Subsurface Soil Exploration and Geotechnical Engineering Evaluation for the Proposed Apalachee Regional Park Stormwater Management Facility Tallahassee, Florida

File No. 113-11-40-1380
January 19, 2012

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Geotechnical, Environmental and
Materials Consultants

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Leon County Public Works
2280 Miccosukee Road
Tallahassee, Florida 32308

Attention: Mr. George Su, P.E.

Subject: Geotechnical Report- Subsurface Soil Exploration and Geotechnical Engineering Evaluation for the Proposed Apalachee Regional Park Stormwater Maintenance Facility, Tallahassee, Florida

Dear Mr. Su:

As authorized under Purchase Order P0054556, dated 12/15/2011, Ardaman and Associates, Inc. (Ardaman) has completed the subsurface soil exploration and geotechnical engineering evaluation for the subject SWMF. The purposes of this exploration were to evaluate subsurface conditions encountered in test borings performed at the site, and to provide a geotechnical evaluation of the encountered subsurface soil and groundwater conditions.

This report has been prepared for the exclusive use of Leon County Public Works and their consultants for specific application to the subject project.

We recommend that Ardaman and Associates, Inc. be retained to perform site and laboratory testing during construction, to confirm compliance with design documents.

Ardaman and Associates, Inc. are pleased to be of assistance to you on this phase of your project. When we may be of further service to you or should you have any questions, please do not hesitate to contact us.

Sincerely,

ARDAMAN & ASSOCIATES, INC.
Florida Certificate of Authorization No. 5950

MICHAEL S WILSON
LICENSE
No. 46088
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Jeremy M. Clark, E.I.
Staff Engineer

JMC/MSW/ms

Michael S. Wilson, P.E.
Tallahassee Branch Manager
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1.0 PROJECT DESCRIPTION

Based on the provided preliminary site plans, the proposed development includes the construction of a stormwater management facility with a bottom area of approximately 218-feet by 18-feet. The bottom grade will be +95-feet (plan datum) and the top of the berm will be at +100-feet with overflow at +99.5-feet. This pond will be constructed in an existing slope with grades between about +92 and +101-feet. Up to about 7-feet of fill and 4-feet of cut is planned to achieve final grade. Slopes are planned to be 4H: 1V.

2.0 SCOPE OF SERVICES

Geotechnical services performed were based on our authorized proposal for the project, as follows:

1. Ardaman mobilized a drill rig and crew to the site and performed four (4) test borings to 15-feet below grade in the proposed pond area.

2. During performance of the test borings, our drillers field-classified the soils and obtained soil samples. Portions of the samples were then transported to our laboratory for further classification by our engineers. The drillers also estimated the depth to groundwater in the borings, where encountered.

3. Recovered soil samples were visually/manually classified by our engineers, whom developed a soil profile for each boring, and directed laboratory testing on selected soil samples, to further define the engineering and index properties of the soils.

4. We developed geotechnical engineering evaluations of the subsurface conditions encountered at the site and provide recommendations in regards to stormwater management facility design. Our findings and recommendations are documented in this report, along with a test boring location plan, and the soil boring profiles.

3.0 FIELD SUBSURFACE EXPLORATION-LOCATIONS AND METHODS

The locations of the test borings are shown on the *Test Boring Location Plan*, on the attached **Figure 1**. The borings were located on site by our staff using a wheel tape, measuring from existing landmarks. The boring locations indicated are approximate.

Three of the four test borings were advanced by rotary drilling with 4-inch diameter continuous flight augers, using a Central Mine Equipment Model CME-55 drill rig mounted on a flat-bed truck, utilizing Standard Penetration Testing (SPT) in general accordance with ASTM D1586. The test borings were sampled at 18-inch intervals to 10.5 feet depth and at 5 foot intervals thereafter. Soil samples were removed from the split-spoon sampler in the field and were examined and visually classified by our drill crew chief. Soil samples from each split-spoon drive were sealed and packaged for transportation to our laboratory for further classification by engineers, and lab tests. Due to accessibility issues, the fourth test hole was advanced with hand operated bucket augers utilizing Dynamic Cone Penetration (DCP) testing in accordance with ASTM STP#399.

Upon completion of the test borings, they were backfilled with tamped site soils and auger cuttings.

