WASTEWATER PUMP STATION IMPROVEMENTS
NORTH BAY VILLAGE

APPENDIX B

- Geotechnical Engineering Study

RELIABLE IN-DEPTH SOLUTIONS

Geotechnical Engineering | Material Testing | Inspection Services

Revised October 15, 2019
October 8, 2019

Kimley-Horn & Associates, Inc.
600 N. Pine Island Road, Suite 450
Plantation, Florida 33324

Attention: Ms. Marissa Maring, P.E.

Re: Geotechnical Engineering Study
North Bay Village Lift Stations
North Bay Village, Florida
TSF File No. 7111-19-344

Dear Marissa:

TIERRA SOUTH FLORIDA, INC. (TSF) is pleased to present the results of our Geotechnical Engineering Study Report for the referenced project. This report includes the results of field exploration and geotechnical recommendations for the proposed project, as well as general site development.

EXECUTIVE SUMMARY

A geotechnical exploration and evaluation of the subsurface conditions have been completed for the proposed Lift Stations at the intersection of Hispanola Avenue and Mutiny Avenue and at the intersection of Galleon Street and East Treasure Drive in North Bay Village, Florida. In general, the subsurface conditions beneath the asphalt consisted of limerock fill followed by sand with shell or silty sand with shell, underlain by silt and limestone to the boring termination depth. Standard Penetration N-Values indicated the limerock fill to be in a medium dense condition; the sandy soils to be in a loose condition; the silt in a soft condition; and the limestone in a weakly cemented to medium hard condition. The groundwater was encountered at a depth of about 3 feet below existing grade.

The owner/designer should not rely solely on this Executive Summary and must read and evaluate the entire contents of this report prior to utilizing our engineering recommendations in preparation of design/construction documents.

PROJECT INFORMATION

Project Authorization

TSF has completed a geotechnical exploration for the proposed North Bay Village Lift Stations in North Bay Village, Florida. Our services were authorized by Kimley-Horn & Associates (KHA).

Project Description

Review of the "Soil Survey of Miami-Dade County, Florida," prepared by the United States Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS), indicates the site is mapped as Urban Land, 0 to 2 percent slopes.

Our understanding of the project is based on information provided by KHA and the pump stations improvement plans. The project will consist of constructing a Lift Station at two locations. The project is located at the intersection of Hispanola Avenue and Mutiny Avenue and at the intersection of Galleon Street and East Treasure Drive in North Bay Village, Florida.

The geotechnical recommendations presented in this report are based on the available project information, building location, and the subsurface materials described in this report. If any of the noted information is incorrect, please inform TSF in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client. TSF will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site to enable an evaluation of acceptable construction and site development considerations.

Our scope of services included the drilling of one (1) Standard Penetration Test (SPT) boring to a depth of 20 feet below existing grade and one (1) SPT boring to a depth of 6 feet below existing grade at the intersection of Hispanola Avenue and Mutiny Avenue. In addition, one (1) SPT to a depth of 20 feet below existing grade and one (1) SPT to a depth of 6 feet below existing grade at the intersection of Galleon Street and East Treasure Drive, as well as the preparation of this geotechnical report. This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and presents recommended soil parameters.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air on, below or around this site. Any statements in this report regarding odors, colors, and unusual or

suspicious items or conditions are strictly for informational purposes. Prior to further development of this site, an environmental assessment is advisable.

SUBSURFACE CONDITIONS

Subsurface Conditions

Our subsurface investigation consisted of drilling one (1) SPT boring to a depth of 20 feet below existing grade and one (1) SPT boring to a depth of 6 feet below existing grade at the intersection of Hispanola Avenue and Mutiny Avenue. In addition, one (1) SPT to a depth of 20 feet below existing grade and one (1) SPT to a depth of 6 feet below existing grade at the intersection of Galleon Street and East Treasure Drive for the proposed lift stations. Boring locations were located in the field by TSF personnel by tape measurements using site features as reference. The attached Boring Location Plan, Sheet 1, shows approximate location of the borings.

