Andreyev Engineering, Inc.

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▼ Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

September 30, 2020
GPGT-20-106

To: **GAI Consultants, Inc.**
618 East South Street, Suite 700
Orlando, Florida, 32801

Attention: Frank Bellomo, PLA

Subject: **Geotechnical Investigation, Proposed South Lake Trail Improvements, County Road 455, Clermont, Lake County, Florida**

Dear Mr. Bellomo:

Andreyev Engineering, Inc. (AEI) has completed a geotechnical investigation for the above referenced project location. We understand that the proposed South Lake Trail improvements will include a proposed boardwalk aligned to the west of C.R. 455. The proposed boardwalk is planned to be supported on a system of concrete piers, however, final design details and loading information were not available at the time of this report. Once foundation design plans for the proposed boardwalk have been finalized
, AEI should be afforded the opportunity to review the plans prior to construction. This report presents the results of our geotechnical investigation along with an evaluation of the soil and groundwater conditions encountered.

SITE LOCATION AND DESCRIPTION

The subject site is located in Sections 23, Township 22 South, and Range 26 East, in Clermont, Lake County, Florida. We have included the U.S.G.S. Topographic Map, which depicts the location of the site, on the attached **Figure 1**. In addition, the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) map for the subject site has been included on the attached **Figure 2**.

PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to explore subsurface soil and groundwater conditions at this site along the proposed boardwalk alignment. The boring locations were selected by representatives of GAI Consultants, Inc.

The scope of this investigation included:

- Drilled five (5) Standard Penetration Test (SPT) borings, designated as TB-1 through TB-5, to depths of 20 to 25 feet below ground surface, along the proposed boardwalk alignment.

Samples were recovered from the borings and returned to AEI's laboratory for visual classification and stratification. Soil strata were classified according to the Unified Soil Classification System (USCS). Approximate boring locations are shown on **Figure 3,** and results of the soil borings, in profile form, are presented on **Figure 4**. On the profiles, horizontal lines designating the interface between differing materials represent approximate boundaries. The actual transition between layers is typically gradual.

NATURAL RESOURCES CONSERVATION SERVICE SOIL SURVEY

The publication titled "Soil Survey of Lake County, Florida" published by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) was reviewed. For your reference, we have included a portion of the NRCS Soil Map which depicts the location of the subject site on the attached **Figure 2**. The three soil map units for the subject project location are identified as:

Soil Map Unit 8:* ***Candler Sand, 0 to 5 Percent Slopes*

Brief Description: "This soil is nearly level to gently sloping and is excessively drained. It is on ridges, knolls, and broad uplands. The slopes range from smooth to broken. Typically, the surface layer is dark grayish brown sand about 6 inches thick. The subsurface layer, to a depth of about 63 inches is light yellowish brown and yellowish brown sand. The next layers to a depth of 80 inches or more are yellow sand that has thin strong textural bands. This soil does not have a high water table within 80 inches of the surface. The available water capacity is very low throughout. Permeability is high to very high."

Soil Map Unit 17: ***Arents***

Brief Description: "This soil consists of material dug up from several areas that have different kinds of soil. This fill material is the result of earthmoving operations. This material is used to fill such areas as sloughs, marshes, shallow depressions, swamps, and other low-lying areas above their natural ground levels, for use in land leveling operations, or as a final cover for sanitary landfills. Fill material used in some areas contain fragments of shells, whole shells, and a few rock fragments. The high water table varies with the amount of fill material and artificial drainage within any mapped area. The Arents soil is used mainly for urban development."

Soil Map Unit 44: ***Swamp***

Brief Description: "Swamp consists of level, very poorly drained mineral and organic soils that have not been classified because excess water and dense vegetation make detailed investigation impractical."

* This soil map unit description is not presented in the 1975 NRCS "Soil Survey of Lake County, Florida" publication including revisions made to soil descriptions in 2004. These soil descriptions are interpreted from corresponding soil survey map units published from adjacent or nearby counties.

SOIL AND GROUNDWATER CONDITIONS

Soil Conditions

The soil types encountered at the boring locations are presented in the form of soil profiles on the attached **Figure 4**. The stratification presented is based on visual examination of the recovered soil samples and the interpretation of the field logs by a geotechnical engineer.

