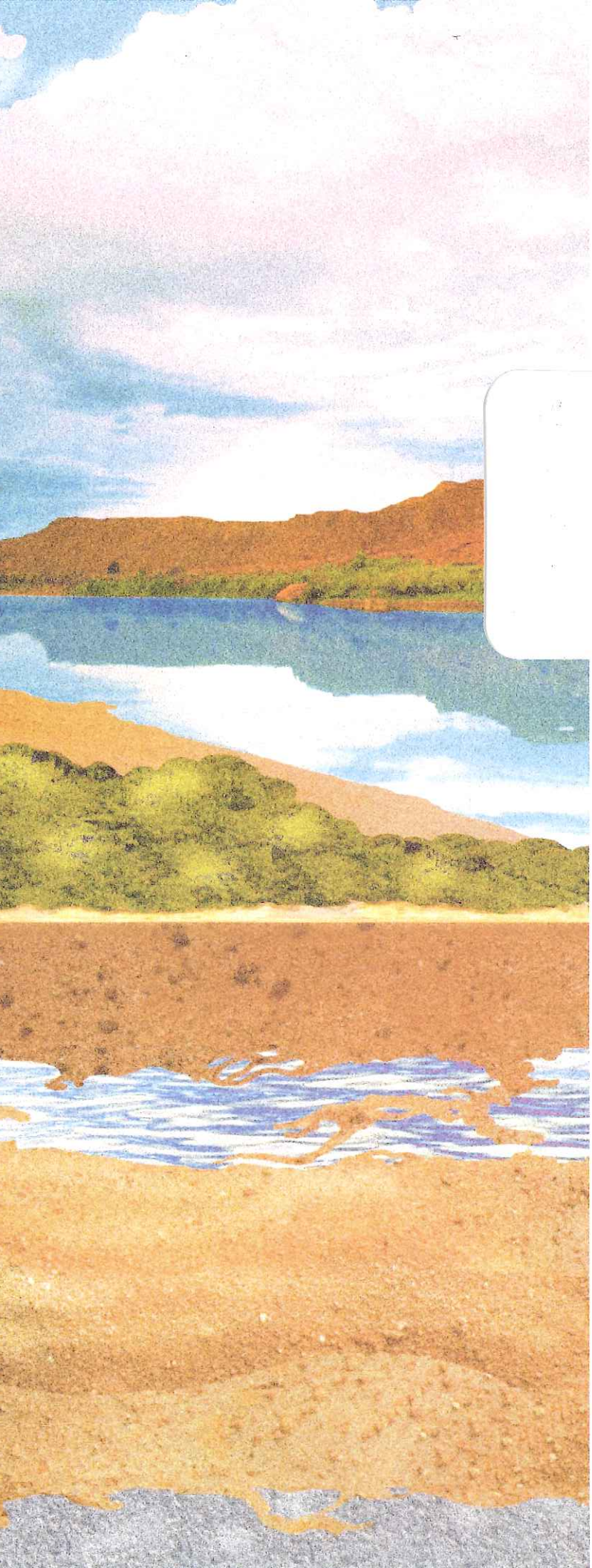

Andreyev Engineering, Inc.

- *Groundwater*
- *Environmental*
- *Geotechnical*
- *Materials Testing*

GEOTECHNICAL INVESTIGATION FOR

PALM RIVER RESTORATION

TAMPA, FLORIDA

Andreyev Engineering, Inc.

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▼ Groundwater ▼ Environmental ▼ Geotechnical ▼ Construction Materials Testing

June 20, 2013
AEI Project No. APGT-13-0070

TO: **King Engineering**
4921 Memorial Highway, Suite 300
Tampa, Florida 33634

Attention: Mr. Michael Palmer

SUBJECT: Geotechnical Investigation for Weir Structure and Temporary Haul Road, Palm River Restoration Project (W367), Tampa, Florida

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Dear Mr. Palmer:

At your request, Andreyev Engineering, Inc. (AEI) has completed a geotechnical investigation for the above referenced project. Our work has been performed in general accordance with the AEI Proposal No: P3139.Pro dated November 29, 2012. This report presents the results of the field explorations performed together with an engineering evaluation of the observed soil and groundwater conditions and their implications for design and construction of the proposed project.