The SPT borings were drilled using a truck mounted CME-45 drill rig, and mud rotary and casing procedures. Samples of the in-place materials were recovered at frequent intervals using a standard split spoon driven with a 140-pound hammer freely falling 30 inches (the SPT sampling after ASTM D 1586). The samples of the in-place soils were returned to our laboratory for classification by a geotechnical engineer. The samples were classified in general accordance with the Unified Soil Classification System (ASTM D 2488).

Based on visual classifications, beneath the asphalt, the subsoil typically consisted of limerock fill followed sand with shell /or silty sand with shell, underlaying by silt and limestone to the boring termination depth. Standard Penetration N-Values indicated the limerock fill to be in a medium dense condition, the sandy soils in a loose condition, the silt in a soft condition and the limestone in a weakly cemented to medium hard condition. The soil profiles are presented on Sheet 1 in the Appendix.

The above subsurface descriptions are of a generalized nature intended to highlight the major subsurface stratification features and material characteristics. The boring log should be reviewed for specific information at the boring location. These records include soil descriptions, stratifications, and penetration resistances. The stratifications shown on the boring log represent the conditions only at the actual boring location. Variations may occur and should be expected. The stratifications represent the approximate boundary between subsurface materials, and the actual transition may be gradual. Water level information obtained during field operations is also shown on the boring logs. The samples that were not altered by laboratory testing will be retained for 30 days from the date of this report and then will be discarded.

Groundwater Information

Groundwater level was measured in the boring when first encountered. The groundwater was encountered at a depth of about 3 feet below existing grade. Groundwater levels are expected to fluctuate with seasonal fluctuations. We expect the groundwater to typically fluctuate within about 2 feet from where it was encountered during the drilling operation. At this time, information is not available to assess if groundwater will impact the proposed foundation construction.

In general, the seasonal high groundwater level is not intended to define a limit or ensure that future seasonal fluctuations in groundwater levels will not exceed the estimated levels. Post-development groundwater levels could exceed the normal seasonal high groundwater level estimate as a result of a series of rainfall events, changed conditions at the site that alter surface water drainage characteristics, or variations in the duration, intensity, or total volume of rainfall. We recommend that the Contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on his or her construction procedures.

EVALUATION AND RECOMMENDATIONS

Geotechnical Discussion

The geotechnical study completed for the proposed lift stations confirm that the sites are suitable for the planned construction when viewed from a soil mechanics and foundation engineering perspective. Subsurface conditions at the sites are not expected to impose any major geotechnical constraints or limitations on the proposed construction.

Above normal excavation efforts should be expected in areas which require excavations through the limestone. In addition, boulder like fill should be expected when excavating the limestone stratum and should be budgeted accordingly.

The lift stations consisted of a wet well and a valve vault. We understand that the wet well will be founded to about a depth of 17 to 19 feet from existing grade and the valve vault will be founded to about a depth of 5 feet from ground surface. **Both structures should be designed and installed to resist buoyancy.**

The wet well can be supported on a mat foundation system bearing on the limestone. The mat foundation should be designed and proportioned for a maximum bearing pressure of 2,500 pounds per square foot (psf).

The valve vault can be supported on a mat foundation bearing on the sandy or silt material. The mat foundation should be designed and proportioned for a maximum bearing pressure of 1,000 pounds per square foot (psf). **If this option is chosen, the owner should be willing to accept the periodic maintenance and up-keep costs associated with leaving silty soils in-place**. As an alternative option, the valve vault could be supported on Auger Cast in Place (ACIP) piles or Helical piles. Also, the proposed valve vault structure all the silt material could remove (about 13 to 18 feet of silt) and replaced with compacted fill. For specific silt thickness refer to the soil profiles presented in the appendix. This option can be further discussed if deemed economical and/or feasible.

Proper shoring and dewatering may be required depending on the type of construction methodology selected. Densification of the surficial soils of the site will be needed to increase the shear strength and reduce foundation and slab settlements to tolerable values.

Recommendations for site preparation, foundation design and related construction are presented in the following sections of this report.

Foundation Recommendations for both Lift Stations

Wet well foundation

Based on the data currently available, the planned wet well foundation for the lift stations can be supported on a mat foundation bearing on the sandy limestone. The mat foundation should be

designed and proportioned for a maximum bearing pressure of 2,500 psf **The structure should be designed and installed to resist buoyancy.**

Settlement of foundations based on sandy limestone are expected to occur as an elastic response of the soils to the loads applied. We estimate that the total average foundation settlements should be on the order of 1 inch. The settlement forecast is based on imposed soil bearing pressure of 2,500 pounds per square foot.

