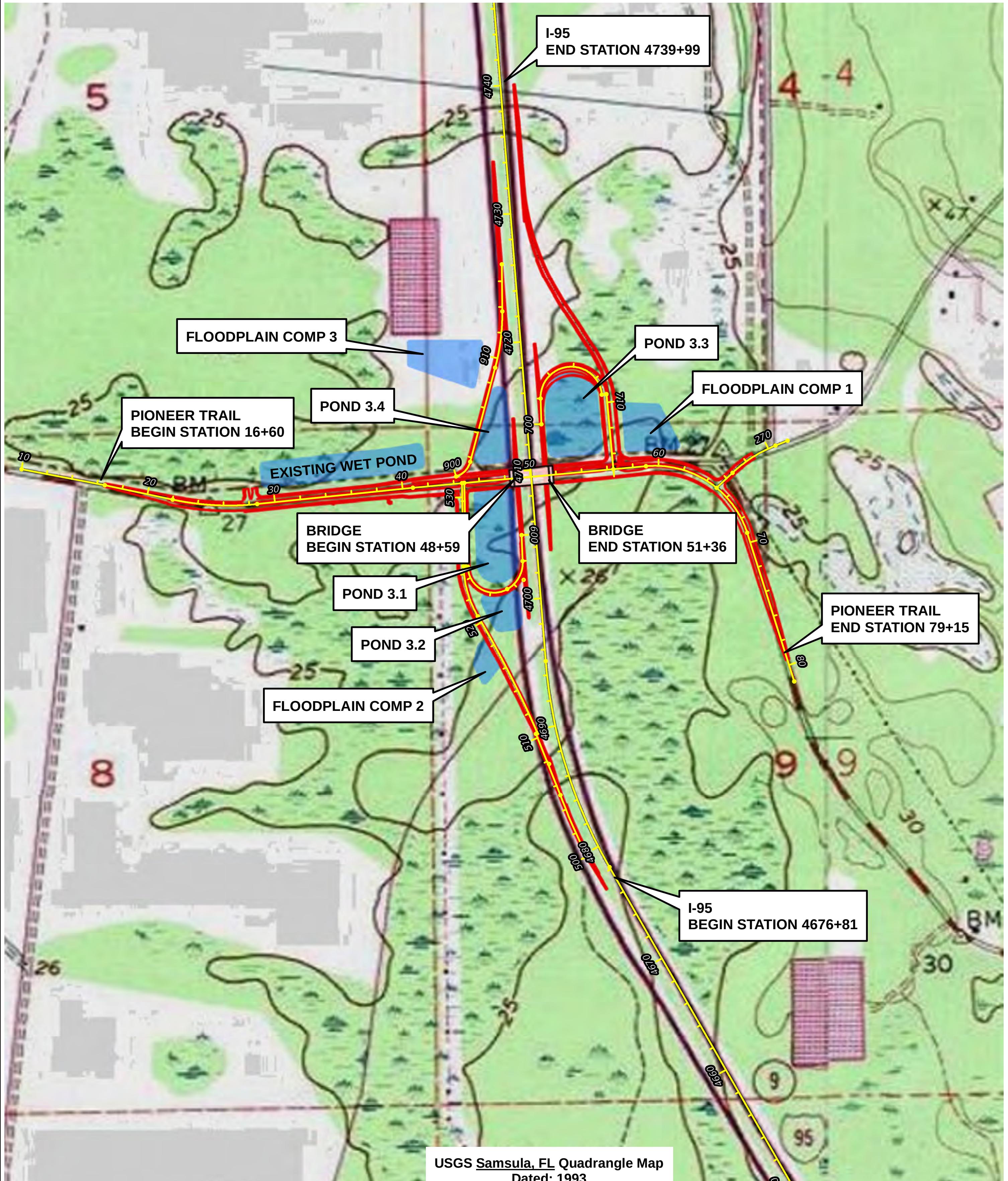
GEC has prepared this preliminary report for the exclusive use of our client, Stantec and the FDOT District 5, and for specific application to this project. GEC will not be held responsible for any other party's interpretation or use of this report's subsurface data or engineering analysis without our written authorization.

The sole purpose of the borings performed by GEC at this site was to obtain indications of subsurface conditions as part of a geotechnical exploration program. GEC has not evaluated the soil from the borings for the potential presence of contaminated soil or groundwater, nor have we subjected any soil samples to analysis for contaminants.

GEC has strived to provide the services described in this report in a manner consistent with that level of care and skill ordinarily exercised by members of our profession currently practicing in Florida. No other representation is made or implied in this document.

APPENDIX

USGS QUADRANGLE AND NRCS SOIL SURVEY MAPS



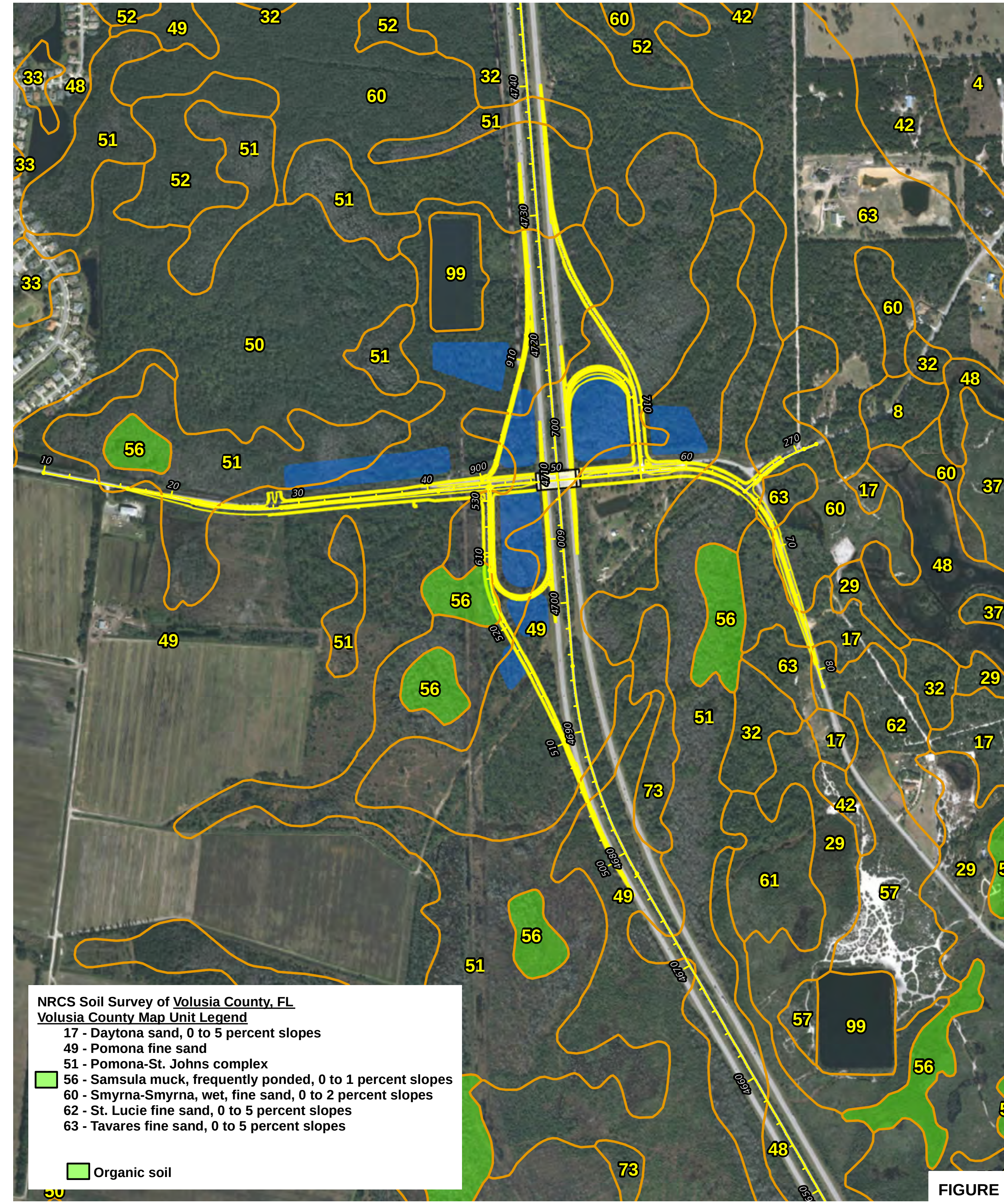


FIGURE 1

N

0 500 1,000
Feet

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

USGS QUADRANGLE AND NRCS SOIL SURVEY MAPS

SHEET NO.

W:\Projects\J4162G1E1 I-95 at Pioneer Trail Final Design\Geotechnical\7 CADD Files\4162G\4162Gquad.mxd 8/11/2020

ROADWAY SOIL SURVEY

DATE OF SURVEY: FEBRUARY, MARCH AND APRIL 2020
SURVEY MADE BY: GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
SUBMITTED BY: DANIEL C. STANFILL, P.E.

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

DISTRICT: 5
ROAD NO.: SR 9
COUNTY: VOLUSIA

FINANCIAL PROJECT ID: 436292-1-22-01
PROJECT NAME: I-95 INTERCHANGE AT PIONEER TRAIL
PROJECT DEVELOPMENT AND ENVIRONMENT (PD&E) STUDY

CROSS SECTION SOIL SURVEY FOR THE DESIGN OF ROADS AND PONDS

	ORGANIC CONTENT		MOISTURE CONTENT		SIEVE ANALYSIS RESULTS PERCENT PASS (%)						ATTERBERG LIMITS (%)					CORROSION TEST RESULTS				
STRATUM NO.	NO. OF TESTS	% ORGANIC	NO. OF TESTS	MOISTURE CONTENT	NO. OF TESTS	10 MESH	40 MESH	60 MESH	100 MESH	200 MESH	NO. OF TESTS	LIQUID LIMIT	PLASTIC INDEX	AASHTO GROUP	DESCRIPTION	NO. OF TESTS	RESISTIVITY ohm-cm	CHLORIDE ppm	SULFATES ppm	pH
1	2	3.8-4.7	2	20-26	61(FULL)	90-100	63-99	36-93	4-53	2-10	0	-	-	A-3	BROWN TO LIGHT BROWN TO DARK BROWN TO GRAY FINE SAND TO FINE SAND WITH SILT, OCCASIONAL TRACE ORGANIC MATERIAL, TRACE TO SOME ROOTS, LIMEROCK, ASPHALT FRAGMENTS, SHELL, AND CEMENTED SAND	25	1,500-23,000	15-90	<6-129	4.5-8.4
2	2	3.3-4.3	9	17-42	29(FULL)	81-100	53-99	45-94	26-56	11-29	7	NP-28	NP-10	A-2-4	LIGHT BROWN TO BROWN TO LIGHT GRAY TO GRAY FINE SAND WITH SILT TO SILTY FINE SAND, OCCASIONAL TRACE ORGANIC MATERIAL, TRACE TO SOME ROOTS, LIMEROCK, ASPHALT FRAGMENTS, AND SHELL	8	1,900-12,000	15-60	<6-198	4.4-8.3
3	0	-	2	20-23	2(FULL)	100	91-95	77-80	44-45	23-24	2	31-34	13-17	A-2-6	BROWN TO GRAY CLAYEY FINE SAND	1	4,300	15	<6	6.1
4	11	7.1-46.0	11	18-225	11(FULL)	100	90-100	72-98	25-95	11-53	0	-	-	A-8	DARK BROWN MUCKY FINE SAND TO SANDY MUCK	2	6,800-25,000	30-45	<6	4.7-5.0
5	0	-	0	-	1(FULL)	95	82	63	21	5	0	-	-	A-3	BROWN TO LIGHT BROWN TO GRAY CEMENTED FINE SAND TO FINE SAND WITH SILT (HARDPAN)	0	-	-	-	-
6	0	-	0	-	2(FULL)	96	28-47	15-25	7-11	3-5	0	-	-	A-1-a, A-1-b	BROWN TO LIGHT BROWN TO GRAY SHELLY FINE SAND TO FINE SAND WITH SILT	0	-	-	-	-