Andreyev Engineering, Inc. appreciates the opportunity to provide our geotechnical engineering services on this project and trust that the information presented herein is sufficient for your current needs. Should you have any questions concerning the contents of this report or if we may be of further service during the construction phase please do not hesitate to contact us.

Sincerely,

ANDREYEV ENGINEERING, INC.

6-26-13

Jeffery E. Eller, P.E.
Vice President
Florida Registration No. 57434

Andre Kniazeff, E.I.
Project Engineer

PROJECT DESCRIPTION

The proposed project will consist of the design and construction of a permanent concrete weir structure and a temporary haul road through reclaimed areas.

PURPOSE AND SCOPE

The purpose of this investigation was to determine the shallow soil and groundwater conditions at the locations of the proposed weir structure and temporary haul road for purposes of providing general recommendations for design and construction/stabilization.

The specific scope of investigation included the following:

1. Performed one (1) standard penetration test (SPT) boring to an estimated depth of 30 feet within the proposed weir structure area.

2. Drilled seven (7) hand auger borings to depths of 6 feet at the two selected transects along the temporary haul road alignment.

3. Measured the depth of the groundwater table at the locations of the borings.

4. Conducted visual and laboratory soil classification tests on selected soil samples to define soil types and soil consistency.

5. Prepared this report detailing the results of our investigation and recommendations regarding the design and construction/stabilization of the proposed weir structure and the temporary haul road.

Existing Site Conditions

The study area is located within reclaimed spoil areas south of the Palm River in Tampa, Hillsborough County, Florida.

The USGS, "Tampa, Fla." topographic map dated 1956, photorevised 1981, showing the area on which the borings are located, was reviewed. Based on this review, the boring locations are estimated to occur at an elevation of approximately +5 feet above National Geodetic Vertical Datum (NGVD). The topography is generally flat. The USGS map showing the project area and vicinity is included as **Figure 1**.

Subsurface Soil Conditions

According to the U.S.D.A. "Soil Survey of Hillsborough County", the soils mapped over the haul road area are classified as Myakka fine sand, frequently flooded type soils. This complex consists of level, very poorly drained sandy soils with a seasonal high water table at a depth of 0 to 10 inches below natural ground surface. The soils mapped at the weir location are classified as Winder fine sands. Winder soils are level, poorly drained sandy soils found on broad low lying

sloughs on the flatwoods. The natural seasonal high water table is generally at a depth of less than 10 inches.

Field Exploration Program

For our study, we conducted one Standard Penetration Test (SPT) boring (B-1) to a depth of 30 feet bls within the proposed weir structure area. In addition, seven hand auger borings (HA-1 through HA-7) were conducted to depths of 6 feet in transects along the temporary haul road alignment. The borings were approximately located in the field according to the site plan provided by the project civil engineer. The approximate boring locations are indicated on **Figure 2**.

The SPT boring procedure was conducted using rotary-mud drilling techniques. Soil sampling using a 1-3/8 inch I.D. split-spoon sampler was conducted continuously through the first 10 feet and at 5 foot intervals thereafter. The number of successive blows required to drive the sampler into the soil constitutes the test result commonly referred to as the "N"-value. The "N"-value has been empirically correlated with various soil properties and is considered to be indicative of the relative density of less cohesive soils and the consistency of cohesive soils. The recovered split spoon samples were visually classified in the field, and representative samples were placed in jars and transported to our office for further review and confirmation of the field classification.

Laboratory Testing Program

Soil samples collected from the borings were returned to our laboratory facility where they were visually classified. The samples were classified in accordance with the Unified Soil Classification System (USCS). The soil classifications are presented in the boring logs. The laboratory testing program consisted of performing one (1) passing No. 200 sieve tests, one (1) moisture content tests and one (1) Atterberg limits test. The results of the tests are shown adjacent to the soil profiles presented in the boring logs.

