Geotechnical Exploration and Evaluation Report

Buffalo Avenue Pump Station Rehabilitation
Jacksonville, Florida

CSI Geo Project No.: 71-18-339-07
Constantine Project No.: 100431.17

Prepared by

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Prepared for

Constantine Engineering, Inc.

April 18, 2018

CSIGeo

Geotechnical • CMT • CEI

April 18, 2018

Mr. Ricky Hendrix, P.E.
Constantine Engineering, Inc.
100 Center Creek Rd, Suite 108
St Augustine, FL 32084

RE: Buffalo Avenue Pump Station Rehabilitation
Jacksonville, Florida

Subject: Geotechnical Exploration and Evaluation Report
CSI Geo Project No.: 71-18-339-07
Constantine Project No.: 100431.17

Dear Mr. Hendrix:

CSI Geo, Inc. has performed the authorized geotechnical exploration and laboratory testing program for the proposed Buffalo Avenue Pump Station Rehabilitation project in Jacksonville, Florida. This report presents our understanding of the subsurface conditions along with our engineering evaluation and recommendations.

We have enjoyed working with you on this project and look forward to working with you on future projects. If you have any questions concerning this report, please contact our office.

Sincerely,

CSI Geo, Inc.

Nader Amer, Ph.D
Geotechnical Engineer

Digitally signed by Bruce Khosrozadeh
Date: 2018.04.18 17:20:10-04'00'

Bruce Khosrozadeh, P.E.
Senior Geotechnical and Materials Engineer
Registered, Florida No. 45273

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1.0 PROJECT INFORMATION

1.1 General Project Information

This Geotechnical Exploration and Evaluation Report has been prepared for the proposed JEA Buffalo Avenue pump station rehabilitation in Jacksonville, Florida. Based on the information provided to us, we understand that the project consists of the construction of two new service buildings to the north of the existing pump station. We also understand that the new buildings will be supported on slab-on-grade concrete pads. This report discusses the geotechnical investigation program, geotechnical related findings geotechnical evaluation and recommendations for the service building pads. Information regarding this project has been provided to CSI Geo, Inc. (CSI Geo) by Mr. Ricky Hendrix, P.E. of Constantine Engineering, Inc. (Constantine). The following related document has been furnished to us electronically:

- Topographic Survey of Buffalo Avenue Long Branch Pump Station Plan (Exhibit)
  Survey Prepared by: R.E. Holland & Associates, Inc.
  Dated: March 6, 2018

1.2 Existing Site Conditions and Project Description

This site is located at the southwest corner of the intersection of Buffalo Avenue and Evergreen Avenue in Jacksonville, Florida. A Site Location Map is included in the **Appendix**. The existing pump station is fenced in and the surrounding grounds are grass covered with few scattered trees. Deep tire marks and wet conditions were observed in the grass area to the north of the pump station and adjacent to Evergreen Avenue indicating that the area is prone to being wet. The site is generally flat, but gradually slopes downwards towards Evergreen Avenue to the north. It should be noted that the site is located approximately 60 feet north of a tributary to the St. Johns River and approximately 1,600 feet west of the St. Johns River.

This geotechnical exploration was performed to obtain subsurface data for use in the evaluation of the site with respect to the construction of two new service buildings to be located on each side of the existing transformer as shown on the Field Exploration Plan included in the **Appendix**. We understand that the buildings will be supported on concrete pads with footprints on the order of 10’x20’ and 15’x15’.

2.0 GEOTECHNICAL EXPLORATION

2.1 Field Exploration

The proposed buildings were explored by means of a total of two (2) Standard Penetration Test (SPT) borings (B-1 & B-2) drilled to a depth of 25 feet each. The location, depth, and drilling date of the test borings performed are shown on the Report of SPT Borings sheet included in the **Appendix**. In this presentation, soil strata encountered by the borings are classified using the Unified Soil Classification System (USCS).