NOTES

1. STRATA BOUNDARIES ARE APPROXIMATE AND REPRESENT SOIL STRATA AT EACH BORING LOCATION ONLY. ANY STRATUM CONNECTING LINES SHOWN ARE FOR ESTIMATING EARTHWORK ONLY AND DO NOT INDICATE ACTUAL STRATUM LIMITS. SUBSURFACE VARIATIONS BETWEEN BORINGS SHOULD BE ANTICIPATED AS INDICATED IN SECTION 2.4. FOR FURTHER DETAILS SEE SECTION 120-3.
2. GROUNDWATER LEVEL SHOWN AS ▼ WHERE ENCOUNTERED AT TIME OF SURVEY. ESTIMATED SEASONAL HIGH GROUNDWATER LEVEL TO BE SHOWN AS ▽ . ESTIMATED SEASONAL HIGH GROUNDWATER LEVEL ABOVE THE GROUND SURFACE SHOWN AS ▽ AGS . GROUNDWATER NOT ENCOUNTERED SHOWN AS "GNE".
3. REMOVAL OF MUCK AND PLASTIC MATERIAL OCCURING WITHIN THE ROADWAY SHALL BE ACCOMPLISHED IN ACCORDANCE WITH STANDARD PLANS, INDEX 120-002, OF THE FDOT DESIGN STANDARDS UNLESS OTHERWISE SHOWN ON THE PLANS. THE MATERIAL USED IN EMBANKMENT CONSTRUCTION SHALL BE IN ACCORDANCE WITH STANDARD PLANS, INDEX 120-001, OF THE FDOT DESIGN STANDARDS.
4. SOIL ANALYSIS INCLUDES DATA FROM PROPOSED ROADWAY, STORMWATER POND AND FLOODPLAIN COMPENSATION AREAS.
5. THE SYMBOL "-" REPRESENTS AN UNMEASURED PARAMETER.
6. THE SYMBOL "NP" REPRESENTS NON-PLASTIC.
7. STRATA 1, 2, 5 AND 6 SHALL BE TREATED AS SELECT (S) MATERIAL, IN ACCORDANCE WITH STANDARD PLANS, INDEX 120-001.
8. STRATA 2 AND 5 MAY RETAIN EXCESS MOISTURE AND MAY BE DIFFICULT TO DRY AND COMPACT.
9. STRATUM 3 SHALL BE TREATED AS PLASTIC (P) MATERIAL, IN ACCORDANCE WITH STANDARD PLANS, INDEX 120-001.
10. STRATUM 4 SHALL BE TREATED AS MUCK (M) MATERIAL, IN ACCORDANCE WITH STANDARD PLANS, INDEX 120-001.
11. STRATA 5 AND 6 MAY BE DIFFICULT TO DEWATER AND/OR PENETRATE AND MAY REQUIRE SPECIAL EQUIPMENT AND/OR PROCEDURES TO FACILITATE EXCAVATION AND/OR PENETRATION. STRATA 5 AND 6 CAN BE TREATED AS SELECT (S) MATERIAL BUT MAY NEED TO BE PULVERIZED PRIOR TO USE AS FILL.
12. LAYERS OF VERY HARD MATERIAL SUCH AS HARDPAN, CEMENTED SAND, ETC MAY BE ENCOUNTERED IN VARIOUS AREAS OF THE PROJECT. SUCH MATERIALS WILL BE DIFFICULT TO EXCAVATE OR PENETRATE. THE CONTRACTOR SHALL EXPECT TO ENCOUNTER THESE VERY HARD MATERIALS IN ALL EXCAVATIONS AND SHALL USE SPECIALIZED EQUIPMENT AND/OR PROCEDURES AS NECESSARY TO FACILITATE EXCAVATION AND/OR PENETRATION.

FIGURE 2

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

DANIEL C. STANFILL, P.E.
P.E. LICENSE NUMBER 42763
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
919 LAKE BALDWIN LANE
ORLANDO, FL 32814

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

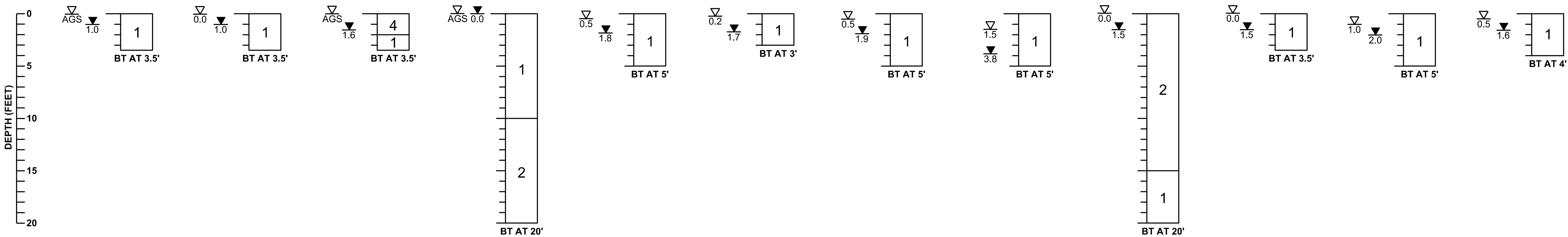
ROADWAY SOIL SURVEY

SHEET NO.

SOIL BORING RESULTS

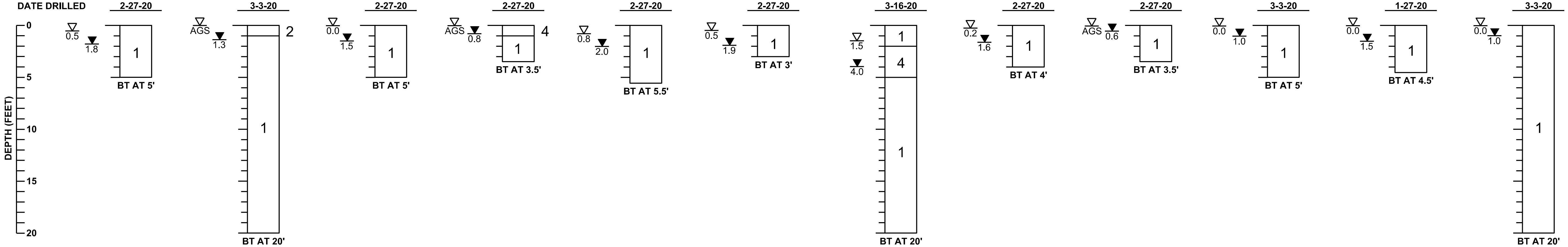
PIONEER TRAIL

BORING NO.	AB-1	AB-2	AB-3	AB-4	AB-5	AB-6	AB-7	AB-8	AB-9	AB-10	AB-11	AB-12
STATION	17+00	18+00	19+00	20+00	21+00	22+00	23+00	24+00	25+00	26+00	27+10	28+00
OFFSET	17' LEFT	15' RIGHT	24' LEFT	36' RIGHT	28' LEFT	28' RIGHT	28' LEFT	18' RIGHT	28' LEFT	28' RIGHT	36' LEFT	36' RIGHT
DATE DRILLED	2-27-20	2-27-20	2-27-20	3-2-20	2-27-20	4-7-20	2-27-20	2-27-20	4-7-20	2-27-20	2-27-20	2-27-20



PIONEER TRAIL

	AB-13	AB-14	AB-15	AB-16	AB-17	AB-18	AB-19	AB-20	AB-21	AB-22	AB-23	AB-24
STATION	29+05	30+00	31+00	32+00	33+00	34+00	35+00	36+00	37+00	38+00	39+00	40+00
OFFSET	49' LEFT	17' RIGHT	59' LEFT	37' RIGHT	32' LEFT	27' RIGHT	20' LEFT	10' RIGHT	40' LEFT	56' RIGHT	21' LEFT	53' RIGHT
DATE DRILLED	2-27-20	3-3-20	2-27-20	2-27-20	2-27-20	2-27-20	3-16-20	2-27-20	2-27-20	3-3-20	1-27-20	3-3-20



BORING LEGEND

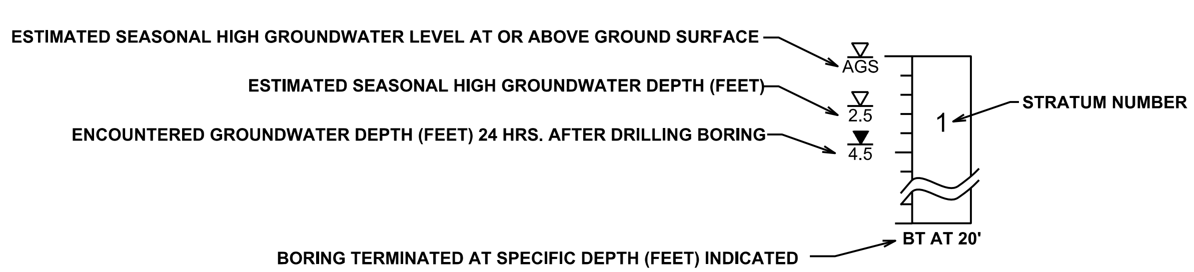


FIGURE 3

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

DANIEL C. STANFILL, P.E.
P.E. LICENSE NUMBER 42763
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
919 LAKE BALDWIN LANE
ORLANDO, FL 32814

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

SOIL BORING RESULTS

SHEET NO.

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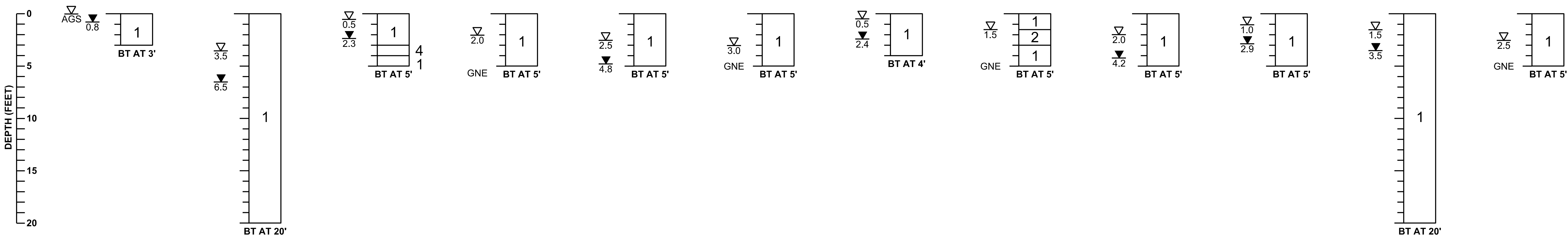
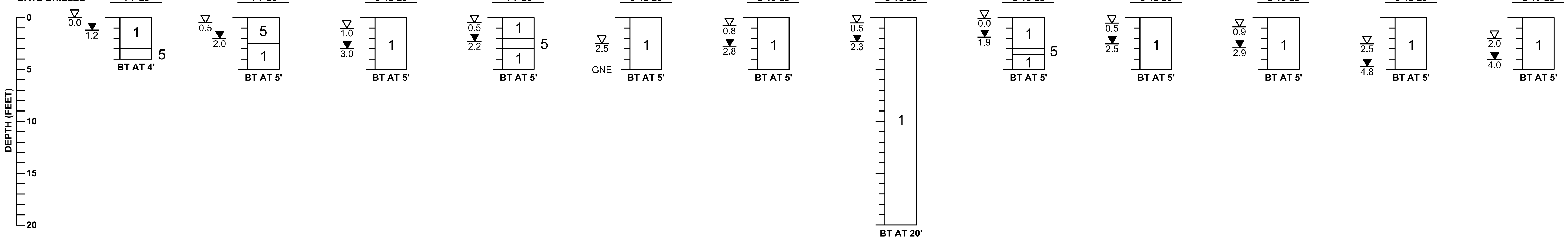
PIONEER TRAIL

BORING NO.	AB-25	AB-26	AB-27	AB-28	AB-29	AB-30	AB-31	AB-32	AB-33	AB-34	AB-35	AB-36
STATION	41+32	60+00	61+00	62+00	62+00	63+00	63+00	64+00	64+00	64+70	64+73	66+00
OFFSET	57' LEFT	58' LEFT	28' RIGHT	40' LEFT	20' RIGHT	43' LEFT	43' RIGHT	38' LEFT	15' RIGHT	47' LEFT	21' RIGHT	40' LEFT
DATE DRILLED	2-27-20	3-5-20	2-22-20	2-27-20	4-7-20	2-27-20	2-27-20	2-27-20	4-7-20	2-27-20	3-18-20	3-18-20