4.0 LABORATORY TESTING

Laboratory testing was directed by our engineers on selected soil samples form the test borings, to aid classification and to further define the engineering properties of the soils. The laboratory tests included: natural moisture content (NM)(ASTM D 2216), percent finer than the U.S. No. 200 sieve (-200)(ASTM D 1140; percent silt and clay), and Atterberg Limits Determinations (LL&PI)(ASTM D 4318; plasticity). The results of the laboratory tests are presented adjacent to the ***Soil Boring Profiles*** on the attached **Figure 1**, at the respective depths from which the tests samples were recovered.

5.0 SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

5.1 General

Our interpretations of the subsurface conditions encountered during the field exploration are depicted in the *Soil Boring Profiles* presented on the attached **Figure 1**. The soil descriptions presented in the *Soil Legend* are based upon visual/manual and laboratory test-based classification procedures in general accordance with ASTM D 2488; ASTM D 2487; and AASHTO M145.

The stratification lines on the *Soil Boring Profiles* represent the approximate boundaries between the soil types, but the actual transitions may be more gradual than implied. This report cannot address any variations which may occur between, or away from the borings. The nature and extent of such variations may not become evident until during the course of construction. If any variations become evident, Ardaman must be contacted to provide additional evaluations.

5.2 Soil Conditions-Generalized

In general, TH-1 and TH-3 encountered greater thicknesses of clayey soils than in TH-2 and TH-4. In TH- 1 and 3, the profiles were dominated by a reddish-brown very clayey sand to very sandy lean clay (Stratum 3), while in the other two borings, Stratum 3 was present, but in much thinner layers. In TH-2 and 4, a reddish-brown silty, clayey sand (Stratum 2) was encountered about as often as Stratum 3. Strata 2 and 3 were very similar soil types, however Stratum 3 had an increased amount of clay contents in comparison to Stratum 2. Test holes TH-2, 3, and 4 encountered Stratum 2 at depths ranging from 7-feet to 10-feet.

SPT blow counts generally indicated loose/medium dense to medium stiff conditions. Please refer to the *Soil Boring Profiles* on Figure 1 for more details regarding soil stratification at each test boring location.

5.3 Groundwater Conditions and Normal Seasonal High Groundwater Level

At the time the test borings were performed, groundwater was not encountered within the depths of the test borings. According to the USDA Soil Survey of Leon County, the depth to the seasonal high groundwater table is greater than 6-feet. Given the proximity to the nearby pond,

we anticipate that groundwater would occur a few feet above the pond water level, although temporarily perched groundwater could occur atop Stratum 3 during rainy periods.

The term "Seasonal High Water Table" (SHWT) is generally accepted to indicate the high groundwater table at or shortly after the end of the wet season of an average year. A number of factors affect the seasonal high water table, including: drainage characteristics of the soils; the land surface elevations and slopes; the presence of "closed basins"; and the locations of relief points such as drainage ditches, lakes, rivers, swamp areas, etc. It is the opinion of Ardaman & Associates that there is no approved scientific method to determine the normal seasonal high water table precisely. As such the estimated level presented in this section is approximate.

6.0 EARTHWORK RECOMMENDATIONS

6.1 General Soils

In our opinion, subsurface conditions encountered in the test borings appear suitable for the proposed construction. The subgrade bearing soils shall be prepared in accordance with the recommendations presented in Section 6.2, below.

After striping the topsoil layer, proof-rolling compaction of the existing soils is recommended to provide a relatively uniform bearing surface for the embankment, and to reveal any areas with objectionable soil conditions which have not necessarily been encountered in the borings.

Ardaman shall be requested to inspect exposed subgrade soils during earthwork to test densities of subgrade soils and fills.

6.2 Typical Site Preparation Procedures

The following are recommendations for site soil preparation and foundation design, which, in our opinion, are suitable for the proposed construction:

1. The entire construction area footprint, plus a minimum margin of three feet laterally, shall be stripped and grubbed of all vegetation.

2. Excavate a key below the upstream side, nearest the pond, of the proposed berm. The purpose in the key is to remove possible deleterious materials, particularly roots, below the berm which may act as conduits. Typically, the key is a minimum of 2-feet deep and 8-feet wide, with side slopes no greater than 1H:1V. Fill in the key in accordance with Items 5 and 6, below.

