Report of Final Geotechnical Exploration

For

Nassau WRF Improvements
Phase 1B

MAE Project No. 0110-0003E
October 1, 2019

Prepared for:

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Attention: Ms. Caitlin Klug, P.E.

Reference: Report of Final Geotechnical Exploration
Nassau WRF Improvements – Phase 1B
Nassau County, Florida
MAE Project No. 0110-0003E

Dear Ms. Klug:

Meskel & Associates Engineering, PLLC (MAE) has completed a final geotechnical exploration for the subject project. Our work was performed in general accordance with our Subcontract Agreement for Professional Services dated June 4, 2018. The purpose of this exploration was to evaluate the subsurface conditions encountered at the planned Ground Storage Tank, Booster Pump Station and Electrical Room locations as shown on the provided plan sheet, to provide recommendations for foundation design and construction. A summary of our findings and recommendations are presented below; however, we recommend that this report be considered in its entirety.

As further discussed in this report, the borings located within the proposed structure areas encountered a surficial topsoil layer 3 to 6 inches thick, underlain by fine sands (SP), fine sands with silt (SP-SM) and silty fine sands (SM) to the boring termination depths of 20, 30 and 60 feet below existing grade. Trace amounts of root fragments were noted in some of the recovered samples from the ground surface to depths of 2 to 6 feet. Groundwater was encountered at all boring locations at depths varying from 3 feet 6 inches to 4 feet 2 inches below the existing ground surface at the time of this recent exploration.

Based on our findings, the encountered soils are suitable for support of the planned construction on conventional mat or shallow foundation systems provided a program of site preparation is followed. The encountered soils are generally suitable to be reused as general site development or structural fill across the site. The moisture content will need to be controlled to achieve the required level of compaction below proposed structures. This will likely require dewatering of excavations or stockpiling of soils excavated below the groundwater level to dry before placement and compaction.

We appreciate this opportunity to be of continued 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 10/01/2019 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: 2019.10.01 11:07:43 -04'00'

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

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1.0 PROJECT INFORMATION

1.1 General

Project information was provided to us by Ms. Caitlin Klug, P.E. and Mr. John Wilhoit, E.I., with Hazen and Sawyer, PC via several electronic correspondence and telephone conversations. We were provided with the Site and Yard Piping Plan sheet prepared by Hazen and Sawyer and dated May 2019. This plan sheet showed the proposed construction and the requested soil boring locations and their corresponding Northing and Easting coordinates.

A preliminary geotechnical exploration was performed for this site and reported on July 19, 2018 (MAE Project No. 0110-0003D). The results from that field exploration were reviewed as referenced in this report during our evaluation of the subsurface conditions below the proposed structures.

1.2 Project Description

The site for the subject project is an undeveloped 3.5-acre parcel, located east of Art Wilson Lane and north of Radio Avenue in Nassau County, Florida. The general site location is shown on Figure 1.

Based on the provided information and our discussions with Ms. Klug, we understand that JEA will construct a remote pump station and storage tank to act as an intermediate storage and repump for the nearby Nassau Regional Water Reclamation Facility (WRF) and to accommodate peak demands for the expected growth and development of the East Nassau Community Planning Area. We understand the proposed Ground Storage Tank (GST) will be a prestressed concrete tank with a capacity of 1.5 million gallons and a diameter of about 120 feet. Therefore, we estimate the maximum water height within the tank to be about 20 feet. We have assumed the GST will be supported on a flexible mat foundation system.

A Booster Pump Station and a Generator and Fuel Tank are also planned. The Booster Pump Station is approximately 35 feet by 65 feet in plan area. The Generator and Fuel Tank slab is approximately 8 feet by 20 feet in plan area. We have assumed that both structures will have monolithic, cast-in-place concrete grade-supported slabs.

The provided plan sheet shows the Finished Floor Elevation of the GST to be 31.0 feet, and that of the Booster Pump Station and Generator Pad and Fuel Tank is 29.5 feet. Therefore, we have estimated 2 to 3 feet of fill will be placed within the construction areas.

The recommendations provided in this report are based on the site and structure details provided above. If final project design details vary from those given above, then the recommendations in this report may need to be re-evaluated. Any changes in these conditions should be provided so the need for re-evaluation of our recommendations can be assessed.

2.0 FIELD EXPLORATION

A field exploration was performed on August 14 and 15, 2018. The Northing and Easting coordinates as shown on the provided Yard and Piping Plan were used to locate the soil borings on the site. The final boring locations are shown on the *Boring Location Plan*, Figure 2, which is a copy of the provided plan. Boring B-8, drilled on June 15, 2018 for our preliminary report, was added to Figure 2 as it was located within the proposed GST structure area.

Prior to mobilizing our equipment, a Utility Locate Request was submitted to the Sunshine State One-Call Center (SSOC). Once the site utilities were located and marked, we mobilized our ATV-mounted drilling equipment. Our field personnel located each boring using a Garmin GPSMAP 78 hand-held GPS receiver; therefore, the boring locations should be considered accurate only to the degree implied by the method of layout used.

2.1 SPT Borings

A total of 6 Standard Penetration Test (SPT) borings were located within the planned GST, Electrical Room and Booster Pump Station areas. Boring B-9, located at the approximate center of the proposed GST, was to be advanced to a depth of approximately 60 feet below existing grade. It should be noted that the boring encountered an apparent shell layer at a depth of about 51 feet below existing grade. At that depth, all drilling fluid circulation was lost and the borehole collapsed. The crew moved approximately 8 feet to the west and advanced a borehole (Boring B-9A) by rotary wash methods to a depth of about 53.5 feet, where they continued the boring as an SPT boring to the termination depth of 60 feet. No loss of drilling fluids was observed during the performance of this boring.

Borings B-10, B-11 and B-12 were located along the approximate perimeter of the GST and were each advanced to a depth of approximately 30 feet below existing grade. The borings for the Booster Pump Station and Generator and Fuel Tank (B-13 and B-14, respectively) were each advanced to a depth of approximately 20 feet. All of the borings were performed in general accordance with the methodology outlined in ASTM D 1586. Split-spoon soil samples recovered during performance of the borings were visually described in the field and representative portions of the samples were transported to our laboratory for classification and testing.

3.0 LABORATORY TESTING

Representative soil samples obtained during our field exploration were visually classified by a geotechnical engineer using the *Unified Soil Classification System* (USCS) in general accordance with ASTM D 2488. 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 soils encountered and to provide data for correlation to their anticipated strength and compressibility characteristics. The laboratory testing determined the natural moisture content, the percent passing the 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*, Figures 3 through 5, and on the *Log of Boring* records at the respective depths from which the tested samples were recovered. A description of the laboratory testing procedures is included in Appendix B.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General Soil Profile

Graphical presentation of the generalized subsurface conditions as encountered within the proposed structure areas is presented on the *Generalized Soil Profiles*, Figures 3 through 5. Detailed boring records are included in Appendix A. When reviewing the soil profiles and boring records, it should be understood that the soil conditions will vary between the boring locations. The following table summarizes the soil conditions encountered.

GENERAL SOIL PROFILE			
APPROXIMATE DEPTH (FT)		SOIL DESCRIPTION	USCS(1)
FROM	TO		
0	0.25 – 0.5	Topsoil	---(2)
0.25 - 0.5	2 - 6	Very loose to loose fine SAND and fine SAND with silt, poorly graded, with trace root fragments.	SP, SP-SM
2 - 6	8 - 13	Loose to medium dense fine SAND to fine SAND with silt, poorly graded.	SP, SP-SM
8 - 13	13 - 18	Dense fine SAND to fine SAND with silt, poorly graded.	SP-SM
13 - 18	43	Medium dense fine SAND with silt, poorly graded	SP-SM
43	60	Loose to medium dense silty fine SAND, few to little amounts of gravel (shell fragments) from 48 to 60 feet	SM

(1) Unified Soil Classification System
(2) Topsoil does not have an associated USCS classification

4.2 Groundwater Level

The groundwater level was encountered at each of the recent soil boring locations and recorded at the time of drilling at depths varying from 3 feet 6 inches to 4 feet 2 inches below the existing ground surface. The groundwater level was encountered at boring location B-18 at a depth of 1 foot 3 inches at the time of drilling (June 15, 2018).

