



Geotechnical Exploration and Evaluation Report

Nassau Reclaimed Water Main From Radio Avenue to Harts Road Nassau County, Florida

**CSI Geo Project No.: 71-17-329-04
Client Project No.: JEA 09302-049-01**

Prepared by

**CSI Geo, Inc.
2394 St. Johns Bluff Road S., Suite 200
Jacksonville, FL 32246
Tel: (904) 641-1993
Fax: (904) 641-0057**

Prepared for

Jones Edmunds & Associates, Inc.

May 19, 2017

May 19, 2017

Dr. Harold Bridges, Ph.D, P.E.
Jones Edmunds & Associates, Inc.
8657 Baypine Road, Suite 300
Jacksonville, FL 32256-8634

RE: Nassau Reclaimed Water Main from Radio Avenue to Harts Road
Nassau County, Florida

Subject: Geotechnical Exploration and Evaluation Report
CSI Geo Project No.: 71-17-329-04
Client Project No.: JEA 09302-049-01

Dear Dr. Bridges:

CSI Geo, Inc. has performed the authorized geotechnical exploration and laboratory testing program for the proposed reclaimed water main in Nassau County, Florida. This report presents our understanding of the subsurface conditions along with our engineering evaluation and recommendations.

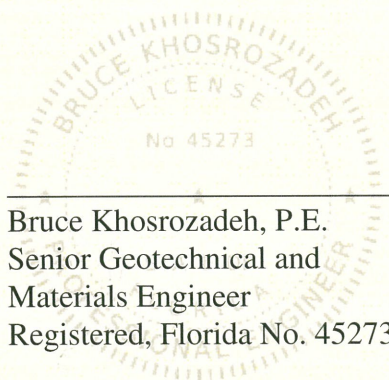
We have enjoyed working with you on this project and look forward to working with you on future projects. If you have any questions concerning this report, please contact our office.

Sincerely,

CSI Geo, Inc.



Nader Amer, Ph.D
Geotechnical Engineer



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

TABLE OF CONTENTS

| SECTION | PAGE NUMBER |
|--|--------------------|
| 1.0 <u>Project Information</u> | 1 |
| 1.1 General Project Information | |
| 1.2 Existing Conditions and Project Description | |
| 2.0 <u>Geotechnical Exploration</u> | 3 |
| 2.1 Field Exploration | |
| 2.1.1 Previous Exploration (2010) | |
| 2.1.2 Current Exploration | |
| 2.2 Laboratory Testing | |
| 3.0 <u>General Subsurface Conditions</u> | 5 |
| 3.1 General | |
| 3.2 Soil Conditions | |
| 3.3 Groundwater Conditions | |
| 3.4 Existing Pavement System Thickness | |
| 4.0 <u>Design Recommendations</u> | 7 |
| 4.1 General | |
| 4.2 Open Cut Excavations | |
| 4.3 Horizontal Directional Drilling / Jack & Bore Design Soil Parameters | |
| 5.0 <u>Site Preparation & Earthwork Recommendations</u> | 9 |
| 5.1 Existing Utilities | |
| 5.2 Temporary Groundwater Control | |
| 5.3 Excavation Protection | |
| 5.4 Pipe Backfill and Compaction of Pipe Backfill | |
| 6.0 <u>Report Limitations</u> | 11 |

APPENDIX

- Site Location Map
- Field Exploration Plan
- Report of Core Borings
- Summary of Laboratory Testing Results
- Existing Pavement System Thickness
- Key to Soil Classification
- Field and Laboratory Test Procedures

1.0 PROJECT INFORMATION

1.1 General Project Information

The purpose of this geotechnical exploration program was to develop information concerning the subsurface conditions in order to evaluate the site with respect to the proposed reclaimed water main from Radio Avenue to Harts Road in Nassau County, Florida.

CSI Geo prepared and submitted a geotechnical exploration and evaluation report for the Yulee Outfall and Force main project on June 22, 2010. Since that submittal, we understand that some portions of the force main and reclaimed water main alignments have been changed. The purpose of our investigation is to supplement the findings of that report with additional field and laboratory testing.

This report describes the field and laboratory testing activities performed and presents the findings. The subsurface soil and groundwater conditions encountered are presented in this report along with site preparation and construction recommendations.

Information regarding this project was provided to CSI Geo, Inc. (CSI Geo) by Dr. Harold Bridges, PhD, P.E, and Mr. Greg Perrine, P.E. of Jones Edmunds & Associates, Inc. (Jones Edmunds). The information provided to us included the following:

- Nassau Outfall / Reclaimed WM and Sewer FM – Part II (As Built Plans)
Prepared by: Jordan Jones and Goulding
Received: March 8th, 2017
- Yulee Outfall and Force Main Geotechnical Exploration And Evaluation Report
Prepared by: CSI Geo, Inc. (Project No. 7110-131-06)
Dated: June 22, 2010

1.2 Existing Conditions and Project Description

We understand that this project includes the installation of a new 16-inch reclaimed water main. The new water main will be an extension of the existing 16-inch reclaimed water main along the Florida Power & Light (FPL) easement adjacent to the Yulee Outfall Wetlands to the south side of William Burgess Boulevard at Harts Road. The water main is proposed to be extended from

Radio Avenue to Harts Road and will provide reclaimed water to the west of I-95 and for the East Nassau Community Planning Area. The reclaimed water main is to be routed within the FPL Transmission easement, Wilson Lane, Radio Avenue, US 17 (Main St.), Commercial Park Drive and Harts Road Right-of-ways.

