Report of Geotechnical Exploration

For

JEA Radio Avenue Storage & Repump Station: Stormwater Pond and Access Road

MAE Project No. 0110-0003F
April 2, 2019

Prepared for:

Hazen

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JEA®

Prepared by:

TEN YEARS 10 MAE
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Geotechnical ◤ Environmental ◤ Inspection ◤ Testing

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Attention: Ms. Caitlin Klug, P.E.

Reference: Report of Preliminary Geotechnical Exploration
JEA Radio Avenue Storage & Repump Station: Stormwater Pond and Access Road
Nassau County, Florida
MAE Project No. 0110-0003F

Dear Ms. Klug:

Meskel & Associates Engineering, PLLC (MAE) has completed a geotechnical exploration for the referenced project. Our work was performed in general accordance with our proposal dated February 27, 2019. The geotechnical exploration was performed to evaluate the general subsurface conditions encountered within the proposed stormwater pond and along the proposed access road, and to provide recommendations for construction and site preparation. A summary of our findings and related recommendations are presented below; however, we recommend that you consider this report in its entirety.

As further discussed in this report, the borings along the planned roadway encountered fine sands and fine sands with silt (A-3) to their termination depth of 6 feet below existing grade. The pond boring encountered a surficial topsoil layer underlain by fine sands and fine sands with silt (A-3) to an approximate depth of 5 feet, followed by fine sands with silt (A-3) and silty fine sands (A-2-4) to the boring termination depth of 15 feet. It is our opinion that the encountered soil conditions are suitable to support the planned access road provided the recommendations in this report are followed. Furthermore, the fine sands with silt and slightly silty fine sands (A-3, A-2-4) to a depth of about 5 feet as encountered in the pond boring are suitable for reuse as fill material. The groundwater was encountered at all the boring locations between depths of 2 feet and 2 feet 8 inches.

We appreciate this opportunity to be of service as your geotechnical consultant on this phase of the project. If you have any questions, or if we may be of any further service, please contact us.

Sincerely,
MESKEL & ASSOCIATES ENGINEERING, PLLC
MAE FL Certificate of Authorization No. 28142

P. Rodney Mank, State of Florida, Professional Engineer, License No. 41986. This item has been electronically signed and sealed by P. Rodney Mank, P.E. on 04/02/2019 using a Digital Signature. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Philip R Mank Digitally signed by Philip R Mank
Date: 2019.04.02 16:36:32 -04'00'

W. Josh Mele, E.I.
Staff Engineer

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Distribution: Ms. Caitlin Klug, P.E. – Hazen and Sawyer, PC 1 pdf

TABLE OF CONTENTS

Subject **Page No.**

1.0 PROJECT INFORMATION 1
1.1 General 1
1.2 Project Description 1
2.0 FIELD EXPLORATION 1
2.1 Auger Borings 1
2.2 Field Permeability Test 2
3.0 LABORATORY TESTING 2
4.0 GENERAL SUBSURFACE CONDITIONS 2
4.1 General Soil Profile 2
4.2 Groundwater Level 3
4.3 Review of the USDA Web Soil Survey Map 3
4.4 Seasonal High Groundwater Level 3
5.0 DESIGN RECOMMENDATIONS 4
5.1 General 4
5.2 Access Road Pavement Considerations 4
5.3 Pond Considerations 5
6.0 SITE PREPARATION AND EARTHWORK RECOMMENDATIONS 6
6.1 Clearing and Stripping 6
6.2 Temporary Groundwater Control 6
6.3 Compaction 7
6.4 Embankment Fill Soils 7
7.0 QUALITY CONTROL TESTING 8
8.0 REPORT LIMITATIONS 8

FIGURES

Figure 1. Site Location Map
Figure 2. Boring Location Plan
Figures 3, 4. Generalized Soil Profiles

APPENDICES

Appendix A. Soil Boring Logs
Field Exploration Procedures
Key to Boring Logs
Key to Soil Classification
Appendix B. Summary of Laboratory Test Results
Laboratory Test Procedures

1.0 PROJECT INFORMATION

1.1 General

Project information for the proposed access road and stormwater pond was provided to us by Ms. Caitlin Klug, P.E. with Hazen and Sawyer, PC via email and telephone conversations. This information included an Access Road Existing Conditions plan that showed the limits of the proposed access road. MAE previously performed a preliminary geotechnical exploration for the storage and repump station site, which was reported on July 19, 2018. This report was referenced for details of the encountered subsurface conditions.

1.2 Project Description

The site for the storage and repump station is an undeveloped 3.5-acre parcel, located east of Art Wilson Lane and north of Radio Avenue in Nassau County, Florida. The proposed access road begins off Art Wilson Lane, just north of Radio Avenue, and continues as a dirt road to the northeast along the south border of the pump station site. The general site location is shown on Figure 1.

Based on the provided information, we understand that the focus of this exploration includes a proposed stormwater pond near the southeast corner of the storage and repump site, and a permanent access road generally following the alignment of the existing dirt road from Art Wilson Lane to the site entrance. We understand that the pond depth will be approximately 7 to 8 feet below existing grade. The proposed width of the access road is 12 feet, and the length is approximately 1,000 feet. We have assumed that the access road will consist of a flexible pavement section. If the final design details vary from the details provided in this report, then the recommendations in this report may need to be re-evaluated. Any changes in the design or location of the pond or access road should be provided to MAE so that the need for re-evaluation of our recommendations can be assessed prior to final design.

2.0 FIELD EXPLORATION

A field exploration was performed on March 6, 2019. An aerial obtained from Google Earth, which shows the approximate boring locations, is included as the *Boring Location Plan*, Figure 2. The boring locations were determined by us, and then submitted to Hazen and Sawyer for approval. Upon approval, and prior to starting our field exploration, a utility locate request was submitted to the Sunshine State One-Call Center. Once the site utilities were located and marked, our field crew mobilized to the site. Our field personnel then located each boring location using a Garmin GPSMAP 78 hand-held GPS receiver. The boring locations as shown on Figure 2 should be considered accurate only to the degree implied by the method of layout used.

