ECS Florida, LLC

Initial Geotechnical Engineering Report - Draft

Iona District Canal H-7 Improvements

8051 – 8099 College Parkway
Fort Myers, Lee County, Florida

ECS Project No. 60:1293

January 5, 2021

January 5, 2021

Ms. Kelly Clark, P.E.
Kimley Horn
1412 Jackson Street
Suite 2
Fort Myers, Florida 33901

ECS Project No. 60:1293

Reference: Initial Geotechnical Engineering Report - Draft
Iona District Canal H-7 Improvements
8051-8099 College Parkway
Fort Myers, Florida 33919

Dear Ms. Clark:

ECS Florida, LLC (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations. Further data points are to be collected over the course of one year from the initial sampling to assay seasonal water levels. A final report will be forthcoming at the terminus of the survey.

It has been our pleasure to be of service to Kimley-Horn during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify subsurface conditions assumed for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Florida, LLC

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EXECUTIVE SUMMARY

The following summarizes the main findings of the geotechnical exploration and soil observation, particularly those that may have a cost impact on the planned canal improvements. Further, our stormwater management design recommendations are summarized. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

- We understand the development will consist of the improvement of stormwater management system, Canal H-7.

- The site is currently an in-place canal approximately 1.3 miles long and 10 to 20 feet wide. The geotechnical exploration performed preliminary site investigation included one SPT boring advanced to depth of twenty feet below ground surface (bgs) near the proposed weir structure, 7 hand augers advanced to a depth of 5 feet or one foot below groundwater level, two infiltration tests, and groundwater table measurements. Future site investigation events will consist of planned groundwater table monitoring.

- Subsurface conditions within the borings generally consisted of fine to medium sands with roots and trace silt (SP) with varying densities followed by sand with silt (SP-SM), silty sand (SM) and sand (SP), to the boring termination depths. The groundwater table was encountered from 1.5 to 6 feet (bgs) depending on boring location.

- Based on the material encountered within the borings, clearing and grubbing of the site, we estimate the depth of suitable structural fill to be to a depth of at least ten feet (bgs).

1.0 INTRODUCTION

The purpose of this study was to provide geotechnical information for the design of improvements to Canal H-7 of the Iona Drainage District, Lee County, Florida.

It is our understanding the project is in a design stage and we understand the project will consist of the design and construction of improvements to existing stormwater control structures associated with the Iona District H-7 canal. Further, we understand the weir and related structures will be lowered by approximately 1.5 feet.

The recommendations developed for this report are based on project information supplied by Ms. Kellie Clark, P.E. of Kimley-Horn. This report contains the results of our subsurface explorations and laboratory testing programs, site characterization, geotechnical engineering analyses, and recommendations for the design and construction of the planned stormwater management system.

The report includes the following items.

a. Information on site conditions including surface drainage, geologic information, and special site features.
b. Description of the field exploration and laboratory tests performed.
c. Final log of the soil boring and records of the field exploration per the standard practice of geotechnical engineers. A site location plan will be included, and the results of the laboratory tests will be plotted on the final boring logs.
d. Evaluation of the on-site soil characteristics encountered in the soil borings. Specifically, we will discuss the suitability of the on-site materials for reuse as engineered fill. We will also include compaction requirements and suitable material guidelines.
e. Recommended allowable soil bearing pressure(s) for conventional shallow foundations (spread footings) and estimates of predicted foundation settlement based on assumed structural loadings for the weir structure.
f. Discussion of infiltration rates of the soil.
g. Discussion of NRCS soil classification as confirmed in situ.
h. A discussion of the normal ground water conditions encountered along the canal and estimate of seasonal high groundwater table.
i. Recommendations for fill placement and subgrade preparations.
j. Recommendations for additional testing and/or consultation that might be required to complete the geotechnical assessment and related engineering for this project.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE/PAST SITE USE

The western portion of the canal is located within the campus of Florida Southwestern State College. The eastern portion is located north of Pine Valley Drive in the Seven Lakes Condo Association property and south of the Provincetown subdivision. Summerlin Road bisects the canal at approximately the halfway point of the project alignment. See the red rectangle in the following Figure 2.1, showing the subject project area.

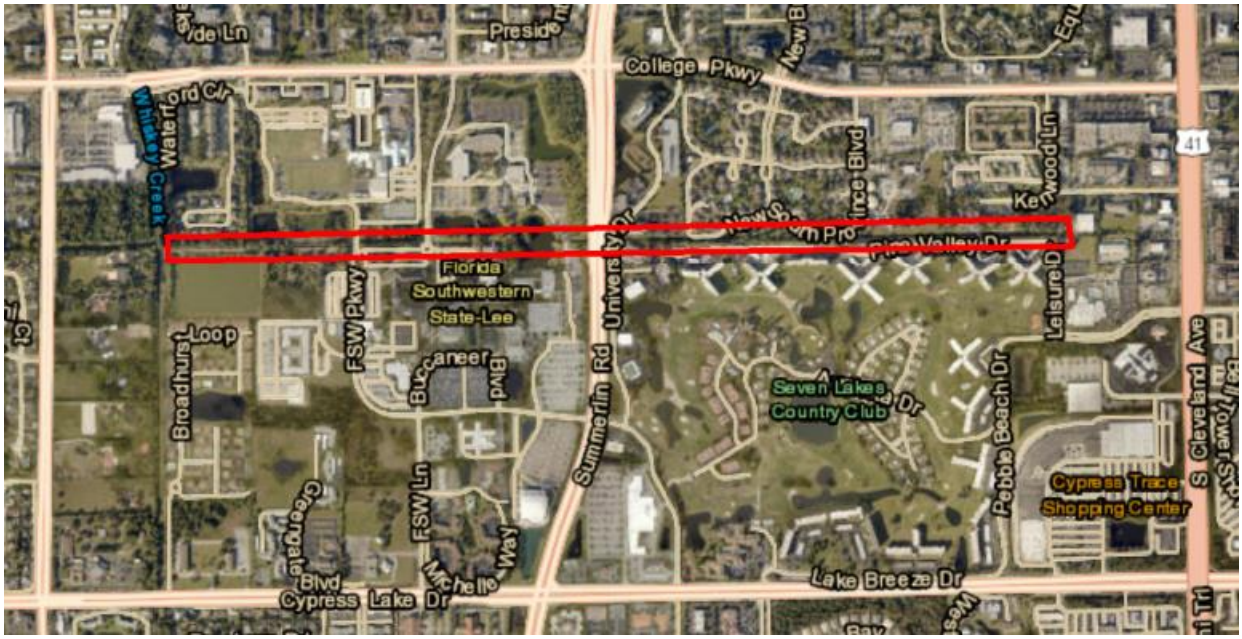


Figure 2.1 Site Location

ECS reviewed aerial photographs of the subject property and immediate surrounding properties on Google Earth. The aerial photographs reviewed were dated 1994, 1995, 1999, 2004 through 2008, 2010 and 2012 through 2014, 2016, 2017, and 2019. The canal predates these images. The surrounding land use has changed little in that time and consists of the afore mentioned college and suburban developments. Of note, commercial development has occurred along Summerlin Road, which has, in turn, been expanded. Ground surface elevations and distances are interpolated and should not be relied upon for design.

Canal H-7 is embanked with 6 inches to 12 inches of rip-rap along its length near the water level. The weir is located immediately east of FSW Parkway. Existing canal varies in width from 10 to 20 feet at an average elevation of +7' (WGS84) based on a review of publicly available topographic information. We note a site survey was not available at the time of this report.