PIONEER TRAIL

BORING NO.	AB-37	AB-38	AB-39	AB-40	AB-41	AB-42	AB-43	AB-44	AB+45	AB-46	AB-47	AB-48
STATION	66+00	67+00	68+00	68+00	69+00	69+00	70+00	70+00	71+00	72+20	73+45	74+21
OFFSET	52' RIGHT	24' RIGHT	40' LEFT	35' RIGHT	20' LEFT	48' RIGHT	39' LEFT	38' RIGHT	32' RIGHT	28' LEFT	31' RIGHT	19' LEFT
DATE DRILLED	4-7-20	4-7-20	3-18-20	4-7-20	3-18-20	3-18-20	3-16-20	3-18-20	3-18-20	3-18-20	3-18-20	3-17-20



BORING LEGEND

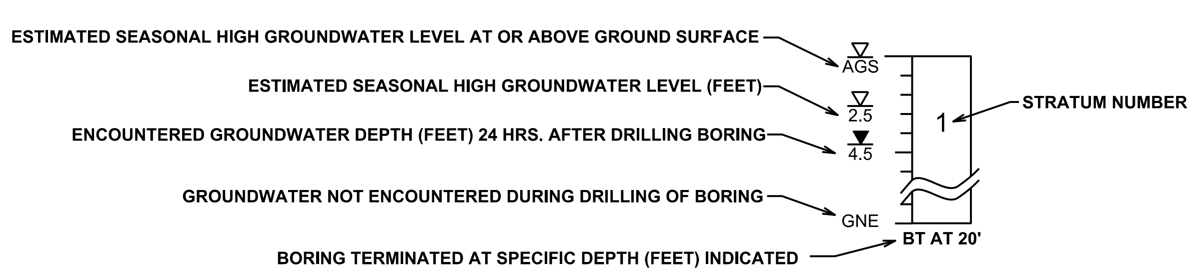


FIGURE 4

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

DANIEL C. STANFILL, P.E.
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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

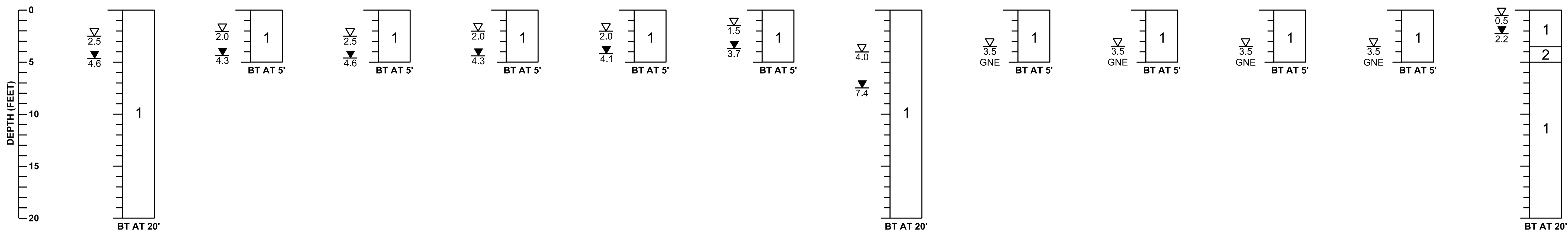
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

SOIL BORING RESULTS

SHEET NO.

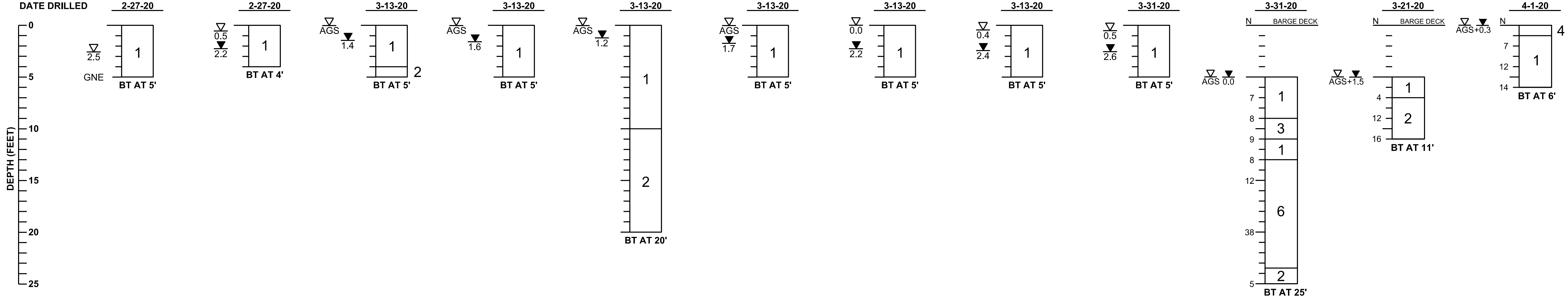
PIONEER TRAIL / RAMP E

BORING NO.	AB-49	AB-50	AB-51	AB-52	AB-53	AB-54	RE-1	RE-2	RE-3	RE-4	RE-5	RE-6
STATION	75+28	76+50	77+25	77+73	79+00	80+00	500+00	501+00	502+00	503+00	504+00	505+00
OFFSET	67' RIGHT	31' LEFT	37' RIGHT	23' LEFT	30' RIGHT	20' LEFT	7' LEFT	C/L	11' LEFT	9' RIGHT	C/L	10' LEFT
DATE DRILLED	3-16-20	3-17-20	3-18-20	3-17-20	3-16-20	3-16-20	3-13-20	2-27-20	2-27-20	2-27-20	2-27-20	3-13-20

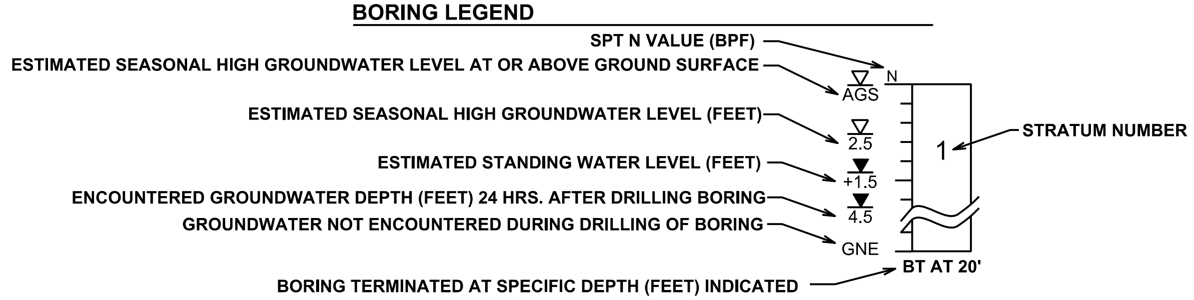


RAMP E

BORING NO.	RE-7	RE-8	RE-9	RE-10	RE-11	RE-12	RE-13	RE-14	RE-15	RE-16	RE-17	RE-18
STATION	506+00	507+00	508+00	509+00	510+00	511+00	512+00	513+00	514+00	515+00	516+00	517+00
OFFSET	26' RIGHT	12' RIGHT	7' LEFT	7' RIGHT	22' RIGHT	37' RIGHT	18' RIGHT	6' RIGHT	9' LEFT	7' RIGHT	27' RIGHT	13' RIGHT
DATE DRILLED	2-27-20	2-27-20	3-13-20	3-13-20	3-13-20	3-13-20	3-13-20	3-13-20	3-31-20	3-31-20	3-21-20	4-1-20



BORING LEGEND



CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY OF SOIL

GRANULAR SOILS	MANUAL HAMMER (SAFETY) N VALUE (blows per foot)	RELATIVE DENSITY
SANDS	0-4	VERY LOOSE
	4-10	LOOSE
	10-30	MEDIUM DENSE
	30-50	DENSE
	OVER 50	VERY DENSE

NON-GRANULAR SOILS	MANUAL HAMMER (SAFETY) N VALUE (blows per foot)	CONSISTENCY
SILTS, CLAYS, MUCK, PEAT	0-2	VERY SOFT
	2-4	SOFT
	4-8	FIRM
	8-15	STIFF
	15-30	VERY STIFF
	OVER 30	HARD

FIGURE 5

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

DANIEL C. STANFILL, P.E.
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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
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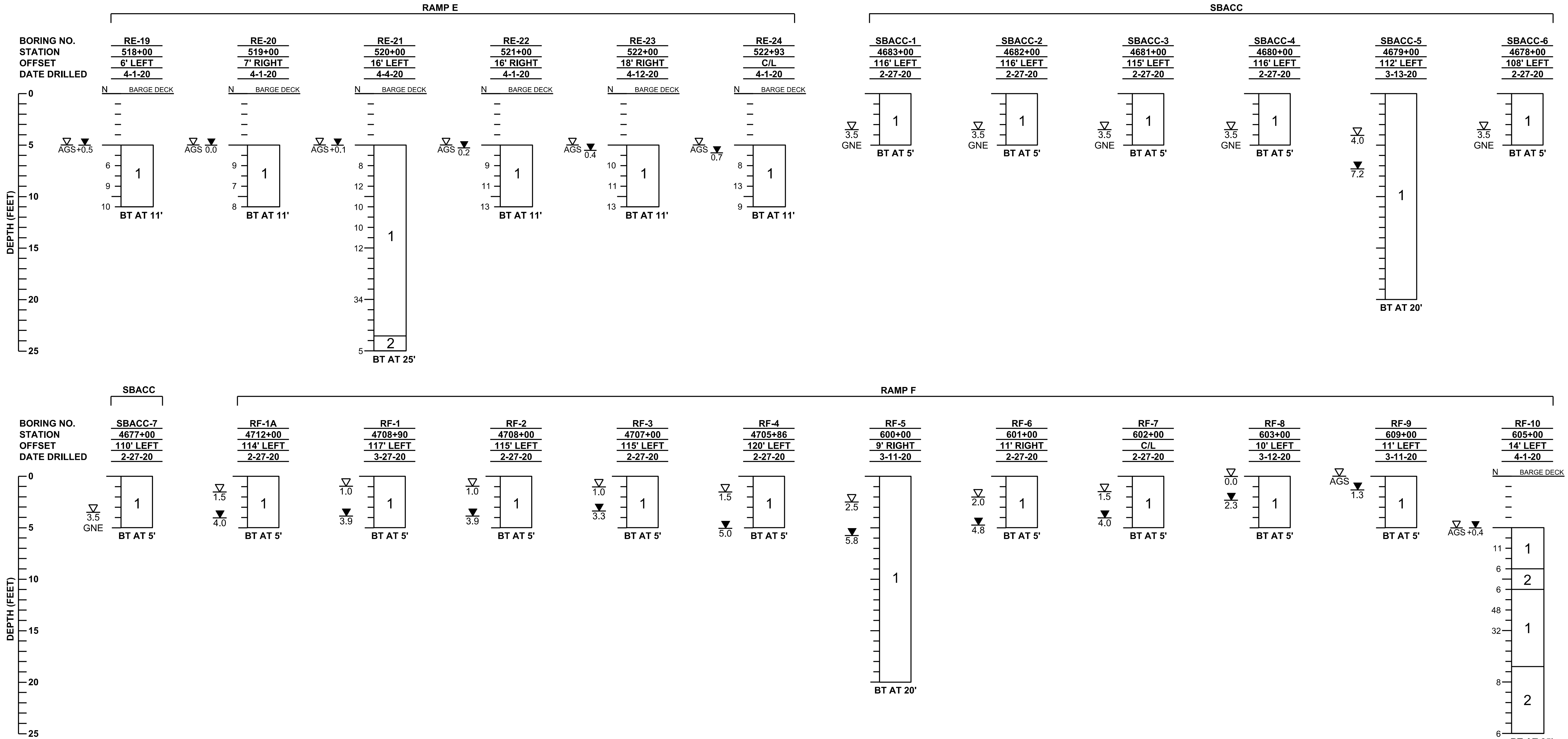
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

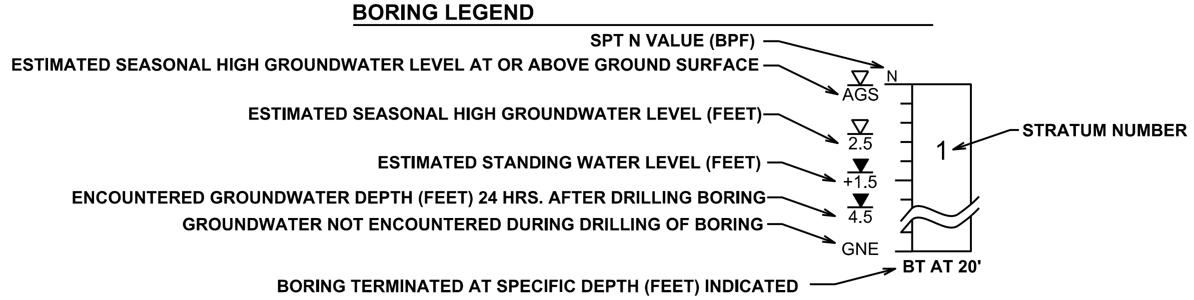
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

SOIL BORING RESULTS

SHEET NO.