The field exploration also included the performance of two pavement cores (C-1 & C-2) with one core obtained from the asphalt paved driveway and the other from the concrete pad located at the northwest corner of the existing building. The pavement and concrete pad thicknesses are shown on the Exiting Pavement System Thickness table included in the **Appendix**.

The location of the SPT borings and cores were selected by Constantine and located in the field by CSI Geo using a hand-held GPS. These locations are shown on the Field Exploration Plan sheet presented in the **Appendix**. A brief description of the exploratory drilling and sampling techniques used are presented in the Field and Laboratory Test Procedure sheets also included in the **Appendix**.

Soil samples obtained during the field exploration were first visually classified in the field and then reclassified visually by an engineer at our office. The Report of SPT Borings sheet presents the descriptions of the subsurface soils encountered, the groundwater levels encountered at the time of drilling, and the penetration resistance recorded when drilling and sampling the test borings. The stratification lines and depth designations on the boring records represent the approximate boundary between the various soils encountered, and the transition from one stratum to the next should be considered approximate. Representative soil samples were also tested in the laboratory for a more definitive assessment. A brief discussion of the drilling, sampling, and field-testing techniques used during the exploratory boring program is provided in the Field and Laboratory Test Procedures presented in the **Appendix**.

2.2 Laboratory Testing

Quantitative laboratory testing was performed on representative soil samples recovered from the field exploration. These tests were performed to better define the physical properties of the soils encountered. The laboratory tests were performed to determine percent fines (-200 sieve) and natural moisture content of the soil samples. Results of the laboratory tests performed are presented in the Summary of Laboratory Test Results included in the **Appendix**. The laboratory testing procedures used are presented in the Field and Laboratory Test Procedures sheet included in the **Appendix**.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 General

The subsurface conditions outlined below and presented in the Report of SPT Borings sheet highlight the major subsurface stratifications encountered during our geotechnical exploration program. When reviewing the Report of SPT Borings and the subsurface conditions outlined below, it should be understood that the subsurface conditions will vary across the proposed construction area and between the boring locations, and that the transition between soil strata may be gradual.

3.2 Subsurface Conditions

Review of test borings B-1 and B-2 indicates that the subsurface conditions generally consist of 6 to 9 inches of topsoil (PT; USCS), followed by loose to medium dense sands (SP) and slightly silty sands (SP-SM) until the boring termination depth of 25 feet below the existing ground surface.

3.3 Groundwater Level

The groundwater level was measured and recorded as encountered at the time of drilling. The groundwater level encountered at the time of drilling was measured to be 2.0 and 3.0 feet below the existing ground surface. The depths of the groundwater level at each boring location are marked on the Report of SPT Borings sheet presented in the **Appendix**.

Fluctuations of the groundwater level should be anticipated as a result of seasonal climatic variations, surface water runoff patterns, tidal fluctuations of adjacent water bodies, construction activities, and other factors. Therefore, the water table is anticipated to fluctuate and be influenced by nearby ditches, swales, and the St. Johns tributary within the project limits. Also, during seasonal high precipitation, groundwater levels can be expected to rise above the levels recorded during this exploration. Therefore, design drawings and specifications should account for the possibility of groundwater level variations, and construction planning should be based on the assumption that such variations will occur.

3.4 Existing Pavement System Thickness

Two cores (C-1 and C-2) were conducted to determine the thickness of the existing pavement and concrete pad. Generally, the existing pavement system was found to consist of 1-½ inches of asphalt. Limerock base was not encountered at pavement core C-1 location. The concrete pad thickness was found to be of 8-¾ inches. The results of the cores are included in the **Appendix**.

4.0 GEOTECHNICAL ENGINEERING EVALUATION AND RECOMMENDATIONS

4.1 Basis of Evaluation & Recommendations

Geotechnical evaluation and recommendations as presented in this report are based on our site observations, field and laboratory test data obtained, and our understanding of the project information as previously described in this report. The discovery of site and/or subsurface conditions during construction that deviate from the data obtained in this exploration should be reported to CSI Geo for evaluation and review.