2.2 PROPOSED CONSTRUCTION

The following information explains our understanding of the planned improvements to the existing infrastructure:

SUBJECT	DESIGN INFORMATION / ASSUMPTIONS
Canal Dimensions	Approximately 1.3 miles long and 10 to 20 feet wide
Usage	Stormwater control
Materials	cast-in-place concrete with steel flow control mechanism
Spread Footing Loads	Maximum 3 kips (Full Dead and Factored Live) (assumed)
Lowest Weir Finish Elevation	EL. 3 ft (or about 4 feet below present embankment grades)

3.0 FIELD EXPLORATION AND LABORITORY TESTING

Our exploration procedures are explained in greater detail in Appendix B including the insert titled Subsurface Exploration Procedures. Our scope of work included drilling 1 Standard Penetration Test (STP) and 7 hand auger borings with temporary piezometers and 6 shovel excavations to confirm the Natural Resources Conservation Service (NRCS) soil types. Additionally, 2 open hole percolation tests were performed adjacent to the current weir. Our boring and hand augers were located with a handheld GPS unit and their approximate locations are shown on the Boring Location Diagram in Appendix A.

3.1 REGIONAL/SITE GEOLOGY

The southwest Florida region is located on the southern flank of Florida Plateau, a stable, carbonate platform on which thick deposits of limestones, dolomites, and evaporates have accumulated. The general geology of the upper 200 feet of this platform within the area of South Florida where the proposed project is to be located is composed predominantly of limestone and quartz sand. The major geological formations that are usually encountered from top to bottom within Lee County are Shelly Sediments of Plio-Pleistone age and the Tamiami formation.

The following table below describes the generalized stratigraphic column of the general local geology and subsurface materials that may be associated with the geologic unit shown:

Table 3.1.1 Regional Site Geology

Geologic Formation	Subsurface Materials
Shelly sediments of Plio-Pleistocene (TQsu)	Shell beds, undifferentiated, includes sediments previously placed in units primarily differentiated by the included fauna
Tamiami formation (Tt)	Poorly defined lithostratigraphic unit containing a wide range of mixed carbonate-siliciclastic lithologies and associated faunas

Geologic Formation details for Table 3.1.1 obtained from the Florida Department of Environmental Protection website, http://www.dep.state.fl.us/geology/gisdatamaps/state_geo_map.htm

Geologic map of the state of Florida – Southern Peninsula including the approximate site location is shown in the following Figure 3.1.1:

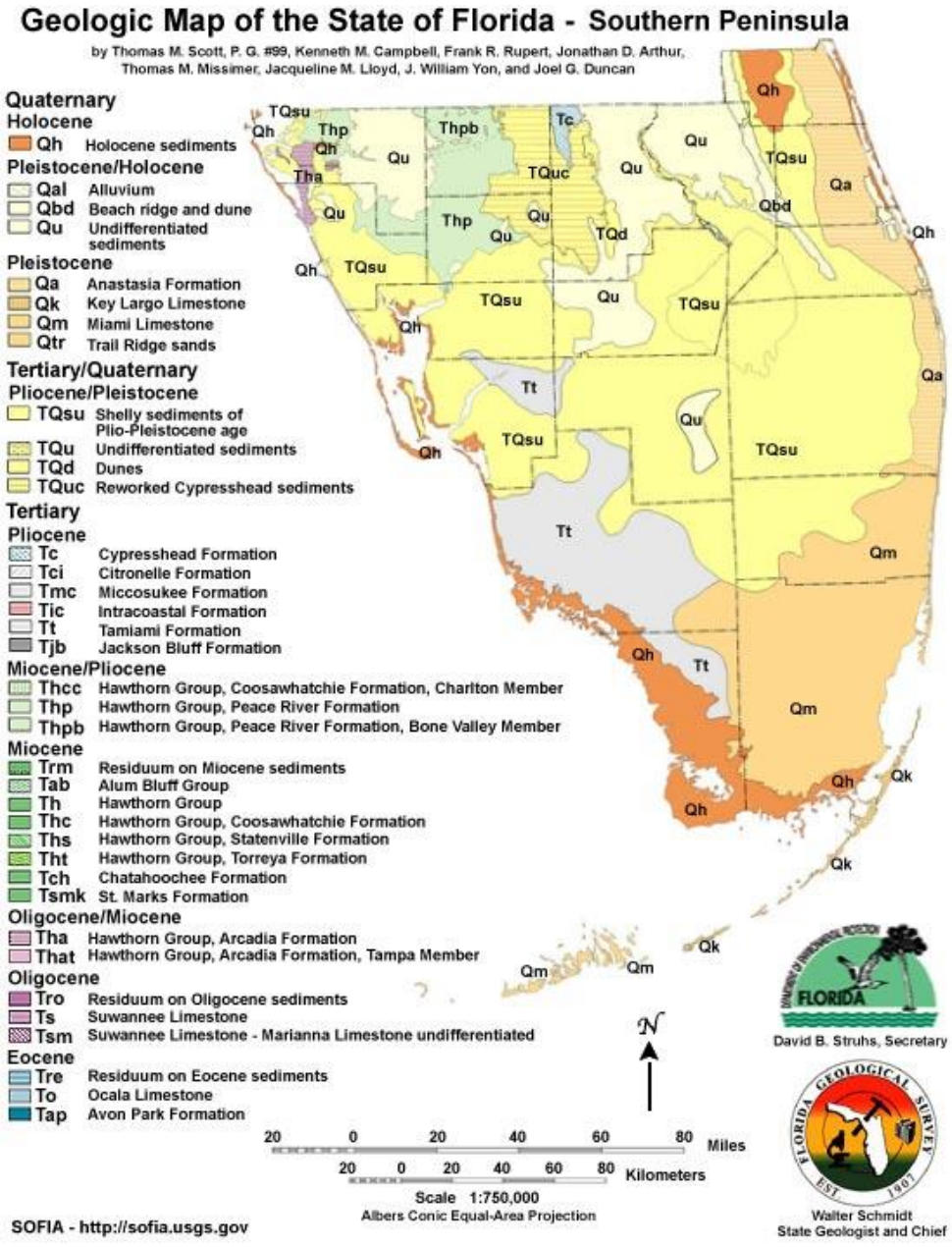


Figure 3.1.1 Regional Geologic Map

Geologic map for Figure 3.1.1 obtained from the Florida Department of Environmental Protection website, *http://www.dep.state.fl.us/geology/gisdatamaps/state_geo_map.htm*

3.2 SOIL SURVEY MAPPING (NRCS)

Based on the Soil Survey for Lee County, Florida by the US Department of Agriculture Soil Conservation Service (USDA) the predominant predevelopment soil types at the site are identified and a summary of characteristics of this soil series is included below in Table 3.2.1.

Table 3.2.1 Soil Survey

Soil Type	Constituents	Drainage Class	Estimated Water Table Elevation
7 – Matlacha gravelly fine sand – Urban land complex, 0 to 2 percent slopes	Fine Sand	Poorly Drained	12 to 24 inches
36 – Immokalee sand – Urban land complex, 0 to 2 percent slopes	Fine Sand	Poorly Drained	36 to 48 inches
59 – Urban land, 0 to 2 percent slopes	Fine Sand	Poorly Drained	36 to 48 inches
64 – Hallandale fine sand, wet – Urban land complex, 0 to 2 percent slopes	Fine Sand	Poorly Drained	12 to 24 inches
102 – Boca fine sand – Urban land complex, 0 to 2 percent slopes	Fine Sand	Poorly Drained	12 to 24 inches
125 - Oldsmar fine sand – Urban land complex, 0 to 2 percent slopes	Fine Sand	Poorly Drained	36 to 48 inches
141 - Cocoa fine sand – Urban land complex, 0 to 2 percent slopes	Fine Sand	Poorly Drained	36 to 48 inches

Soil mapping of the site vicinity showing soil type numbers is presented in Figure 3.2.1 obtained from the United States Department of Agriculture (USDA) Web Soil Site.

Figure 3.2.1 Regional Geologic Map

Soil map for Figure 3.2.1 obtained *from* USDA – Natural Resources Conservation Service;
https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

3.3 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered in the upper stratum were generally fill material. Native soils encountered below fill levels appeared consistent with published geological mapping. The following sections provide generalized characterizations of the soil strata. Please refer to the boring logs in Appendix B.