The overall length of the proposed 16-inch reclaimed water main is approximately 11,000 feet. A CSX railway intersects the proposed alignment just south of Clyde Higginbotham Road intersection with Harts Road. It is anticipated that the majority of the reclaimed water main will be installed by means of open cut excavation method. Additionally, horizontal directional drilling (HDD) or Jack and Bore methods of installation may be used at the US-17 (Main St.), CSX Railroad, and Radio Avenue crossings. A site location map is included in the **Appendix**.

It should be noted that a previous geotechnical subsurface exploration was performed by CSI Geo along the proposed reclaimed water main alignment in 2010 as part of the Yulee Outfall and Force main Project. Based on the information provided to us, we understand that the proposed reclaimed water main alignment has shifted in some areas since 2010 especially near Radio Avenue. Therefore, additional supplemental borings and pavement cores were performed along the sections where the alignment has changed. In addition, the results of the previous exploration and laboratory testing performed within the limits of the reclaimed water main have been incorporated into this report.

2.0 GEOTECHNICAL EXPLORATION

2.1 Field Exploration

2.1.1 Previous Exploration (2010)

The areas of the reclaimed water main proposed to be installed by means of open cut method of installation were explored in 2010 by a total of 18 auger borings (A-33 through A-50), and drilled to a depth of 12 feet below the existing ground surface.

In areas of Horizontal Directional Drilling (HDD) method of installation, a total of four Standard Penetration Test (SPT) borings (HDD-11 through HDD-14) were performed and drilled to a depth of 25 feet below the existing ground surface.

2.1.2 Current Exploration

To supplement the exploration along the pipe alignment where open cut method of installation is anticipated, a total of five additional auger borings (A-33A through A-36A and A-41A) were performed to a depth of 15 feet below the existing ground surface.

The HDD / Jack and Bore areas were explored by means of a total of three additional SPT borings (HDD-R1, HDD-R2 and HDD-11A) and drilled to a depth of 30 feet below the existing ground surface. This current field exploration also included a total of 12 pavement cores taken along the existing roadway in order to evaluate the existing pavement system thicknesses.

The boring and pavement core locations were located in the field by personnel from CSI Geo and survey information was provided to us by R.E. Holland & Associates, Inc. Soil samples collected were visually classified in the field and then transported to our laboratory for re-classification and testing. The approximate locations of the soil borings and pavement cores are shown on the Field Exploration Plan sheets included in the Appendix.

2.2 Laboratory Testing

Representative soil samples obtained during the field exploration program were visually classified using the American Association of State Highway and Transportation Officials (AASHTO) and the Unified Soil Classification System (USCS). Quantitative laboratory testing was performed on representative soil samples to better define their composition. Laboratory tests performed were percent fines, natural moisture content, and organic content. A Summary of Laboratory Test Results, and Field and Laboratory Test Procedures are included in the **Appendix**.

3.0 GENERAL SUBSURFACE CONDITIONS

3.1 General

An illustrated representation of the subsurface conditions encountered in the proposed construction areas are shown on the Report of Core Borings sheets presented in the **Appendix**. The Report of Core Borings and the soil conditions outlined below highlight the major subsurface stratification. The Report of Core Borings in the **Appendix** should be consulted for a detailed description of the subsurface conditions encountered at each boring location. When reviewing the Report of Core Borings, it should be understood that soil conditions may vary between the borings and along the pipe alignment.

3.2 Soil Conditions

Open Cut Method of Pipe Installation

Review of auger borings A-33 through A-50, A-33A through A-36A and A-41A, indicates that the reclaimed water main alignment is generally underlain by inter-bedded deposits of sands and slightly silty sands (A-3; AASHTO) until the boring termination depths of 12 and 15 feet below the existing ground surface. An isolated layer of silty sands (A-2-4) was encountered in auger boring A-43 between the depths of 7 and 9 feet below the existing ground surface. In addition, clayey fine sands (A-2-6) and sandy clays (A-6) were encountered in auger borings A-47 through A-49 between the depths of 5 and 12 feet below the existing ground surface.

Horizontal Directional Drilling (HDD) or Jack & Bore

Review of test borings HDD-11 through HDD-14, HDD-R1, HDD-R2, and HDD-11A indicates that the pipe alignment in the areas of the HDD or Jack & Bore entry and exit points is generally underlain by inter-bedded deposits of loose to medium dense sands (SP; USCS) and slightly silty sands (SP-SM) until the boring termination depths of 25 and 30 feet below the existing ground surface.