3. The cleared surfaces in the berm areas, including the excavated key, shall be proof-rolled, under the direction of a professional engineer, using the appropriate compaction equipment for site and soil conditions. Adjust the moisture content of the soil, as necessary to aid compaction. Sufficient passes shall be made to develop a minimum of 95% of the modified Proctor maximum dry density (ASTM D 1577), utilizing water contents a few percentage points wet of the modified Proctor optimum moisture content, to a depth of 12-inches below the compacted surface.

4. If any areas yield during proof-rolling, explore in test trenches to evaluate if excessive organics or other deleterious materials are encountered that may act as conduits. If deleterious materials (such as buried tree stumps or roots) are encountered in the key and berm area, remove and replace with properly compacted Suitable Fill as indicated in Item 5 and 6, below.

5. Filling shall occur in level lifts not exceeding 12-inches in uncompacted thicknesses. Each lift shall be compacted by repeated passes with appropriate compaction equipment to achieve a minimum of 95% of the modified Proctor maximum dry density (ASTM D 1557), utilizing a water content wet of the modified Proctor optimum moisture content, and maintain that moisture between lifts. Lightly scarify the compacted soil surfaces before the next lift is placed to promote bonding between lifts. The filling and compaction operations shall continue until the desired elevations are achieved.

6. Fill used for the berm and key shall have a minimum of 20% fines, generally clayey fines. Stratum 2 and 3 are judged to be appropriate for the use of constructing the key and berm. Typically, the more clayey material shall be utilized on the upstream side of the berm, and sandier material on the downstream side. Avoid horizontal zones of high permeability.

7. We recommend the following minimum testing frequencies:

    a. Proof-rolled subgrade: one compaction test per 2,000 square feet, and continuous observation of proof-rolling throughout berm and key areas.
    b. Fill areas: one compaction test per 2,000 square feet per lift, minimum 3 per lift

    It is important to contact Ardaman at least a few days prior to proof-rolling so that bulk samples of site soils and proposed fills can be obtained, and Proctor tests performed in the laboratory. In this manner, the maximum Proctor dry density values will be available at the time of proof-rolling and density testing.

7.0 STORMWATER FACILITY EVALUATION

7.1 Subsurface Drainage

In general, the recovery of retention or detention facilities depends upon several factors including thickness of permeable layers, pond configuration and sand filters, if any; the bottom elevation of the pond and its proximity to the groundwater table, proximity and extent of confining layers, pond loading rate and frequency, and the head of water above the bottom of the pond. Based on the USDA soil texture class, permeability of the Stratum 2 is estimated to be on the order of 0.06 to 0.43 inches per hour (0.12 to 0.86 feet per day) and Stratum 3 is estimated to be on the order of 0.02 to 0.06 inches per hour (0.04 to 0.12 feet per day).

7.2 Karst

The borings in the four locations shown on Figure 1 did not encounter subsurface conditions indicative of karst formations to the depth of boring termination. Note however that these borings are relatively shallow and that karst conditions originate in the deeper limestone.

7.3 Slope Stability

Proposed slopes are approximately 4H:1V. Based upon review of the soil types, and their density conditions revealed by the Standard Penetration Test "N"-Values, it is our opinion that the proposed excavation and fill slopes will be stable, provided they are not exposed to excess, concentrated stormwater runoff or seepage.

8.0 CLOSURE

The recommendations submitted in this report are based upon the data obtained from the soil borings presented on the attached Figure 1. This report does not reflect any variations which may occur between the borings. The nature and extent of variations between the borings may not become evident until construction. If site or soil variations appear evident, it will be necessary to reevaluate the recommendations of this report after performing further onsite observations during the construction period and noting the characteristics of such variations.

In the event any changes occur in the design, nature, location of the facility, or assumed conditions, Ardaman and Associates, Inc. must review the applicability of the conclusions and recommendations in this report. Ardaman and Associates, Inc. must also perform a general review of final design drawings and specifications to determine if earthwork and foundation recommendations have been properly interpreted and implemented in the design specifications. Recommendations in this report shall not be applicable if all the above are not fulfilled by the client or the consultant involved in the project.