It should be anticipated that groundwater levels will fluctuate seasonally and with changes in climate. As such, we recommend that the water table be measured prior to construction. Measured groundwater levels are shown on the *Generalized Soil Profiles*, Figures 3 through 5, 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 site: 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 to Poorly Drained	A, A/D	12 to 42

Map Unit Symbol	Map Unit Name	Drainage Class	Hydrologic Group	Depth to the Water Table(1) (inches)
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, 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, we estimate the seasonal high groundwater levels at the site to be generally 6 to 18 inches below the ground surface at the time of our exploration. However, it should be understood that this seasonal high estimate is 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, we recommend that piezometers be installed across the site to measure groundwater fluctuations over time.

It is possible that groundwater levels may exceed the estimated seasonal high groundwater level as a result of significant or prolonged rains, which may result in ponded water in areas of the site. 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 FINAL DESIGN RECOMMENDATIONS

5.1 General

We reviewed the results of our preliminary field exploration, particularly boring B-8, which was located near the west perimeter of the proposed GST, during our evaluation for this report. Based on the results of both field explorations, it is our opinion that the encountered subsurface conditions are adaptable to support the proposed GST, Electrical Room and Booster Pump Station structures on shallow foundations and grade-supported slabs. The following evaluation and recommendations are based on the provided project information as presented in this report, the 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 are changed after this report, or if subsurface conditions encountered during construction are different from those reported, then MAE should be notified so that these recommendations can be re-evaluated and revised, if necessary. We recommend that MAE review the foundation plans and earthwork specifications to verify that the recommendations in this report have been properly interpreted and implemented.

5.2 GST Foundation Design Recommendations

We have assumed that the prestressed concrete tank will be supported on a 4-inch-thick concrete slab-on-grade. The slab will be thickened at the tank edge to support the tank walls and dome. Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed GST structure when constructed on a properly designed shallow foundation system. Provided the site preparation and earthwork construction recommendations outlined in Section 6.0 of this report are performed, the following parameters may be used for foundation design.

5.2.1 Bearing Pressure

Based on the 1.5 million-gallon storage capacity and the tank diameter of 120 feet, we calculated a water storage height of approximately 20 feet. Therefore, we estimate the maximum load applied to the subgrade soils, or the net soil bearing pressure, to be on the order of 1,500 pounds per square foot (psf). The maximum allowable net soil bearing pressure for shallow foundations supporting the tank walls or adjacent tank features such as stair pads should not exceed 2,500 psf.

Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the natural overburden pressure at that level. The mat foundation for the GST should be designed based on the maximum load that could be imposed by all loading conditions.

5.2.2 Foundation Size

The minimum width of the perimeter footing supporting the tank walls should be 18 inches. Isolated pad footing should have a minimum dimension of 24 inches. Even though the maximum allowable soil bearing pressure may not be achieved, this width recommendation should control the size of these foundations.

5.2.3 Bearing Depth

The minimum embedment depth for the thickened edge footing portion of the GST slab is 12 inches below the adjacent outside finished grades. The minimum embedment depth of any isolated footings, supporting structures or equipment adjacent to the tank, should be 18 inches below the adjacent outside finished grades. It is recommended that surface grades adjacent to the tank structure and outside any isolated pads be graded to divert surface water away from the tank and isolated pads to reduce the possibility of erosion beneath the thickened edge slab and pad foundations.

5.2.4 Bearing Material

The tank slab including the thickened-edge portion and the isolated pad foundations may bear on either the compacted existing site soils, or on compacted import structural fill if needed to raise the site grade. The bearing level soils, after compaction, should exhibit densities equivalent to 98 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of at least 2 feet below the foundation bearing levels.

5.2.5 Settlement Estimates

Post-construction settlements of the tank structure will be influenced by several interrelated factors, such as (1) subsurface stratification and strength/compressibility characteristics; (2) the size of the tank foundation and the bearing level, the applied loads, and the resulting bearing pressures beneath the foundation; and (3) site preparation and earthwork construction techniques used by the contractor. The settlement estimates presented below are based on the results of our field exploration at the site, laboratory test results, and the use of the site preparation/earthwork construction techniques as recommended in this report. Any deviation from these recommendations could result in an increase in the estimated post-construction settlements of the storage tank structure.

Using the estimated load of 1,500 psf to be applied to the foundation soils by the full water tank, and the field and laboratory test data that we have correlated to geotechnical strength and compressibility characteristics of the subsurface soils, we estimate that the total settlement of the tank structure at the tank center to be approximately 1.25 inches. Total settlement of any isolated pad foundations adjacent to the tank is estimated to be less than one inch.

Differential settlements result from differences in applied bearing pressures and variations in the compressibility characteristics of the subsurface soils. Because of the general uniformity of the subsurface conditions, and assuming the recommended site preparation and earthwork construction techniques outlined in Section 6.0 are followed, we estimate the differential settlement between the center and perimeter of the tank to be approximately 0.5 to 0.75-inch. We recommend that piping, tank nozzles, and other attachments be designed with adequate consideration for the anticipated settlement.

The soil borings encountered predominately sandy soils within the expected stress zone of influence for the tank structure. Therefore, we expect the majority of the estimated total and differential settlement to occur in an elastic manner during construction and initial filling of the tank. The remainder of the estimated settlement will likely occur within approximately 2 weeks once the tank is constructed and filled to its design water level, as pore water pressures within the foundation soils recede. The majority of the estimated settlement for isolated pad foundation located adjacent to the tank will occur as the load is applied.

5.2.6 Tank Slab

The tank slab can be constructed as a slab-on-grade bearing on the existing site soils or suitable compacted structural fill soil and designed for a modulus of subgrade reaction of 200 pci. The surficial topsoil and other unsuitable material should be removed as discussed in Section 6.1.1 below. Any import structural fill needed to raise the site grade should be placed and compacted as outlined in Section 6.1.4. It is recommended that the tank slab bearing soils be covered with an impervious membrane to reduce moisture entry and floor dampness. A 6-mil thick plastic membrane is commonly used for this purpose. Care should be exercised not to tear large sections of the membrane during placement of reinforcing steel and concrete. In addition, we recommend that a minimum separation of 2 feet be maintained between the tank slab bearing level and the estimated seasonal high groundwater level.

5.3 Electrical Room and Booster Pump Station

Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed Electrical Room and Booster Pump Station structures on monolithic slab-on-grade foundations designed for a modulus of subgrade reaction of 200 pci. Provided the site preparation and earthwork construction recommendations outlined in Section 6.0 of this report are performed, the following parameters may be used for foundation design.

5.3.1 Bearing Pressure

The maximum allowable net soil bearing pressure for the turned-down-edge footings and any isolated pad footings should not exceed 2,500 psf. Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the natural overburden pressure at that level. The footings, grade-supported slabs and wet well slab should be designed based on the maximum load that could be imposed by all loading conditions.

5.3.2 Foundation Size

The minimum width of the turned-down-edge footings should be 12 inches. Isolated pad footing should have a minimum dimension of 24 inches. Even though the maximum allowable soil bearing pressure may not be achieved, this width recommendation should control the size of these foundations.

5.3.3 Bearing Depth

The turned-down-edge footings should bear at a depth of at least 12 inches below the exterior final grades. The minimum embedment depth of any isolated pad footings should be 18 inches below the adjacent outside finished grades. It is recommended that stormwater be diverted away from these foundations to reduce the possibility of erosion beneath the slabs and any isolated footings.

5.3.4 Bearing Material

The wet well slab and grade-supported slabs including the turned-down-edge footings and the isolated pad foundations may bear on either the compacted existing site soils, or on compacted import structural fill if needed to raise the site grade. The bearing level soils, after compaction, should exhibit densities equivalent to 98 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of at least 2 feet below the foundation bearing levels.

5.3.5 Settlement Estimates

Post-construction settlements of the Electrical Room and Booster Pump Station structures will be influenced by several interrelated factors, such as (1) subsurface stratification and strength/compressibility characteristics; (2) the area of each structure and the bearing level, the applied loads, and the resulting bearing pressures; and (3) site preparation and earthwork construction techniques used by the contractor. The settlement estimates presented below are based on the results of our field exploration at the site, laboratory test results, and the use of the site preparation/earthwork construction techniques as recommended in this report. Any deviation from these recommendations could result in an increase in the estimated post-construction settlements of the structures.