4.2 Evaluation of Building Pads

Based on the subsurface conditions, we consider the encountered sandy soils to be suitable for support of the proposed buildings founded on concrete pads provided that the general site preparation and construction procedures are followed as outlined in section 5.0 of this report. Based on the subsurface soil conditions encountered, we estimate the allowable bearing capacity for the concrete pads to be on the order of 2,500 psf.

Using a 2,500 psf bearing pressure, we estimate that total settlements of the new buildings could be on the order of 1 inch, or less. We expect these compression settlements of the subsurface soil to take place in an elastic manner and to occur fairly rapidly during the construction process. Following site work and construction techniques in general accordance with our subsequent recommendations, we anticipate that differential settlement of the structure should be within tolerable magnitudes.

The building pads should bear in either the existing sands, which will require compaction, or in compacted structural fill. The bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the Modified Proctor maximum dry density (ASTM D1557).

5.0 SITE PREPARATION & CONSTRUCTION RECOMMENDATIONS

5.1 Initial Site Preparation

To prepare for construction, we recommend that all vegetation, topsoils, trees, stumps, and roots be removed from construction areas for a distance of at least 5 feet beyond the improvement footprint areas. The depth to which stripping will be required will vary to some degree. Some localized areas may require more than 12 inches of stripping to remove significant root zones, whereas, most areas may require 9 inches or less.

5.2 Surface Water Control

If applicable, any surface water runoff that is encountered should be controlled during the initial site preparations. Depending on the climatic conditions at the time of construction, surface water control may be required during subgrade preparation. In order to control the water, interceptor perimeter drainage ditches should be excavated immediately adjacent to the construction areas for temporary collection of surface water runoff. Construction areas should be graded to assure drainage of stormwater away from immediate areas of preparation.

5.3 Groundwater Control

Lowering of groundwater by 2 to 3 feet can be achieved in general by pumping from barrel sumps situated in perimeter ditches or pits, if site conditions prevent establishment of drainage by gravity. Groundwater should be maintained at least 1 foot below the bottom of any excavations made during construction and 2 feet below the surface of any compaction operations. Where deeper or more positive groundwater control is desired for prolonged periods, a well point system may be required.

6.0 CONSTRUCTION MONITORING & TESTING GUIDELINES

The fill placement and compaction operations should be observed and documented by a qualified engineering technician working under the direction of the Engineer. Significant deviations, either from the Specifications or from good practice, should be brought to the attention of the Geotechnical Engineer for evaluation and appropriate recommendations.

Prior to initiating any of the compaction operations, we recommend that representative samples of the backfill or structural fill material to be used and acceptable exposed in-place soils to be collected and tested to determine their compaction and classification characteristics. The maximum dry density, optimum moisture content, gradation and plasticity characteristics should be determined. These tests are needed for compaction quality control of the backfill or structural fill and existing soils and to determine if the fill material is acceptable.

A representative number of in-place field density tests should be performed on each lift for the compacted backfill materials. Also, where no additional fill is needed, in-place field density tests should be performed on existing soils to confirm that the required degree of compaction has been obtained.

7.0 REPORT LIMITATIONS

The subsurface exploration program including our evaluation and recommendations was performed in general accordance of accepted geotechnical engineering principles and standard practices. CSI Geo is not responsible for any independent conclusions, opinions, or interpretations made by others based on the data presented in this report.

This report does not reflect any variations that may occur adjacent or between soil borings. The discovery of any site or subsurface condition during construction that deviates from the findings and data as presented in this report should be reported to CSI Geo for evaluation. If the location of the proposed project features is changed, our office should be contacted so our recommendations can be re-evaluated. We recommend that CSI Geo be given the opportunity to review the final design drawings and specifications to ensure that our recommendations are properly included and implemented.