Generalized Soil Stratigraphy

The results of the subsurface exploration program including the soil stratification profiles and some pertinent exploration information such as SPT "N"-values and groundwater levels as well as a legend describing the different soil types encountered are presented on **Figure 3**. Soil stratification was based on the review of recovered soil samples and interpretation of the field boring logs by a geotechnical engineer. The stratification lines represent the approximate boundaries between soil types; the actual transition may be gradual. The soil strata were visually classified using the Unified Soils Classification System. Minor variations in soil types not considered important to our engineering evaluations may have been abbreviated or omitted for clarity.

In general, the SPT boring encountered fine sands to clayey fine sands with rock (Strata 1 through 4) to a depth of 28 feet bls. Underlying the fine sands the boring encountered silty clay (Stratum 5) which continued to the boring's termination depth of 30 feet. The hand auger borings encountered layers of soft silts and clays (Strata 5, 7 and 8) to depths of 6 feet bls. Auger borings

HA-5, HA-6 and HA-7 encountered shallow layers (6 to 18 inches) of fine sands and clayey fine sands at the ground surface.

Based on the SPT "N"-values taken from our SPT boring, the sandy soils over the site to a depth of about 28 feet (+/-) are generally considered to be very loose to medium-dense materials. The deeper clay soils were generally found to exist in a very stiff condition. The SPT-N values are presented adjacent to the soil profile on **Figure 3**. 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

Groundwater Conditions

Groundwater levels were recorded following the soil investigation. The measured levels are indicated adjacent to the boring profile on **Figure 3**. The shallow groundwater table was encountered between the ground surface and depths of 2.4 feet in the SPT and auger borings conducted. The shallow groundwater level should be expected to vary during wet seasons and heavy rainfall events.

Seasonal fluctuations of groundwater levels can be anticipated in response to variations in rainfall. The level recorded during this investigation is estimated to be lower than the normal seasonal high levels. Based on the review of the SCS soil survey, boring results, measured groundwater levels, adjacent surface water features and antecedent rainfall, the project areas are in tidal areas and are subject to shallow flooding.

GEOTECHNICAL RECOMMENDATIONS

Weir Structure

Based on the plans provided, a weir structure will be constructed at the existing drainage ditch east of 45th Street South. No specific construction plans have been provided and it is assumed that the structure will consist of a concrete capped, sheet pile wall.

For purposes of estimating lateral earth pressures against walls constructed below grade, assuming fine sand and clayey fine sand backfill, we recommend a Rankine passive earth pressure coefficient of 3.0 and an active earth pressure coefficient of 0.33. These earth pressure coefficients are recommended because fill will be compacted against the walls and the walls are not free to move or yield. One method of calculating the estimated lateral earth pressure is to assume an equivalent fluid pressure distribution with a soil unit weight (compacted structural sand fill) of 120 to 125 pcf above the watertable and 63 to 68 pcf for sands below the water table. The equivalent fluid pressure is calculated by multiplying the earth pressure coefficient by the vertical effective soil pressure (unit weight multiplied by depth). This earth pressure criteria does not include a factor of safety or effects of surcharge loadings at the surface. The structure should be designed for hydrostatic loads (and uplift), with the water table conservatively estimated at the top of the weir.

Temporary Haul Road

The temporary haul road can be constructed using either crushed concrete or limerock. The auger borings conducted identified relatively weak silts and clays at the areas investigated. In addition, it is expected that the area investigated will likely have standing water at some point during the wet season. Based on the results of our investigation we recommend the haul road through this area be constructed with 18 inches of limerock base placed above the existing grades through this area. The quality of limerock should be in accordance with current Florida Department of Transportation specifications and compacted to a minimum density equivalent to 98 percent of the Modified Proctor Maximum Density (AASHTO T-180). The limerock should have a minimum Limerock Bearing Ratio of 100.

In order to minimize rutting caused by movement/consolidation of the underlying weak soil layers we recommend that a stabilizing geotextile fabric be utilized below the limerock base. The geotextile fabric (Mirafi RS380i or equivalent) should be placed directly on top of 6 inches of sandy subgrade compacted to a minimum of 95 percent of the Modified Proctor density. The fabric should be installed in accordance with the manufacturer's recommendations with 2 foot overlaps side to side and 4 foot overlaps end to end over the compacted subgrade.