Soils were found to generally consist of FINE TO MEDIUM SAND (SP) and FINE TO MEDIUM SAND WITH SILT (SP-SM) to a depth of 4 feet below ground surface level. At the eastern most portion of the canal, cobbles were encountered at a depth of 18 inches and continued to the end of exploration indicating fill was placed at the locations surveyed. Soils between 4 and 8 feet below ground surface level appeared to consist of FINE TO MEDIUM SAND (SP), FINE TO MEDIUM SAND WITH SILT (SP-SM), and SILTY SAND (SM). The soil between 8 and 20 feet below ground surface level appeared to consist of SILTY SAND (SM) in a very loose condition. Soil encountered less than 5 feet below ground surface level appears to be fill material.

Approximate Depth (ft)	Stratum	Description	Ranges of SPT[(1)] N-values (bpf)
0-0.5 ft	n/a	Topsoil	N/A

Approximate Depth (ft)	Stratum	Description	Ranges of SPT(1) N-values (bpf)
0.5-4 ft	I	FILL, Very Loose to Loose SAND or SAND WITH SILT (SP, SP-SM), Moist to Wet	2 to 7
4-8	II	Loose, Fine to Medium SAND, SAND WITH SILT, and SILTY SAND (SP, SP-SM, SM), Wet	5 to 7
8-20	III	Very Loose SILTY SAND (SM) with trace shell and limestone fragments, Wet	3

Notes:
(1) Standard Penetration Testing

A graphical presentation of the subsurface conditions is shown on the Subsurface Cross Section Diagram(s) included in Appendix A.

3.4 GROUNDWATER OBSERVATIONS

Water levels were measured in our borings in Appendix B. Groundwater depths measured at the time of drilling ranged from 1.5 to 4.0 feet below the ground surface, corresponding to EL. +3 to EL +5.5 ft. Piezometer readings taken 72 hours after placement resulted in groundwater levels from 1.5 to 3.0 feet below ground surface levels, corresponding to EL. +4.0 to +5.5. Variations in the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors. Based upon our interpretation of the subsurface data, it appears that the seasonal high groundwater level is at depth(s) ranging from approximately 1.5 to 3.0 feet, or approximately EL. +4.0 to +5.5 feet.

Seasonal High Ground Water Table soil indicators were not indicated in the fill layers. Seasonal High Ground Water Table will need to be obtained using onsite monitoring wells during subsequent site visits.

Piezometer No.	Approximate Elev.[1] (ft)	Measured Ground Water Depth on 11/11/20	Measured Ground Water Depth on 03/30/21	Measured Ground Water Depth on 09/30/21
P-1	7	4.0	TBD[2]	TBD
P-2	7	3.5	TBD	TBD
P-3	7	3.0	TBD	TBD
P-4	7	1.5	TBD	TBD
P-5	7	2.0	TBD	TBD

1. *Elevations are estimated from publicly available topographic information.*
2. *TBD – To Be Determined*

3.5 LABORATORY TESTING

The laboratory testing consisted of selected tests performed on samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil

Piezometer Monitor ID	Approximate Ground Elevation (ft)	Measured Ground Water Depth on 11/11/20	Measured Ground Water Depth on 4/18/21	Measured Ground Water Depth on 9/30/21
P-1	7	4	5.3	TBD
P-2	7	3.5	6.3	TBD
P-3	7	3	4.6	TBD
P-4	7	1.5	3.4	TBD
P-5	7	2	3.0	TBD
P-6	7	1.5	2.3	TBD
P-7	7	1.5	2.2	TBD

samples. Moisture content (ASTM D2216) and Percent Fines Sieve Analysis (ASTM D1140) tests were performed on selected boring samples.

Each sample was visually classified on the basis of texture and plasticity in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) and including USCS classification symbols. After classification, the samples were grouped in the major zones noted on the boring/hand auger logs in Appendix B. The group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the logs are approximate; in situ, the transitions may be gradual.

3.6 PERMEABILITY TESTING

ECS Field Engineering personnel performed two Constant Head Open-Hole Permeability tests in general accordance with standard practice. The tests were performed at boring P-3 and P-4 using a piezometer installed to a depth of 5.8 feet and 4.3 feet (bgs), respectively. The soil was first saturated then a head was maintained at ground surface using controlled water flow. The results of the test indicated the saturated horizontal hydraulic conductivity (k) at the location of the test is 5.24E-05 cft/sqft-ft of head at boring P-3 and 2.01E-04 cft/sqft-ft of head at boring P-4 at depths of 5.8 and 4.3 feet below the existing site grades, respectively. A summary of the field permeability testing is provided in Appendix B.

3.7 SHOVEL EXCAVATIONS

Further NRCS identifications was not reliable due to fill being present up to 5 feet below current grade.

4.0 DESIGN RECOMMENDATIONS

4.1 FOUNDATIONS (WEIR STRUCTURES)

Provided subgrades and Structural Fills are prepared as recommended in this report, the proposed structures can be supported by shallow foundations including isolated footings and continuous strip footings. We recommend the foundation design use the following parameters:

Design Parameter	Continous Footing	Strip Footing
Net Allowable Bearing Pressure(1)	2,000 psf	2,000 psf
Acceptable Bearing Soil Material	Medium Dense SAND (SP) - Stratum I	Medium Dense SAND (SP) - Stratum I
Minimum Width	18 inches	18 inches
Minimum Footing Embedment Depth (below finished grade of embankment)	18 inches	12 inches
Estimated Total Settlement (2)	Less than 1- inch	Less than 1- inch
Estimated Differential Settlement (3)	Less than ¾ inches between columns	Less than ¾ inches

Notes:

(1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
(2) Based on assumed structural loads. If final loads are different, ECS must be contacted to update foundation recommendations and settlement calculations.
(3) Based on maximum column/wall loads and variability in borings. Differential settlement can be re-evaluated once the foundation plans are more complete

Potential Undercuts: Most of the soils at the foundation bearing elevation are anticipated to be suitable for support of the proposed structure. If soft or unsuitable soils are observed at the footing bearing elevations, the unsuitable soils should be undercut and removed. Any undercut should be backfilled with lean concrete ($f'_c \geq 1{,}000$ psi at 28 days) up to the original design bottom of footing elevation; the original footing shall be constructed on top of the hardened lean concrete.

4.2 SOIL DESIGN PARAMETERS AT WEIR

The following design parameters including hydraulic conductivity values and estimated seasonal high groundwater table have been established using assumed values, field, and laboratory testing:

Table 4.2.1 - Soil Design Parameters

Design Parameter	Recommended Values (Average of three borings)
Relevant Boring Logs	B1, P-3, P-4
Fillable Porosity of Surficial in-situ Sands [SP, SP-SM] (%)	25
Estimated Seasonal High Groundwater Elevation (feet-NGS84) *	+5.5 (Approximate Estimation)
Estimated Seasonal High Groundwater Depth Blow Ground Surface Adjacent to Canal	3.25 ft
Horizontal Saturated Hydraulic Conductivity of Surficial Sands [SP, SP-SM] (k_{Hoz})**	5.24E-05 cft/sqft-ft of head (P-3) 2.01E-04 cft/sqft-ft of head (P-4)
Estimated Vertical Unsaturated Hydraulic Conductivity of Surficial Sands [SP, SP-SM] ($K_{VertUnsat}$)	3.49E-05 cft/sqft-ft of head (P-3) 1.34E-04 cft/sqft-ft of head (P-4)

*Approximate elevation based on published topographic data, do not use for design.
**Average value based on field testing.

All fill material used to bring the canal to final grades should be clean, inorganic, granular soil (sand) with a fines content of no more than five percent. Care should be taken not to overcompact the canal bottom during excavation and grading of the canal. The soil encountered at the site may be susceptible to overcompaction which can significantly decrease the infiltration capacity of the pond.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 EARTHWORK OPERATIONS

The materials encountered on site were generally suitable for use as structural fill to a depth of ten feet (bgs). After stripping and grubbing, the subsurface soils consisted of clean sands from the depths of approximately one half foot to ten feet (bgs) at the locations of the borings.

5.1.1 Structural Fill Materials

Existing Fill Content: Existing fill consists of loose fine to medium sand and sand with silt. Depth of fill material ranges from 4 to 7 feet.