Foundations of existing adjacent structures should be adequately protected/shored during construction/adjacent excavation.

Valve vault foundation

Option 1- Shallow foundation for the valve vault

Based on the data currently available, the planned valve vault foundation for the lift stations, can be supported on a mat foundation bearing on the sandy or silt material. The mat foundation should be designed and proportioned for a maximum bearing pressure of 1,000 pounds per square foot (psf). **The structure should be designed and installed to resist buoyancy.**

Excavation should be dewatered, and the footings will likely require shoring or temporary retaining systems to maintain the stability of nearby soils. Excavating equipment may disturb the granular bearing soil in foundation areas. The upper 12 inches of foundation bottom soils should be compacted to achieve not less than 95 percent of the maximum dry density, as determined by ASTM D 1557, immediately prior to reinforcing and concrete placement.

The foundation excavations should be observed by a representative of TSF prior to steel or concrete placement to assess that the foundation materials are capable of supporting the design loads and are consistent with the materials discussed in this report. Loose soil zones encountered at the bottom of the footing excavations should be adequately compacted to the aforementioned 95% criteria.

The majority of settlement of foundations is based on the in-situ granular soils and/or silty soils that will occur as an elastic response of the soils to the loads applied; and a minor settlement based on the silty material will occur due to consolidation. We expect that total settlements to be about 2 to 2 ½ inches in about 5 years due to consolidation of the underlaying silt. The settlement forecast is based on imposed soil bearing pressure of 1,000 pounds per square foot. Because the subsoils of the site are granular and plastic, the elastic settlement should occur as the loads are applied to foundations on the granular soils and should essentially be completed by the time the building superstructures are finished and the consolidation settlement based on the plastic soil should occur in about 5 years after the building superstructures are finished.

If this option is chosen, the owner should be willing to accept the periodic maintenance and up-keep costs associated with leaving silty soils in-place.

Foundations of existing adjacent structures should be adequately protected/shored during construction/adjacent excavation.

Option 2 -Auger Cast-in Place (ACIP) / or Helical piles for the valve vault

As an alternative, the valve vault could be supported on Auger Cast in Place (ACIP) piles installed into the competent limestone below, silt and the weakly cemented limestone. ACIP piles are drilled with an auger and primarily derives its capacity through friction (i.e. contact between the soil and the pile). Conventional driven piles could also be utilized; however, due to the proximity of existing structures and the potential for vibration issues, conventional driven piles were not evaluated. This can be further discussed with the Design team and the Structural Engineer, if deemed economical and/or feasible.

If Helical piles are chosen, the design recommendations will be provided by a Specialty Contractor based on their experience, proprietary system being utilized, and once structural loading information is finalized. **Helical pile contractor shall submit a signed and sealed submittal for the design of the helical piles.**

Option 3 – Desilted (Remove the silt and backfill with compacted granular soil)

The proposed valve vault structure could be desilted. All silt material should be removed (about 13 to 18 feet of silt) and replaced with compacted fill. For specific silt thickness refer to the soil profiles presented in the appendix. This can be further discussed if deemed economical and/or feasible.

Utilities

Utilities will likely settle due to compression of the underlying silty soils if grades are being raised; therefore, we recommend that utilities be supported on Helical or ACIP piles. If piles for the utilities are not feasible, the owner should be willing to accept the periodic maintenance and up-keep costs associated with leaving silty soils in-place.

Alternatively, if grades are not being raised, utilities can be placed at grade after foundation soil is compacted to at least 95% of the materials' maximum dry density; however, long term maintenance could be associated with this option**.** All utilities should be installed per the requirements of the Civil Engineering drawings and specifications. When backfilling over utility lines, the fill should be placed in lifts and compacted to at least 95% of the materials' maximum dry density as determined by the Modified Proctor Compaction Test (ASTM D 1557). The loose lift thickness is expected to vary between 6 and 12 inches depending on the compaction equipment used by the contractor.