APPENDIX

Site Location Map

Field Exploration Plan

Report of SPT Borings

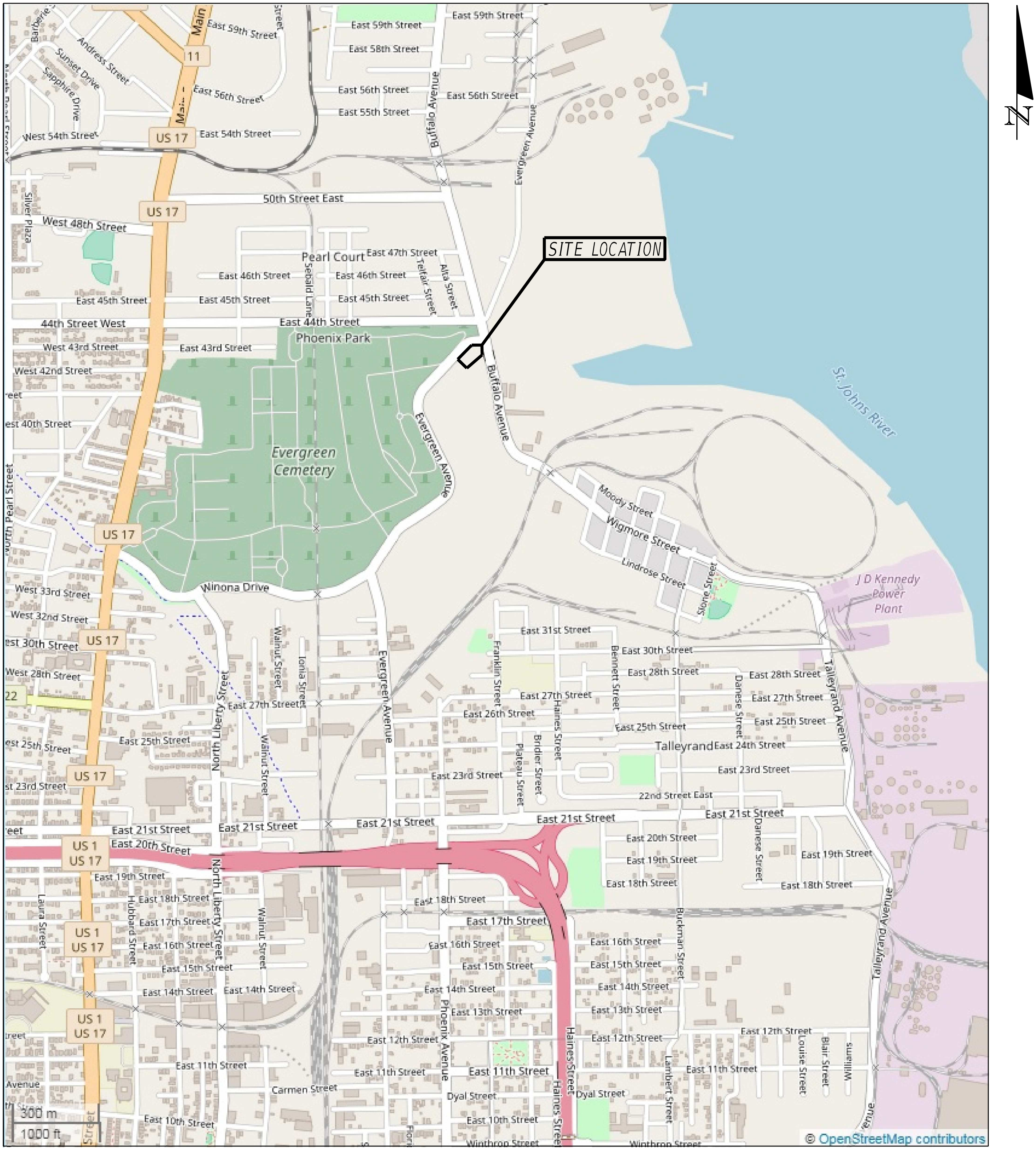
Summary of Laboratory Test Results

Existing Pavement System Thickness

Key to Soil Classification