Satisfactory Structural Fill Materials: Materials satisfactory for use as Structural Fill should consist of inorganic soils with the following engineering properties and compaction requirements.

STRUCTURAL FILL INDEX PROPERTIES	
Subject	**Property**
Construction Areas	LL < 40, PI<6
Max. Particle Size	4 inches
Fines Content	Max. 12 % > #200 sieve
Max. organic content	5% by dry weight

5.1.2 Structural Fill

Prior to placement of Structural Fill, representative bulk samples (about 50 pounds) of on-site and/or off-site borrow should be submitted to ECS for laboratory testing, which will typically include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships (i.e., Proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications. Alternatively, Proctor data from other accredited laboratories can be submitted if the test results are within the last 90 days.

Compaction: Assuming that the organic content of the soils does not exceed five percent, structural fill should be placed in loose lifts, which do not exceed 12 inches in thickness, and should be compacted to at least 95 percent of the maximum dry density, as determined by the Modified Proctor Compaction Test (ASTM D-1557) within the lift thickness. Generally, the moisture content of the fill materials should be maintained between two percentage points below to the optimum moisture content for the fill material, as determined by ASTM D-1557. Fill placed in non-structural areas (e.g. grassed areas) should be compacted to at least 90 percent of the maximum dry density according to ASTM D-1557, in order to avoid significant subsidence. ECS should be called on to document that proper fill compaction has been achieved.

STRUCTURAL FILL COMPACTION REQUIREMENTS	
Subject	**Requirement**
Compaction Standard	Modified Proctor, ASTM D-1557
Required Compaction	95% of Max. Dry Density
Moisture Content	-2 to +3 % points of the soil's optimum value

Fill Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for building and pavements at the time of fill placement. Grade controls should be maintained throughout the filling operations. All filling operations should be observed on a full-time basis by a qualified representative of the construction testing laboratory to determine that the minimum compaction requirements are being achieved. Field density testing of fills will be performed at the frequencies shown in Table 5.2.2.1, but not less than one test per lift.

Table 5.1.2.1 Frequency of Compaction Tests in Fill Areas

Location	Frequency of Tests
Building Limits	One test per 2,500 sq. ft. per lift
Pavement Areas	One test per 10,000 sq. ft. per lift
Utility Trenches	One test per 300 linear ft. per lift
All Other Non-Critical Areas	One test per 10,000 sq. ft. per lift

Compaction Equipment: Compaction equipment suitable to the soil type being compacted should be used to compact the subgrades and fill materials. A vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands) as well as for sealing compacted surfaces.

Fill Placement Considerations: Fill materials should not be placed on excessively wet soils. Excessively wet soils or aggregates should be scarified, aerated, recompacted and moisture conditioned.

At the end of each workday, all fill areas should be graded to facilitate drainage of any precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of four inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

Proper drainage should be maintained during the earthwork phases of construction to prevent ponding of water which has a tendency to degrade subgrade soils.

If any problems are encountered during the earthwork operations, or if site conditions deviate from those encountered during our subsurface exploration, the Geotechnical Engineer should be notified immediately to provide adjusted recommendations.

We recommend that favorable unit rates be established in the construction contract for undercutting and backfilling. Unit rates could be established as follows:

a. Undercut and backfill with Imported Engineered Fill, per cubic yard in place;
b. Undercut and backfill with On-site Borrow Engineered Fill, per cubic yard in place;
c. Undercut and backfill with Aggregate Base Material, per ton;
d. Undercut and backfill with No. 57 Stone (wet areas and below footings), per ton;
e. Dispose of undercut material off-site, per cubic yard,
f. Place medium duty, woven and non-woven geotextile fabrics, per square yard. Suitable non-woven fabric for use in stabilization and separation would include Mirafi 160N or equivalent. Suitable woven fabric would include Mirafi 600X or equivalent.

The Geotechnical Engineer should be called on to recommend and/or approve material type and placement procedures where subgrade remediation is required.

5.2 GENERAL CONSTRUCTION CONSIDERATIONS

Moisture Conditioning: During rainy season of the year, delays and additional costs should be anticipated. At these times, moisture conditioning may be required. The rainy season in Florida is normally between June and September. Alternatively, during the drier times of the year, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to prevent construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of one percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to minimize infiltration of surface water.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. All erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

5.3 TEMPORARY GROUNDWATER CONTROL

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

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

6.0 CLOSING

ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation, expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by Kimley-Horn. If any of this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our recommendations and provide additional or alternate recommendations that reflect the proposed construction.

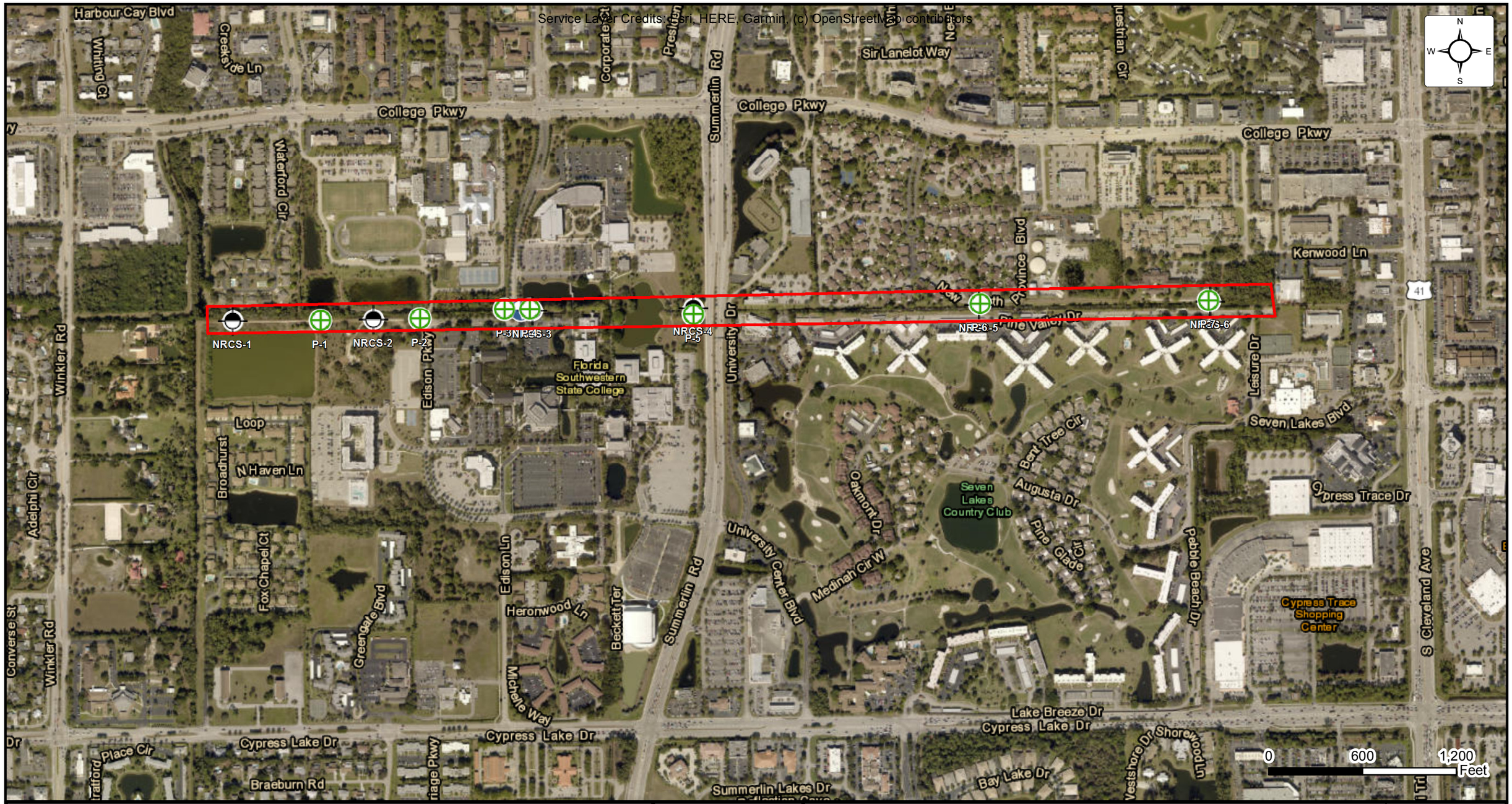
We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