Excavations and Dewatering

Subsoils found at the site consist primarily of loose to medium dense sandy soil below the existing ground surface. These sandy soils can be excavated with a hydraulically controlled backhoe in good

working order. If the excavation extends to the limestone, the excavations should be made with an excavator or backhoe with a welded plate tooth. The welded plate will enable a relatively smooth excavation and minimize over-excavation of the limestone. Unsuitable material or organic soils (if any) at the excavation bottoms should be removed and replaced with structural fill.

Above normal excavation efforts should be expected in areas which require excavations through the sandy limestone. In addition, boulder like fill should be expected when excavating the sandy limestone stratum and should be budgeted accordingly.

We expect that unbraced cut slopes made in the granular soils at an inclination of 1.7 horizontal to 1 vertical will remain stable for short periods of time provided they are not subjected to seepage, surcharge loads (e.g., from stockpiled soil or equipment) and excessive vibration. Furthermore, open-cut excavations exceeding 10 feet in depth should be properly dewatered and sloped 2H:1V or flatter or be benched using a bracing plan approved by a professional engineer licensed in the State of Florida. Excavated materials should not be stockpiled at the top of the slope within a horizontal distance equal to the excavation depth.

Dewatering will be required for in-the-dry construction over those sections of the site where the elevations of the structure fall below the water table. If the draw down requirement is greater than one (1) foot, well point dewatering may be required.

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P." This document was issued to better ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely adhered to the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and/or federal safety regulations.

We are providing this information solely as a service to our client. TSF is not assuming responsibility for construction site safety or the contractor's activities. Such responsibility is not being implied and should not be inferred.

Lateral Earth Pressures

Below grade structures should be designed to resist earth pressure from backfill, surcharge loads, and unbalanced hydrostatic forces. For walls that are not restrained during backfilling but are free to rotate at the top, active earth pressure should be used in design. Walls that are restrained should be designed assuming at-rest earth pressure. In cases where the wall moves into the backfill, passive earth pressure criteria should be used. Recommended equivalent fluid densities for each pressure condition **with no allowance for surcharge loads** are presented.

Active Pressure:
Above Water Table = 45 pcf
Below Water Table = 83 pcf*

At Rest Pressure
Above Water Table = 65 pcf
Below Water Table = 92 pcf*

Passive Pressure
Above Water Table = 295 pcf
Below Water Table = 198 pcf*

* Includes hydrostatic pressure.

The above values are based on moist and buoyant of existing soils with unit weights of 115 and 53 pcf, respectively. The active, at-rest, and passive earth pressure coefficients used in this analysis equal to 0.391, 0.56, and 2.56, respectively.

OTHER CONSIDERATIONS

Preconstruction Conditions Survey

A preconstruction conditions survey should be performed prior to any construction at the site. The preconstruction conditions survey will involve visually inspecting. videotape documenting the adjacent structures; as well as photographing observable existing cracks, deterioration, and/or other signs of distress. The preconstruction conditions survey will provide valuable information of the existing conditions of the structures adjacent to the proposed development. It will serve as a qualitative record document of the existing conditions of the adjacent structures prior to the start of construction.

REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by TSF and project information furnished by KHA. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, TSF should be notified immediately to determine if changes in the recommendations are required. If TSF is not retained to perform these functions, TSF will not be responsible for the impact of those conditions of the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

This report has been prepared for the exclusive use of KHA for the specific application to the proposed North Bay Village Lift Stations in North Bay Village, Florida.

If you have any questions pertaining to this report, or as we may be of further service, please contact our office.