2.1 Auger Borings

A total of 3 auger borings (A-1, A-2, A-3) were located along the proposed access road, each advanced to a depth of approximately 6 feet below the existing ground surface using a hand-held bucket auger. In addition, one auger boring (P-1) was located at the approximate center of the proposed stormwater pond, advanced to a depth of about 15 feet below the existing ground surface using our ATV-mounted drilling equipment with a flight auger. The borings were advanced in general accordance with the methodology outlined in ASTM D 1452. Representative soil samples recovered from the auger borings were returned

to our laboratory for classification and testing. A field procedure summary is included in Appendix A.

2.2 Field Permeability Test

One field permeability test was located adjacent to the pond boring location P-1. The field permeability tests were performed by installing a solid-walled, open-bottom PVC casing snugly fit into a 4-inch diameter borehole augered to the test depth of 9 feet. To measure the vertical permeability rate of the soil, the pipe was left flush with the borehole bottom. To measure the horizontal permeability rate of the soil, the bottom 1-foot of the pipe was filled with silica sand or gravel, and the pipe was raised one foot above the bottom of the borehole. Both tests were run as "falling head" tests since relatively permeable sand soils were encountered at the test depth from the adjacent boring. After filling the pipe with water, the rate of water (head) drop within the pipe was measured over a period of up to 8 minutes for the horizontal permeability tests, and up to 24 minutes for the vertical permeability tests. Each test was conducted three times and then averaged to estimate the in-situ permeability rate for the soil conditions encountered at the test depths.

3.0 LABORATORY TESTING

Representative soil samples obtained during our field exploration were visually classified by a geotechnical engineer using the AASHTO Soil Classification System in general accordance with ASTM D 3282. A *Key to the Soil Classification System* is included in Appendix A.

Quantitative laboratory testing was performed on selected samples of the soils encountered during the field exploration to better define the composition of the encountered soils. The laboratory testing determined the natural moisture content, the percent passing a U.S. No. 200 sieve (percent fines), and the organic content of the selected soil samples. The results of the laboratory testing are shown in the *Summary of Laboratory Test Results* table included in Appendix B. Also, these results are shown on the *Generalized Soil Profiles* sheets, Figures 3 and 4, and on the soil boring logs at the respective depths from which the tested samples were recovered.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General Soil Profile

Graphical presentation of the generalized subsurface conditions is presented on the *Generalized Soil Profiles* sheets, Figures 3 and 4. Detailed boring records are included in Appendix A. When reviewing these records, it should be understood that the soil conditions will vary between the boring locations.

In general, pond boring P-1 encountered a surficial topsoil layer approximately 6 inches thick. Below the topsoil layer, the boring encountered fine sand and fine sand with silt (A-3) to an approximate depth of 5 feet below the existing ground surface, underlain by black fine sands with silt (A-3) and silty fine sands (A-2-4) containing trace to few amounts of organic fines and root fragments to a depth of approximately 11 feet below existing grade. These soils were underlain by fine sands with silt (A-3, A-2-4) to the boring termination depth of 15 feet below existing grade. It was noted by the field crew that the sands became significantly denser beginning at a depth of about 6 feet and remained relatively dense to the boring termination depth.

The borings along the planned roadway (A-1, A-2, A-3) encountered fine sands and fine sands with silt (A-3) to their termination depth of 6 feet below existing grade. They were located within the existing dirt

road; therefore, no topsoil layer was encountered.

4.2 Groundwater Level

The groundwater level was encountered at each of the boring locations and recorded at the time of drilling. The groundwater depth along the proposed roadway varied from 2 feet 2 inches to 2 feet 8 inches below existing grade. The groundwater depth at the pond boring location P-1 was 2 feet below existing grade.

It should be anticipated that the groundwater levels will fluctuate seasonally and with changes in climate. As such, we recommend that the ground water table be re-measured prior to construction. Measured groundwater levels are shown on the *Generalized Soil Profiles* sheets, Figures 3 and 4, and on the soil boring logs.

4.3 Review of the USDA Web Soil Survey Map

The results of a review of the USDA Soil Survey Conservation Service (SSCS) Web Soil Survey of Nassau County are shown in the table below. There are two predominant soil map units at the project sight: Hurricane-Pottsburg and Mandarin fine sands. The soil drainage class, hydrological group, and estimated seasonal high groundwater levels reported in the Soil Survey are as follows:

Map Unit Symbol	Map Unit Name	Drainage Class	Hydrologic Group	Depth to the Water Table[(1)] (inches)
6	Hurricane - Pottsburg fine sands, 0 to 5 percent slopes	Somewhat Poorly Drained	A	24 to 42
10	Mandarin fine sand, 0 to 2 percent slopes	Somewhat Poorly Drained	A	18 to 30

[(1)] The "Water Table" above refers to a saturated zone in the soil which occurs during specified months, typically the summer wet season. Estimates of the upper limit shown in the Web Soil Survey are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

4.4 Seasonal High Groundwater Level

In estimating seasonal high groundwater level, a number of factors are taken into consideration including antecedent rainfall, soil redoximorphic features (i.e., soil mottling), stratigraphy (including presence of hydraulically restrictive layers), vegetative indicators, effects of development, and relief points such as drainage ditches, low-lying areas, etc.

Based on our interpretation of the current site conditions, including the boring logs and review of published data, and our review of the previous geotechnical exploration on the storage and repump station site, we estimate the seasonal high groundwater level at the pond site to be approximately 12 inches below the existing ground surface. We estimate the seasonal high groundwater level along the proposed access road to be about 18 inches below existing grade. However, it should be understood that these seasonal high estimates are based on site observations and measurements at the time of our field work and on historical data on the site soil conditions. Changes in onsite stormwater drainage patterns

caused by off-site development may cause seasonal high water levels to be higher or lower than historical patterns. The project drainage engineer should be consulted to evaluate the influence of these changes on groundwater levels at the site. In addition, as we recommended in our preliminary report for the storage and repump site, piezometers should be installed across the site and along the access road to measure groundwater fluctuations over time.

It is possible that higher groundwater levels may exceed the estimated seasonal high groundwater level as a result of significant or prolonged rains. Therefore, we recommend that design drawings and specifications account for the possibility of groundwater level variations, and construction planning should be based on the assumption that such variations will occur.