Using the recommended bearing pressure applied to the foundation subgrade soils, and the field and laboratory test data that we have correlated to geotechnical strength and compressibility characteristics of the subsurface soils, we estimate that the total settlement of each structure to be less than one inch. Differential settlements result from differences in applied bearing pressures and variations in the compressibility characteristics of the subsurface soils. Because of the general uniformity of the subsurface conditions, and assuming the recommended site preparation and earthwork construction techniques outlined in Section 6.0 are followed, we estimate the differential settlement across the structure to be 0.5 -inch or less. We recommend that any piping or other attachments be designed with adequate consideration for the anticipated settlement.

5.4 Below Grade Structure Support Recommendations

Based on the results of the subsurface exploration and laboratory testing and considering the provided information as discussed in this report, we consider the subsurface conditions at the sites adaptable for supporting the wet well structure and pipelines when constructed upon properly prepared subgrade soils. Provided the site preparation and earthwork construction recommendations outlined in Section 6.0 of this report are performed, the following parameters may be used for design of below-grade utilities.

5.4.1 Wet Well Slab Design Parameters

The maximum allowable net soil bearing pressure for the wet well slab for the Booster Pump Station should not exceed 1,000 psf. The net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the natural overburden pressure at that level. The wet well slab may bear on the compacted existing site soils. The bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of at least one foot below the slab bearing level.

5.4.2 Lateral Pressure Design Parameters

The wet well below-grade walls that are backfilled on one side and restrained against rotation at the top, should be designed to resist lateral pressures from soil and groundwater based on the following equivalent fluid unit weights:

- Above Water Table – Equivalent Fluid Density 60 lb/ft^3
- Below Water Table – Equivalent Fluid Density 90 lb/ft^3

For the design of lateral loads on below-grade walls, we recommend that the groundwater level be assumed to be at the ground surface. Lateral pressure distributions in accordance with the above do not take into account forces from construction equipment, wheel loads or other surcharge loads. To account for this loading, a pressure equal to 0.5 times the anticipated surface surcharge should be applied over the full height of all walls.

5.4.3 Hydrostatic Uplift Resistance

It is anticipated that the buried structures will exert little or no net downward pressure on the soils; rather, the structures may be subject to hydrostatic uplift pressure when empty. Below grade structures should be designed to resist hydrostatic uplift pressures appropriate for their depth below existing grade and the normal seasonal high groundwater table. Hydrostatic uplift forces can be resisted in several ways including:

- Addition of dead weight to the structure.
- Mobilizing the dead weight of the soil surrounding the structure through extension of footings outside the perimeter of the structure.

A moist compacted soil unit weight of 110 lb/ft^3 may be used in designing structures to resist buoyancy.

5.5 Borrow Considerations

Based on the subsurface soil conditions as encountered in the borings, the fine sands (SP) and fine sands with silt (SP-SM) are considered suitable for use as fill soil for general site development and as structural fill placed below proposed structures. However, it should be noted that several borings encountered soils with greater than 4 percent organic fines content. These soils are not considered suitable for use as structural fill due to their relatively high organic content. These soils will need to be stockpiled separately from other structural fill soils and can be used as embankment fill for pavements and in landscape areas. In addition, the soils containing surficial organic material (topsoil) will require removal and are also considered unsuitable for use as structural fill. They could be used in landscape berms.

It should be anticipated that soils excavated below the groundwater level at the time of construction will have moisture contents in excess of the modified Proctor optimum moisture content. Thus, the excavations will need to be dewatered prior to excavation, or the excavated soils will need to be stockpiled or spread to bring the moisture content to within 2 percent of the soil's optimum moisture content corresponding to the required degree of compaction.

6.0 SITE PREPARATION AND EARTHWORK RECOMMENDATIONS

Site preparation as outlined in this section should be performed to provide more uniform foundation bearing conditions and to reduce the potential for post-construction settlements of the planned structures and pipeline.

6.1 GST, Booster Pump Station, Electrical Room Structures

6.1.1 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 proposed structures, plus a minimum additional margin of 5 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.

Based on the results of the recent field exploration and that performed in June 2018, it should be anticipated that approximately 3 to 6 inches of topsoil and soils containing significant amounts of organic materials may be encountered at the structure areas. The actual depths of unsuitable soils and materials should be determined by MAE using visual observation and judgment during earthwork operations. Any topsoil removed from the structure areas can be stockpiled and used subsequently in areas to be grassed.

6.1.2 Temporary Groundwater Control

The groundwater level at the structure locations was encountered at depths varying from 3 feet 6 inches to 4 feet 2 inches below the existing ground surface at the time of the recent exploration. Should groundwater control measures become necessary, the dewatering method should be determined by the contractor. We recommend the groundwater control measures, if necessary, maintain the groundwater level at least 2 feet below the compacted surface and remain in place until compaction of the existing soils is completed. The site should be graded to direct surface water runoff from the construction area.

6.1.3 Compaction

After completing the clearing and stripping operations, and after 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 5 to 10 tons. Typically, the soils should exhibit moisture contents within ±2 percent of the modified Proctor optimum moisture content (ASTM D 1557) during the compaction operations. Several overlapping passes should be made in both directions across the footprint area of the planned structures, with each pass overlapping the previous pass by at least 30 percent. Compaction should continue until densities of at least 98 percent of the modified Proctor maximum dry density (ASTM D 1557) have been achieved within the upper 2 feet of the compacted existing 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 as defined in Section 6.1.4 below, 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. 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 75 feet from existing structures. Within this zone, use of a track-mounted bulldozer or a vibratory roller, operating in the static mode, is recommended. If such methods are deemed necessary, then it may be necessary to excavate the top foot of soil subgrade, following site clearing, and compact the underlying soils to the specified level of compaction, followed by re-placement and compaction of the excavated soil.

6.1.4 Structural Backfill and Imported Fill Soils

Any structural backfill or fill required for site development 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.

Imported structural fill is defined as a non-plastic, inorganic, granular soil having less than 12 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The existing site soils consisting of fine sands and fine sands with silt, without roots or debris, as encountered in the borings, are also considered suitable as fill and backfill and, with proper moisture control, should densify using conventional compaction methods.

It should be noted that soils with more than 12 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 (ASTM D 1557) during the compaction operations. Compaction should continue until densities of at least 98 percent of the modified Proctor maximum dry density (ASTM D 1557) have been achieved within each lift of the compacted structural fill.

6.1.5 Foundation Areas

After satisfactory surface compaction and placement and compaction of any additional imported structural fill, the foundation areas may be excavated to the planned bearing levels. The foundation bearing level soils, after compaction, should exhibit densities equivalent to 98 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of two feet below the bearing level. For confined areas, such as the footing excavations, any additional compaction operations can probably best be performed by the use of a lightweight vibratory sled or roller having a total weight on the order of 500 to 2000 pounds.

6.2 Wet Well and Pipelines

6.2.1 Clearing

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.

Based on the results of our field exploration, it should be anticipated that approximately 4 inches of topsoil and soils containing significant amounts of organic materials may be encountered across the site. The actual depths of unsuitable soils and materials should be determined by MAE using visual observation and judgment during earthwork operations. Any topsoil removed from the structure areas can be stockpiled and used subsequently in areas to be grassed.

6.2.2 Temporary Groundwater Control

Because of the need for excavation to the wet well slab and pipe bearing levels, followed by compaction of the wet well slab subgrade and pipe bedding and backfill soils, it may be necessary to install temporary groundwater control measures to dewater the area to facilitate the excavation and compaction processes. The groundwater control measures should be determined by the contractor but can consist of sumps or wellpoints (or a combination of these or other methods) capable of lowering the groundwater level to at least 3 feet below the required depth of excavation. The dewatering system should not be decommissioned until excavation, compaction, and fill placement is complete, and sufficient deadweight exists on the structures to prevent uplift.

6.2.3 Preparation of Foundation Soils

For the wet well slab and pipelines that are anticipated to bear in the existing sandy soils (SP, SP-SM), the soils should be excavated to the proposed bearing elevation and the exposed excavation surface should be compacted as outlined in the following sections. Once the wet well slab and walls and pipe are installed, the wet well excavation and pipe trenches should be backfilled with compacted structural backfill to final grade.

6.2.4 Compaction of Excavation Bottom

After installing the temporary groundwater control measures, and achieving the required depth of excavation, the exposed sandy soil pipe bedding should be compacted with appropriate compaction equipment. Typically, the wet well slab subgrade and pipe bedding soils 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 one foot below the wet well slab or pipe invert elevations.