Respectfully submitted,

TSF

Maximo Peralta Alvarez, P.E.
Geotechnical Engineer
FL Registration No. 84213

Ramakumar Vedula, P.E.
Principal Engineer
FL Registration No. 54873

MPA/KV:

Attachments: SUMMARY OF LABORATORY TEST RESULTS
SUMMARY OF CORROSION TEST RESULTS
BORING LOCATION PLAN AND SOIL PROFILES – SHEETS 1 & 2

APPENDIX

SUMMARY OF LABORATORY TEST RESULTS
SUMMARY OF CORROSION TEST RESULTS
BORING LOCATION PLAN AND SOIL PROFILES – SHEETS 1 & 2

Summary of Laboratory Test Results
Wastewater Pump Station Improvements
North Bay Village, Florida

TSF Project No. 7111-19-344

Boring Number	Sample Depth (ft)	USCS Symbol	Sieve Analysis, Percentage Passing								Atterberg Limits			Organic Content (%)	Natural Moisture Content (%)
			3/4"	3/8"	#4	#10	#40	#60	#100	#200	Liquid Limit	Plastic Limit	Plasticity Index		
B-1	8.0-10.0	ML	100	100	100	100	100	99	99	97				4.4	49.3
B-4	10.0-12.0	ML	100	100	100	100	99	98	95	87				2.9	47.0

TIERRA SOUTH FLORIDA

SUMMARY OF CORROSION TEST RESULTS

Wastewater Pump Station Improvements
North Bay Village, Florida
TSF Project No.: 7111-19-344
September 19, 2019

Boring Number	Depth (ft)	pH (FM 5-550)	Resistivity (ohm-cm) (FM 5-551)	Chlorides (ppm) (FM 5-552)	Sulfates (ppm) (FM 5-553)	Environmental Classification* (Soil)	
						Steel	Concrete
B-1	6.0 - 8.0	7.9	190	660	300.0	Extremely Aggressive	Extremely Aggressive
B-3	2.0 - 4.0	8.7	1,225	60	117.0	Moderately Aggressive	Moderately Aggressive

* As per FDOT Structures Design Guidelines, Table 1.1, Updated January, 2019
**** Any reading represented as "0.0" is below the detection limit of 4.8 ppm**

Structures Design Guidelines — Topic No. 625-020-018
1 - General Requirements — January 2019

Table 1.3.2-1 Criteria for Substructure Environmental Classifications

Classification	Environmental Condition	Units	Steel		Concrete	
			Water	Soil	Water	Soil
Extremely Aggressive (If any of these conditions exist)	pH		< 6.0		< 5.0	
	Cl	ppm	> 2000		> 2000	
	SO_4	ppm	N.A.		> 1500	> 2000
	Resistivity	Ohm-cm	< 1000		< 500	
Slightly Aggressive (If all of these conditions exist)	pH		> 7.0		> 6.0	
	Cl	ppm	< 500		< 500	
	SO_4	ppm	N.A.		< 150	< 1000
	Resistivity	Ohm-cm	> 5000		> 3000	
Moderately Aggressive	This classification must be used at all sites not meeting requirements for either slightly aggressive or extremely aggressive environments.					

pH = acidity ($-\log_{10}H^+$; potential of Hydrogen), Cl = chloride content, SO_4 = Sulfate content.

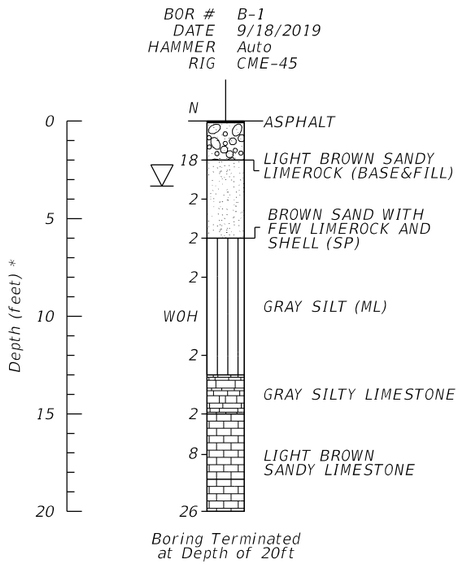
2. Superstructure: Any superstructure located within 2,500 feet of any coal burning