In general, the borings encountered the following soil Strata:

- Brownish Gray to Gray to Brown Fine Sand (Stratum 1)
- Light Gray to Grayish Brown to Brownish Gray Clayey Fine Sand to Sandy Clay (Stratum 2)
- Light Gray to Grayish Brown to Brownish Gray Slightly Silty to Silty Fine Sand (Stratum 3)
- Light Gray to Light Brown Fine Sand (Stratum 4)
- Dark Brown Peat/Muck (Stratum 5)
- Dark Gray to Dark Grayish Brown Fine Sand (Stratum 6)
- Dark Brown Organic Fine Sand (Stratum 7)

Standard Penetration Test (SPT) borings measure soil density using a split spoon sampler advanced by a 140-pound hammer dropped repeatedly a distance of 30 inches. The N-value, which is shown next to the corresponding depths of the boring profile, is the number of blows by the hammer required to advance the split spoon sampler one (1) foot. Split spoon sampling was conducted continuously in the upper 10 feet and at 5-foot intervals thereafter. Also included, adjacent to the SPT borings, are the blow counts or “N” values. The “N” values have been empirically correlated with various soil properties and are considered to be indicative of the relative density of cohesionless soils and the consistency of cohesive material. Upon completion of drilling, the SPT boreholes were backfilled with additional bentonite and soil materials.

Correlation of the SPT-N values with relative density, unconfined compressive strength and consistency are provided in the following table:

Coarse-Grained Soils		**Fine Grained Soils**		
Penetration Resistance N (blows/ft)	Relative Density of Sand	Penetration Resistance N (blows/ft)	Unconfined Compressive Strength of Clay (tons/ft^2)	Consistency of Clay
0-4	Very Loose	<2	<0.25	Very Soft
4-10	Loose	2-4	0.25-0.50	Soft
10-30	Medium-Dense	4-8	0.50-1.00	Medium
30-50	Dense	8-15	1.00-2.00	Stiff
>50	Very Dense	15-30	2.00-4.00	Very Stiff
		>30	>4.00	Hard

Please refer to **Figures 3** and **4** for boring locations, strata depths, and encountered soil conditions. The stratification lines represent the approximate boundaries between soil types. The actual transition may be gradual. Minor variations not considered important to our engineering evaluations may have been abbreviated or omitted for clarity.

Groundwater Conditions

At the time of drilling TB-1, TB-2, and TB-5, groundwater was encountered at depths between 0.5 to 6.5 feet. At the locations of TB-3 and TB-4, groundwater was encountered in a ponded condition, at 1.0 and 0.5 feet above the ground surface, respectively. Based on the encountered subsurface conditions, our local experience, review of the NRCS soil map, and antecedent rainfall conditions, the normal seasonal high groundwater level, at TB-1 and TB-5, is estimated to exist at depths of about 2 feet above the measured levels, and the water level at TB-2, TB-3, and TB-4, is expected to exist in a ponded condition during the wet season and during periods of heavy or extended rainfall.

Laboratory Test Results

The results of the laboratory classification tests selected for moisture content and organic content for the Stratum 5 peat/muck are presented as follows:

TB-2

Sample Depth:	3.0 feet
Classification:	Peat/Muck
Moisture Content:	231.6%
Organic Content:	53.2%

TB-3

Sample Depth:	1.0 feet
Classification:	Peat/Muck
Moisture Content:	250.0%
Organic Content:	44.2%

Typically, organic content values of 4% to 5% are indicative of organic material that is susceptible to decomposition related settlement that can cause differential settlement related damage of overlying supported structures. The results of the two laboratory classification tests for the Stratum 5 peat/muck indicate that the measured organic content of the tested samples ranged between 44.2% and 53.2%. The results of the laboratory classification tests for moisture content and organic content are shown adjacent to the tested depth and corresponding soil profile on **Figure 4**.

EVALUATIONS AND RECOMMENDATIONS

General

Based on the results of this investigation and our evaluation of the encountered subsurface conditions, it is our opinion that the site soils are generally suitable to support the proposed site improvements. At TB-2, TB-3, and TB-4, that were performed along the proposed boardwalk alignment, Strata 5 and 7 peat/muck and organic fine sand were encountered extending to depths of 2.5 to 5.0 feet. It should be noted that organic soils, such as the Strata 5 and 7 peat/muck and organic fine sand, can vary significantly in depth and thickness over short distances and may also exist in “pockets”.