The limerock base should be installed in two lifts with the lower lift consisting of approximately 9 inches (loose depth) of limerock and compacted with rubber tired construction equipment in order to place the geotextile fabric into tension. After trafficking, the lower limerock lift surface should be compacted to the specified density listed above. If the compacted surface is firm, then place and compact the remaining limerock layer. If the compacted surface of the first limerock lift is not firm or yields to traffic, then a geogrid system (Mirafi BXG110 or equivalent) should be installed prior to placing the final lift of limerock.

Permanent Maintenance Road

It is our understanding that following construction the temporary haul road will be removed and a permanent access/maintenance road will need to be constructed which does not exceed current grades. Based on our discussions the roadway traffic will consist of electrical service vehicles with maximum wheel loads of 3,250 lbs. The road will be inundated during extreme wet periods and abnormally high tides.

The permanent access road can be constructed using a 10 inch thick section of No. 57 crushed aggregate installed with a woven geotextile fabric in conjunction with an 8-inch thick geoweb system. The entire pavement section, which should be a minimum of 10 inches thick, will need to be installed in a cut of equal thickness in order to preserve existing grades.

Prior to placement of the No. 57 crushed aggregate and geoweb a stabilizing geotextile fabric should be utilized over the stripped subgrade. The geotextile fabric (Mirafi RS580i or equivalent) should be placed directly on top of the subgrade. The fabric should be installed in accordance with the manufacturer's recommendations with 2 foot overlaps side to side and 4 foot overlaps end to end over the subgrade. The geoweb (Presto Genuine Geoweb GW30V8 or equivalent) should be placed over the geotextile fabric and filled/loaded in accordance with the manufacture's recommendations. A 2 inch layer of No. 57 crushed aggregate should be placed over the filled geoweb to provide a wearing surface.

LIMITATIONS

The geotechnical investigation and engineering recommendations submitted herein are based on the data obtained from the soil borings presented on **Figure 3**. This report does not reflect any variations which may occur adjacent to or between the individual borings. Should variations or anomalies then appear evident, it will be necessary for Andreyev Engineering, Inc. to re-evaluate our engineering recommendations after performing additional on-site observations and possible additional soil tests to note the characteristics of reported variations.

FIGURES

REFERENCE:
U.S.G.S. TAMPA, FLA.
QUADRANGLE MAP
DATED 1995
SECTION 28
TOWNSHIP 29 SOUTH
RANGE 19 EAST

Andreyev Engineering, Inc.