5.0 DESIGN RECOMMENDATIONS

5.1 General

The following evaluation and recommendations are based on the provided project information as presented in this report, results of the field exploration and laboratory testing performed, and the construction techniques recommended in Section 6.0 below. If the described project conditions are incorrect or changed after this report, or subsurface conditions encountered during construction are different from those reported, MAE should be notified so these recommendations can be re-evaluated and revised, if necessary. We recommend that MAE review the roadway plans and earthwork specifications to verify that the recommendations in this report have been properly interpreted and implemented.

5.2 Access Road Pavement Considerations

Based on the results of our exploration, we consider the subsurface conditions encountered along the proposed access road alignment to be favorable for support of a flexible pavement section, when constructed on properly prepared subgrade soils as outlined in Section 6.0 of this report. A typical pavement section used in northeast Florida for mixed truck and auto traffic is shown on the following table. If requested, we can prepare a project-specific pavement design if specific traffic data is provided.

TYPICAL PAVEMENT SECTION	
Pavement Layer	**Thickness**
Asphaltic Concrete Wearing Surface	2.0"
Limerock or Recycled Concrete Aggregate Base [(1)]	8.0"
Stabilized Subgrade [(1)]	12.0"
[(1)] Groundwater should be maintained at least 2 feet below the bottom of the base layer if limerock is used. This separation can be reduced to one foot if Recycled Concrete Aggregate base is used.	

5.2.1 Wearing Surface

The wearing surface should consist of Florida Department of Transportation (FDOT) Type S asphaltic concrete having a minimum Marshall Stability of 1,500 lbs. Specific requirements for Type S asphaltic concrete wearing surface are outlined in the latest edition of the *Florida Department of Transportation,*

Standard Specifications for Road and Bridge Construction.

5.2.2 Base and Subgrade

The limerock base course should have a minimum Limerock Bearing Ratio (LBR) of 100 and should be compacted to 100 percent of the modified Proctor maximum dry density (ASTM D 1557, AASHTO T-180) value. Recycled Concrete Aggregate base material should have a minimum LBR value of 150 and should be compacted to the same degree as the limerock material.

The soil subgrade should be stabilized with sufficient stabilizer material to achieve a minimum LBR of 40. The stabilized subgrade should be compacted to 98 percent of the modified Proctor maximum dry density (ASTM D 1557, AASHTO T-180) value.

5.2.3 Underdrains

Satisfactory pavement life is dependent on dry/strong pavement support provided by the base and subgrade courses. Accordingly, a minimum clearance of 2 feet must be maintained between the estimated seasonal high groundwater table and the bottom of the limerock base layer. This clearance interval may be reduced to one foot between the seasonal high groundwater level and the bottom of the Recycled Concrete Aggregate base layer. Depending on final pavement grades, subsurface drains may be required to maintain dry base and subgrade materials. Once the final paving and drainage plans are prepared, we would be pleased to review them and the need for underdrains.

5.3 Pond Considerations

5.3.1 Soil Permeability

The results of the permeability tests indicated the following vertical/horizontal permeabilities:

Test Location	Test Depth (feet)	Measured Permeability (cm/s)
P-1 - Vertical	9	4.8×10^{-4}
P-1 - Horizontal	8 to 9	9.3×10^{-4}

The measured permeability rates should not be construed to represent the actual pond exfiltration rate. For pond drawdown calculations, we recommend a factor of safety of at least 2.5 be applied to the above permeability rate values. If requested, MAE can assist in evaluating the pond design permeabilities, underdrains, and/or groundwater baseflow as pond geometry and stormwater volume requirements become available.

5.3.2 Borrow Suitability

Based on the pond boring results and classification of the soil samples, the fine sands and fine sands with silt, and silty fine sands (A-3) without organics, as encountered to a depth of about 5 feet below existing grade, are considered suitable for use as fill soil. It should be anticipated that soils excavated from below the groundwater level will have moisture contents in excess of the modified Proctor optimum moisture content. Stockpiling or spreading of these soils is recommended to bring the moisture content to within 2 percent of the soil's optimum moisture content corresponding to the required degree of compaction.

The A-3 and A-2-4 soils encountered below a depth of 5 feet contained trace to few amounts of organic material, plus had generally higher fines contents that may make them difficult to place and compact. It should be expected that significant drying of these soils will be necessary to facility compaction. It should be anticipated that if these soils are not properly dewatered prior to excavation, drying of these soils to obtain the proper moisture content for compaction may take approximately 2 to 3 weeks, if weather permits. Depending on the anticipated time for completing the site work portion of the project and the drying time required to preclude pumping and yielding of these soils during placement and compaction operations, these soils may be considered unsuitable for use as fill material.

The field crew noted a significant increase in soil density of the soils encountered beginning at a depth of about 6 feet below existing grade. It should be anticipated that difficult excavation of these soils may be encountered during construction. In addition, any cemented soils greater than 2 inches in dimension will need to be processed to sand-sized particles prior to placement and compaction if used as fill material.

The soils containing surficial organic material (topsoil) will require removal and are considered unsuitable for use as structural fill. The organic soils could be used in landscape berms.

6.0 SITE PREPARATION AND EARTHWORK RECOMMENDATIONS

Site preparation as outlined in this section should be performed to maintain the integrity of a flexible pavement section.

6.1 Clearing and Stripping

Prior to construction, the location of existing underground utility lines within the construction area should be established. Provisions should then be made to relocate interfering utilities to appropriate locations. It should be noted that, if underground pipes are not properly removed or plugged, they may serve as conduits for subsurface erosion, which may subsequently lead to excessive settlement of overlying structures.

The "footprint" of the planned roadway alignment plus a minimum additional margin of 3 feet, should be stripped of all surface vegetation, stumps, debris, organic topsoil, or other deleterious materials. During grubbing operations, roots with a diameter greater than 0.5-inch, stumps, or small roots in a concentrated state, should be grubbed and completely removed.

The soil borings for the proposed access road were located within the existing unpaved road. However, it should be expected that some surficial organics and organic soils will be encountered within the defined construction area that is outside the unpaved roadway. The actual depths of unsuitable soils and materials should be determined by MAE using visual observation and judgment during earthwork operations. Any organic soils removed from the proposed roadway area can be stockpiled and used subsequently in areas to be grassed such as swales.