At this time, design plans for the boardwalk landings and concrete walkways have been prepared, however; design plans for pile support of the proposed boardwalk have not been finalized. AEI understands that the proposed boardwalk is planned to be supported on a system of concrete piers. The vertical, lateral, and uplift pile loads and maximum pile height above existing site grades are not known at the time of this investigation. Once design plans for pile support of the proposed boardwalk have been prepared, AEI should be afforded the opportunity to review the plans prior to construction.

Site Preparation

After clearing of the boardwalk alignment, the boardwalk landing areas and concrete slab on grade walkway areas, plus a minimum margin of 5 feet beyond their outer lines, should be cleared and stripped to remove all surface vegetation, roots, topsoil, organic debris, including any encountered Stratum 5 peat/muck, or any other encountered deleterious materials. At the proposed boardwalk landing areas and concrete walkway areas, the exposed foundation subgrade soils should then be proof rolled and compacted to a minimum of 95% of the soil’s modified Proctor maximum dry density as determined by ASTM Specification D-1557 before any fill material is placed. Compaction should be completed to a depth of 2 feet below exposed subgrade. All fill required to bring the site to final grade should be inorganic, non-plastic, granular soil (clean sands) with less than 10% passing a U.S #200 sieve. In structural areas, the fill should be placed in level lifts not to exceed 12 inches loose and should be compacted to a minimum of 95% of the soil’s modified Proctor maximum dry density as determined by ASTM Specification D-1557. In-place density tests should be performed on each lift by an experienced engineering technician working under the direction of a registered geotechnical engineer to verify that the recommended degree of compaction has been achieved. This fill should extend a minimum of 5 feet beyond the boardwalk landings and concrete walkway foundations to prevent possible erosion or undermining of foundation bearing soils. Further, fill slopes should not exceed 2 horizontal to 1 vertical (2H: 1V). All fill placed in utility line trenches and adjacent to footings beneath slabs on grade should also be properly placed and compacted to the specifications stated above. However, in these restricted working areas, compaction should be accomplished with

lightweight, hand-guided compaction equipment and lift thicknesses should be limited to a maximum of 4 inches loose thickness.

Pile Foundation Design

Based on the results of our exploration, we are of the opinion that the soil and groundwater table conditions are generally suitable for the construction of the concrete piers to support the boardwalk. However, the encountered Strata 5 and 7 organic soils in the vicinity of TB-2, TB-3, and TB-4 may decompose and compress over time, adding additional down-drag forces to the proposed pier foundations. The soil properties presented below take into account the presence of surficial organic soils that were encountered within the wetland area. The following average soil properties over the entire soil profile are recommended for the design of the concrete pier foundations for the elevated boardwalk:

Soil Classification:	Fine Sand (Cohesionless)
Effective Friction Angle, ϕ':	30^{o}
Unit Weight (submerged), $\gamma_{b:}$	52.6 lb/ft^3
Horizontal Modulus of Subgrade Reaction, k:	20 lb/in^3

The recommended average strength properties for the foundation soil should be used for the design of the required depth and size of the pier foundations for the boardwalk at this site. If requested, AEI can provide additional assistance for the design of the depth and size of the pier foundations once loading information is available.

Excavations

All excavations should be constructed in accordance with applicable local, state and federal regulations including those outlined by the Occupational Safety and Health Administration (OSHA). It is the contractor's sole responsibility for designing and constructing safe and stable excavations. Excavations should be sloped, benched or braced as required to maintain stability of the excavation sides and bottoms. Excavations should take into account loads resulting from equipment, fill stockpiles and existing construction. Any shoring needed to maintain a safe excavation should be designed by a professional engineer registered in the State of Florida in accordance with local, state and federal guidelines.