Field observations, and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Diagrams & Reports

Site Location Diagram
Boring Location Diagram
Subsurface Cross-Section(s)



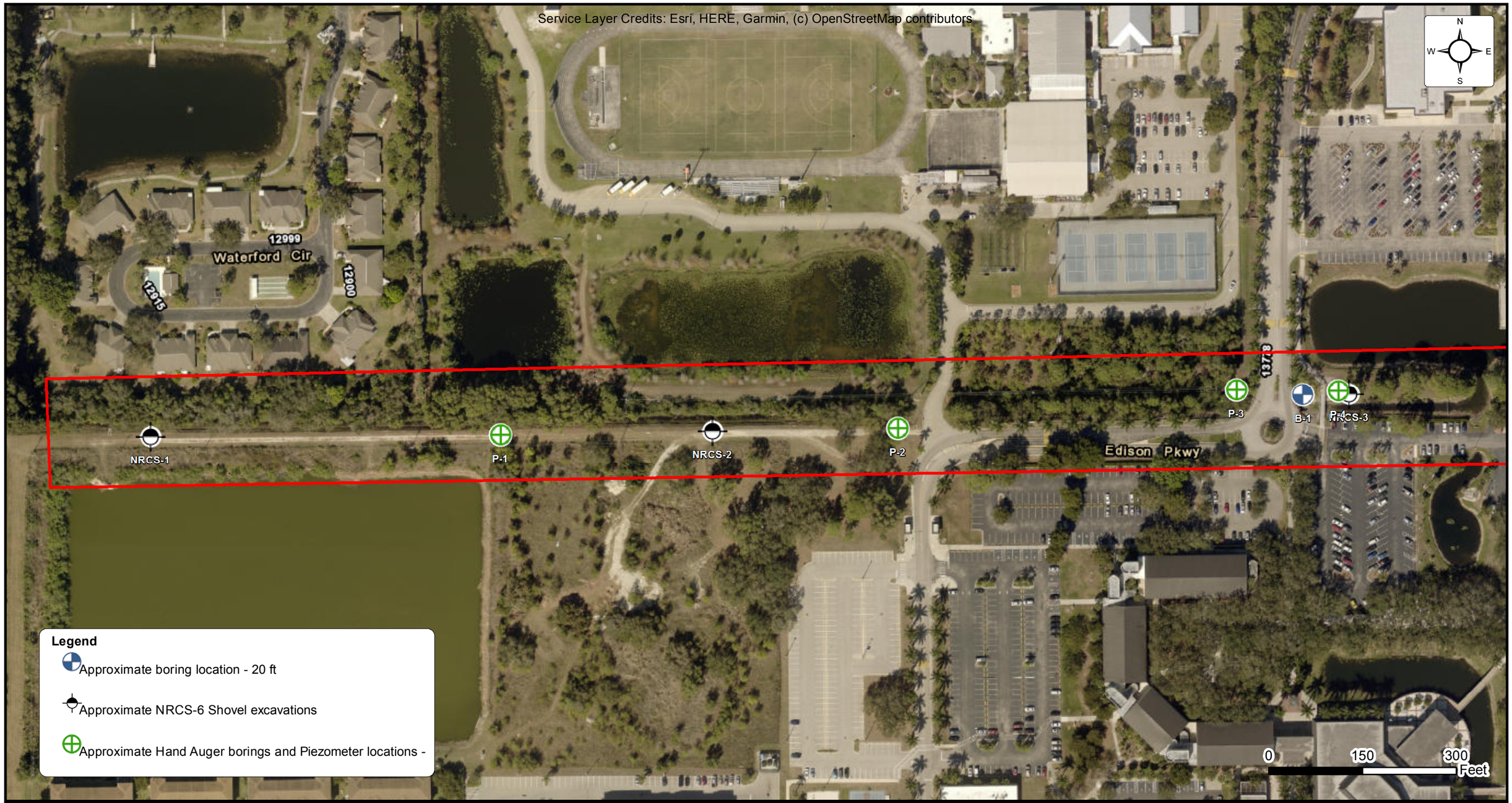
Site Location Diagram

KIMLEY-HORN

IONA DISTRICT CANAL H-7 IMPROVEMENTS

8099 COLLEGE PKWY, FT MYERS, FLORIDA

ENGINEER	DS05
SCALE	AS NOTED
PROJECT NO.	60:1293
SHEET	1
DATE	1/5/2021



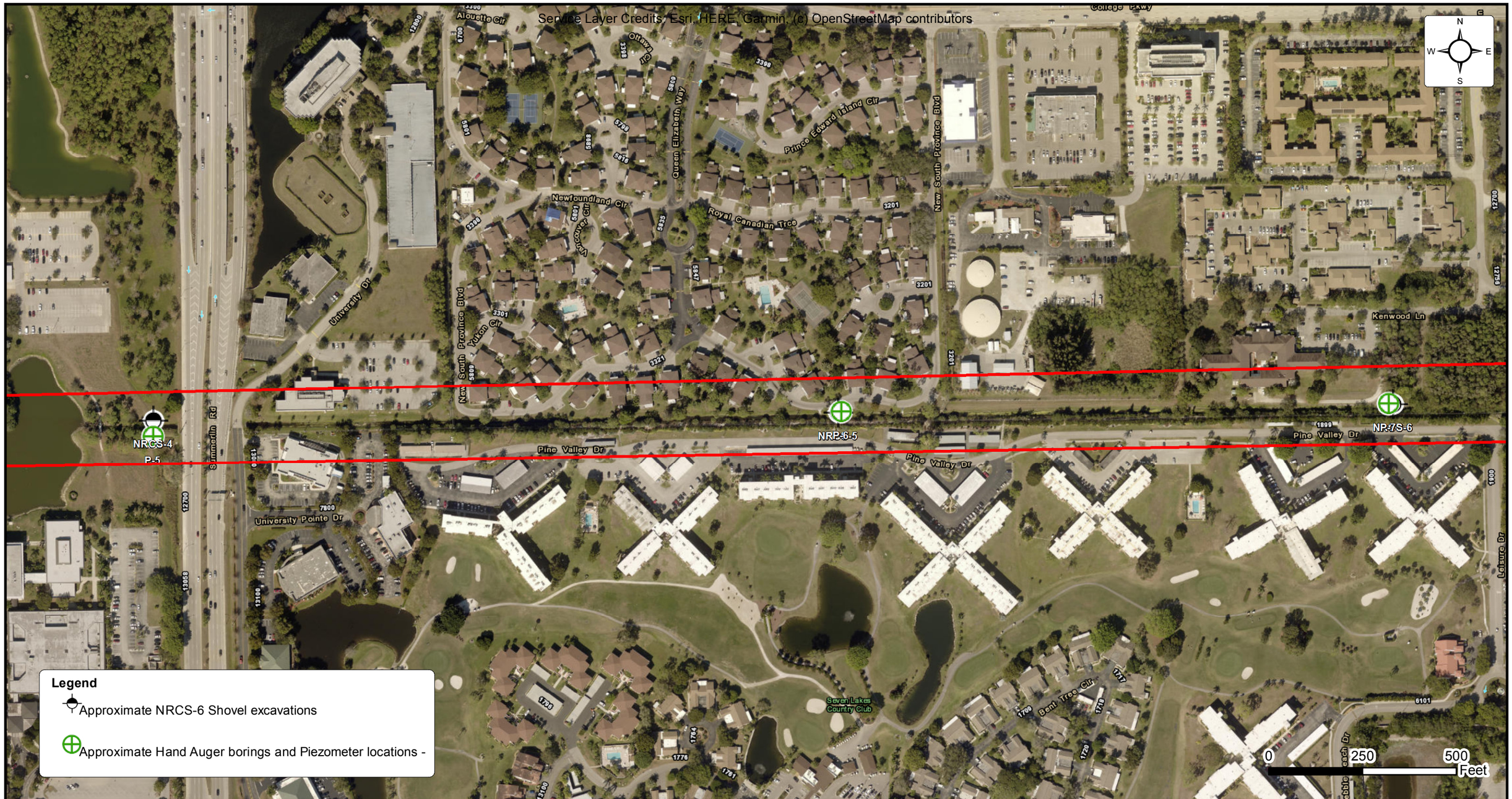
Boring Location Diagram

KIMLEY-HORN

IONA DISTRICT CANAL H-7 IMPROVEMENTS

8099 COLLEGE PKWY, FT MYERS, FLORIDA

ENGINEER	DS05
SCALE	AS NOTED
PROJECT NO.	60:1293
SHEET	1 OF 2
DATE	1/5/2021