6.2 Temporary Groundwater Control

The groundwater level along the proposed roadway was encountered at depths varying from 2 feet 2 inches to 2 feet 8 inches below the existing ground surface at the time of our exploration. Because of the need for densification of the soils within the upper 2 feet below the stripped surface, temporary groundwater control measures may be required if the groundwater level is within 2 feet below the stripped and grubbed surface at the time of construction. Should groundwater control measures become necessary, dewatering methods should be determined by the contractor. We recommend the

groundwater control measures, if necessary, remain in place until compaction of the existing soils is completed. The dewatering method should be maintained until backfilling has reached a height of 2 feet above the groundwater level at the time of construction. The site should be graded to direct surface water runoff from the construction area.

Note that discharge of produced groundwater to surface waters of the state from dewatering operations or other site activities is regulated and requires a permit from the State of Florida Department of Environmental Protection (FDEP). This permit is termed a *Generic Permit for the Discharge of Produced Groundwater From Any Non-Contaminated Site Activity*. If discharge of produced groundwater is anticipated, we recommend sampling and testing of the groundwater early in the site design phase to prevent project delays during construction. MAE can provide the sampling, testing, and professional consulting required to evaluate compliance with the regulations.

6.3 Compaction

After completing the clearing and stripping operations and installing the temporary groundwater control measures (if required), the exposed surface area should be compacted with a vibratory drum roller having a minimum static, at-drum weight, on the order of 3 to 5 tons. Typically, the material should exhibit moisture contents within ±2 percent of the modified Proctor optimum moisture content (AASHTO T-180) during the compaction operations. Compaction should continue until densities of at least 95 percent of the modified Proctor maximum dry density (AASHTO T-180) have been achieved within the upper 2 feet of the compacted natural soils at the site.

Should the bearing level soils experience pumping and soil strength loss during the compaction operations, compaction work should be immediately terminated. The disturbed soils should be removed and backfilled with dry structural fill soils, which are then compacted, or the excess moisture content within the disturbed soils should be allowed to dissipate before recompacting.

Care should be exercised to avoid damaging any nearby structures while the compaction operation is underway. Prior to commencing compaction, occupants of adjacent structures should be notified, and the existing conditions of the structures should be documented with photographs and survey (if deemed necessary). Compaction should cease if deemed detrimental to adjacent structures, and MAE should be contacted immediately. It is recommended that the vibratory roller remain a minimum of 50 feet from existing structures. Within this zone, use of a track-mounted bulldozer or a vibratory roller, operating in the static mode, is recommended.

6.4 Embankment Fill Soils

Any fill required for the roadway embankment should be placed in loose lifts not exceeding 12 inches in thickness and compacted by the use of the above described vibratory drum roller. The lift thickness should be reduced to 8 inches if the roller operates in the static mode or if track-mounted compaction equipment is used. If hand-held compaction equipment is used, the lift thickness should be further reduced to 6 inches.

Suitable fill is defined as a non-plastic, inorganic, granular soil having less than 10 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The fine sand and slightly silty fine sand, without roots, as encountered in the borings, are suitable as fill materials and, with proper moisture control, should densify using conventional compaction methods. It should be noted that soils with more than 10 percent passing the No. 200 sieve will be more difficult to compact, due to their nature to retain soil moisture, and may require drying. Typically, the material should exhibit moisture contents

within ±2 percent of the modified Proctor optimum moisture content (AASHTO T-180) during the compaction operations. Compaction should continue until densities of at least 95 percent of the modified Proctor maximum dry density (AASHTO T-180) have been achieved within each lift of the compacted structural fill. As an exception, densities of at least 98 percent of the modified Proctor maximum dry density (AASHTO T-180) should be obtained within the upper one foot of the materials immediately below the proposed base course.

7.0 QUALITY CONTROL TESTING

A representative number of field in-place density tests should be made in the upper 2 feet of compacted natural soils and in each lift of compacted embankment fill. The density tests are considered necessary to verify that satisfactory compaction operations have been performed. We recommend density testing be performed at one location for every 200 linear feet of roadway.

8.0 REPORT LIMITATIONS

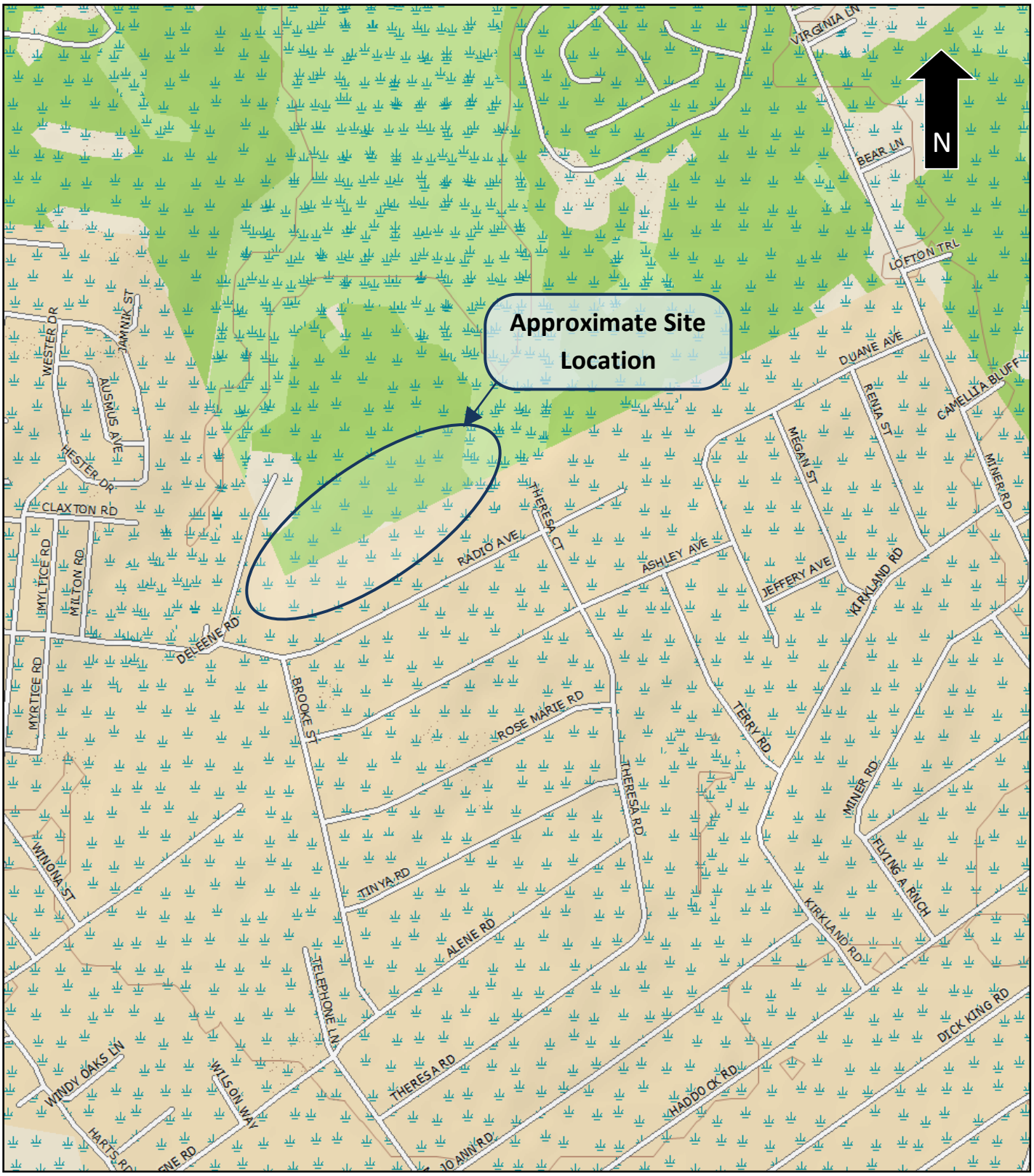
This report has been prepared for the exclusive use of Hazen and Sawyer, PC and the JEA for specific application to the design and construction of the *JEA Radio Avenue Storage and Repump Station: Stormwater Pond & Access Road* project. An electronically signed and sealed version, and a version of our report that is signed and sealed in blue ink, may be considered an original of the report. Copies of an original should not be relied on unless specifically allowed by MAE in writing. Our work for this project was performed in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made.