LIMITATIONS

This report has been prepared for the exclusive use of GAI Consultants, Inc., and their designers, based on our understanding of the project as stated in this report. Any modifications in design concepts from the description stated in this report should be made known to AEI for possible modification of recommendations presented in this report. As previously discussed, the encountered Strata 5 and 7 peat/muck and organic fine sand can vary significantly in in depth and thickness over short distances and may also exist in "pockets". This exploration was performed in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made as to the professional advice presented herein. Statements regarding all geotechnical recommendations are for use by the designers and are not intended for use by potential contractors. The geotechnical exploration and recommendations submitted herein are based on the data obtained from the soil borings presented on **Figure 4**. The report does not reflect any variations which may occur adjacent to, between, or away from the borings. The nature and extent of the variations between the borings may not become evident until during construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented in this report. An on-site visit may be required by a geotechnical engineer to note the characteristics of the variations during the construction period. This geotechnical study investigated the soil conditions to drilled depths of 20 to 25 feet below ground surface and was not intended to investigate deeper soil conditions with regard to the presence or absence of Karst activity.

CLOSURE

AEI appreciates the opportunity to participate in this project, and we trust that the information herein is sufficient for your immediate needs. If you have any questions or comments concerning the contents of this report, please do not hesitate to contact the undersigned.

Sincerely,

ANDREYEV ENGINEERING, INC.

Mark L. Jung
Senior Project Manager

This item has been digitally signed and sealed by Ray Jones, P.E. on 10/8/20.

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

RAYMOND W. JONES LICENSE NO. 58079 STATE OF FLORIDA PROFESSIONAL ENGINEER

Raymond W. Jones, P.E.
Vice President
Florida Registration No.58079

FIGURES

REFERENCE:
U.S.G.S. CLERMONT EAST, FLA.
QUADRANGLE MAP
DATED 2018
SECTION 23
TOWNSHIP 22 SOUTH
RANGE 26 EAST

Andreyev Engineering, Inc.

APPROXIMATE SCALE:	DATE: 09/30/20	ENGINEER: RJ
1"=2000'	PN: GPGT-20-106	DRAWN BY: DLS

GEOTECHNICAL INVESTIGATION

PROPOSED SOUTH LAKE TRAIL IMPROVEMENTS

COUNTY ROAD 455
CLERMONT, LAKE COUNTY, FL

U.S.G.S. TOPOGRAPHIC MAP

FIGURE 1

LEGEND:

8	CANDLER SAND 0 TO 5% SLOPES
17	ARENTS
44	SWAMP

REFERENCE:
U.S.D.A. N.R.C.S. WEB SOIL SURVEY

Andreyev Engineering, Inc.