Should the bearing level soils experience pumping and soil strength loss during the compaction operations, compaction work should be immediately terminated and (1) the disturbed soils removed and backfilled with dry structural fill soils as defined in Section 6.2.6 that are then compacted, or (2) the excess moisture content within the disturbed soils allowed to dissipate before recompacting.

Care should be exercised to avoid damaging any nearby structures while the compaction operations are underway. Compaction should cease if deemed detrimental to adjacent structures.

6.2.5 Excavation Protection

Excavation work for the wet well and pipeline construction will be required to meet OSHA Excavation Standard Subpart P regulations for Type C Soils. The use of excavation support systems will be necessary where there is not sufficient space to allow the side slopes of the excavation to be laidback to at least 2H:1V (2 horizontal to 1 vertical) to provide a safe and stable working area and to facilitate adequate compaction along the sides of the excavation. In addition, it should be anticipated that an excavation support system may be necessary to protect adjacent existing structures, pavement and/or utilities that are located along the proposed pipeline alignment.

The method of excavation support should be determined by the contractor but can consist of a trench box, drilled-in soldier piles with lagging, interlocking steel sheeting or other methods. The support structure should be designed according to OSHA sheeting and bracing requirements by a Florida registered Professional Engineer. Where the wet well and pipeline excavations and the construction of excavation support systems are within 50 feet of existing structures, the existing structures should be monitored for adverse reactions to construction vibrations and dewatering activities.

6.2.6 Structural Backfill and Compaction of Structural Backfill

Import structural backfill is defined as a non-plastic, granular soil having less than 12 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The sandy soils (SP, SP-SM) without roots, as encountered in the borings, may also be used as structural backfill. Typically, the backfill 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 6- or 12-inch-thick lift of the compacted structural backfill.

Structural backfill placed within 5 feet of the wet well structure walls should be placed in 6-inch-thick loose lifts and compacted with hand-held equipment. Outside of this 5-foot zone, backfill may be placed in 12-inch-thick lifts and compacted with appropriate equipment. Care should be taken not to damage the structure walls.

Structural backfill should be placed around and above the pipeline in loose lifts not exceeding six inches in thickness and compacted by the use of hand-operated compaction equipment. At elevations greater than 12 inches above the top of pipe, structural backfill may be placed in loose lifts not exceeding 12 inches in thickness and compacted by hand-operated compaction equipment.

We recommend that soils excavated from the pipeline trenches that will be reused as backfill be stockpiled a safe distance from the excavations and in such a manner that promotes runoff away from the open trenches and limits saturation of the materials.

7.0 QUALITY CONTROL TESTING

For all structures, a representative number of field in-place density tests should be made in the upper 2 feet of compacted existing site soils, in each lift of compacted backfill and fill, in the upper 12 inches of compacted subgrade soil in the foundation areas. 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 5,000 square feet of tank or slab foundation area, with a minimum of 2 test locations per structure.

For the raw water pipeline, a representative number of field in-place density tests should be made in the upper 2 feet of compacted pipe bedding soils, in each lift of compacted backfill and fill, and in the upper 12 inches below the bearing levels in the pipeline excavations. The density tests are considered necessary to verify that satisfactory compaction operations have been performed. We recommend density testing be performed at a minimum of one location for every 300 feet of pipeline.

8.0 REPORT LIMITATIONS

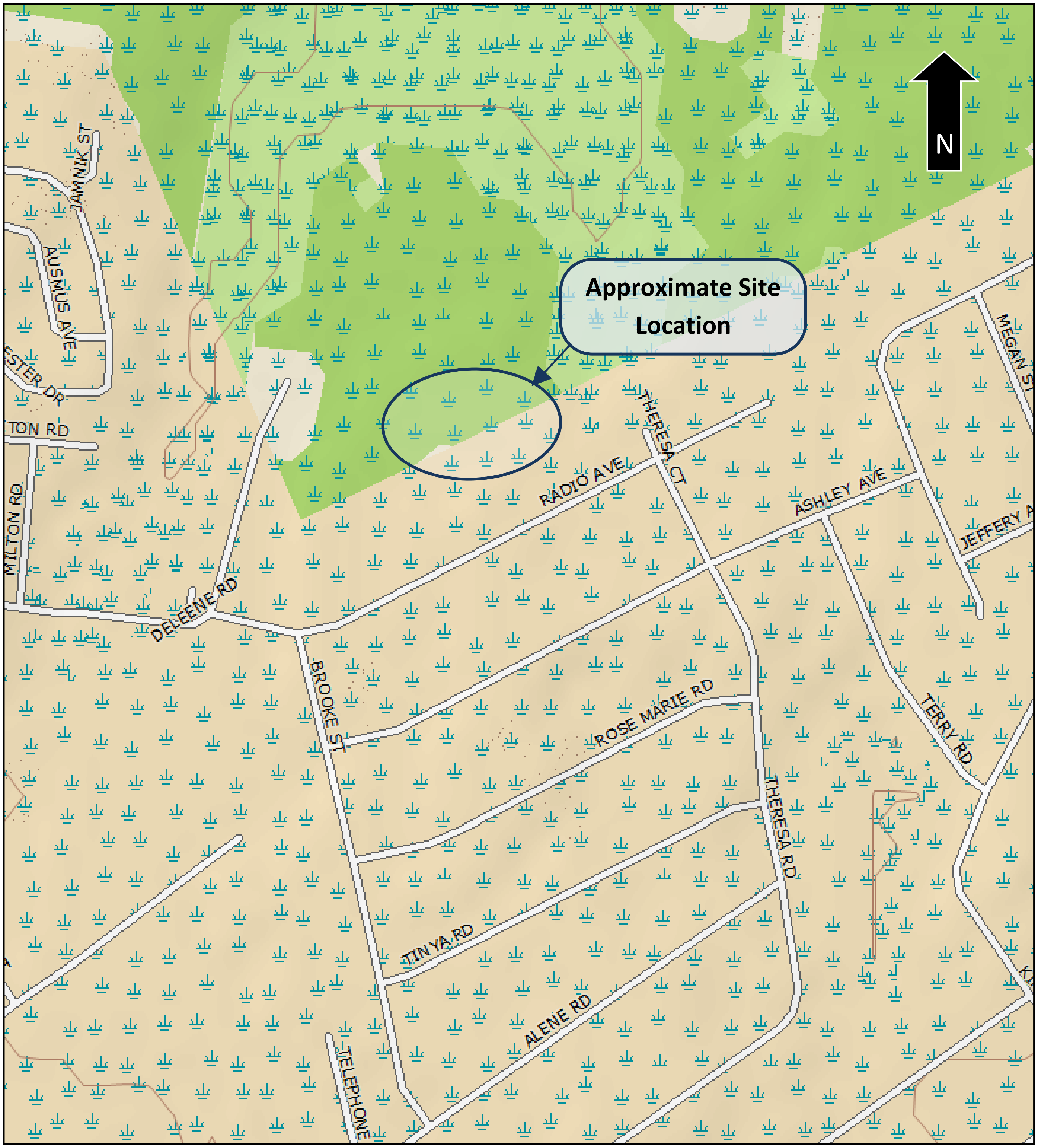
This report has been prepared for the exclusive use of Hazen and Sawyer, PC and the JEA for specific application to the design and construction of the Nassau WRF Improvements – Phase 1B project. An electronically signed and sealed version, and a version of our report that is signed and sealed in blue 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 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.

The evaluations and recommendations contained in this report are based on the data obtained from the borings performed for the proposed development. 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 encountered 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.