The analyses and recommendations contained in this report are based on the data obtained from this project. This testing indicates subsurface conditions only at the specific locations and times, and only to the depths explored. These results do not reflect subsurface variations that may exist away from the boring locations and/or at depths below the boring termination depths. Subsurface conditions and water levels at other locations may differ from conditions occurring at the tested locations. In addition, it should be understood that the passage of time may result in a change in the conditions at the tested locations. If variations in subsurface conditions from those described in this report are observed during construction, the recommendations in this report must be re-evaluated.

The scope of our services did not include any environmental assessment or testing for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the subject site. Any statements made in this report, and/or notations made on the generalized soil profiles or boring logs, regarding odors or other potential environmental concerns are based on observations made during execution of our scope of services and as such are strictly for the information of our client. No opinion of any environmental concern of such observations is made or implied. Unless complete environmental information regarding the site is already available, an environmental assessment is recommended.

If changes in the design or location of the pond and/or access road occur, the conclusions and recommendations contained in this report may need to be modified. We recommend that these changes be provided to us for our consideration. MAE is not responsible for conclusions, interpretations, opinions or recommendations made by others based on the data contained in this report.

Figures



Site Location Map

PREPARED BY	PROJECT NAME	
Meskel & Associates Engineering	JEA Radio Ave, Pump Station: Stormwater Pond & Access Road Yulee, Nassau County, Florida	
	REFERENCE	SCALE
	Delorme XMap 7.0	NTS
PREPARED FOR	MAE PROJECT NO.	FIGURE NO.
Hazen & Sawyer	0110-0003F	1

Project Manager:	PRM
Drawn by:	MCV
Checked by:	MCV
Approved by:	WJM

Project No.	0110-0003F
Scale:	AS SHOWN
File Name:	0110-0003F.BLP
Date:	3/14/2019

Meskel & Associates Engineering

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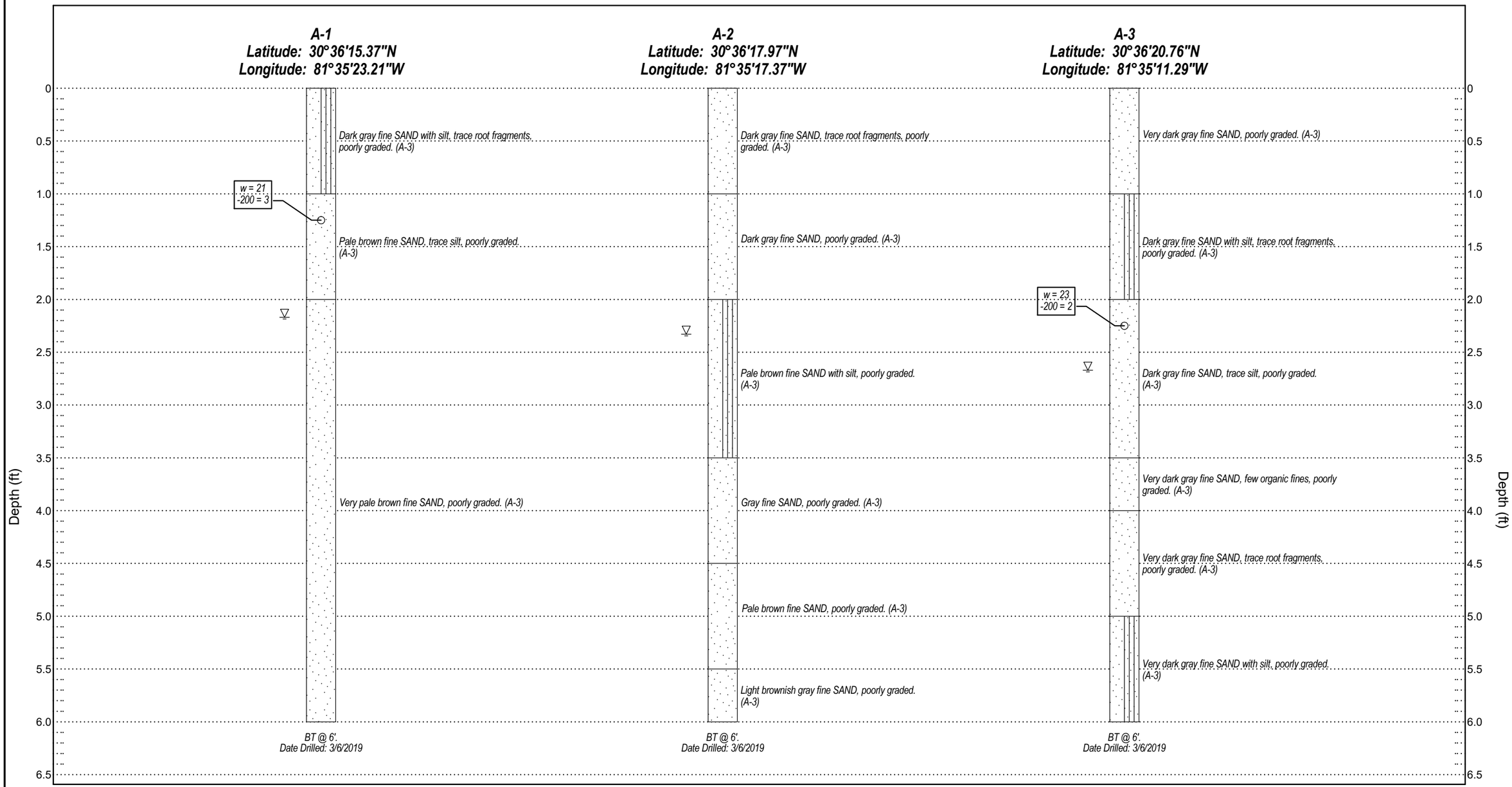
BORING LOCATION PLAN