Field and Laboratory Test Procedures

Site Location Map



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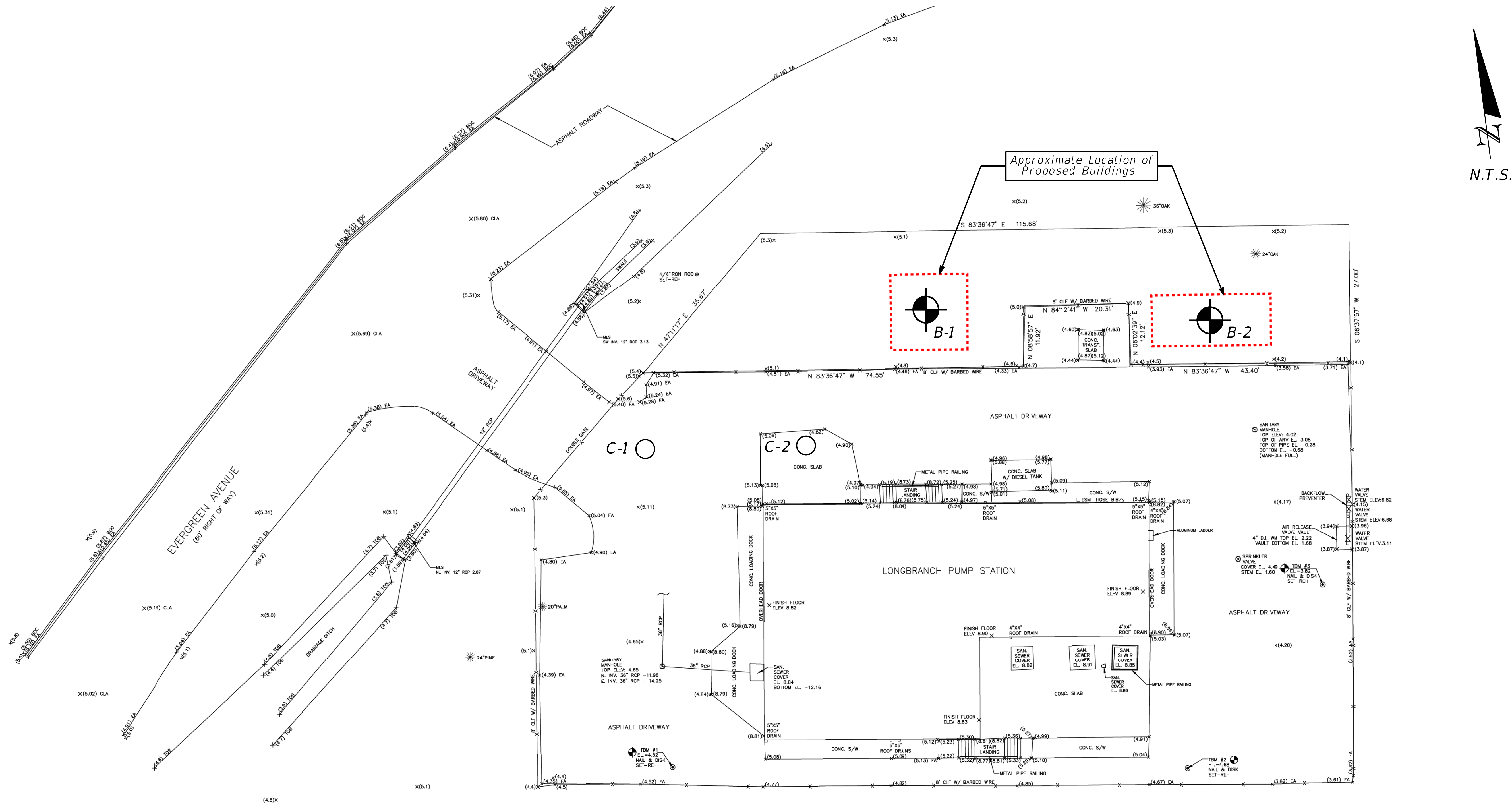
SITE LOCATION MAP
BUFFALO AVENUE PUMP STATION REHABILITATION
JACKSONVILLE, FLORIDA