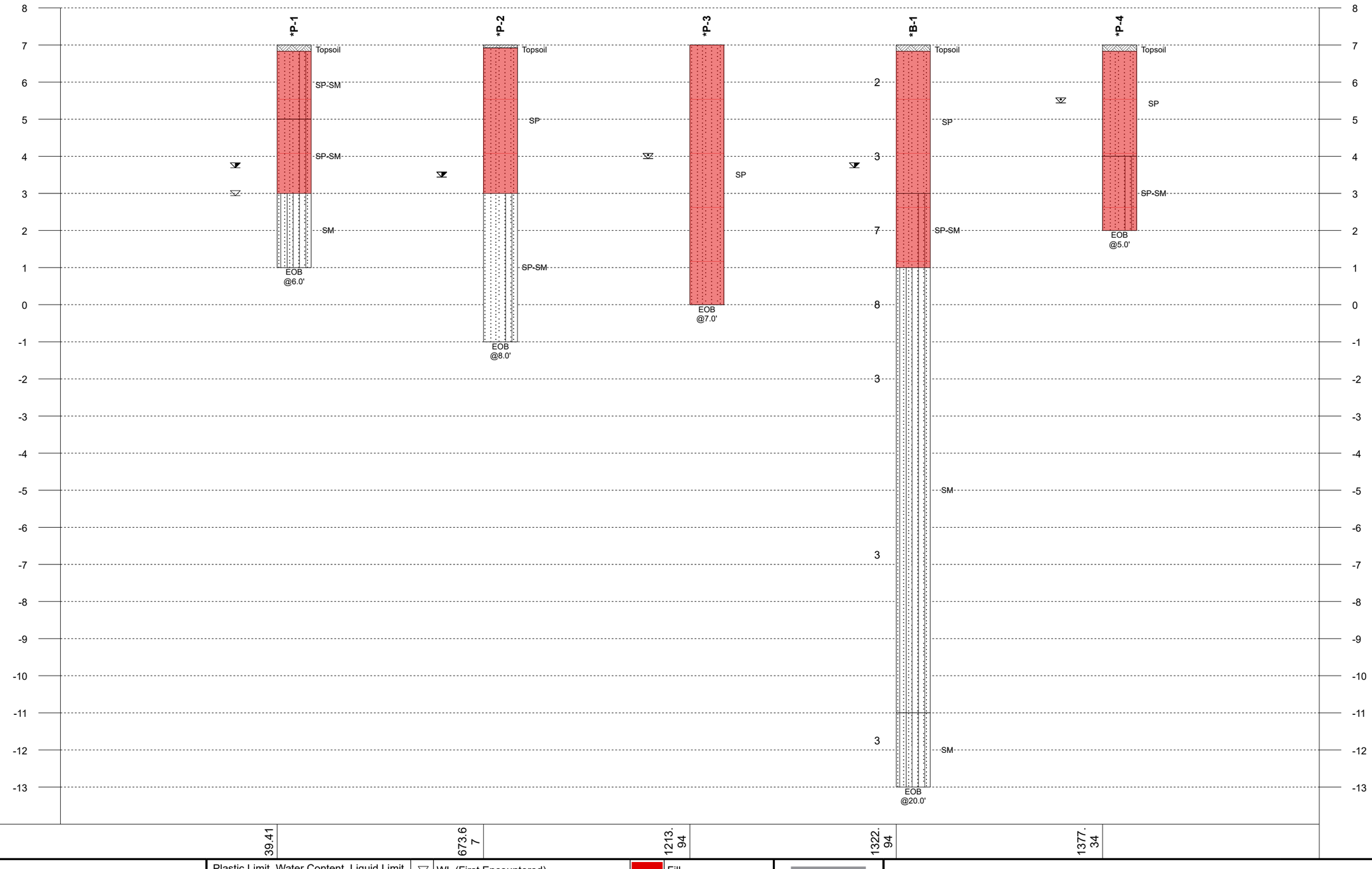
Boring Location Diagram

KIMLEY-HORN

IONA DISTRICT CANAL H-7 IMPROVEMENTS

8099 COLLEGE PKWY, FT MYERS, FLORIDA

ENGINEER	DS05
SCALE	AS NOTED
PROJECT NO.	60:1293
SHEET	2 OF 2
DATE	1/5/2021



Legend Key

- Topsoil
- Poorly Graded SAND
- Poorly Graded SAND w…
- SILTY SAND

-14.00

Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit
X———●———△

[FINES CONTENT%]

BOTTOM OF CASING

100 LOSS OF CIRCULATION

WL (First Encountered)
WL (Completion)
WL (Seasonal High Water)
WL (Stabilized)

Fill
Possible Fill
Probable Fill
Rock

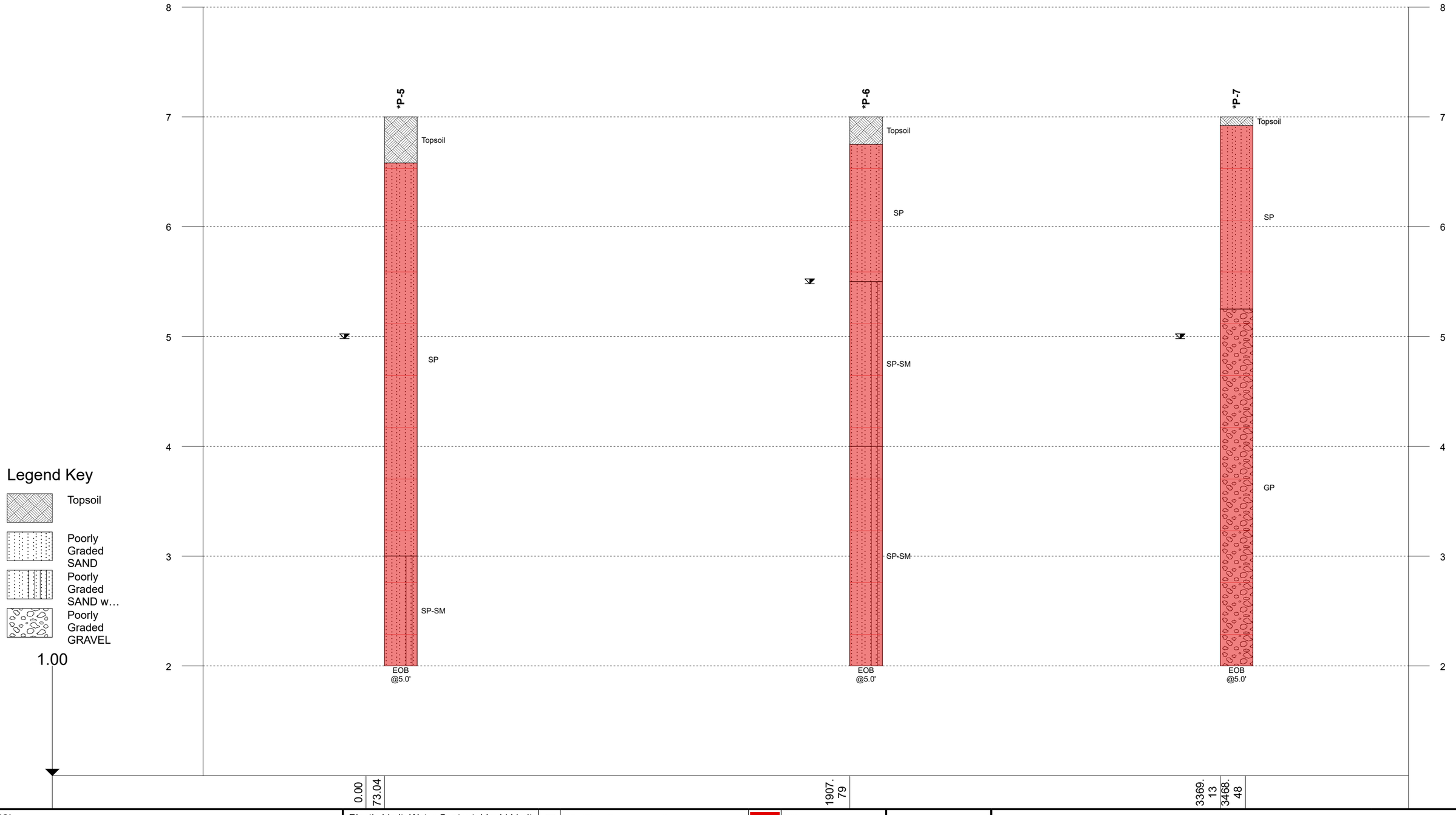
GENERALIZED SUBSURFACE SOIL PROFILE Section line A