JEA RADIO AVE, PUMP STATION: STORMWATER POND & ACCESS ROAD
YULEE, NASSAU COUNTY, FLORIDA

FIG NO. 2



Legend

Fine Sand with Silt

Fine Sand

(A-3) *AASHTO Soil Classification System*

BT *Boring Terminated at Depth Below Existing Grade*

▽ *Depth to Groundwater at Time of Drilling*

-200 *% Passing No. 200 U.S. Standard Sieve*

w *Natural Moisture Content (%)*

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

P. RODNEY MANK, P.E. P.E. NO.: 41986

Meskel & Associates Engineering

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8936 Western Way, Suite 12, Jacksonville, FL 32256

Hazen & Sawyer

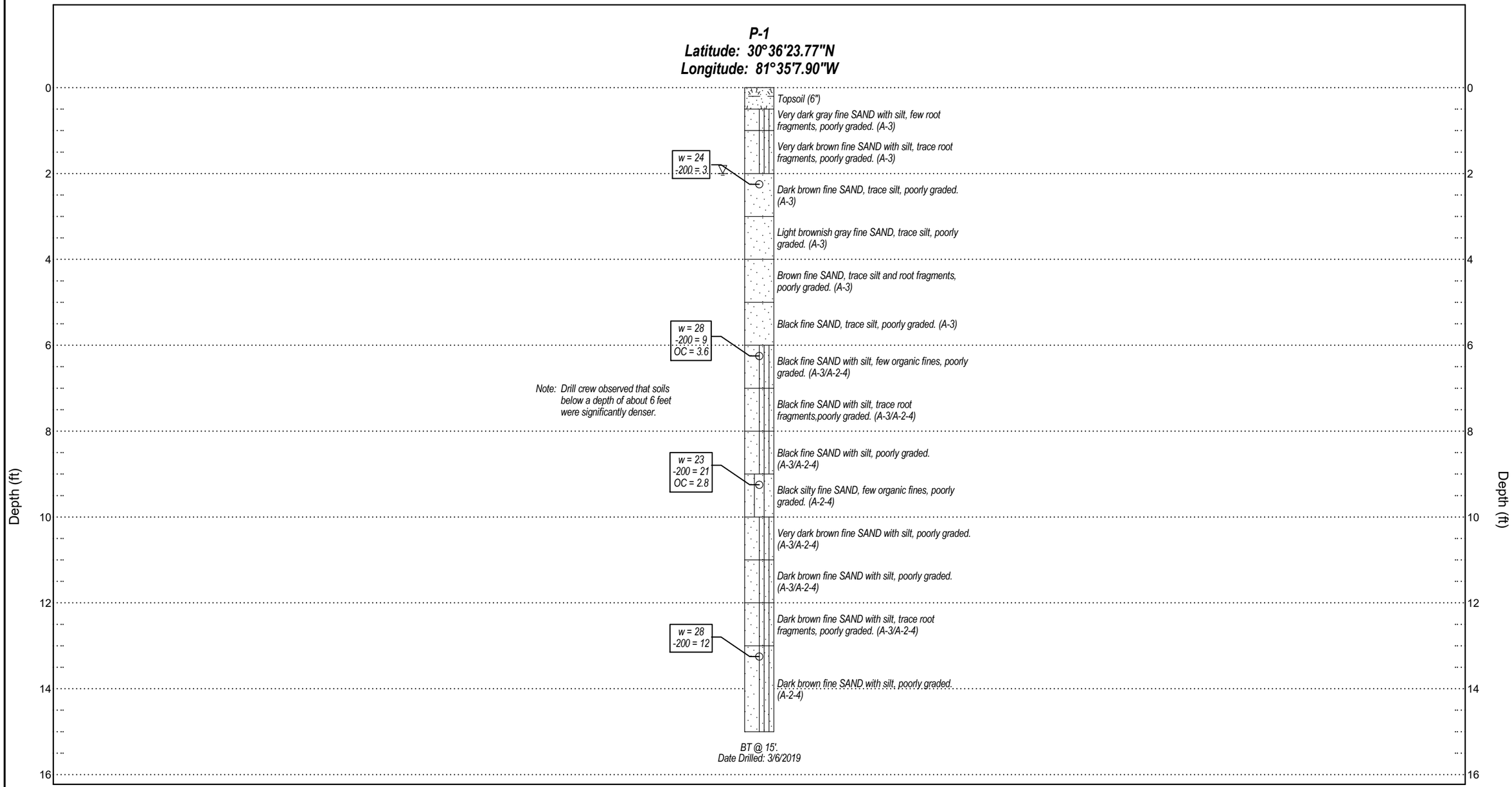
DATE:	MAE PROJECT NO.
4/2/2019	0110-0003F

SHEET TITLE: *Generalized Soil Profiles*

PROJECT NAME: *JEA Radio Ave, Pump Station: Stormwater Pond & Access Road*
Yulee, Nassau County, Florida

FIGURE NO. 3

P-1
Latitude: 30°36'23.77"N
Longitude: 81°35'7.90"W



Note: Drill crew observed that soils below a depth of about 6 feet were significantly denser.