Field Exploration Plan



LEGEND

STANDARD PENETRATION TEST (SPT) BORING LOCATION

CORE LOCATION

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

FIELD EXPLORATION PLAN
BUFFALO AVENUE PUMP STATION REHABILITATION
JACKONVILLE, FLORIDA

Report of SPT Borings

LEGEND

FINE SAND (SP); SLIGHTLY SILTY FINE SAND (SP–SM)

TOPSOIL (PT)

(SP) UNIFIED SOIL CLASSIFICATION SYSTEM

GROUND WATER LEVEL AT TIME OF DRILLING

W / −200 NATURAL MOISTURE CONTENT (%) FINES PASSING NO. 200 SIEVE (%)

B.T. STANDARD PENETRATION TEST BORING TERMINATION

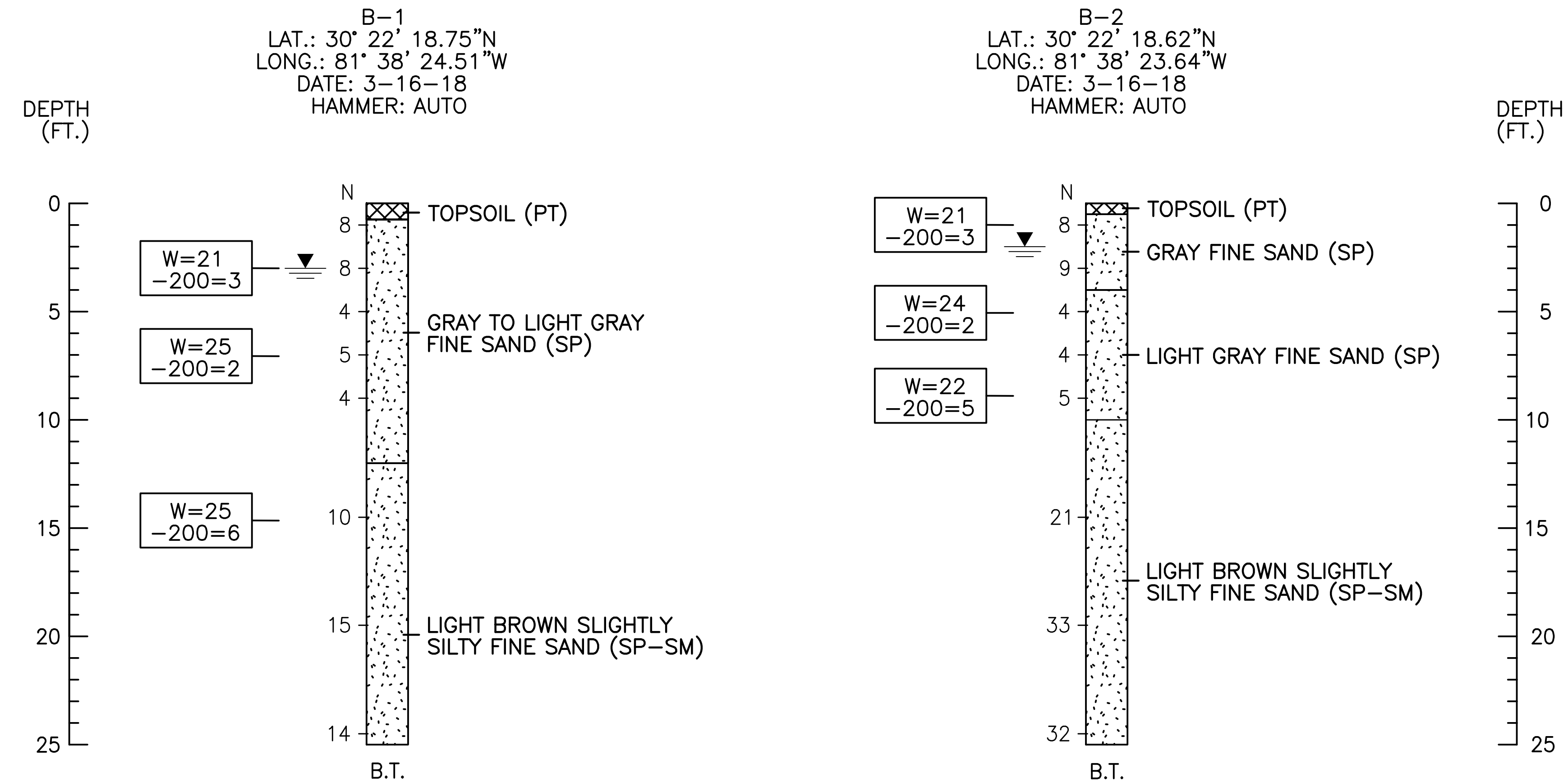
N STANDARD PENETRATION RESISTANCE IN BLOWS PER FT UNLESS OTHERWISE NOTED, NUMBERS TO THE LEFT OF BORING INDICATE N–VALUES.