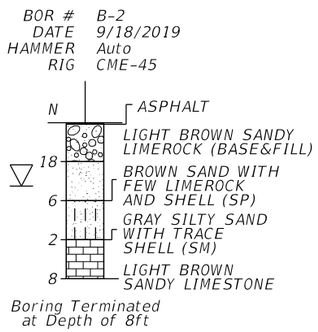
BORING LOCATION PLAN

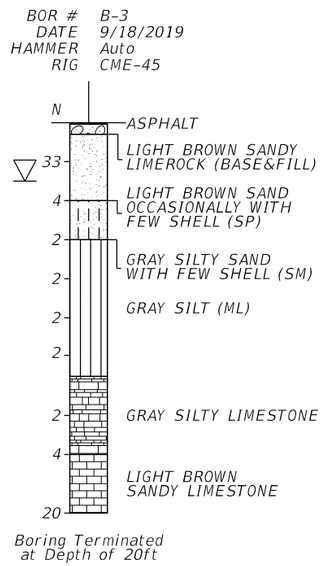
Approximate Location of SPT Boring

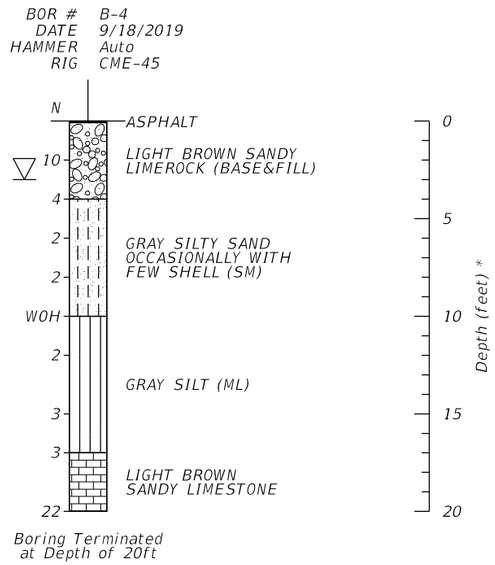
DRAWN BY: NG CHECKED BY: JO	APPROVED BY: RK DATE: 09-26-2019	ENGINEER OF RECORD: RAJ KRISHNASAMY, P.E. FLORIDA LICENSE NO.: 53567	RAJ KRISHNASAMY, P.E. P.E. LICENSE NUMBER 53567 TIERRA SOUTH FLORIDA 2765 VISTA PARKWAY, S-10 WEST PALM BEACH, FL 33411 CERTIFICATE OF AUTHORIZATION 28073	SCALE: NTS	PROJECT NUMBER: 7111-19-344	BORING LOCATION PLAN AND SOIL PROFILE WASTEWATER PUMP STATION IMPROVEMENTS NORTH BAY VILLAGE , FLORIDA	Sheet: 1

ngonzalez 10/4/2019 12:57:07 PM J:\Tierra Documents\Projects\TSF 2019\7111-19-344.Wastewater Pump Station Improvements (KHA-Plantation)\7111-19-344_Splan_Sprofiles.DGN









NOTE: SPT N-VALUES SHOWN ABOVE WERE OBTAINED USING AUTOMATIC HAMMERS. GENERALLY DESIGN CORRELATIONS AND PROGRAMS USE SAFETY HAMMER N-VALUES. HENCE, THE ABOVE N-VALUES NEED TO BE MULTIPLIED BY 1.24 TO OBTAIN EQUIVALENT SAFETY HAMMER N-VALUES FOR DESIGN PURPOSE.

LEGEND

- Asphalt
- Sandy Gravel
- Sand
- Silt
- Limestone Soft
- Limestone Hard
- Silty Sand

NOTES

- ▽ ENCOUNTERED GROUNDWATER TABLE
- N NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12" PENETRATION.
- * DENOTES DEPTH IN FEET FROM EXISTING GROUND SURFACE

DRAWN BY: NG
CHECKED BY: JO
APPROVED BY: RK
DATE: 09-26-2019
ENGINEER OF RECORD: RAJ KRISHNASAMY, P.E.
FLORIDA LICENSE NO.: 53567

RAJ KRISHNASAMY, P.E.
P.E. LICENSE NUMBER 53567
TIERRA SOUTH FLORIDA
2765 VISTA PARKWAY, S-10
WEST PALM BEACH, FL 33411
CERTIFICATE OF AUTHORIZATION 28073

SCALE: NTS
PROJECT NUMBER: 7111-19-344

BORING LOCATION PLAN AND SOIL PROFILE

WASTEWATER PUMP STATION IMPROVEMENTS

NORTH BAY VILLAGE , FLORIDA

Sheet: 2