Legend

Topsoil

Silty Fine Sand

Fine Sand with Silt

Fine Sand

(A-3) *AASHTO Soil Classification System*

BT *Boring Terminated at Depth Below Existing Grade*

▽ *Depth to Groundwater at Time of Drilling*

-200 *% Passing No. 200 U.S. Standard Sieve*

w *Natural Moisture Content (%)*

OC *Organic Content (%)*

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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8936 Western Way, Suite 12, Jacksonville, FL 32256

Hazen & Sawyer

DATE:	MAE PROJECT NO.
4/2/2019	0110-0003F

SHEET TITLE: *Generalized Soil Profile*

PROJECT NAME: *JEA Radio Ave, Pump Station: Stormwater Pond & Access Road Yulee, Nassau County, Florida*

FIGURE NO. 4

Appendix A

Meskel & Associates Engineering, PLLC
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Meskel & Associates Engineering

BORING A-1

PROJECT NO. 0110-0003F

PROJECT NAME JEA Radio Ave, Pump Station: Stormwater Pond & Access Road

PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer

DATE STARTED 3/6/19 **COMPLETED** 3/6/19 **LATITUDE** 30°36'15.37"N **LONGITUDE** 81°35'23.21"W

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Hand Auger

LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** —

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	AASHTO	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0.0	1	Dark gray fine SAND with silt, trace root fragments, poorly graded.	A-3											
	2	Pale brown fine SAND, trace silt, poorly graded.	A-3				21	3						
2.5	3 ▽	Very pale brown fine SAND, poorly graded.	A-3											
	4													
	5													
5.0	6													
		Bottom of borehole at 6 feet.												

NOTES

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 2 ft 2 in *▽ **END OF DAY** ---

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Meskel & Associates Engineering

BORING A-2

PROJECT NO. 0110-0003F

PROJECT NAME JEA Radio Ave, Pump Station: Stormwater Pond & Access Road

PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer

DATE STARTED 3/6/19 **COMPLETED** 3/6/19 **LATITUDE** 30°36'17.97"N **LONGITUDE** 81°35'17.37"W

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Hand Auger

LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** —

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	AASHTO	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0.0	1	Dark gray fine SAND, trace root fragments, poorly graded.	A-3											
	2	Dark gray fine SAND, poorly graded.	A-3											
2.5	3 ▽	Pale brown fine SAND with silt, poorly graded.	A-3											
	4	Gray fine SAND, poorly graded.	A-3											
5.0	5	Pale brown fine SAND, poorly graded.	A-3											
	6	Light brownish gray fine SAND, poorly graded.	A-3											
		Bottom of borehole at 6 feet.												

NOTES

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 2 ft 4 in *▽ **END OF DAY** ---

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BORING A-3

PROJECT NO. 0110-0003F

PROJECT NAME JEA Radio Ave, Pump Station: Stormwater Pond & Access Road

PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer

DATE STARTED 3/6/19 **COMPLETED** 3/6/19 **LATITUDE** 30°36'20.76"N **LONGITUDE** 81°35'11.29"W

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Hand Auger

LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** —

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	AASHTO	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0.0	1	Very dark gray fine SAND, poorly graded.	A-3											
	2	Dark gray fine SAND with silt, trace root fragments, poorly graded.	A-3											
2.5	3	▽ Dark gray fine SAND, trace silt, poorly graded.	A-3				23	2						
	4	Very dark gray fine SAND, few organic fines, poorly graded.	A-3											
5.0	5	Very dark gray fine SAND, trace root fragments, poorly graded.	A-3											
	6	Very dark gray fine SAND with silt, poorly graded.	A-3											
		Bottom of borehole at 6 feet.												

NOTES

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 2 ft 8 in *▽ **END OF DAY** ---

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BORING P-1

PROJECT NO. 0110-0003F

PROJECT NAME JEA Radio Ave, Pump Station: Stormwater Pond & Access Road

PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer

DATE STARTED 3/6/19 **COMPLETED** 3/6/19 **LATITUDE** 30°36'23.77"N **LONGITUDE** 81°35'7.90"W

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Flight Auger

LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** —

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	AASHTO	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0.0		Topsoil (6")												
	1	Very dark gray fine SAND with silt, few root fragments, poorly graded.	A-3											
	2	Very dark brown fine SAND with silt, trace root fragments, poorly graded.	A-3											
2.5	3	Dark brown fine SAND, trace silt, poorly graded.	A-3				24	3						
	4	Light brownish gray fine SAND, trace silt, poorly graded.	A-3											
5.0	5	Brown fine SAND, trace silt and root fragments, poorly graded.	A-3											
	6	Black fine SAND, trace silt, poorly graded.	A-3											
	7	Black fine SAND with silt, few organic fines, poorly graded.	A-3/ A-2-4				28	9	3.6					
7.5	8	Black fine SAND with silt, trace root fragments,poorly graded.	A-3/ A-2-4											
	9	Black fine SAND with silt, poorly graded.	A-3/ A-2-4											
10.0	10	Black silty fine SAND, few organic fines, poorly graded.	A-2-4				23	21	2.8					

NOTES Drill crew observed that soils below a depth of about 6 feet were significantly denser.