BORING LEGEND



CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY OF SOIL

GRANULAR SOILS	MANUAL HAMMER (SAFETY) N VALUE (blows per foot)	RELATIVE DENSITY
SANDS	0-4	VERY LOOSE
	4-10	LOOSE
	10-30	MEDIUM DENSE
	30-50	DENSE
	OVER 50	VERY DENSE

NON-GRANULAR SOILS	MANUAL HAMMER (SAFETY) N VALUE (blows per foot)	CONSISTENCY
SILTS, CLAYS, MUCK, PEAT	0-2	VERY SOFT
	2-4	SOFT
	4-8	FIRM
	8-15	STIFF
	15-30	VERY STIFF
	OVER 30	HARD

FIGURE 6

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

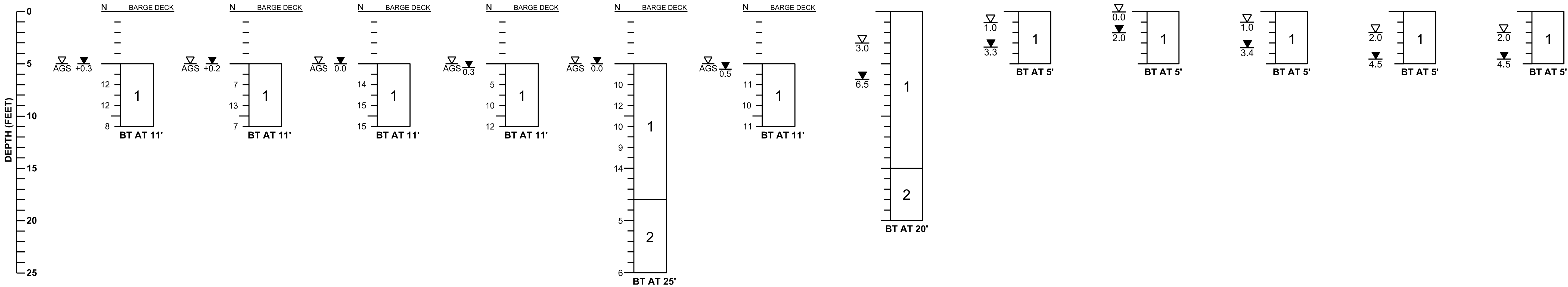
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

SOIL BORING RESULTS

SHEET NO.

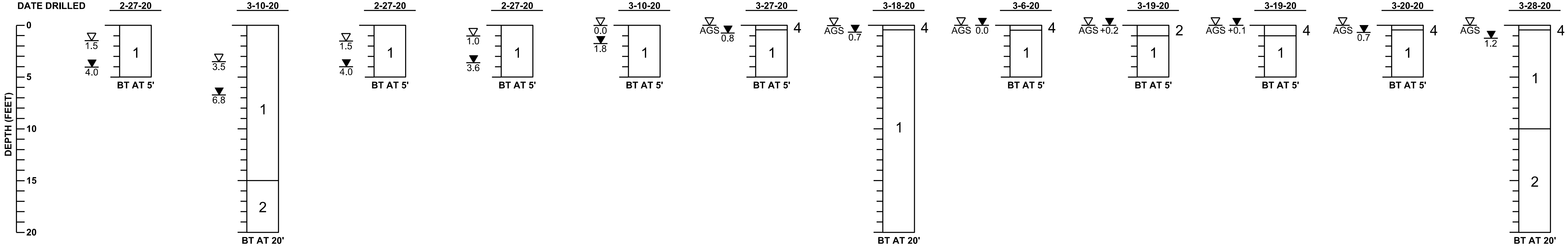
RAMP F / RAMP G

BORING NO.	RF-11	RF-12	RF-13	RF-14	RF-15	RF-16	RG2-1	RG2-2	RG2-3	RG2-4	RG2-5	RG2-6
STATION	606+00	607+00	608+00	609+00	610+00	611+00	4705+00	4706+00	4707+08	4708+00	4709+00	4711+53
OFFSET	9' LEFT	9' LEFT	13' LEFT	C/L	13' RIGHT	18' LEFT	110' RIGHT	115' RIGHT	117' RIGHT	117' RIGHT	117' RIGHT	117' RIGHT
DATE DRILLED	4-1-20	4-1-20	4-1-20	4-1-20	4-2-20	4-1-20	3-10-20	2-27-20	2-27-20	2-27-20	2-27-20	2-27-20

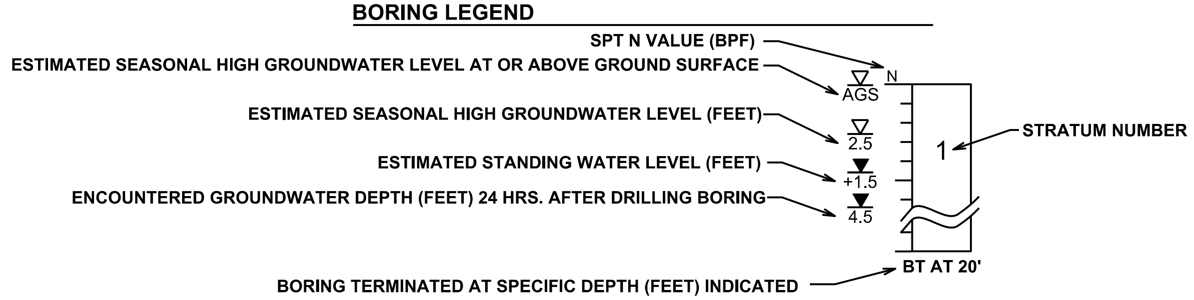


RAMP G

BORING NO.	RG2-7	RG2-8	RG2-9	RG2-10	RG2-11	RG2-12	RG2-13	RG2-14	RG2-15	RG2-16	RG2-17	RG2-18
STATION	4712+48	700+00	701+00	702+00	703+00	704+00	705+00	706+00	707+00	708+00	709+00	710+00
OFFSET	118' RIGHT	6' RIGHT	6' RIGHT	4' LEFT	2' LEFT	21' LEFT	13' LEFT	4' LEFT	4' RIGHT	26' RIGHT	14' LEFT	11' RIGHT
DATE DRILLED	2-27-20	3-10-20	2-27-20	2-27-20	3-10-20	3-27-20	3-18-20	3-6-20	3-19-20	3-19-20	3-20-20	3-28-20



BORING LEGEND



CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY OF SOIL

GRANULAR SOILS	MANUAL HAMMER (SAFETY) N VALUE (blows per foot)	RELATIVE DENSITY
SANDS	0-4	VERY LOOSE
	4-10	LOOSE
	10-30	MEDIUM DENSE
	30-50	DENSE
	OVER 50	VERY DENSE

NON-GRANULAR SOILS	MANUAL HAMMER (SAFETY) N VALUE (blows per foot)	CONSISTENCY
SILTS, CLAYS, MUCK, PEAT	0-2	VERY SOFT
	2-4	SOFT
	4-8	FIRM
	8-15	STIFF
	15-30	VERY STIFF
	OVER 30	HARD

FIGURE 7

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

DANIEL C. STANFILL, P.E.
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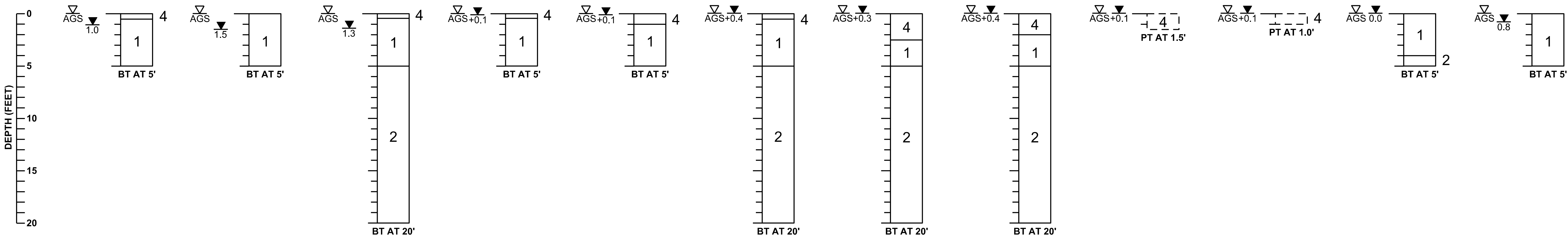
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

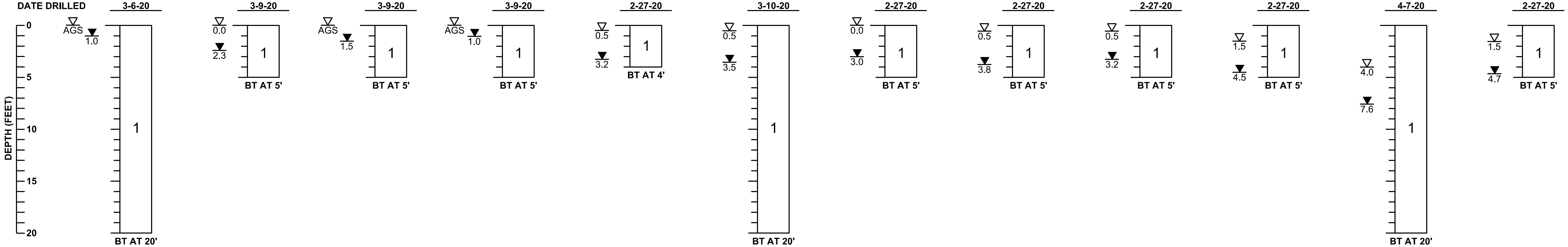
SOIL BORING RESULTS

SHEET NO.

	RAMP G	RAMP H										
BORING NO.	RG2-19	RH2-1	RH2-2	RH2-3	RH2-4	RH2-5	RH2-6	RH2-7	RH2-8	RH2-9	RH2-10	RH2-11
STATION	711+00	804+00	805+06	806+00	807+06	808+12	809+00	810+00	811+00	812+00	813+00	814+00
OFFSET	24' RIGHT	43' RIGHT	6' RIGHT	23' RIGHT	21' RIGHT	32' RIGHT	18' LEFT	5' LEFT	7' RIGHT	6' LEFT	19' LEFT	30' LEFT
DATE DRILLED	3-23-20	3-5-20	3-23-20	3-20-20	3-20-20	3-25-20	3-25-20	3-26-20	4-8-20	4-8-20	3-6-20	3-6-20



	RAMP H									NBACC		
BORING NO.	RH2-12	RH2-13	RH2-14	RH2-15	RH2-16	RH2-17	RH2-18	RH2-19	RH2-20	NBACC-1	NBACC-2	NBACC-3
STATION	815+00	816+00	817+00	818+00	819+00	820+00	821+00	822+00	823+00	4733+00	4734+00	4735+00
OFFSET	17' LEFT	8' LEFT	5' RIGHT	13' LEFT	22' LEFT	11' LEFT	C/L	8' RIGHT	7' RIGHT	118' RIGHT	117' RIGHT	118' RIGHT
DATE DRILLED	3-6-20	3-9-20	3-9-20	3-9-20	2-27-20	3-10-20	2-27-20	2-27-20	2-27-20	2-27-20	4-7-20	2-27-20



BORING LEGEND

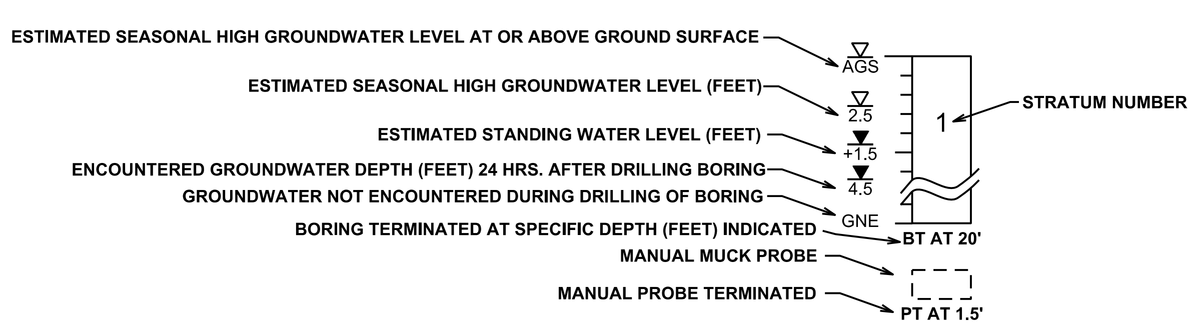


FIGURE 8

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

DANIEL C. STANFILL, P.E.
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SR 9	VOLUSIA	436292-1-22-01

SOIL BORING RESULTS

SHEET NO.