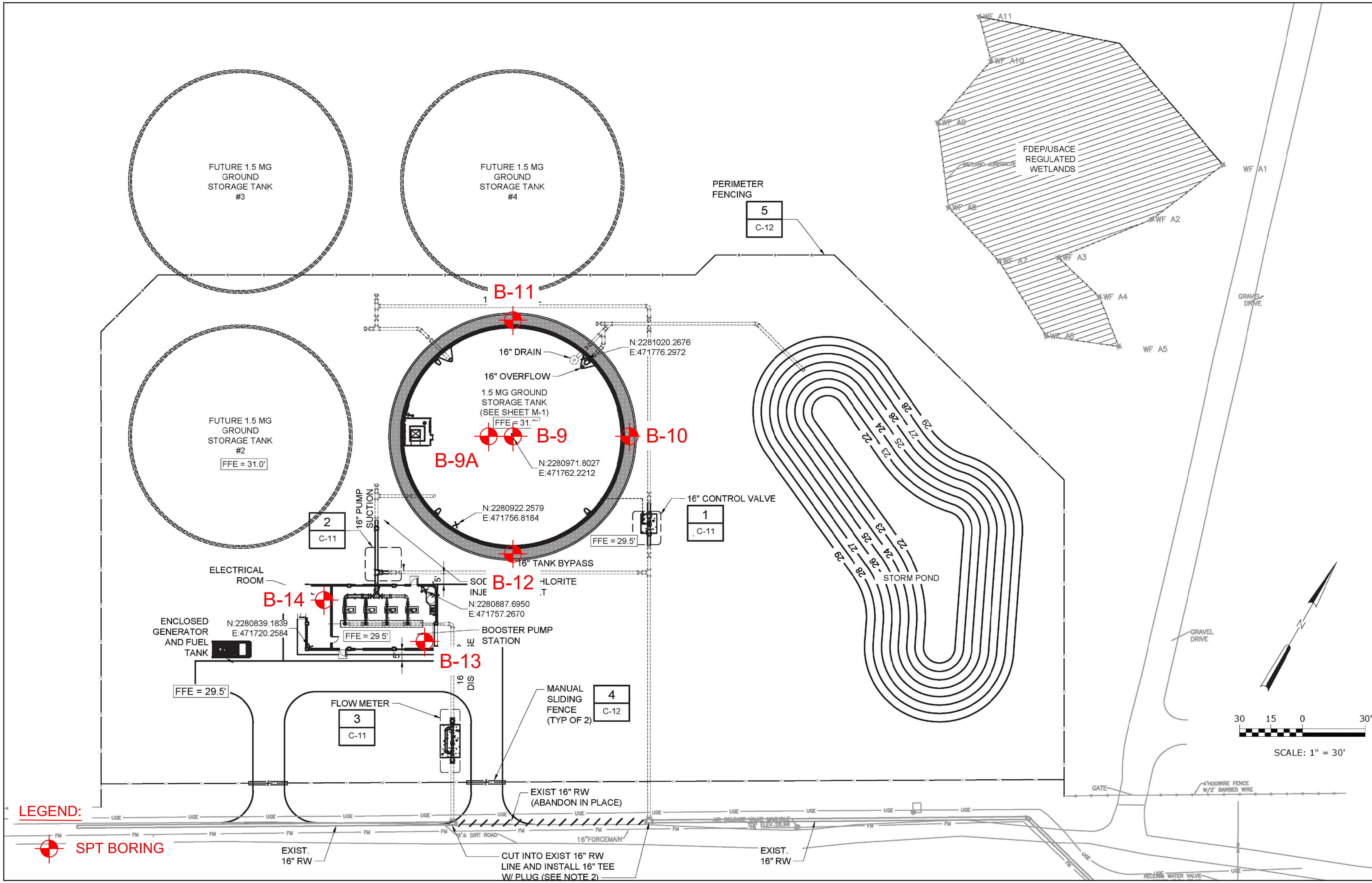
If changes in the design or location of the structures occur, the conclusions and recommendations contained in this report may need to be modified. We recommend that these changes be provided to us for our consideration. MAE is not responsible for conclusions, interpretations, opinions or recommendations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

Figures



Site Location Map

PREPARED BY	PROJECT NAME	
TEN YEARS 10 Meskel & Associates Engineering	**Nassau WRF Improvements-Phase 1B** **Final Geotech Evaluation Rep** **Yulee, Nassau County, Florida**	
	REFERENCE	SCALE
	Delorme XMap 7.0	NTS
PREPARED FOR	MAE PROJECT NO.	**FIGURE NO.**
Hazen & Sawyer	0110-0003E	1



NOTE: Site and Yard Piping Plan dated May 2019 was provided by Hazen & Sawyer.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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

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8936 Western Way, Suite 12, Jacksonville, FL 32256

CLIENT: Hazen & Sawyer

DATE: 9/9/2019

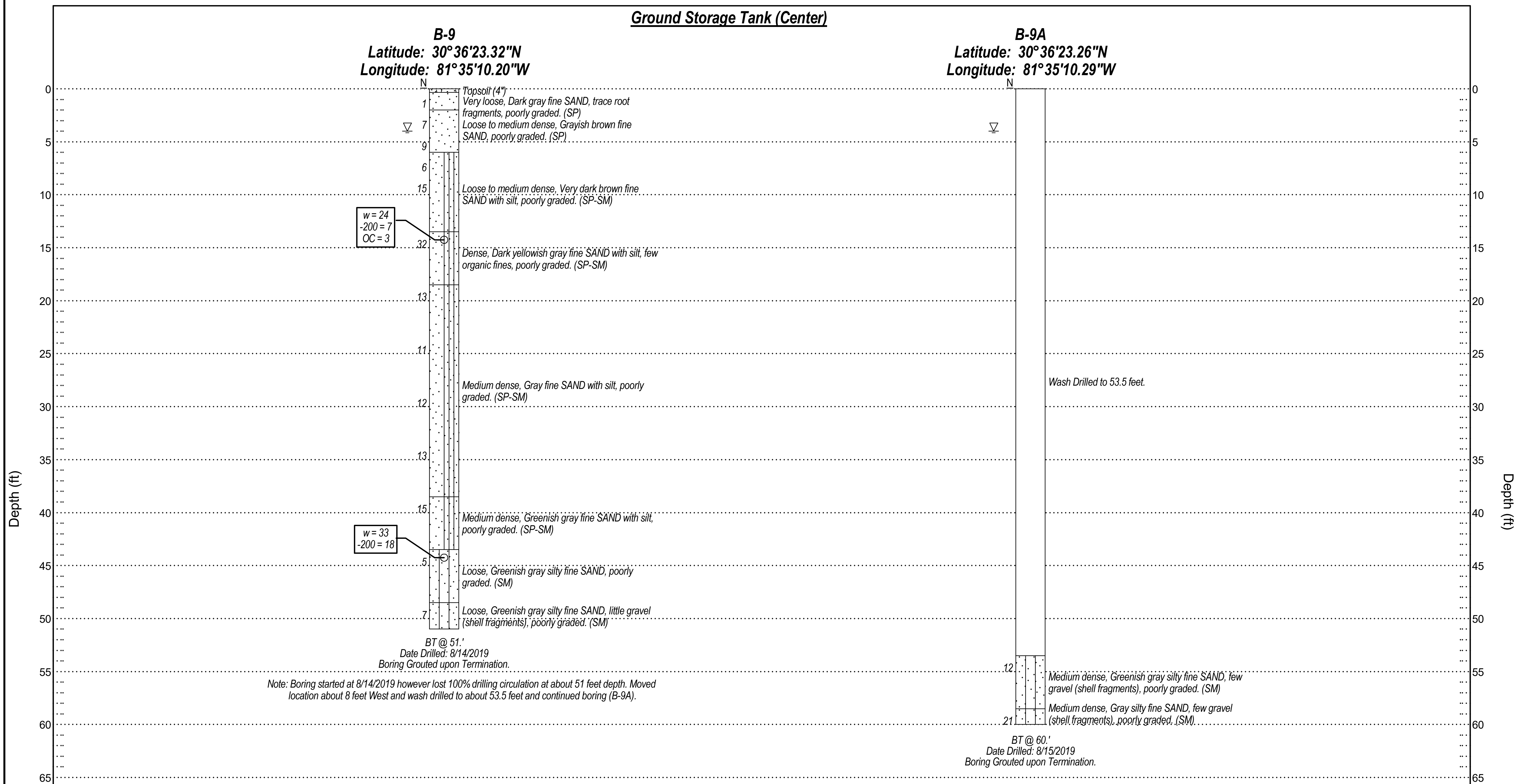
MAE PROJECT NO. 0110-0003E

SHEET TITLE: BORING LOCATION PLAN

PROJECT NAME: Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report
Yulee, Nassau County, Florida

FIGURE NO. 2

Ground Storage Tank (Center)



Legend

Topsoil	Silty Fine Sand
Fine Sand	Wash Boring
Fine Sand with Silt	

N Standard Penetration Resistance, Blows/Foot

BT Boring Terminated at Depth Below Existing Grade

(SP) Unified Soil Classification System (USCS)

∇ Depth to Groundwater at Time of Drilling

w Natural Moisture Content (%)

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

OC Organic Content (%)

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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TEN YEARS

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8936 Western Way, Suite 12, Jacksonville, FL 32256