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 2 ft 0 in *▽ **END OF DAY** ---

(Continued Next Page)

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BORING P-1

PROJECT NO. 0110-0003F

PROJECT NAME JEA Radio Ave, Pump Station: Stormwater Pond & Access Road

PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	AASHTO	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
10.0	11	Very dark brown fine SAND with silt, poorly graded.	A-3/ A-2-4											
	12	Dark brown fine SAND with silt, poorly graded.	A-3/ A-2-4											
12.5	13	Dark brown fine SAND with silt, trace root fragments, poorly graded.	A-3/ A-2-4											
	14	Dark brown fine SAND with silt, poorly graded.	A-2-4				28	12						
15.0	15													
		Bottom of borehole at 15 feet.												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 2 ft 0 in ***END OF DAY** ---

FIELD EXPLORATION PROCEDURES

Flight Auger Boring

The auger boring(s) were performed mechanically by the use of a continuous-flight auger attached to a drill rig in general accordance with the latest revision of ASTM D 1452, "Soil Investigation and Sampling by Auger Borings." Representative samples of the soils brought to the ground surface by the augering process were visually classified in the field, and representative portions of the samples were obtained for further evaluation by a geotechnical engineer.

Hand Auger Boring

The auger boring(s) were performed manually by the use of a hand-held bucket auger in general accordance with the latest revision of ASTM D 1452, "Standard Practice for Soil Exploration and Sampling by Auger Borings." Representative samples of the soils brought to the ground surface by the augering process were placed in sealed containers and transported to our laboratory, where they were examined by our engineer to verify the driller's field descriptions and classify the soil, and to select samples for laboratory testing.

FIELD EXPLORATION PROCEDURES

Field Permeability Testing

The purpose of this testing is to measure the vertical and horizontal permeability of selected soil strata underlying the proposed ponds. The field permeability testing will consist of constant head tests with a test interval consisting of a one-foot section of uncased borehole to measure the horizontal soil permeability, and cased constant head tests with a flush bottom at the test depth to measure the vertical soil permeability.

The vertical (cased) field permeability tests begin by installing a solid-wall steel casing to the target depth. Once the casing is set, it is cleaned out to the bottom and flushed with clean water. The casing was then filled with water to the top to begin the test. Three test intervals are run for a period of up to 10 minutes. The flow volume to maintain a constant head is measured with a graduated cylinder, and this volume is recorded after each interval.

The horizontal field permeability tests are performed in the same borehole as the vertical field permeability test. Once the vertical test is complete, clean gravel is inserted to maintain the borehole (casing) diameter, and the casing raised one foot to expose the borehole side soils. The casing is then filled with water to the top to begin the test. Three test intervals are run for a period of up to 10 minutes each. The flow volume to maintain a constant head is measured with a graduated cylinder, and this volume is recorded after each interval.

After collecting the field data, the permeability rates were calculated using the Hvorslev methods (Hvorslev, U.S. Corps of Engineers, W.E.S).

KEY TO BORING LOGS – AASHTO

Soil Classification

Soil classification of samples obtained at the boring locations is based on the American Association of State Highway and Transportation Officials (AASHTO) Classification System. Coarse grained soils have more than 50% of their dry weight retained on a #200 sieve. Their principal descriptors are: sand, cobbles and boulders. Fine grained soils have less than 50% of their dry weight retained on a #200 sieve. They are principally described as clays if they are plastic and silts if they are slightly to non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

BORING LOG LEGEND	
Symbol	Description
(A-3)	AASHTO Classification System
-200	Fines content, % Passing No. 200 U.S. Standard Sieve
w	Natural Moisture Content (%)
OC	Organic Content (%)
LL	Liquid Limit
PI	Plasticity Index
NP	Non-Plastic
PP	Pocket Penetrometer in tons per square foot (tsf)

MODIFIERS	
SECONDARY CONSTITUENTS (Sand, Silt or Clay)	
Trace	Less than 5%
With	5% to 12%
Sandy, Silty or Clayey	12% to 35%
Very Sandy, Very Silty or Very Clayey	35% to 50%
ORGANIC CONTENT	
Trace	2% or less
With	3% to 5%
Organic Soils	5% to 20%
Highly Organic Soils (Muck)	20% to 75%
PEAT	Greater than 75%
MINOR COMPONENTS (Shell, Rock, Debris, Roots, etc.)	
Trace	Less than 5%
Few	5% to 10%
Little	15% to 25%
Some	30% to 45%

AASHTO Soil Classification System
(from AASHTO M 145 or ASTM D 3282)

General Classification	***Granular Materials*** *(35% or less passing the 0.075 mm sieve)*							***Silt-Clay Materials*** *(>35% passing the 0.075 mm sieve)*			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5* A-7-6*
Sieve Analysis, % passing:											
2.00 mm (No. 10)	50 max	…	…	…	…	…	…	…	…	…	…
0.425 (No. 40)	30 max	50 max	51 min	…	…	…	…	…	…	…	…
0.075 (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing 0.425 mm (No. 40):											
Liquid Limit	…		…	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min
Usual types of significant constituent materials	stone fragments, gravel and sand		fine sand	silty or clayey gravel and sand				silty soils		clayey soils	
General ***local*** rating as a subgrade	excellent to good			fair to poor							

* Plasticity index of A-7-5 subgroup is equal to or less than the LL - 30. Plasticity index of A-7-6 subgroup is greater than LL – 30

** *Northeast Florida*

Appendix B

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SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 0110-0003F

PROJECT NAME JEA Radio Ave, Pump Station: Stormwater Pond & Access Road **DATE.** 3/14/2019

PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer

Borehole	Sample No.	Approx. Depth (ft)	%<#200 Sieve	Water Content (%)	Organic Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	AASHTO Classification	Comments
A-1	2	2	3	21	---	---	---	---	A-3	
A-3	3	3	2	23	---	---	---	---	A-3	
P-1	3	3	3	24	---	---	---	---	A-3	
P-1	7	7	9	28	3.6	---	---	---	A-3	
P-1	10	10	21	23	2.8	---	---	---	A-2-4	
P-1	14	14	12	28	---	---	---	---	A-2-4	

Note: "---" Untested Parameter

LABORATORY TEST PROCEDURES

Percent Fines Content

The percent fines or material passing the No. 200 mesh sieve of the sample tested was determined in general accordance with the latest revision of ASTM D 1140. The percent fines are the soil particles in the silt and clay size range.

Natural Moisture Content

The water content of the tested sample was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ratio of "pore" or "free" water in a given mass of material to the mass of solid material particles.

Organic Loss on Ignition (Percent Organics)

The organic loss on ignition or percent organic material in the sample tested was determined in general accordance with ASTM D 2974. The percent organics is the material, expressed as a percentage, which is burned off in a muffle furnace at 455±10 degrees Celsius.