This study does not deal with the possibility of eventual sinkhole development at the site. This exploration and analysis covers only the near surface soil deposits. It is not intended to include deep soil or rock strata where cavities and caverns may exist. Additional deep structural borings and/or geophysical explorations are necessary in order to evaluate the structural condition and stability of deep rock formations.

This report has been prepared in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

End of Report

ENGINEERING CLASSIFICATION

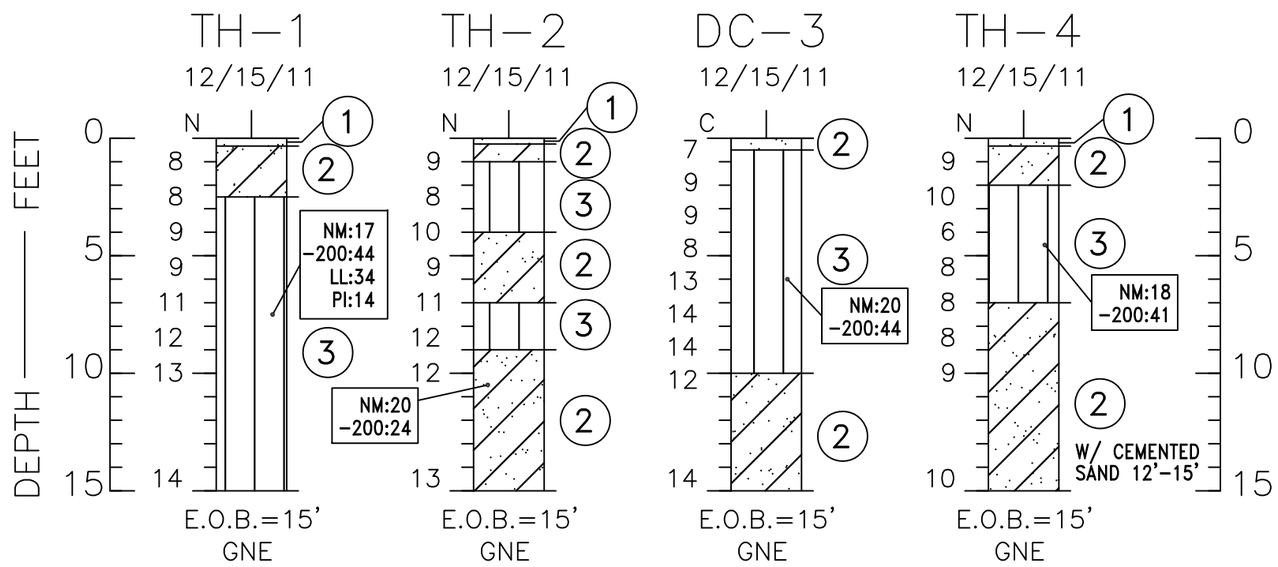
I COHESIONLESS SOILS

DESCRIPTION	"N" ≈ "C"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

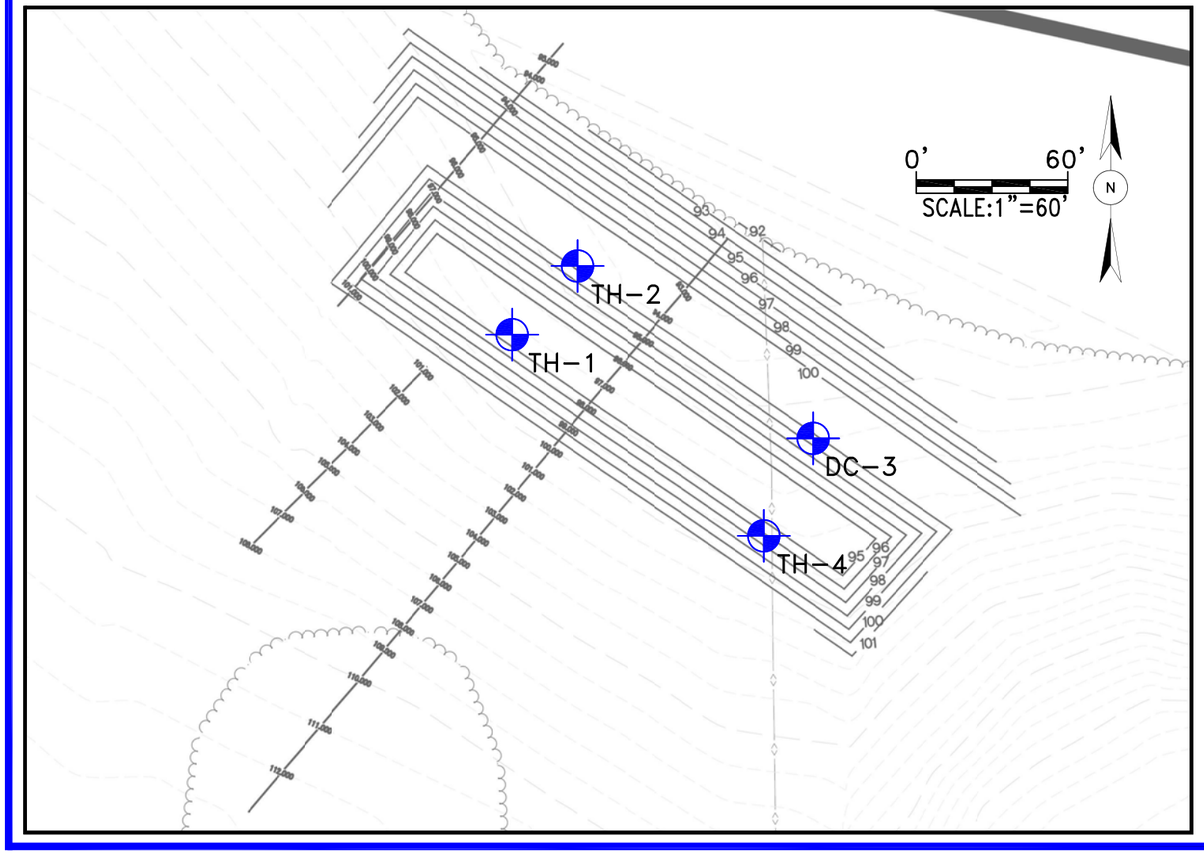
II COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSF	"N" ≈ "C"
VERY SOFT	<1/4	0 TO 2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30

SOIL BORING PROFILES



TEST BORING LOCATION PLAN



SOIL LEGEND

1. BROWN MEDIUM TO FINE SAND W/ SILT AND ORGANICS; TOPSOIL (SP–SM W/ OH; A–3 W/ A–8)
2. REDDISH–BROWN SILTY, CLAYEY SAND (SM–SC; A–2–4)