Iona District Canal H-7 Improvements

Kimley-Horn

8099 College Parkway, Fort Myers, Florida 33919

Project No: 60:1293 Date: 01/05/2021



Legend Key

- Topsoil
- Poorly Graded SAND
- Poorly Graded SAND w…
- Poorly Graded GRAVEL

1.00

Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit
X———●———△

[FINES CONTENT%]

BOTTOM OF CASING

LOSS OF CIRCULATION

WL (First Encountered)		Fill	
WL (Completion)		Possible Fill	
WL (Seasonal High Water)		Probable Fill	
WL (Stabilized)		Rock	

GENERALIZED SUBSURFACE SOIL PROFILE Section line B

Iona District Canal H-7 Improvements

Kimley-Horn

8099 College Parkway, Fort Myers, Florida 33919

Project No: 60:1293 Date: 01/05/2021

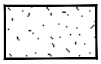
APPENDIX B – Field Operations

Reference Notes for Boring Logs
Subsurface Exploration Procedure: Standard Penetration Testing (SPT)
Boring Log B-1 and P-1 through P-7
Infiltration Test Results

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]


ASPHALT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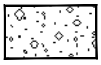
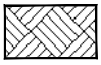
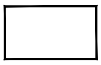
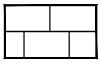

GRAVEL

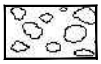

TOPSOIL

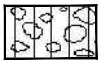

VOID


BRICK

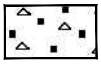

AGGREGATE BASE COURSE

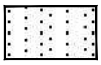

GW **WELL-GRADED GRAVEL**
gravel-sand mixtures, little or no fines

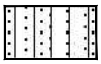

GP **POORLY-GRADED GRAVEL**
gravel-sand mixtures, little or no fines


GM **SILTY GRAVEL**
gravel-sand-silt mixtures

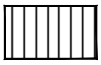

GC **CLAYEY GRAVEL**
gravel-sand-clay mixtures

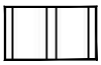

SW **WELL-GRADED SAND**
gravelly sand, little or no fines

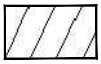

SP **POORLY-GRADED SAND**
gravelly sand, little or no fines


SM **SM SILTY SAND**
sand-silt mixtures

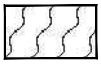

SC **CLAYEY SAND**
sand-clay mixtures

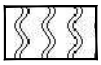

ML **SILT**
non-plastic to medium plasticity

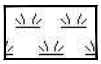

MH **ELASTIC SILT**
high plasticity


CL **LEAN CLAY**
low to medium plasticity


CH **FAT CLAY**
high plasticity


OL **ORGANIC SILT or CLAY**
non-plastic to low plasticity


OH **ORGANIC SILT or CLAY**
high plasticity


PT **PEAT**
highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

WATER LEVELS[6]

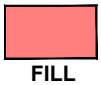

WL (First Encountered)


WL (Completion)


WL (Seasonal High Water)


WL (Stabilized)

FILL AND ROCK


FILL


POSSIBLE FILL


PROBABLE FILL


ROCK

[1]Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2]To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3]Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4]Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5]Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6]The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7]Minor deviation from ASTM D 2488-17 Note 14.

[8]Percentages are estimated to the nearest 5% per ASTM D 2488-17.

SUBSURFACE EXPLORATION PROCEDURE: STANDARD PENETRATION TESTING (SPT) ASTM D 1586 Split-Barrel Sampling

Standard Penetration Testing, or **SPT**, is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The N-Value, or blow counts, when corrected and correlated, can approximate engineering properties of soils used for geotechnical design and engineering purposes.

SPT Procedure:

- Involves driving a hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30-inches at desired depth
- Recording the number of hammer blows required to drive split-spoon a distance of 12 inches (in 3 or 4 Increments of 6 inches each)

- Auger is advanced* and an additional SPT is performed
- One SPT test is typically performed for every two to five feet

- Obtain two-inch diameter soil sample

**Drilling Methods May Vary—* The predominant drilling methods used for SPT are open hole fluid rotary drilling and hollow-stem auger drilling.

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Kimley-Horn	**60:1293**	**B-1**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Iona District Canal H-7 Improvements	**ECS**

SITE LOCATION: **8099 College Parkway, Fort Myers, Florida 33919**

LOSS OF CIRCULATION

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
806851.0	**692388.0**		**7.0**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	SS	24	24	Topsoil Thickness[2.00"] (SP FILL) FILL, SAND, contains roots, gray to brown, moist to wet, very loose			1-1-1-1 (2)
	S-2	SS	24	24		▼		1-1-2-2 (3)
5	S-3	SS	24	24	(SP-SM FILL) FILL, FINE TO MEDIUM SAND WITH SILT, brown, wet, loose		2	2-3-4-5 (7)
	S-4	SS	24	24	(SM) SILTY FINE TO MEDIUM SAND, gray, wet, loose to very loose, trace shell and limestone fragments			2-4-4-5 (8)
	S-5	SS	24	24				3-2-1-2 (3)
10							-3	
	S-6	SS	18	18				3-1-2 (3)
15							-8	
	S-7	SS	18	18	(SM) SILTY SAND, gray, wet, very loose			2-1-2 (3)
20					**END OF DRILLING AT 20.0 FT**		-13	
25							-18	
30							-23	

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered) **3.25**	BORING STARTED: **Nov 12 2020**		CAVE IN DEPTH:
▼ WL (Completion)	BORING COMPLETED: **Nov 12 2020**		HAMMER TYPE: **Automatic**
▼ WL (Seasonal High Water) **3.25**	EQUIPMENT: **Truck**	LOGGED BY: **RCS2**	DRILLING METHOD:
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	SHEET:
Kimley-Horn	**60:1293**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Iona District Canal H-7 Improvements	**P-1**	**7.0**
SITE LOCATION:		STATION:
8099 College Parkway, Fort Myers, Florida 33919		
NORTHING: **806788.1**	EASTING: **691105.4**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
			Topsoil Thickness[2.00"]					
			(SP-SM FILL) FILL, FINE TO MEDIUM SAND WITH SILT, gray and brown, moist	E				
			(SP-SM FILL) FILL, FINE TO MEDIUM SAND WITH SILT, brown, moist to wet	E				
	▽							
	▼							
5		2	(SM) SILTY FINE TO MEDIUM SAND, brown, wet	E				
			END OF DRILLING AT 6.0 FT					
10		-3						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered) **4.00**	▼ WL (Seasonal High) **4.00**	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion)		**JDY**	**Nov 11 2020**	**English**	