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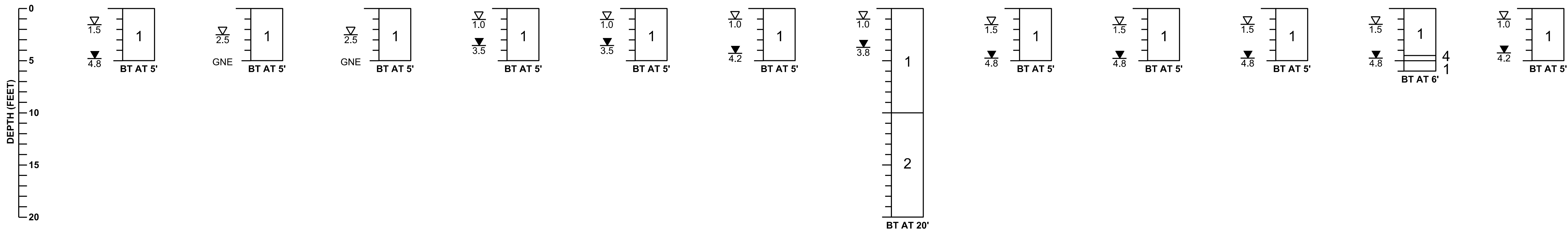
BORING NO.	NBACC-4	NBACC-5	NBACC-6
STATION	4736+00	4737+00	4738+00
OFFSET	117' RIGHT	116' RIGHT	114' RIGHT
DATE DRILLED	2-27-20	2-27-20	2-27-20

NBACC

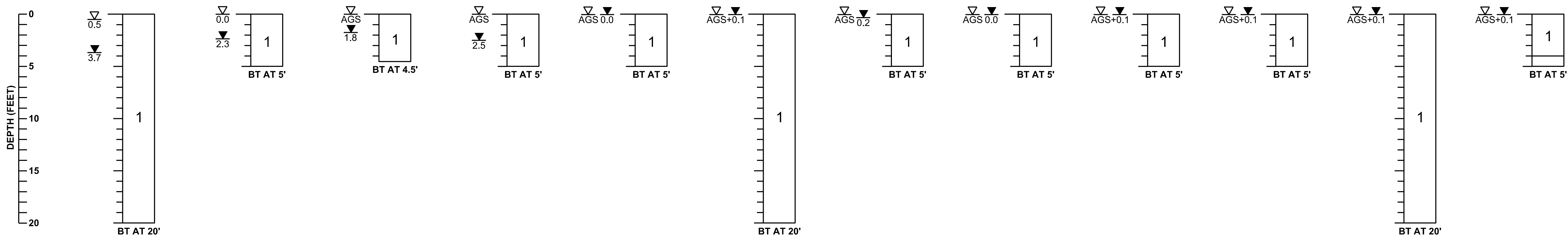
BORING NO.	RI-1	RI-2	RI-3	RI-4	RI-5	RI-6	RI-7	RI-8	RI-9
STATION	4733+00	4732+15	4731+14	4730+10	4729+12	4728+11	4727+10	917+00	916+00
OFFSET	112' LEFT	115' LEFT	117' LEFT	115' LEFT	115' LEFT	117' LEFT	117' LEFT	7' RIGHT	11' RIGHT
DATE DRILLED	2-27-20	2-27-20	2-27-20	3-6-20	2-27-20	2-27-20	2-27-20	2-27-20	2-27-20

RAMP I



RAMP I

BORING NO.	RI-10	RI-11	RI-12	RI-13	RI-14	RI-15	RI-16	RI-17	RI-18	RI-19	RI-20	RI-21
STATION	915+00	914+00	913+00	912+00	911+00	910+00	909+00	908+00	907+00	906+00	905+00	904+00
OFFSET	6' RIGHT	14' RIGHT	10' RIGHT	5' RIGHT	2' LEFT	8' RIGHT	9' RIGHT	7' RIGHT	9' RIGHT	7' RIGHT	14' RIGHT	6' RIGHT
DATE DRILLED	3-6-20	2-27-20	2-27-20	3-6-20	3-4-20	3-4-20	3-4-20	3-4-20	3-4-20	3-4-20	3-3-20	3-3-20



BORING LEGEND

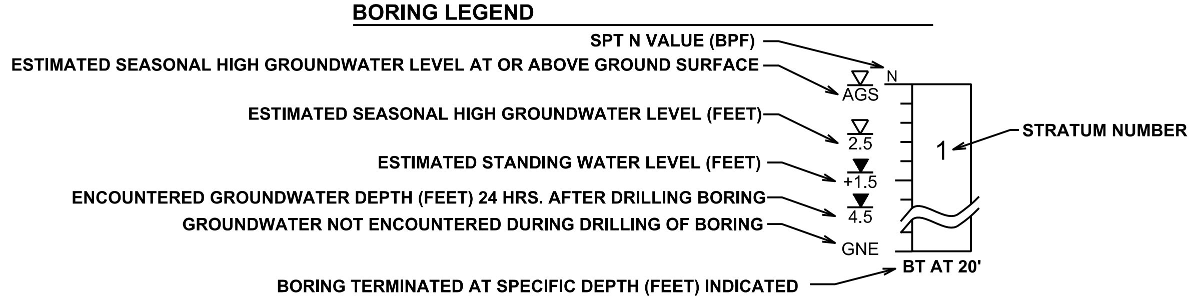


FIGURE 9

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

DANIEL C. STANFILL, P.E.
P.E. LICENSE NUMBER 42763
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
919 LAKE BALDWIN LANE
ORLANDO, FL 32814

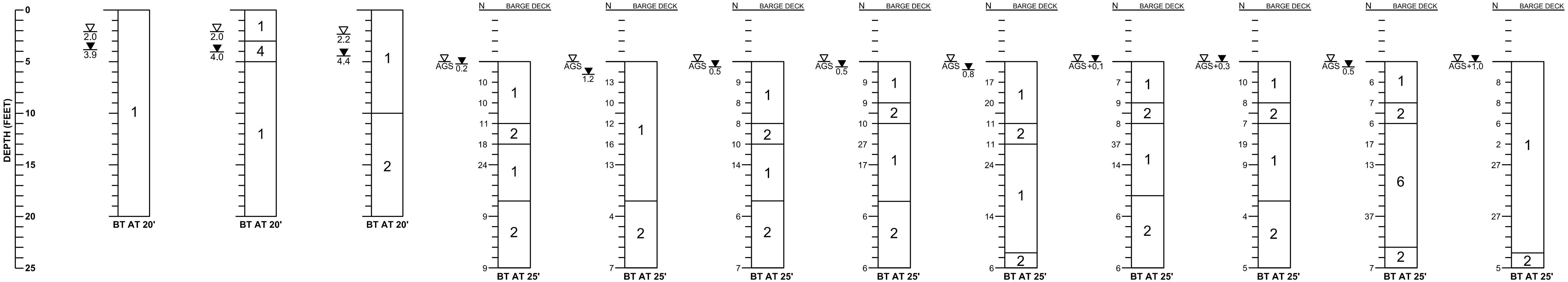
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

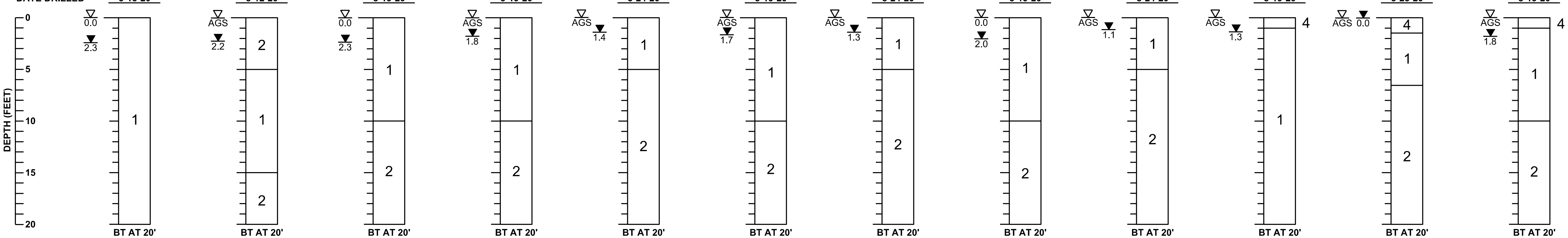
SOIL BORING RESULTS

SHEET NO.

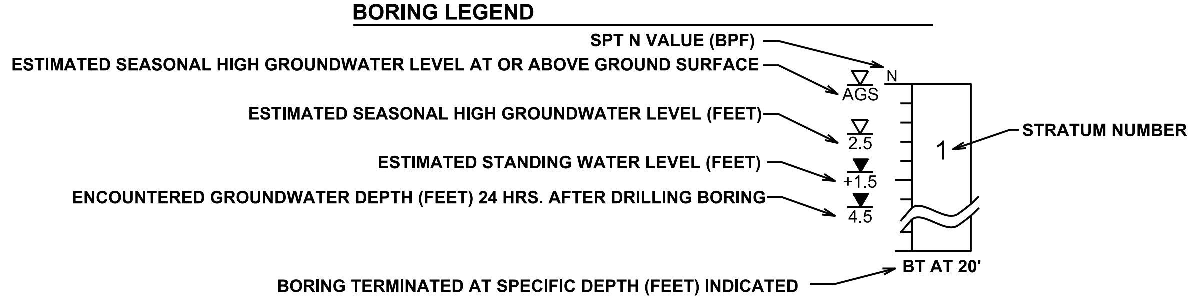
BORING NO.	PB-1	PB-2	PB-3	P3.1-1	P3.1-2	P3.1-3	P3.1-4	P3.1-5	P3.1-6	P3.1-7	P3.1-8	P3.2-1
	EXISTING POND			POND 3.1								POND 3.2
STATION	29+10	34+62	39+47	612+82	612+50	611+65	610+62	609+64	609+10	608+33	604+79	517+09
OFFSET	119' LEFT	89' LEFT	93' LEFT	109' RIGHT	259' RIGHT	108' RIGHT	265' RIGHT	107' RIGHT	270' RIGHT	118' RIGHT	128' RIGHT	146' RIGHT
DATE DRILLED	3-16-20	3-16-20	3-16-20	4-2-20	4-6-20	4-2-20	4-6-20	4-6-20	4-6-20	4-6-20	4-6-20	3-31-20



BORING NO.	P3.2-2	P3.2-3	P3.3-1	P3.3-2	P3.3-3	P3.3-4	P3.3-5	P3.3-6	P3.3-7	P3.3-8	P3.3-9	P3.3-10
	POND 3.2		POND 3.3									
STATION	516+30	515+48	705+87	702+50	701+92	701+43	700+63	700+43	803+28	803+00	802+14	801+73
OFFSET	237' RIGHT	140' RIGHT	108' RIGHT	129' RIGHT	322' RIGHT	102' RIGHT	382' RIGHT	114' RIGHT	253' LEFT	417' LEFT	214' LEFT	379' LEFT
DATE DRILLED	3-13-20	3-12-20	3-19-20	3-19-20	3-24-20	3-19-20	3-24-20	3-19-20	3-24-20	3-19-20	3-23-20	3-19-20



BORING LEGEND



CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY OF SOIL

GRANULAR SOILS	MANUAL HAMMER (SAFETY) N VALUE (blows per foot)	RELATIVE DENSITY
SANDS	0-4	VERY LOOSE
	4-10	LOOSE
	10-30	MEDIUM DENSE
	30-50	DENSE
	OVER 50	VERY DENSE

NON-GRANULAR SOILS	MANUAL HAMMER (SAFETY) N VALUE (blows per foot)	CONSISTENCY
SILTS, CLAYS, MUCK, PEAT	0-2	VERY SOFT
	2-4	SOFT
	4-8	FIRM
	8-15	STIFF
	15-30	VERY STIFF
	OVER 30	HARD