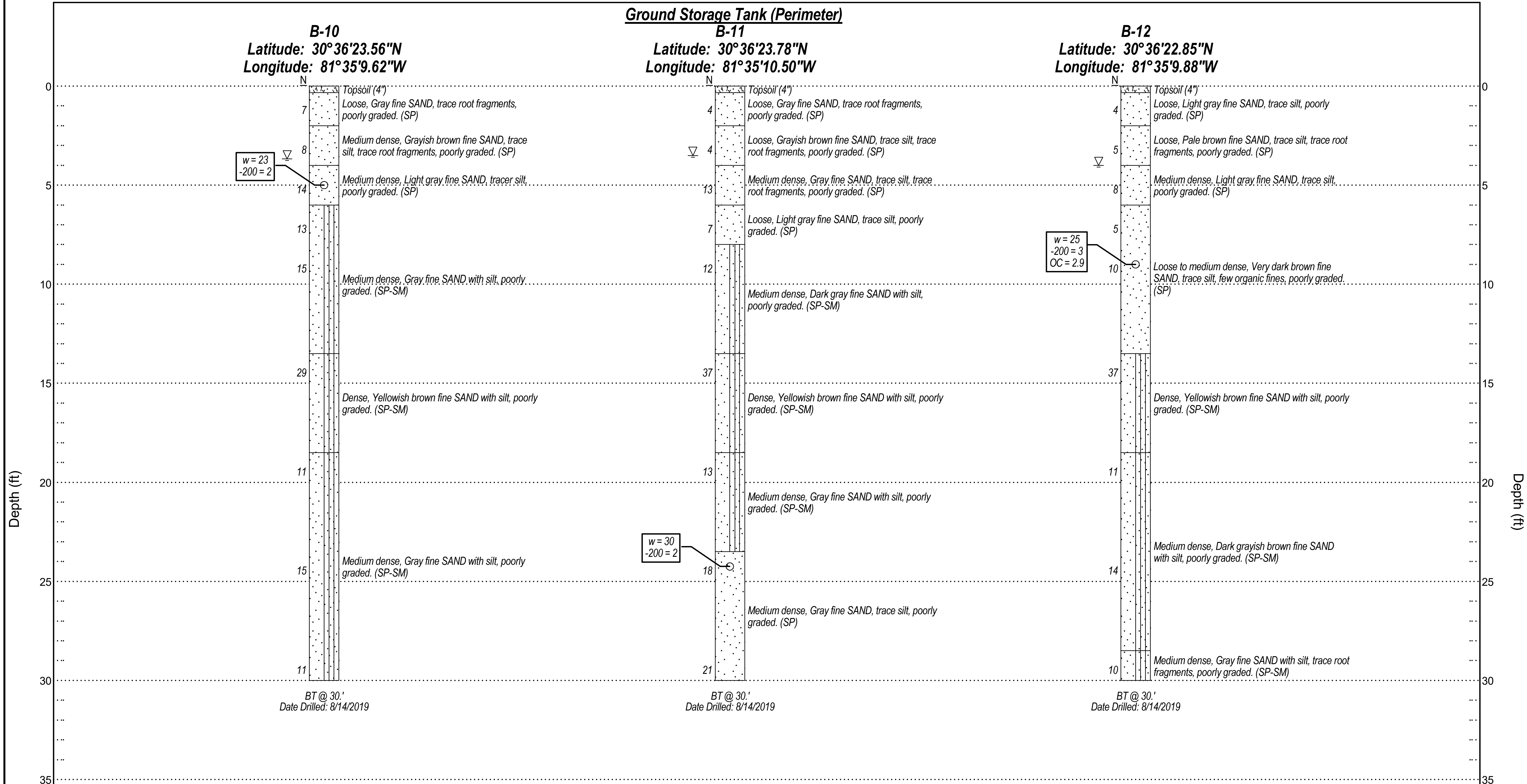
Hazen & Sawyer

DATE:	MAE PROJECT NO.
9/9/2019	0110-0003E

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report
Yulee, Nassau County, Florida

FIGURE NO. 3



Legend

Topsoil	
Fine Sand	
Fine Sand with Silt	
N	Standard Penetration Resistance, Blows/Foot
BT	Boring Terminated at Depth Below Existing Grade
(SP)	Unified Soil Classification System (USCS)
▽	Depth to Groundwater at Time of Drilling
w	Natural Moisture Content (%)
-200	% Passing No. 200 U.S. Standard Sieve
OC	Organic Content (%)

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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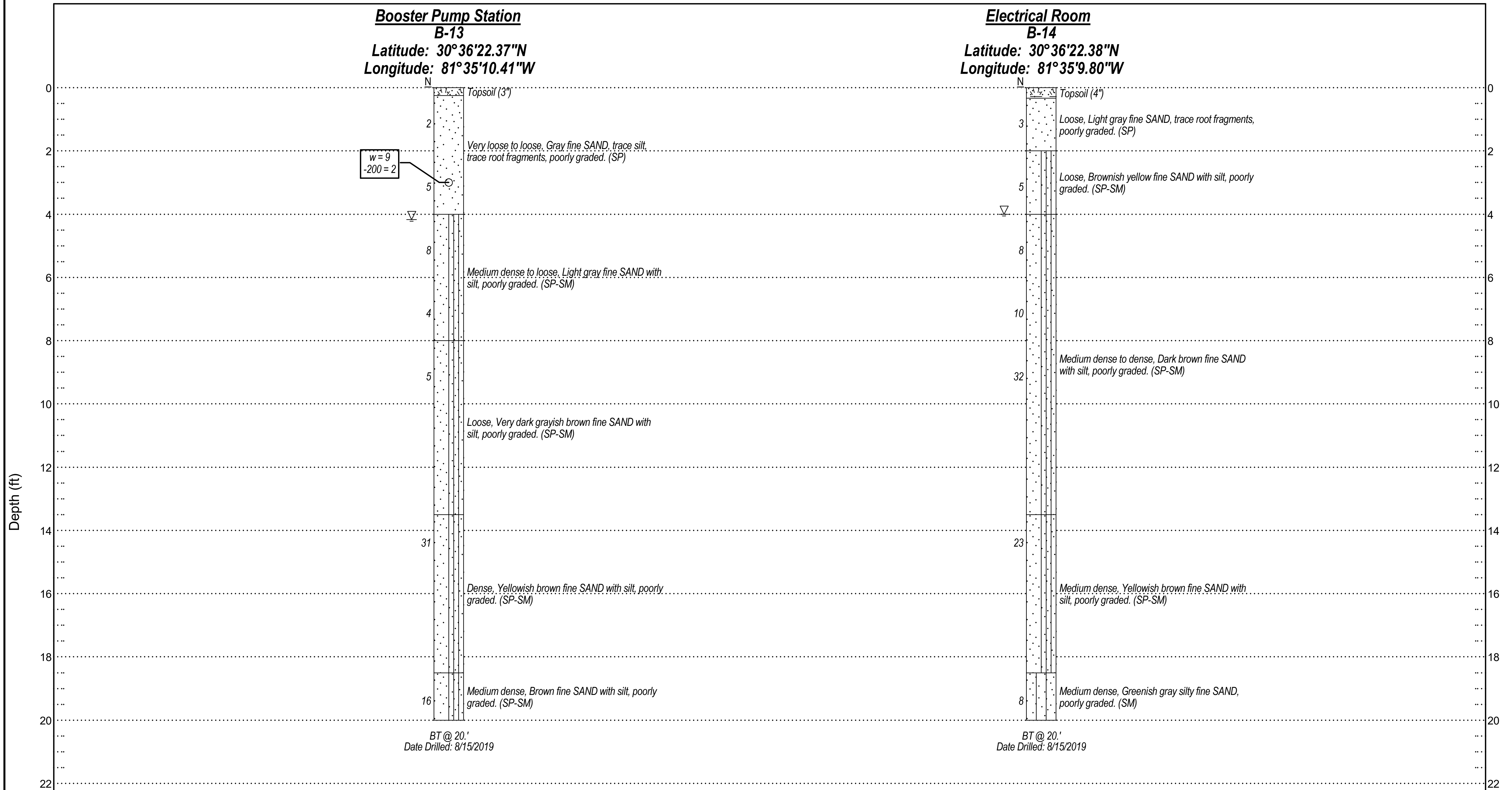
9/9/2019	0110-0003E