HAND AUGER LOG

CLIENT:	PROJECT NO.:	SHEET:
Kimley-Horn	**60:1293**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Iona District Canal H-7 Improvements	**P-2**	**7.0**
SITE LOCATION:		STATION:
8099 College Parkway, Fort Myers, Florida 33919		
NORTHING: **806798.4**	EASTING: **691739.6**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
			Topsoil Thickness[1.00"]					
	▼		(SP FILL) FILL, FINE TO MEDIUM SAND, gray and brown to white, moist	E				
				E				
5		2	(SP-SM) FINE TO MEDIUM SAND WITH SILT, brown, moist to wet	E				
				E				
			END OF DRILLING AT 8.0 FT					
10		-3						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered) **3.50**	▼ WL (Seasonal High) **3.50**	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion)		**JDY**	**Nov 11 2020**	**English**	

HAND AUGER LOG

CLIENT:	PROJECT NO.:	SHEET:
Kimley-Horn	**60:1293**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Iona District Canal H-7 Improvements	**P-3**	**7.0**
SITE LOCATION:		STATION:
8099 College Parkway, Fort Myers, Florida 33919		
NORTHING: **806860.0**	EASTING: **692278.9**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
			(SP FILL) FILL, FINE TO MEDIUM SAND, gray and brown, moist to wet	E				
	▼			M				
5		2		E				
				E				
			END OF DRILLING AT 7.0 FT					
10		-3						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High) **3.00**	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion)			**Nov 11 2020**	**English**	

HAND AUGER LOG

CLIENT:	PROJECT NO.:	SHEET:
Kimley-Horn	**60:1293**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Iona District Canal H-7 Improvements	**P-4**	**7.0**
SITE LOCATION:		STATION:
8099 College Parkway, Fort Myers, Florida 33919		
NORTHING: **806858.3**	EASTING: **692442.3**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
	▽		Topsoil Thickness[2.00"]					
			(SP FILL) FILL, FINE TO MEDIUM SAND, gray, moist	E				
			(SP-SM FILL) FILL, FINE TO MEDIUM SAND WITH SILT, brown, moist to wet	E				
				E				
5		2	**END OF DRILLING AT 5.0 FT**					
10		-3						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered)	▼ WL (Seasonal High) **1.50**	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion)		**JDY**	**Nov 11 2020**	**English**	

HAND AUGER LOG

CLIENT:	PROJECT NO.:	SHEET:
Kimley-Horn	**60:1293**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Iona District Canal H-7 Improvements	**P-5**	**7.0**
SITE LOCATION:		STATION:
8099 College Parkway, Fort Myers, Florida 33919		
NORTHING: **806826.9**	EASTING: **693488.4**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
			Topsoil Thickness[5.00"]					
	▼		(SP FILL) FILL, FINE TO MEDIUM SAND, gray and brown, moist	E				
				E				
			(SP-SM FILL) FILL, FINE TO MEDIUM SAND WITH SILT, gray and brown, moist to wet, contains gravel and shell	E				
5		2	**END OF DRILLING AT 5.0 FT**					
10		-3						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered) **2.00**	▼ WL (Seasonal High) **2.00**	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion)		**JDY**	**Nov 11 2020**	**English**	

HAND AUGER LOG

CLIENT:	PROJECT NO.:	SHEET:
Kimley-Horn	**60:1293**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Iona District Canal H-7 Improvements	**P-6**	**7.0**
SITE LOCATION:		STATION:
8099 College Parkway, Fort Myers, Florida 33919		
NORTHING: **806893.2**	EASTING: **695322.3**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
			Topsoil Thickness[3.00"]					
	▼		(SP FILL) FILL, FINE TO MEDIUM SAND, tan, moist	E				
			(SP-SM FILL) FILL, FINE TO MEDIUM SAND WITH SILT, tan and gray, moist to wet	E				
			(SP-SM FILL) FILL, FINE TO MEDIUM SAND WITH SILT AND GRAVEL, tan, wet	D				
5		2	**END OF DRILLING AT 5.0 FT**					
10		-3						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered) **1.50**	▼ WL (Seasonal High) **1.50**	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion)		**JDY**	**Nov 11 2020**	**English**	

HAND AUGER LOG

CLIENT:	PROJECT NO.:	SHEET:
Kimley-Horn	**60:1293**	**1 of 1**
PROJECT NAME:	HAND AUGER NO.:	SURFACE ELEVATION:
Iona District Canal H-7 Improvements	**P-7**	**7.0**
SITE LOCATION:		STATION:
8099 College Parkway, Fort Myers, Florida 33919		
NORTHING: **806914.2**	EASTING: **696783.5**	

DEPTH (FT)	WATER LEVELS	ELEVATION (FT)	DESCRIPTION OF MATERIAL	EXCAVATION EFFORT	DCP	SAMPLE NUMBER	FINES CONTENT (%)	MOISTURE CONTENT (%)
			Topsoil Thickness[1.00"]					
			(SP FILL) FILL, FINE TO MEDIUM SAND, gray, moist	E				
	▼		Placed Cobbles with gray sand, moist to wet	D				
				D				
5		2	**END OF DRILLING AT 5.0 FT**					
10		-3						
15								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDRY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

▽ WL (First Encountered) **2.00**	▼ WL (Seasonal High) **2.00**	ECS REP:	DATE COMPLETED:	UNITS:	CAVE-IN-DEPTH:
▼ WL (Completion)		**JDY**	**Nov 11 2020**	**English**	

HAND AUGER LOG

HYDRAULIC CONDUCTIVITY TEST
BY
CONSTANT HEAD OPEN-HOLE TEST

CLIENT: Kimley-Horn

PROJECT: Iona Canal H-7

TEST #: P-3

CREW: JY

NUMBER: 60:1293

CHECKED BY: MR

12/10/2020

Effective Pumping Rate:	0.0007	cfs
Actual Hole Diameter:	0.25	ft
Initial Hole Depth:	5.8	ft
Final Hole Depth:	5.8	ft
Saturated Hole Depth:	1.3	ft
Depth to Water Table:	4.5	ft

The effective pumping rate did raise the water level in the augered hole to the ground surface. This level was maintained for ten minutes.

Hydraulic Conductivity, K	5.24E-05	cfs/ft sqd-ft of head

SURFACE C COVER Soil

SOIL LOG (Based on auger cuttings)

0 - 7' Gray and brown fine to medium SAND (SP, Fill)

HYDRAULIC CONDUCTIVITY TEST
BY
CONSTANT HEAD OPEN-HOLE TEST

CLIENT: Kimley-Horn

PROJECT: Iona Canal H-7

TEST #: P-4

CREW: JY

NUMBER: 60:1293

CHECKED BY: MR

12/10/2020

Effective Pumping Rate:	0.0014	cfs
Actual Hole Diameter:	0.25	ft
Initial Hole Depth:	4.3	ft
Final Hole Depth:	4.3	ft
Saturated Hole Depth:	1.4	ft
Depth to Water Table:	2.9	ft

The effective pumping rate did raise the water level in the augered hole to the ground surface. This level was maintained for ten minutes.

Hydraulic Conductivity, K	2.01E-04	cfs/ft sqd-ft of head

SURFACE C COVER Soil

SOIL LOG (Based on auger cuttings)

0 - 3' Gray fine to medium SAND (SP, Fill)

3 - 5' Brown fine to medium SAND with Silt (SP-SM, Fill)

APPENDIX C – Laboratory Testing

Laboratory Test Results Summary

Laboratory Testing Summary								
Sample Source	**Sample Number**	**Depth (feet below ground surface)**	**Percent Passing No. 200 Sieve**	**Natural Moisture**	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**	**USCS**
B-1	S-3	4 to 6	6.8%	21.9%				SP-SM
B-1	S-6	13.5 to 15	31.1%	17.5%				SM
B-1	S-7	18.5 to 20	25.3%	23.9%				SM

Project No: 60:1293

Project Name: Iona District Canal H-7

PM JY

PE MR