FIGURE 10

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

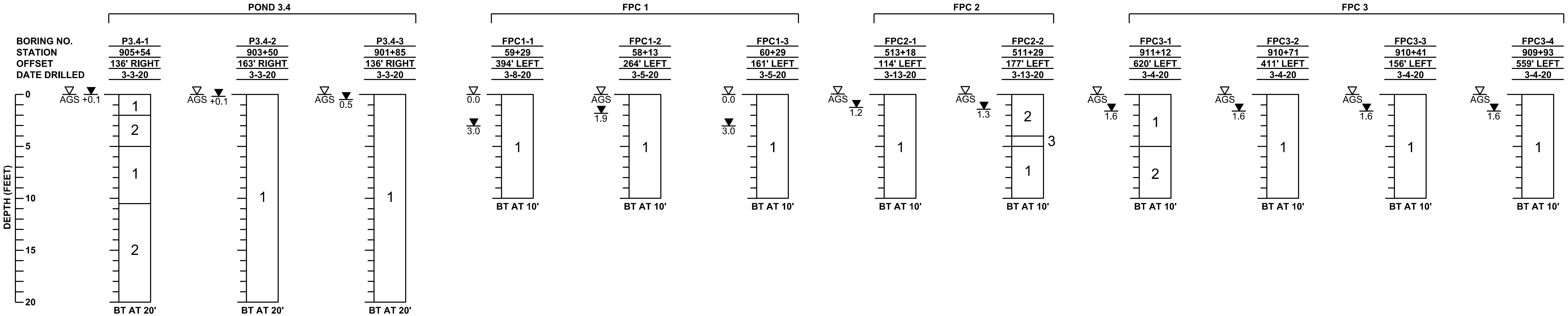
DANIEL C. STANFILL, P.E.
P.E. LICENSE NUMBER 42763
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
919 LAKE BALDWIN LANE
ORLANDO, FL 32814

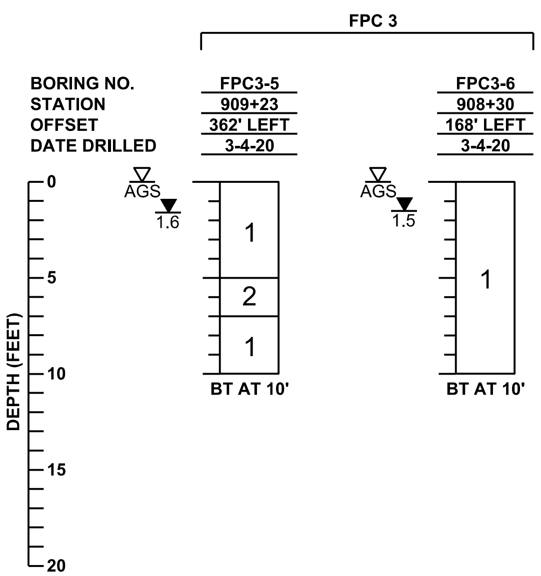
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

SOIL BORING RESULTS

SHEET NO.





BORING LEGEND

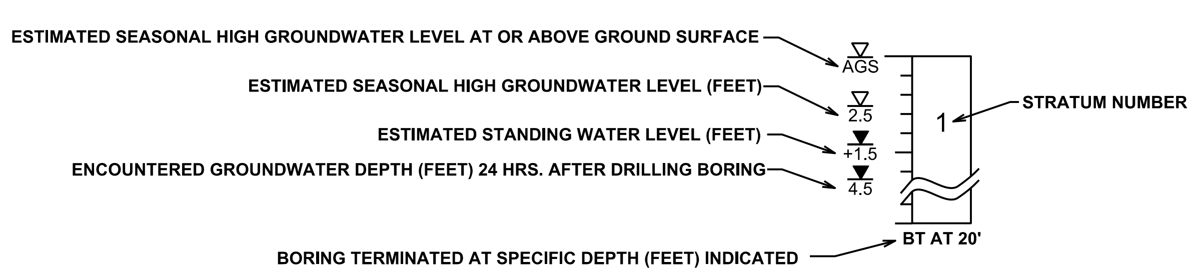


FIGURE 11

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

DANIEL C. STANFILL, P.E.
P.E. LICENSE NUMBER 42763
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
919 LAKE BALDWIN LANE
ORLANDO, FL 32814

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 9	VOLUSIA	436292-1-22-01

SOIL BORING RESULTS

SHEET NO.

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SUMMARY OF LABORATORY TEST RESULTS

Table 7
Summary of Laboratory Test Results
I-95 Interchange at Pioneer Trail
Project Development and Environment (PD&E) Study
GEC Project No. 4162G

Stratum No.	Boring No.	Station	Offset	Sample Depth (feet)	Percent Passing by Weight #10 Sieve	#40 Sieve	#60 Sieve	#100 Sieve	#200 Sieve	Moisture Content (%)	Atterberg Limits Liquid Limit	Plasticity Index	Organic Content (%)	AASHTO Soil Class.
1	AB-1	17+00	17 LT	0 - 2.5	100	96	84	41	10	26	---	---	3.8	[1]A-3
1	AB-9	25+00	28 LT	15 - 20	100	98	91	53	10	---	---	---	---	A-3
1	AB-14	30+00	17 RT	1 - 5.5	100	97	84	43	5	---	---	---	---	A-3
1	AB-14	30+00	17 RT	5.5 - 10	100	97	85	42	10	---	---	---	---	A-3
1	PB-4	31+24	380 LT	4 - 6	100	97	87	45	5	---	---	---	---	A-3
1	PB-8	37+09	398 LT	8 - 10	100	98	93	49	5	---	---	---	---	A-3
1	AB-24	40+00	53 RT	3 - 6	100	93	71	32	6	---	---	---	---	A-3
1	AB-24	40+00	53 RT	6 - 10	100	92	71	34	9	---	---	---	---	A-3
1	PB-10	40+28	398 LT	4 - 6	100	94	74	31	4	---	---	---	---	A-3
1	PB-11	40+95	227 LT	4 - 6	100	93	74	35	10	21	---	---	3.5	[1]A-3
1	P3.5-1	52+68	169 RT	2 - 4	100	89	72	29	4	---	---	---	---	A-3
1	P3.5-2	57+00	183 RT	8 - 10	100	97	93	54	2	---	---	---	---	A-3
1	FPC1-6	59+80	770 LT	6 - 8	100	93	83	46	6	---	---	---	---	A-3
1	AB-26	60+00	58 LT	5 - 10	100	96	90	47	7	---	---	---	---	A-3
1	AB-30	63+00	43 LT	1 - 5	92	87	84	37	3	---	---	---	---	[2]A-3
1	AB-37	66+00	52 RT	3 - 4	100	82	63	18	6	---	---	---	---	A-3
1	AB-40	68+00	35 RT	2 - 3	100	91	66	14	5	---	---	---	---	A-3
1	AB-43	70+00	39 LT	5 - 10	100	81	68	28	2	---	---	---	---	A-3
1	AB-44	70+00	39 LT	3 - 3.5	100	92	74	17	6	---	---	---	---	A-3
1	AB-49	75+28	67 RT	5 - 10	100	92	81	32	2	---	---	---	---	A-3
1	AB-54	80+00	20 LT	0 - 5	100	88	60	15	2	---	---	---	---	A-3
1	RE-1	500+00	7 LT	10 - 15	99	88	75	31	8	---	---	---	---	[3]A-3

Notes:
1: Trace Organic Material
2: Some Shell, Limerock and Asphalt Fragments
3: Few Shell
4: Some Shell and Cemented Sand
5: Some Shell
6: Few Shell and Limerock
7: Trace Shell and Limerock
8: Cemented Sand

Table 7
Summary of Laboratory Test Results
I-95 Interchange at Pioneer Trail
Project Development and Environment (PD&E) Study
GEC Project No. 4162G

Stratum No.	Boring No.	Station	Offset	Sample Depth (feet)	Percent Passing by Weight #10 Sieve	#40 Sieve	#60 Sieve	#100 Sieve	#200 Sieve	Moisture Content (%)	Atterberg Limits Liquid Limit	Plasticity Index	Organic Content (%)	AASHTO Soil Class.
1	RE-6	505+00	10 LT	15 - 20	99	94	88	48	10	---	---	---	---	[3]A-3
1	RE-11	510+00	22 RT	0 - 5	100	88	68	28	7	---	---	---	---	A-3
1	RE-24	522+93	CL	2 - 4	100	89	70	30	4	---	---	---	---	A-3
1	SBACC-5	4679+00	112 LT	0 - 5	100	92	79	30	5	---	---	---	---	A-3
1	SBACC-5	4679+00	112 LT	10 - 15	100	93	84	33	4	---	---	---	---	[3]A-3
1	RF-1	4708+90	117 LT	2 - 4	90	66	51	22	9	---	---	---	---	[4]A-3
1	RF-6	601+00	11 RT	3.5 - 5	100	90	79	31	6	---	---	---	---	A-3
1	RF-10	605+00	14 LT	6 - 10	96	66	36	8	3	---	---	---	---	[5]A-3
1	RF-15	610+00	13 RT	2 - 4	100	89	69	28	3	---	---	---	---	A-3
1	RG2-1	4705+00	110 RT	5 - 10	100	98	93	52	8	---	---	---	---	A-3
1	RG2-10	702+00	4 LT	3 - 5	100	79	63	11	4	---	---	---	---	A-3
1	RG2-13	705+00	13 LT	0.5 - 5	100	89	70	33	9	---	---	---	---	A-3
1	RG2-13	705+00	13 LT	10 - 15	100	96	86	43	10	---	---	---	---	A-3
1	RG2-19	711+00	24 RT	0.5 - 5	100	86	68	31	8	---	---	---	---	A-3
1	RH2-6	809+00	18 LT	0 - 2.5	100	85	65	29	8	---	---	---	---	A-3
1	RH2-6	809+00	18 LT	5 - 10	100	92	61	20	8	---	---	---	---	A-3
1	RH2-12	815+00	17 LT	10 - 15	100	96	86	42	9	---	---	---	---	A-3
1	RH2-17	820+00	11 LT	0 - 5	100	98	89	43	10	---	---	---	---	A-3
1	RH2-17	820+00	11 LT	15 - 20	100	99	92	47	10	---	---	---	---	A-3
1	NBACC-2	4734+00	117 RT	0 - 5	99	95	82	38	6	---	---	---	---	[6]A-3
1	NBACC-2	4734+00	117 RT	10 - 15	100	97	82	22	3	---	---	---	---	A-3

Notes:
1: Trace Organic Material
2: Some Shell, Limerock and Asphalt Fragments
3: Few Shell
4: Some Shell and Cemented Sand
5: Some Shell
6: Few Shell and Limerock
7: Trace Shell and Limerock
8: Cemented Sand

Table 7
Summary of Laboratory Test Results
I-95 Interchange at Pioneer Trail
Project Development and Environment (PD&E) Study
GEC Project No. 4162G

Stratum No.	Boring No.	Station	Offset	Sample Depth (feet)	Percent Passing by Weight					Moisture Content (%)	Atterberg Limits		Organic Content (%)	AASHTO Soil Class.
					#10 Sieve	#40 Sieve	#60 Sieve	#100 Sieve	#200 Sieve		Liquid Limit	Plasticity Index		
1	RI-2	4732+15	115 LT	1 - 3	99	97	91	47	3	---	---	---	---	[5]A-3
1	RI-4	4730+10	115 LT	2.5 - 5.5	100	96	80	37	10	20	---	---	4.7	[1]A-3
1	RI-4	4730+10	115 LT	15 - 20	100	99	93	48	10	---	---	---	---	A-3
1	RI-11	914+00	14 RT	0 - 5	99	94	78	34	5	---	---	---	---	A-3
1	RI-15	910+00	8 RT	5 - 10	100	94	72	29	5	---	---	---	---	A-3
1	RI-20	905+00	14 RT	0 - 5	100	91	71	31	4	---	---	---	---	A-3
1	RI-20	905+00	14 RT	10 - 15	100	94	83	44	9	---	---	---	---	A-3
1	PB-1	29+10	119 LT	5 - 10	100	96	84	42	10	---	---	---	---	A-3
1	PB-2	34+62	89 LT	0 - 3	100	97	82	40	9	---	---	---	---	A-3
1	PB-2	34+62	89 LT	10 - 15	100	87	58	19	4	---	---	---	---	A-3
1	P3.1-2	612+50	259 RT	6 - 8	100	84	36	4	2	---	---	---	---	A-3
1	P3.1-4	610+62	265 RT	6 - 10	94	69	58	27	6	---	---	---	---	[5]A-3
1	P3.3-1	705+87	108 RT	0 - 5	100	84	65	27	5	---	---	---	---	A-3
1	P3.3-1	705+87	108 RT	5 - 10	100	94	82	39	9	---	---	---	---	A-3
1	P3.3-5	700+63	382 RT	0 - 5	100	87	70	32	8	---	---	---	---	A-3
1	P3.3-8	803+00	417 LT	5 - 10	100	90	71	34	8	---	---	---	---	A-3
1	P3.3-10	801+73	379 LT	5 - 10	100	74	39	19	9	---	---	---	---	A-3
1	P3.4-2	903+50	163 RT	0 - 6	100	89	69	30	8	---	---	---	---	A-3
1	P3.4-2	903+50	163 RT	10 - 15	100	97	85	46	9	---	---	---	---	A-3
1	P3.4-3	901+85	136 RT	0 - 15	100	96	87	46	9	---	---	---	---	A-3
1	FPC1-2	58+13	264 LT	0 - 5	100	90	73	33	9	---	---	---	---	A-3
1	FPC1-2	58+13	264 LT	5 - 10	100	95	88	50	6	---	---	---	---	A-3