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report
Yulee, Nassau County, Florida

FIGURE NO. 4



Legend

Topsoil	Fine Sand	Fine Sand with Silt	N — Standard Penetration Resistance, Blows/Foot	(SP) — Unified Soil Classification System (USCS)	w — Natural Moisture Content (%)
Silty Fine Sand			BT — Boring Terminated at Depth Below Existing Grade	▽ — Depth to Groundwater at Time of Drilling	-200 — % Passing No. 200 U.S. Standard Sieve

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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DATE:	MAE PROJECT NO.
9/9/2019	0110-0003E

SHEET TITLE: Generalized Soil Profiles

PROJECT NAME: Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report
Yulee, Nassau County, Florida

FIGURE NO. 5

Appendix A

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BORING B-9

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DATE STARTED 8/14/19 **COMPLETED** 8/14/19 **LATITUDE** 30°36'23.32"N **LONGITUDE** 81°35'10.20"W

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test

LOGGED BY M.McLellan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Topsoil (4")												
	1	Very loose, Dark gray fine SAND, trace root fragments, poorly graded.	SP		1-0-1-1	1								
	2	▽ Loose to medium dense, Grayish brown fine SAND, poorly graded.	SP		2-3-4-4	7								
5	3				2-4-5-3	9								
	4	Loose to medium dense, Very dark brown fine SAND with silt, poorly graded.	SP-SM		2-2-4-5	6								
10	5				3-6-9-12	15								
15	6	Dense, Dark yellowish gray fine SAND with silt, few organic fines, poorly graded.	SP-SM		13-15-17	32	24	7	3.0					
20	7	Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM		6-6-7	13								

NOTES

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 4 ft 0 in *▽ **END OF DAY** ---

(Continued Next Page)

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20														
25	8				3 5 6	11								
30	9	Medium dense, Gray fine SAND with silt, poorly graded. *(continued)*	SP-SM		2 5 7	12								
35	10				3 5 8	13								
40	11	Medium dense, Greenish gray fine SAND with silt, poorly graded.	SP-SM		5 7 8	15								

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 4 ft 0 in

*END OF DAY ---

(Continued Next Page)

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Meskel & Associates Engineering

BORING B-9

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
		Medium dense, Greenish gray fine SAND with silt, poorly graded. *(continued)*	SP-SM											
45	12	Loose, Greenish gray silty fine SAND, poorly graded.	SM		1 2 3	5	33	18						
50	13	Loose, Greenish gray silty fine SAND, little gravel (shell fragments), poorly graded.	SM		3 4 3	7								Note: Boring started at 8/14/2019 however lost 100% drilling circulation at about 51 feet depth. Moved location about 8 feet West and wash drilled to about 53.5 feet and continued boring (B-9A).
		Bottom of borehole at 51 feet. Boring Grouted upon Termination.												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 4 ft 0 in *END OF DAY ---

NEW MAE LOG LAT/LONG-EOD_CUTTINGS - NEW TEMPLATE 7-30-12.GDT - 9/9/19 15:40 - F:\GINT\GINT FILES\PROJECTS\0110-0003E\RADIO AVE_FINAL EVAL REPORT.GPJ

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BORING B-9A

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DATE STARTED 8/14/19 **COMPLETED** 8/15/19 **LATITUDE** 30°36'23.26"N **LONGITUDE** 81°35'10.29"W

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test

LOGGED BY M.McLellan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0														
		Wash Drilled to 53.5 ft.												
		▽												
5														
10														
15														
20														

NOTES

GROUND WATER LEVELS

▽ **AT TIME OF DRILLING** 4 ft 0 in *▽ **END OF DAY** ---

(Continued Next Page)

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20														
		Wash Drilled to 53.5 ft.												
25														
30														
35														
40														

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 4 ft 0 in

*END OF DAY ---

(Continued Next Page)

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BORING B-9A

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
45		Wash Drilled to 53.5 ft.												
50														
55	14	Medium dense, Greenish gray silty fine SAND, few gravel (shell fragments), poorly graded.	SM		6 7 5	12								
60	15	Medium dense, Gray silty fine SAND, few gravel (shell fragments), poorly graded.	SM		10 11 10	21								
		Bottom of borehole at 60 feet. Boring Grouted upon Termination.												

NOTES

GROUND WATER LEVELS

AT TIME OF DRILLING 4 ft 0 in

*END OF DAY ---

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TEN YEARS Meskel & Associates Engineering

BORING B-10

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report
PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer
DATE STARTED 8/14/19 **COMPLETED** 8/14/19 **LATITUDE** 30°36'23.56"N **LONGITUDE** 81°35'9.62"W
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Topsoil (4")												
	1	Loose, Gray fine SAND, trace root fragments, poorly graded.	SP		2 3 4 7	7								
	2	Medium dense, Grayish brown fine SAND, trace silt, trace root fragments, poorly graded. ∇	SP		4 4 4 6	8								
5	3	Medium dense, Light gray fine SAND, tracer silt, poorly graded.	SP		3 6 8 10	14	23	2						
	4	Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM		5 6 7 9	13								
10	5				4 6 9 11	15								
15	6	Dense, Yellowish brown fine SAND with silt, poorly graded.	SP-SM		13 16 13	29								
20	7	Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM		3 5 6	11								

NOTES Boring backfilled with soil cuttings.

GROUND WATER LEVELS
∇ **AT TIME OF DRILLING** 3 ft 8 in
*∇ **END OF DAY** ---

(Continued Next Page)

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20														
	8				5-8-7	15								
25		Medium dense, Gray fine SAND with silt, poorly graded. *(continued)*	SP-SM											
	9				5-5-6	11								
30		Bottom of borehole at 30 feet.												

NOTES Boring backfilled with soil cuttings.

GROUND WATER LEVELS

AT TIME OF DRILLING 3 ft 8 in

*END OF DAY ---

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TEN YEARS 10 Meskel & Associates Engineering

BORING B-11

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report
PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer
DATE STARTED 8/14/19 **COMPLETED** 8/14/19 **LATITUDE** 30°36'23.78"N **LONGITUDE** 81°35'10.50"W
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY M.McLellan **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Topsoil (4")												
	1	Loose, Gray fine SAND, trace root fragments, poorly graded.	SP		1 2 2 3	4								
	2	∇ Loose, Grayish brown fine SAND, trace silt, trace root fragments, poorly graded.	SP		1 2 2 1	4								
5	3	Medium dense, Gray fine SAND, trace silt, trace root fragments, poorly graded.	SP		4 5 8 10	13								
	4	Loose, Light gray fine SAND, trace silt, poorly graded.	SP		3 4 3 4	7								
10	5	Medium dense, Dark gray fine SAND with silt, poorly graded.	SP-SM		5 5 7 6	12								
15	6	Dense, Yellowish brown fine SAND with silt, poorly graded.	SP-SM		16 20 17	37								
20	7	Medium dense, Gray fine SAND with silt, poorly graded.	SP-SM		4 5 8	13								

NOTES Boring backfilled with soil cuttings.

GROUND WATER LEVELS
∇ **AT TIME OF DRILLING** 3 ft 6 in *∇ **END OF DAY** ---

(Continued Next Page)

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20		Medium dense, Gray fine SAND with silt, poorly graded. *(continued)*	SP-SM											
25	8	Medium dense, Gray fine SAND, trace silt, poorly graded.	SP		4 6 12	18	30	2						
30	9				6 8 13	21								
		Bottom of borehole at 30 feet.												

NOTES Boring backfilled with soil cuttings.

GROUND WATER LEVELS

AT TIME OF DRILLING 3 ft 6 in *END OF DAY ---

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BORING B-12

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DATE STARTED 8/14/19 **COMPLETED** 8/14/19 **LATITUDE** 30°36'22.85"N **LONGITUDE** 81°35'9.88"W

DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test

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

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Topsoil (4")												
	1	Loose, Light gray fine SAND, trace silt, poorly graded.	SP		1 2 2 2	4								
	2	Loose, Pale brown fine SAND, trace silt, trace root fragments, poorly graded. ∇	SP		2 2 3 5	5								
5	3	Medium dense, Light gray fine SAND, trace silt, poorly graded.	SP		2 3 5 3	8								
	4	Loose to medium dense, Very dark brown fine SAND, trace silt, few organic fines, poorly graded.	SP		2 2 3 3	5								
10	5				3 4 6 10	10	25	3	2.9					
15	6	Dense, Yellowish brown fine SAND with silt, poorly graded.	SP-SM		10 14 23	37								
20	7	Medium dense, Dark grayish brown fine SAND with silt, poorly graded.	SP-SM		4 4 7	11								

NOTES Boring backfilled with soil cuttings.