GRANULAR MATERIALS

RELATIVE DENSITY	AUTOMATIC HAMMER SPT N–VALUE (BLOWS/FT)
VERY LOOSE	LESS THAN 3
LOOSE	3–8
MEDIUM DENSE	8–24
DENSE	24–40
VERY DENSE	GREATER THAN 40

SILTS AND CLAYS

CONSISTENCY	AUTOMATIC HAMMER SPT N–VALUE (BLOWS/FT)
VERY SOFT	LESS THAN 1
SOFT	1–3
FIRM	3–6
STIFF	6–12
VERY STIFF	12–24
HARD	GREATER THAN 24



STANDARD PENETRATION TEST DATA

SPOON INSIDE DIA.	1.44 INCHES
SPOON OUTSIDE DIA.	2.0 INCHES
ASTM STANDARD DROP HAMMER, AUTO.	
AVG. HAMMER DROP	30.0 INCHES
HAMMER WEIGHT	140.0 LBS

NOTES:

1) DRILL AND PENETRATION TESTING WAS PERFORMED IN ACCORDANCE WITH ASTM D–1586.

2) LAYER BOUNDARIES ARE APPROXIMATE AND MAY VARY BETWEEN OR AWAY FROM BORING LOCATIONS.

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GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

REPORT OF SPT BORINGS

BUFFALO AVENUE PUMP STATION REHABILITATION
JACKSONVILLE, FLORIDA

Summary of Laboratory Test Results

SUMMARY OF LABORATORY TEST RESULTS

Buffalo Avenue Pump Station Rehabilitation
Jacksonville, Florida

Boring No.	Sample No.	Approximate Depth (ft)			Natural Moisture Content (%)	Organic Content (%)	Percent Passing Sieve Size (%)						Atterberg Limits		Soil Classification Symbol
							#4	#10	#40	#60	#100	#200	LL	PI	
B-1	2	2.0	-	4.0	21							3			SP
B-1	4	6.0	-	8.0	25							2			SP
B-1	6	14.0	-	16.0	25							6			SP-SM
B-2	1	0.0	-	2.0	21							3			SP
B-2	3	4.0	-	6.0	24							2			SP
B-2	5	8.0	-	10.0	22							5			SP