Notes:
1: Trace Organic Material
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4: Some Shell and Cemented Sand
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Table 7
Summary of Laboratory Test Results
I-95 Interchange at Pioneer Trail
Project Development and Environment (PD&E) Study
GEC Project No. 4162G

Stratum No.	Boring No.	Station	Offset	Sample Depth (feet)	Percent Passing by Weight					Moisture Content (%)	Atterberg Limits		Organic Content (%)	AASHTO Soil Class.
					#10 Sieve	#40 Sieve	#60 Sieve	#100 Sieve	#200 Sieve		Liquid Limit	Plasticity Index		
1	FPC2-2	511+29	177 LT	5 - 10	91	63	45	22	7	---	---	---	---	[5]A-3
1	FPC3-3	910+41	156 LT	0 - 5	100	94	73	30	6	---	---	---	---	A-3
1	FPC3-3	910+41	156 LT	5 - 10	100	94	67	23	8	---	---	---	---	A-3
2	AB-4	20+00	36 RT	10 - 15	100	99	94	56	12	---	---	---	---	A-2-4
2	AB-9	25+00	28 LT	0 - 5	93	79	66	35	15	---	---	---	---	[7]A-2-4
2	AB-14	30+00	17 RT	0 - 1	100	97	86	47	12	42	---	---	4.3	[1]A-2-4
2	AB-17	33+00	32 LT	0 - 1	81	53	45	26	15	---	---	---	---	[5]A-2-4
2	PB-6	34+06	390 LT	6 - 8	100	98	85	50	22	19	27	10	---	A-2-4
2	PB-9	37+74	223 LT	2 - 4	100	97	83	41	14	15	---	---	4.7	[1]A-2-4
2	P3.5-3	54+29	334 RT	20	99	93	85	40	12	---	---	---	---	A-2-4
2	FPC1-4	58+64	536 LT	4 - 6	100	89	75	35	14	---	---	---	---	A-2-4
2	AB-32	64+00	38 LT	1.5 - 3	99	92	84	51	29	17	28	9	---	[2]A-2-4
2	RE-6	505+00	10 LT	3.5 - 5	100	87	68	34	17	24	NP	NP	---	A-2-4
2	RE-9	508+00	7 LT	4 - 5	100	87	66	32	16	---	---	---	---	A-2-4
2	RE-11	510+00	22 RT	15 - 20	99	95	87	43	11	---	---	---	---	[3]A-2-4
2	RE-17	516+00	27 RT	4 - 6	100	91	80	44	19	24	NP	NP	---	A-2-4
2	RF-10	605+00	14 LT	4 - 6	100	86	71	38	16	20	NP	NP	---	A-2-4
2	RF-10	605+00	14 LT	15 - 20	98	89	79	40	11	---	---	---	---	[5]A-2-4
2	RF-15	610+00	13 RT	15	98	91	85	46	11	---	---	---	---	[5]A-2-4
2	RG2-1	4705+00	110 RT	15 - 20	100	90	69	35	13	---	---	---	---	[3]A-2-4

Notes:
1: Trace Organic Material
2: Some Shell, Limerock and Asphalt Fragments
3: Few Shell
4: Some Shell and Cemented Sand
5: Some Shell
6: Few Shell and Limerock
7: Trace Shell and Limerock
8: Cemented Sand

Table 7

Summary of Laboratory Test Results

I-95 Interchange at Pioneer Trail

Project Development and Environment (PD&E) Study

GEC Project No. 4162G

Stratum No.	Boring No.	Station	Offset	Sample Depth (feet)	Percent Passing by Weight: #10 Sieve	#40 Sieve	#60 Sieve	#100 Sieve	#200 Sieve	Moisture Content (%)	Atterberg Limits: Liquid Limit	Plasticity Index	Organic Content (%)	AASHTO Soil Class.
2	RG2-15	707+00	4 RT	0 - 1	100	87	68	34	16	32	---	---	3.3	[1]A-2-4
2	RG2-18	710+00	11 RT	15 - 20	98	93	86	45	12	---	---	---	---	[5]A-2-4
2	RH2-12	815+00	17 LT	0 - 5.5	100	93	75	35	12	---	---	---	---	A-2-4
2	P3.1-1	612+82	109 RT	6 - 8	100	86	66	29	13	18	NP	NP	---	A-2-4
2	P3.1-2	612+50	259 RT	15	100	97	91	52	12	---	---	---	---	A-2-4
2	P3.1-4	610+62	265 RT	4 - 6	100	94	77	38	15	25	NP	NP	---	A-2-4
2	P3.1-4	610+62	265 RT	15 - 20	100	90	83	43	11	---	---	---	---	[5]A-2-4
2	P3.1-7	608+33	118 RT	15	100	97	91	49	13	---	---	---	---	A-2-4
2	P3.1-8	604+79	128 RT	4 - 6	100	93	81	45	20	21	27	10	---	A-2-4
2	P3.2-2	516+30	237 RT	0 - 5	100	87	69	33	11	---	---	---	---	A-2-4
2	P3.2-2	516+30	237 RT	13.5 - 20	97	91	79	40	12	---	---	---	---	A-2-4
2	P3.2-3	515+48	140 RT	0 - 5	100	88	70	34	12	---	---	---	---	A-2-4
2	P3.3-5	700+63	382 RT	5 - 10	100	83	65	32	11	---	---	---	---	A-2-4
2	FPC2-2	511+29	177 LT	0 - 4	100	90	73	36	12	---	---	---	---	A-2-4
2	FPC3-1	911+12	620 LT	5 - 10	100	99	93	49	13	---	---	---	---	A-2-4
2	FPC3-5	909+23	362 LT	5 - 7	100	95	76	37	17	---	---	---	---	A-2-4
3	PB-7	34+77	221 LT	2 - 4	100	99	93	43	29	20	29	14	---	A-2-6
3	RE-16	515+00	7 RT	4 - 6	100	91	77	45	24	23	34	17	---	A-2-6
3	FPC2-2	511+29	177 LT	4 - 5	100	95	80	44	23	20	31	13	---	A-2-6
4	PB-5	32+06	224 LT	2 - 4	100	98	89	47	22	35	---	---	6.7	A-8
4	AB-19	35+00	20 LT	2 - 5	100	96	80	45	19	24	---	---	8.8	A-8
4	AB-23	39+00	21 LT	0 - 3	100	96	80	45	19	24	---	---	8.8	A-8

Notes:

1: Trace Organic Material
2: Some Shell, Limerock and Asphalt Fragments
3: Few Shell
4: Some Shell and Cemented Sand
5: Some Shell
6: Few Shell and Limerock
7: Trace Shell and Limerock
8: Cemented Sand

Table 7

Summary of Laboratory Test Results

I-95 Interchange at Pioneer Trail

Project Development and Environment (PD&E) Study

GEC Project No. 4162G

Stratum No.	Boring No.	Station	Offset	Sample Depth (feet)	Percent Passing by Weight #10 Sieve	#40 Sieve	#60 Sieve	#100 Sieve	#200 Sieve	Moisture Content (%)	Atterberg Limits Liquid Limit	Plasticity Index	Organic Content (%)	AASHTO Soil Class.
4	P3.5-4	52+83	513 RT	2 - 4	100	93	76	36	10	20	---	---	6.0	A-8
4	AB-45	71+00	32 RT	0 - 5	100	92	72	25	11	31	---	---	7.4	A-8
4	RE-18	517+00	13 RT	0 - 1	100	92	77	44	23	43	---	---	11.0	A-8
4	RG2-12	704+00	21 LT	0 - 0.5	100	100	98	87	75	225	---	---	46.0	A-8
4	RG2-19	711+00	24 RT	0 - 0.5	100	90	75	38	15	39	---	---	8.3	A-8
4	RH2-6	809+00	18 LT	0 - 2.5	100	92	81	63	53	142	---	---	27.0	A-8
4	RI-8	917+00	7 RT	4.5 - 5	100	97	83	45	20	46	---	---	17.0	A-8
4	PB-2	34+62	89 LT	3 - 5	100	96	80	42	13	18	---	---	7.1	A-8
4	P3.3-8	803+00	417 LT	0 - 1	100	92	78	46	24	60	---	---	13.0	A-8
4	P3.3-10	801+73	379 LT	0 - 1	100	94	82	95	29	151	---	---	28.0	A-8
5	AB-38	67+00	24 RT	0 - 2.5	95	82	63	21	5	---	---	---	---	[8]A-3
6	RE-16	515+00	7 RT	8 - 10	96	28	15	7	3	---	---	---	---	A-1-a
6	P3.1-8	604+79	128 RT	8 - 10	96	47	25	11	5	---	---	---	---	A-1-b

Notes:
1: Trace Organic Material
2: Some Shell, Limerock and Asphalt Fragments
3: Few Shell
4: Some Shell and Cemented Sand
5: Some Shell
6: Few Shell and Limerock
7: Trace Shell and Limerock
8: Cemented Sand