GROUND WATER LEVELS

∇ **AT TIME OF DRILLING** 4 ft 0 in *∇ **END OF DAY** ---

(Continued Next Page)

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BORING B-12

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

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

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
20														
25	8	Medium dense, Dark grayish brown fine SAND with silt, poorly graded. *(continued)*	SP-SM		4 7 7	14								
30	9	Medium dense, Gray fine SAND with silt, trace root fragments, poorly graded.	SP-SM		3 5 5	10								
		Bottom of borehole at 30 feet.												

NOTES Boring backfilled with soil cuttings.

GROUND WATER LEVELS

AT TIME OF DRILLING 4 ft 0 in *END OF DAY ---

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TEN YEARS
Meskel & Associates Engineering

BORING B-13

PAGE 1 OF 1

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report
PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer
DATE STARTED 8/15/19 **COMPLETED** 8/15/19 **LATITUDE** 30°36'22.37"N **LONGITUDE** 81°35'10.41"W
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Topsoil (3")												
	1	Very loose to loose, Gray fine SAND, trace silt, trace root fragments, poorly graded.	SP		1 1 1 2	2								
	2				2 2 3 3	5	9	2						
5	3	Medium dense to loose, Light gray fine SAND with silt, poorly graded.	SP-SM		2 3 5 6	8								
	4				2 2 2 2	4								
10	5	Loose, Very dark grayish brown fine SAND with silt, poorly graded.	SP-SM		1 3 2 4	5								
15	6	Dense, Yellowish brown fine SAND with silt, poorly graded.	SP-SM		9 14 17	31								
20	7	Medium dense, Brown fine SAND with silt, poorly graded.	SP-SM		4 7 9	16								

Bottom of borehole at 20 feet.

NOTES Boring backfilled with soil cuttings.

GROUND WATER LEVELS
∇ **AT TIME OF DRILLING** 4 ft 2 in
*∇ **END OF DAY** ---

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TEN YEARS Meskel & Associates Engineering

BORING B-14

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report
PROJECT LOCATION Yulee, Nassau County, Florida **CLIENT** Hazen & Sawyer
DATE STARTED 8/15/19 **COMPLETED** 8/15/19 **LATITUDE** 30°36'22.38"N **LONGITUDE** 81°35'9.80"W
DRILLING CONTRACTOR MAE, PLLC **DRILLING METHOD** Standard Penetration Test
LOGGED BY P.R.Young **CHECKED BY** W. Josh Mele **GROUND ELEVATION** — **HAMMER TYPE** Automatic

DEPTH (ft)	SAMPLE DEPTH NUMBER	MATERIAL DESCRIPTION	USCS	GRAPHIC LOG	BLOW COUNTS	N-VALUE	MOISTURE CONTENT (%)	FINES CONTENT (%)	ORGANIC CONTENT (%)	LIQUID LIMIT	PLASTICITY INDEX	POCKET PEN. (tsf)	RECOVERY % (RQD)	REMARKS
0		Topsoil (4")												
	1	Loose, Light gray fine SAND, trace root fragments, poorly graded.	SP		1 1 2 3	3								
	2	Loose, Brownish yellow fine SAND with silt, poorly graded.	SP-SM		2 3 2 3	5								
5	3	Medium dense to dense, Dark brown fine SAND with silt, poorly graded.	SP-SM		2 3 5 3	8								
	4				3 5 5 5	10								
10	5				6 13 19 27	32								
15	6	Medium dense, Yellowish brown fine SAND with silt, poorly graded.	SP-SM		6 10 13	23								
20	7	Medium dense, Greenish gray silty fine SAND, poorly graded.	SM		3 4 4	8								

Bottom of borehole at 20 feet.

NOTES Boring backfilled with soil cuttings.

GROUND WATER LEVELS
∇ **AT TIME OF DRILLING** 4 ft 0 in *∇ **END OF DAY** ---

NEW MAE LOG LAT/LONG-EOD_CUTTINGS - NEW TEMPLATE 7-30-12.GDT - 9/9/19 15:40 - F:\GINT\GINT FILES\PROJECTS\0110-0003E\RADIO AVE_FINAL EVAL REPORT.GPJ

FIELD EXPLORATION PROCEDURES

Standard Penetration Test (SPT) Borings

The Standard Penetration Test (SPT) boring(s) are performed in general accordance with the latest revision of ASTM D1586, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils." In some cases, the borings are advanced manually from the ground surface using a hand-held bucket auger to a depth of approximately 5 feet if there are possible shallow utility conflicts. Otherwise, the borings are advanced using rotary drilling techniques. A split-barrel sampler is inserted to the bottom of the borehole at each sampling interval. The sampler is driven 18 to 24 inches into the soil using a 140-pound hammer falling an average height of 30 inches per hammer blow. The number of hammer blows for the final 12 inches of penetration (18" sample) or for the sum of the middle 12 inches of penetration (24" sample) is termed the "penetration resistance, blow count, or N-value." This value is an index to several in-situ geotechnical properties of the material tested, such as relative density and Young's Modulus.

After driving the sampler, it was retrieved from the borehole and representative samples of the material within the split-barrel were containerized and sealed. After completing the drilling operations, the samples for each boring were transported to the laboratory where they were examined by our engineer in order to verify the field descriptions.

Once the boring is complete and the groundwater level is measured, the borehole is backfilled with soil, or it is backfilled from bottom to top with a lean cementitious grout.

KEY TO BORING LOGS – USCS

Soil Classification

Soil classification of samples obtained at the boring locations is based on the Unified Soil Classification System (USCS). 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. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

BORING LOG LEGEND

Symbol	Description
N	Standard Penetration Resistance, the number of blows required to advance a standard spoon sampler 12" when driven by a 140-lb hammer dropping 30".
WOR	Split Spoon sampler advanced under the weight of the drill rods
WOH	Split Spoon sampler advanced under the weight of the SPT hammer
50/2”	Indicates 50 hammer blows drove the split spoon 2 inches; 50 Hammer blows for less than 6-inches of split spoon driving is considered “Refusal”.
(SP)	Unified Soil 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
Few	3% to 5%
Little	5% to 10%
With	Greater than 10%

MINOR COMPONENTS
(Shell, Rock, Debris, Roots, etc.)

Trace	Less than 5%
Few	5% to 10%
Little	15% to 25%
Some	30% to 45%

RELATIVE DENSITY (Coarse-Grained Soils)

Relative Density	N-Value *
Very Loose	Less than 3
Loose	3 to 8
Medium Dense	8 to 24
Dense	24 to 40
Very Dense	Greater than 40

CONSISTENCY (Fine-Grained Soils)

Consistency	N-Value *
Very Soft	Less than 1
Soft	1 to 3
Firm	3 to 6
Stiff	6 to 12
Very Stiff	12 to 24
Hard	Greater than 24

RELATIVE HARDNESS (Limestone)

Relative Hardness	N-Value *
Soft	Less than 50
Hard	Greater than 50

* Using Automatic Hammer

Unified Soil Classification System (USCS)
(from ASTM D 2487)

Major Divisions			*Group Symbol*	*Typical Names*
Coarse-Grained Soils More than 50% retained on the 0.075 mm (No. 200) sieve	**Gravels** 50% or more of coarse fraction retained on the 4.75 mm (No. 4) sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% or more of coarse fraction passes the 4.75 (No. 4) sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils More than 50% passes the 0.075 mm (No. 200) sieve	**Silts and Clays** Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic
Suffix: W = Well Graded, P = Poorly Graded, M = Silty, L = Clay, LL < 50%, H = Clay, LL > 50%

Appendix B

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SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO. 0110-0003E

PROJECT NAME Nassau WRF Improvements-Phase 1B Final Geotech Evaluation Report

DATE. 9/9/2019

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	USCS Classification	Comments
B-9	6	15	7	24	3.0	---	---	---	SP-SM	
B-9	12	45	18	33	---	---	---	---	SM	
B-10	3	5	2	23	---	---	---	---	SP	
B-11	8	25	2	30	---	---	---	---	SP	
B-12	5	9	3	25	2.9	---	---	---	SP	
B-13	2	3	2	9	---	---	---	---	SP	

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.