APPROXIMATE SCALE: 1"=200'	DATE: 09/30/20	ENGINEER: RJ
	PN: GPGT-20-106	DRAWN BY: DLS

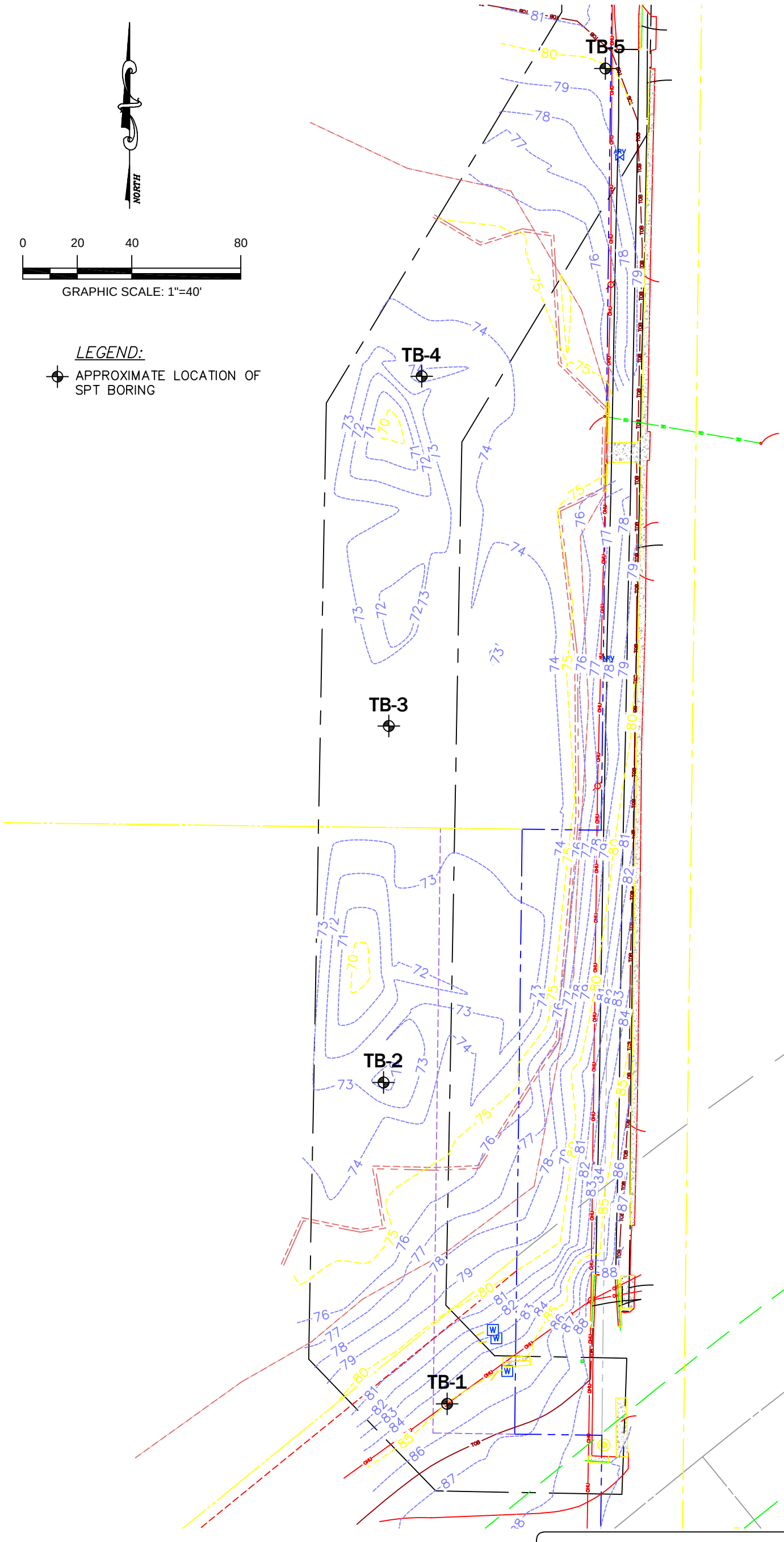
GEOTECHNICAL INVESTIGATION

PROPOSED SOUTH LAKE TRAIL IMPROVEMENTS

COUNTY ROAD 455
CLERMONT, LAKE COUNTY, FL

N.R.C.S. SOIL SURVEY MAP

FIGURE 2



REFERENCE:
BASEMAP DRAWN BY OTHERS

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION

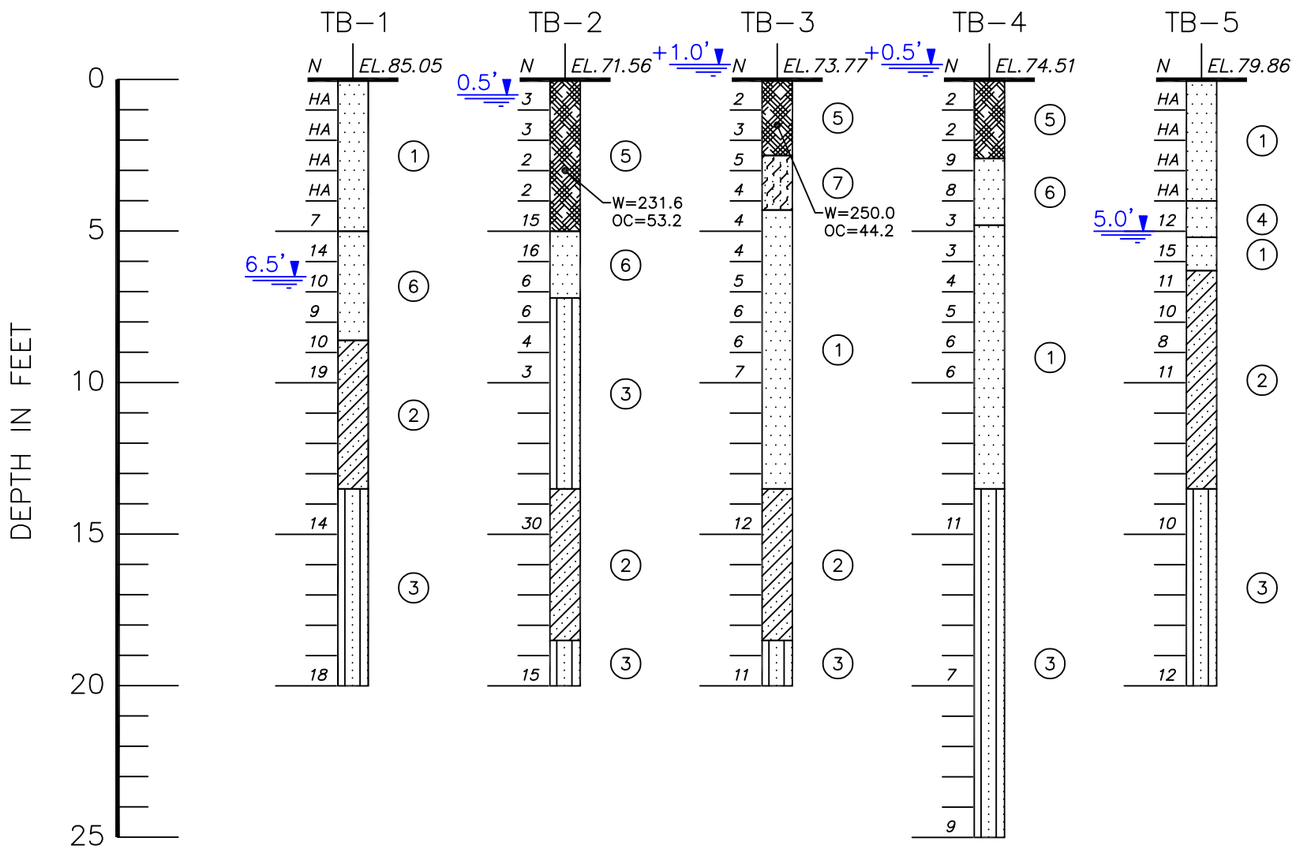
PROPOSED SOUTH LAKE TRAIL IMPROVEMENTS

COUNTY ROAD 455
CLERMONT, LAKE COUNTY, FL

BORING LOCATION PLAN

APPROXIMATE SCALE:	DATE: 09/30/20	ENGINEER: RJ
1"=40'	PN: GPGT-20-106	DRAWN BY: DLS

FIGURE 3



LEGEND:

- (1) BROWNISH GRAY TO GRAY TO BROWN FINE SAND (SP)
- (2) LIGHT GRAY TO GRAYISH BROWN TO BROWNISH GRAY CLAYEY FINE SAND TO SANDY CLAY (SC)(CL)
- (3) LIGHT GRAY TO GRAYISH BROWN TO BROWNISH GRAY SLIGHTLY SILTY TO SILTY FINE SAND (SP–SM)(SM)
- (4) LIGHT GRAY TO LIGHT BROWN FINE SAND (SP)
- (5) DARK BROWN PEAT/MUCK (PT)
- (6) DARK GRAY TO DARK GRAYISH BROWN FINE SAND (SP)
- (7) DARK BROWN ORGANIC FINE SAND (SP–PT)
- *(SP)* UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL
- 1.0' DEPTH TO GROUNDWATER, AUGUST 31 & SEPTEMBER 21, 2020
- *N* STANDARD PENETRATION RESISTANCE, IN BLOWS PER FOOT
- *HA* BORING ADVANCED USING HAND AUGER
- *EL.* GROUND SURFACE ELEVATION AT BORING LOCATION (FT–NAVD88)
- *W* MOISTURE CONTENT, IN PERCENT
- *OC* ORGANIC CONTENT, IN PERCENT

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION

PROPOSED SOUTH LAKE TRAIL IMPROVEMENTS

COUNTY ROAD 455

CLERMONT, LAKE COUNTY, FL

SOIL PROFILES

APPROXIMATE SCALE:	DATE: 10/02/20	ENGINEER: RJ
1"=5'	PN: GPGT–20–106	DRAWN BY: DLS

FIGURE 4