SUMMARY OF CORROSION SERIES TEST RESULTS

Table 8

Summary of Corrosion Series Test Results

I-95 Interchange at Pioneer Trail

Project Development and Environment (PD&E) Study

GEC Project No. 4162G

Stratum No.	Boring No.	Station	Offset (ft)	AASHTO Class.	Sample Depth (ft)	pH	Minimum Resistivity (ohm-cm)	Chlorides (ppm)	Sulfates (ppm)	Substructural Environmental Classification	
										Concrete	Steel
1	AB-15	31+00	59 LT	A-3	0 - 3.5	7.7	2650	30	129	Moderately Aggressive	Moderately Aggressive
1	AB-30	63+00	43 LT	A-3	1 - 5	8.0	13000	15	< 6	Slightly Aggressive	Slightly Aggressive
1	FPC1-2	58+13	264 LT	A-3	0 - 5	4.6	15000	15	9	Extremely Aggressive	Extremely Aggressive
1	FPC1-2	58+13	264 LT	A-3	5 - 10	4.9	13000	30	< 6	Extremely Aggressive	Extremely Aggressive
1	FPC2-2	511+29	177 LT	A-3	5 - 10	7.9	7100	30	< 6	Slightly Aggressive	Slightly Aggressive
1	FPC3-3	910+41	156 LT	A-3	0 - 5	4.8	9500	30	< 6	Extremely Aggressive	Extremely Aggressive
1	FPC3-3	910+41	156 LT	A-3	5 - 10	5.3	5700	15	66	Moderately Aggressive	Extremely Aggressive
1	NBACC-4	4736+00	117 RT	A-3	0 - 3	8.2	6700	30	< 6	Slightly Aggressive	Slightly Aggressive
1	NBACC-4	4736+00	117 RT	A-3	3 - 5	7.6	9100	30	< 6	Slightly Aggressive	Slightly Aggressive
1	P3.1-4	610+62	265 RT	A-3	6 - 10	8.4	4500	60	< 6	Slightly Aggressive	Moderately Aggressive
1	P3.3-5	700+63	382 RT	A-3	0 - 5	8.1	1500	90	< 6	Moderately Aggressive	Moderately Aggressive
1	P3.4-2	903+50	163 RT	A-3	0 - 6	5.3	23000	15	<5	Extremely Aggressive	Extremely Aggressive
1	P3.4-2	903+50	163 RT	A-3	10 - 15	6.0	8400	30	< 6	Slightly Aggressive	Moderately Aggressive
1	PB-2	34+62	89 LT	A-3	0 - 3	5.7	5900	30	< 6	Moderately Aggressive	Extremely Aggressive
1	PB-2	34+62	89 LT	A-3	10 - 15	5.0	16000	30	9	Moderately Aggressive	Extremely Aggressive
1	RE-11	510+00	22 RT	A-3	0 - 5	4.5	19000	30	93	Extremely Aggressive	Extremely Aggressive
1	RF-10	605+00	14 LT	A-3	6 - 10	8.1	4100	45	< 6	Slightly Aggressive	Moderately Aggressive
1	RG2-1	4705+00	110 RT	A-3	5 - 10	7.6	6900	30	< 6	Slightly Aggressive	Slightly Aggressive
1	RG2-13	705+00	13 LT	A-3	0.5 - 5	7.0	4400	45	63	Slightly Aggressive	Moderately Aggressive
1	RG2-13	705+00	13 LT	A-3	10 - 15	7.8	4100	30	27	Slightly Aggressive	Moderately Aggressive
1	RH2-6	809+00	18 LT	A-3	2.5 - 5	5.5	7400	45	< 6	Moderately Aggressive	Extremely Aggressive
1	RH2-6	809+00	18 LT	A-3	5 - 10	6.5	5600	60	< 6	Slightly Aggressive	Moderately Aggressive
1	RI-11	914+00	14 RT	A-3	0 - 5	7.8	11000	30	< 6	Slightly Aggressive	Slightly Aggressive
1	SBACC-5	4679+00	112 LT	A-3	0 - 5	6.2	15000	30	< 6	Slightly Aggressive	Moderately Aggressive
1	SBACC-5	4679+00	112 LT	A-3	10 - 15	7.6	8250	30	< 6	Slightly Aggressive	Slightly Aggressive
2	FPC2-2	511+29	177 LT	A-2-4	0 - 4	4.4	5100	45	< 6	Extremely Aggressive	Extremely Aggressive
2	P3.1-4	610+62	265 RT	A-2-4	15 - 20	7.8	2600	60	105	Moderately Aggressive	Moderately Aggressive
2	P3.2-2	516+30	237 RT	A-2-4	0 - 5	5.0	12000	15	< 6	Moderately Aggressive	Extremely Aggressive
2	P3.2-2	516+30	237 RT	A-2-4	13.5 - 20	6.1	1900	30	198	Moderately Aggressive	Moderately Aggressive
2	P3.3-5	700+63	382 RT	A-2-4	5 - 10	8.3	3700	45	< 6	Slightly Aggressive	Moderately Aggressive
2	RE-11	510+00	22 RT	A-2-4	15 - 20	7.9	3000	30	< 6	Moderately Aggressive	Moderately Aggressive

Table 8

Summary of Corrosion Series Test Results

I-95 Interchange at Pioneer Trail

Project Development and Environment (PD&E) Study

GEC Project No. 4162G

Stratum No.	Boring No.	Station	Offset (ft)	AASHTO Class.	Sample Depth (ft)	pH	Minimum Resistivity (ohm-cm)	Chlorides (ppm)	Sulfates (ppm)	Substructural Environmental Classification	
										Concrete	Steel
2	RF-10	605+00	14 LT	A-2-4	15 - 20	7.9	2800	45	108	Moderately Aggressive	Moderately Aggressive
2	RG2-1	4705+00	110 RT	A-2-4	15 - 20	8.3	7700	45	< 6	Slightly Aggressive	Slightly Aggressive
3	FPC2-2	511+29	177 LT	A-2-6	4 - 5	6.1	4300	15	< 6	Slightly Aggressive	Moderately Aggressive
4	AB-45	71+00	32 RT	A-8	0 - 5	5.0	25000	30	< 6	Moderately Aggressive	Extremely Aggressive
4	PB-2	34+62	89 LT	A-8	3 - 5	4.7	6800	45	< 6	Extremely Aggressive	Extremely Aggressive

APPENDIX 1

RESILIENT MODULUS TEST RESULTS

Florida Department of Transportation

RON DESANTIS
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

KEVIN J. THIBAULT
SECRETARY

MEMORANDUM

DATE: March 4, 2020

TO: Michael Byerly, District Geotechnical Materials Engineer

FROM: David Horhota, State Geotechnical Materials Engineer

SUBJECT: Embankment Resilient Modulus Pavement Design
District 5, Volusia County
FPN 436292-1: I-95 Interchange at Pioneer Trail

Twelve (12), 2-bag samples were received by the State Materials Office (SMO) for determination of an embankment (roadbed) resilient modulus for pavement design. After visual observation of the twelve samples, it was determined that the material from each 2-bag sample looked visually similar and the material from each of the bags were combined to form one sample from each location. After combining materials from the bags, samples from each location were obtained for classification tests (Atterberg limits, organic content, and particle size analysis), Proctor density, and resilient modulus. The classification test results are reported in Tables 1 and 2. Information provided for this project G.E.C., Inc. indicated all samples were collected from between 0.5 and 2.5 feet in depth.

Table 1. Summary of Gradation Results

Sample ID	Passing 3/4" (%)	Passing 1/2" (%)	Passing 3/8" (%)	Passing No. 4 (%)	Passing No. 10 (%)	Passing No. 40 (%)	Passing No. 60 (%)	Passing No. 100 (%)	Passing No. 200 (%)
AB-4	100.0	100.0	99.8	98.8	98.0	94.0	81.0	40.4	5.8
AB-19	100.0	99.7	98.1	96.4	93.6	88.7	81.7	46.2	12.4
AB-35	100.0	99.7	99.2	97.3	92.7	78.6	65.8	30.4	4.8
AB-50	100.0	100.0	100.0	100.0	99.8	87.1	59.1	16.6	1.8
RI-4	100.0	100.0	100.0	99.9	99.9	97.6	82.0	51.2	3.5
RI-20	100.0	100.0	99.9	99.9	99.8	89.5	67.2	31.1	4.4
RE-6	100.0	100.0	100.0	99.9	99.9	86.0	65.0	26.5	2.9
RF-3	100.0	100.0	99.6	98.9	98.4	88.7	72.4	31.9	4.0
RF-8	100.0	100.0	100.0	99.9	99.8	89.4	70.5	29.1	3.5
RG2-8	100.0	99.5	99.1	97.8	96.0	89.8	77.5	39.1	5.0
RH2-2	100.0	100.0	99.9	99.8	99.7	85.6	64.3	27.7	4.3
RH2-12	100.0	100.0	100.0	100.0	99.9	92.3	71.6	31.1	4.9

Table 2. Summary of Classification Results

Sample ID	Station Location	Offset	Soil Class	Organic Content (%)	LL/PI
AB-4	20+00	24 RT	A-3	0.8	N.P.
AB-19	35+00	18 LT	A-2-4	0.6	N.P.
AB-35	34+76	38 RT	A-3	1.2	N.P.
AB-50	76+50	30 LT	A-3	0.3	N.P.
RI-4	4730+00	113 RT	A-3	0.5	N.P.
RI-20	905+00	15 RT	A-3	1.0	N.P.
RE-6	505+00	11 LT	A-3	0.2	N.P.
RF-3	4707+00	111 LT	A-3	1.5	N.P.
RF-8	603+00	C/L	A-3	1.1	N.P.
RG2-8	700+00	6 RT	A-3	0.8	N.P.
RH2-2	805+05	4 RT	A-3	1.3	N.P.
RH2-12	815+00	17 LT	A-3	1.3	N.P.

In addition to the classification testing, the following test program was conducted:

(1) Standard Proctor, AASHTO T 99
(2) Resilient Modulus (M_R), AASHTO T 307.

A summary of laboratory test results is included in Table 3. The resilient modulus values listed in this table were obtained using the relationship developed from each individual test (resilient modulus versus bulk stress - with bulk stress, **Θ,** defined as $\boldsymbol{\Theta = \sigma_1 + \sigma_2 + \sigma_3}$), and using a bulk stress of 11 psi, which is the recommendation from Dr. Ping's research work in modeling the embankment in-situ stresses for Florida pavement conditions. The resilient modulus samples were compacted to within 1 pound per cubic foot (pcf) of the maximum density and 0.5 percent of the optimum moisture content as determined by AASHTO T99.

Table 3. Summary of T-99 and M_R Test Results

Sample ID	Passing No. 200 (%)	Standard Proctor Density (pcf)	Optimum Moisture Content (%)	Resilient Modulus @ Θ=11psi (psi)
AB-4	6	104.1	14.4	11,335
AB-19	12	110.2	12.8	12,291
AB-35	5	106.2	12.6	10,413
AB-50	2	101.7	14.2	10,056
RI-4	4	99.9	15.4	11,189
RI-20	4	102.0	14.3	9,715
RE-6	3	105.1	13.1	11,434
RF-3	4	104.4	14.0	10,569
RF-8	4	103.3	14.7	11,167

RG2-8	5	104.6	13.4	10,691
RH2-2	4	103.2	13.5	9,606
RH2-12	5	105.2	13.9	10,787

To obtain a design embankment resilient modulus, a 90 percent method was used as outlined in both the Flexible Pavement Design Manual and Soils and Foundations Handbook. The resilient modulus values were ranked in ascending order and the percentage of values which were greater than or equal to the individual value were determined. The results of this analysis are recorded in Table 4 and the corresponding graph of these results is included as Figure 1.

Table 4. Ranked M_R Test Results for 90 Percent Method

Rank	Sample ID	% ≥	M_R (psi)
1	RH2-2	100	9,606
2	RI-20	92	9,715
3	AB-50	83	10,056
4	AB-35	75	10,413
5	RF-3	67	10,569
6	RG2-8	58	10,691
7	RH2-12	50	10,787
8	RF-8	42	11,167
9	RI-4	33	11,189
10	AB-4	25	11,335
11	RE-6	17	11,434
12	AB-19	8	12,291

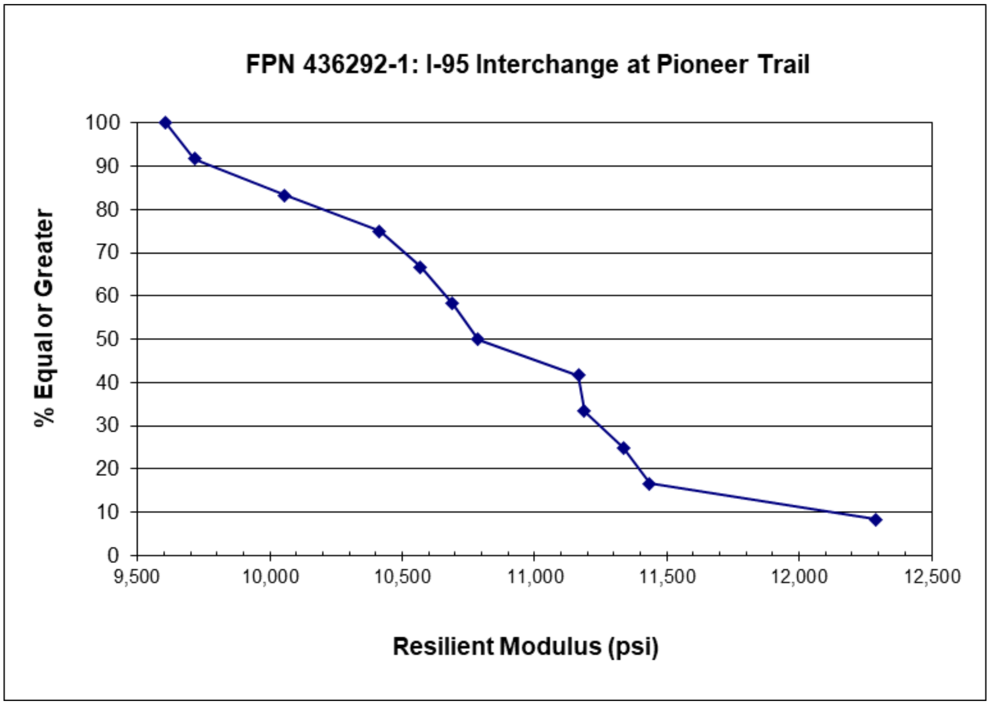

Figure 1. Ranked MR Test Results for 90% Method

Based on the results shown in Table 4 and Figure 1, the resilient modulus corresponding to a 90th percentile is **9,800 psi**, which would represent the design embankment M_R value.