APPROXIMATE SCALE:	DATE: 06/11/13	ENGINEER: JE
1"=2000'	PN: APGT-13-0070	DRAWN BY: DLS

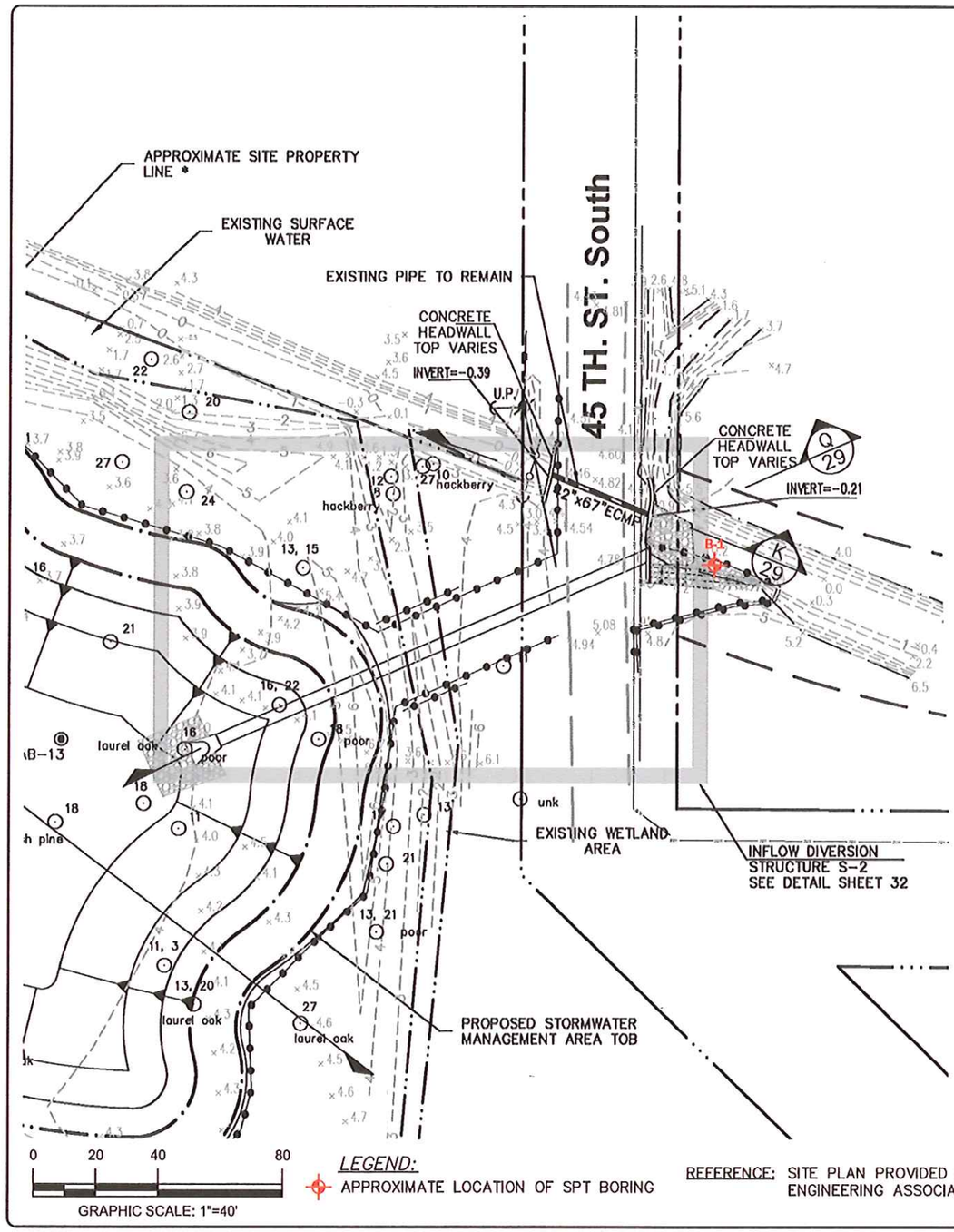