Existing Pavement System Thickness

EXISTING PAVEMENT SYSTEM THICKNESS

Buffalo Ave Pump Station Rehabilitation Project
Duval County, Florida

Core No.	Coordinates		Material Layer Thickness		
	Latitude	Longitude	Asphalt (in)	Limerock (in)	Concrete (in)
C-1	30°22'18.49"N	81°38'25.08"W	1 1/2	Not Encountered	-
C-2	30°22'18.46"N	81°38'24.79"W	-	-	8 3/4

Key to Soil Classification

KEY TO SOIL CLASSIFICATION

Correlation of Penetration Resistance with Relative Density and Consistency

Granular Materials

Relative Density	**Auto Hammer SPT N-Value (Blows/foot)**
Very Loose	Less than 3
Loose	3 – 8
Medium Dense	8 - 24
Dense	24 - 40
Very Dense	Greater than 40

Silts and Clays

Consistency	**Auto Hammer SPT N-Value (Blows/foot)**
Very Soft	Less than 1
Soft	1 – 3
Firm	3 - 6
Stiff	6 - 12
Very Stiff	12 - 24
Hard	Greater than 24

Particle Size Identification (Unified Soil Classification System)

Boulders:	Diameter exceeds 8 inches
Cobbles:	3 to 8 inches diameter
Gravel:	Coarse - 3/4 to 3 inches in diameter
	Fine - 4.76 mm to 3/4 inch in diameter
Sand:	Coarse - 2.0 mm to 4.76 mm in diameter
	Medium - 0.42 mm to 2.0 mm in diameter
	Fine - 0.074 mm to 0.42 mm in diameter

Modifiers

These modifiers provide our estimate of the amount of fines (silt or clay size particles) in soil samples.

Approximate Fines Content	Modifiers
5% Fines 12%	Slightly silty or slightly clayey
12% Fines 30%	Silty or clayey
30% Fines 50%	Very silty or very clayey

These modifiers provide our estimate of shell, rock fragments, or roots in the soil sample.

Approximate Content, By Weight	Modifiers
< 5%	Trace
5% to 10%	Few
15% to 25%	Little
30% to 45%	Some
50% to 100%	Mostly

These modifiers provide our estimate of organic content in the soil sample.

Organic Content	Modifiers
1% to 3%	Trace
3% to 5%	Slightly Organic
5% to 20%	Organic
20% to 75%	Highly Organic (Muck)
> 75%	Peat

Field and Laboratory Test Procedures

FIELD AND LABORATORY TEST PROCEDURES

FIELD TEST PROCEDURES

Standard Penetration Test (SPT) Borings

The soil penetration test borings were made in general accordance with ASTM D-1586, "Penetration Test and Split-Barrel Sampling of Soils". The boring was advanced by continuous driving the split spoon sampler to a depth of 10 feet below the existing ground surface. Below 10 feet, split spoon sampling was performed at a spacing of 5 feet until the boring termination depth. Bentonite drilling fluid was used below the ground water level to stabilize the sides and to flush the cuttings. At the sampling intervals, the drilling tools were removed and soil samples were obtained with a standard 1.4 inch I.D., 2.0 inch O.D., split-tube sampler. The sampler was first seated six inches and then driven an additional foot with blows of a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "Penetration Resistance". The penetration resistance, when properly interpreted, is an index to the soil strength and density.

Representative portions of the soil samples, obtained from the sampler, were placed in glass jars and transported to our laboratory. The samples were then examined by a geotechnical engineer to confirm the field classifications.

LABORATORY TEST PROCEDURES

Natural Moisture Content – The water content is the ratio, expressed as a percentage, of the weight of water in a given mass of soil to the weight of the solid particles. This test was conducted in the general accordance with ASTM D 2216.

Percent Fines Content – To determine the percentage of soils finer than No. 200 sieve, the dried samples were washed over a 200 mesh sieve. The material retained on the sieve was oven dried and then weighed and compared with the unwashed dry weight in order to determine the weight of the fines. The percentage of fines in the soil sample was then determined as the percentage of weight of fines in the sample to the weight of the unwashed sample. This test was conducted in accordance with ASTM D 1140.