3. REDDISH–BROWN VERY CLAYEY SAND TO VERY SANDY LEAN CLAY (SC/CL; A–6)

LEGEND

TH	STANDARD PENETRATION TEST (SPT) BORING LOCATION
DC	DYNAMIC CONE PENETRATION (DCP) BORING LOCATION
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT (ASTM D–1586)
C	DAYNAMIC CONE PENETRATION RESISTANCE OF SOILS IN BLOWS PER 1.75" (ASTM STP#399)
EOB	END OF BORING
GNE	GROUNDWATER NOT ENCOUNTERED ON DATE DRILLED
NM	NATURAL MOISTURE CONTENT IN PERCENT (ASTM D–2216)
–200	PERCENT PASSING NO. 200 SIEVE SIZE (PERCENT FINES)(ASTM D–1140)
LL	LIQUID LIMIT (ASTM D–4318)
PI	PLASTICITY INDEX (ASTM D–4318)
DRILL RIG:	CME 55, MANUAL HAMMER ABOVE 10.5'; AUTO–HAMMER BELOW
SP–SM,SM,SC	UNIFIED SOIL CLASSIFICATION SYSTEM
A–3,A–2–4	AASHTO SOIL CLASSIFICATION SYSTEM
DRILLERS:	JDA, BH

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE.

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SHEET TITLE:
SUBSURFACE SOIL EXPLORATION
APALACHEE REGIONAL PARK SWMF
TALLAHASSEE, LEON COUNTY, FLORIDA

DRAWN BY:	CHECKED BY:	DATE:
JMC	MSW	JANUARY 19, 2012

FILE NO.	APPROVED BY:	FIGURE
113–11–40–1380	M.S. WILSON, P.E.	1