GEOTECHNICAL INVESTIGATION

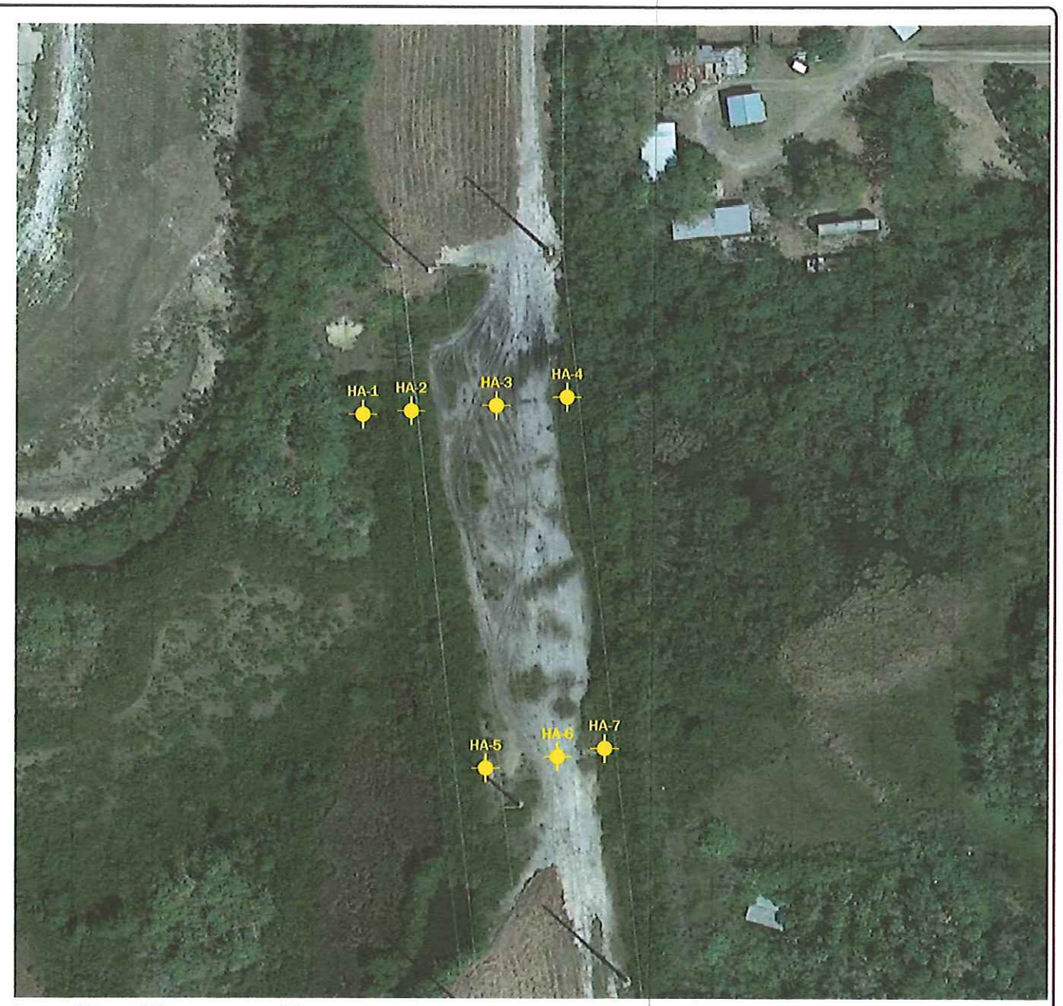
PALM RIVER RESTORATION PROJECT (W367)

TAMPA, HILLSBOROUGH COUNTY, FL

U.S.G.S. TOPOGRAPHIC MAP

FIGURE 1





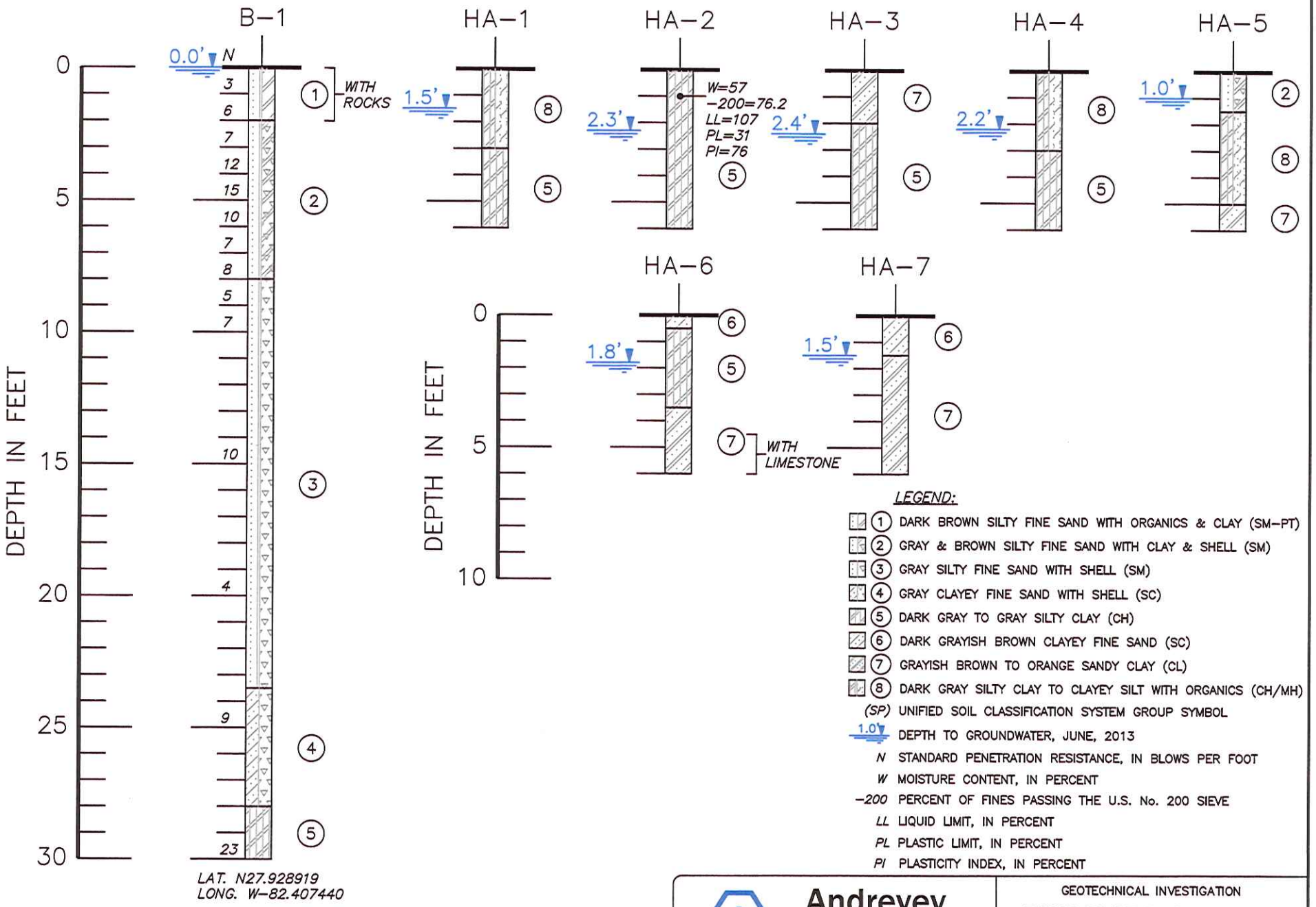
Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION
PALM RIVER RESTORATION PROJECT (W367)
TAMPA, HILLSBOROUGH COUNTY, FL

BORING LOCATION PLAN

APPROXIMATE SCALE:	DATE: 06/11/13	ENGINEER: JE
AS SHOWN	PN: APGT-13-0070	DRAWN BY: DLS

FIGURE 2



LEGEND:

- (1) DARK BROWN SILTY FINE SAND WITH ORGANICS & CLAY (SM-PT)
- (2) GRAY & BROWN SILTY FINE SAND WITH CLAY & SHELL (SM)
- (3) GRAY SILTY FINE SAND WITH SHELL (SM)
- (4) GRAY CLAYEY FINE SAND WITH SHELL (SC)
- (5) DARK GRAY TO GRAY SILTY CLAY (CH)
- (6) DARK GRAYISH BROWN CLAYEY FINE SAND (SC)
- (7) GRAYISH BROWN TO ORANGE SANDY CLAY (CL)
- (8) DARK GRAY SILTY CLAY TO CLAYEY SILT WITH ORGANICS (CH/MH)
- *(SP)* UNIFIED SOIL CLASSIFICATION SYSTEM GROUP SYMBOL
- 1.0' DEPTH TO GROUNDWATER, JUNE, 2013
- *N* STANDARD PENETRATION RESISTANCE, IN BLOWS PER FOOT
- *W* MOISTURE CONTENT, IN PERCENT
- *-200* PERCENT OF FINES PASSING THE U.S. No. 200 SIEVE
- *LL* LIQUID LIMIT, IN PERCENT
- *PL* PLASTIC LIMIT, IN PERCENT
- *PI* PLASTICITY INDEX, IN PERCENT

Andreyev Engineering, Inc.

GEOTECHNICAL INVESTIGATION

PALM RIVER RESTORATION PROJECT (W367)

TAMPA, HILLSBOROUGH COUNTY, FL

SOIL PROFILES

APPROXIMATE SCALE:	DATE: 06/11/13	ENGINEER: JE
1"=5'	PN: APGT-13-0070	DRAWN BY: DLS

FIGURE 3