3.3 Groundwater Conditions

The groundwater level was measured and recorded as encountered at the time of drilling. The depths of the groundwater level and estimated seasonal high water level at the test locations are marked on the Report of Core Borings sheets presented in the **Appendix**. The depth of groundwater level measured at the time of drilling ranged from 3.5 to 11.0 feet below the existing ground surface. The estimated seasonal high water table for the borings performed ranged from 2.0 to 8.0 feet below the existing ground surface. However, it is anticipated that seasonal high groundwater will be at the surface or higher near the wetland areas. It should be anticipated that the groundwater level will fluctuate due to seasonal climate variations, surface water runoff patterns, construction operations, tidal effects, and other related factors.

3.4 Existing Pavement System Thickness

Twelve (12) pavement cores were performed along the pipe alignment to determine the existing pavement system thicknesses. The results of the pavement coring indicate that the asphalt thickness ranged from 1.0 to 3.0 inches over 3.0 to 9.5 inches of limerock. Detailed results of the existing pavement system thickness are included in the **Appendix**.

4.0 DESIGN RECOMMENDATIONS

4.1 General

Our geotechnical evaluation of the site and the subsurface conditions is based on our understanding of the proposed project, our observations, and results of field and laboratory testing. The recommendations provided in this report present construction methods and techniques that are appropriate for the proposed construction. If the project location is changed or if field conditions encountered during construction are different from those presented in this report, the information should be provided to CSI Geo for evaluation. We also recommend that CSI Geo be given the opportunity to review the design plans and specifications to ensure that our recommendations have been properly included and implemented.

In general, we consider the subsurface soil conditions at the site to be favorable for support of the proposed pipe over a properly prepared and compacted subgrade, provided that the site preparation and earthwork construction recommendations in this report are performed.

4.2 Open Cut Excavations

The A-3 type soils are considered select material. Silty sands (A-2-4) can be treated as select material; however, they may contain excess moisture and may be difficult to dry and to compact.

Clayey sands (A-2-6) and sandy clays (A-7) should be considered plastic and highly plastic materials. Therefore, if these soils are encountered along the alignment of the pipes, they should be excavated to a minimum depth of one foot below the design invert elevations and replaced with suitable A-3 fill material. Organic soils (A-8) should be considered as muck and not suitable for use as backfill. If A-8 materials are encountered beneath the pipe or other proposed structures they should be removed in their entirety.

It is cautioned that portions of the pipe alignment are underlain by plastic clayey sands (A-2-6) and sandy clays (A-6) as encountered in auger borings A-47 through A-49. When encountered, these soils should be replaced with select A-3 material and compacted prior to the installation of the pipe. It is very likely that the excavated suitable soils will get mixed with plastic soils during construction. Therefore, it is our opinion that some of the excavated material should be regarded

as unsuitable for backfill purposes. We recommend that an allowance be made for overruns in quantities of subsoil removal and replacement with select backfill. It should be noted that plastic soils boundaries and limits are approximate and represent soil encountered at each boring location. Subsurface variance between borings may occur and should be anticipated.

We anticipate that the buried pipe lines will exert little downward pressure on the subgrade soils. In areas where the surrounding groundwater level is above the pipe invert elevation, the pipe should be designed to resist lateral earth pressures and hydrostatic uplift pressures appropriate to its depth below the existing grade and the seasonal high water level.

4.3 Horizontal Directional Drilling / Jack & Bore Design Soil Parameters

We understand that portions of the reclaimed water main will be installed by means of Horizontal Directional Drilling or Jack & Bore methods of installation. Recommended soil parameters and assumptions to be used for the three crossings at US-17 (Main St.), CSX Railroad, and Radio Avenue should include the following:

RECOMMENDED SOIL PARAMETERS FOR HDD / JACK & BORE DESIGN

Borings HDD-11 through HDD-14, HDD-R1, HDD-R2, HDD-11A

| Soil Parameter | Loose to Medium Dense Sands | Dense to Very Dense Sands | Medium Dense to Dense Sands |
|--|-----------------------------|---------------------------|-----------------------------|
| Depth (ft) | 0.0' to 12.0' | 12.0' to 17.0' | 17.0' to 30.0' |
| Saturated unit weight (pcf) | 105 | 120 | 120 |
| Effective unit weight for input purposes (pcf) | 43 | 58 | 58 |
| Estimated friction angle ϕ (degrees) | 30 | 38 | 35 |
| Cohesion (psf) | --- | --- | --- |
| At Rest Pressure Coefficient (K_o) | 0.50 | 0.38 | 0.43 |
| Active Pressure Coefficient (K_a) | 0.33 | 0.24 | 0.27 |
| Passive Pressure Coefficient (K_p) | 3.00 | 4.20 | 3.69 |

5.0 SITE PREPARATION & EARTHWORK RECOMMENDATIONS

5.1 Existing Utilities

The locations of existing utilities should be established prior to construction. Provisions should be made to relocate utilities interfering with the proposed alignments and construction, as needed. Underground pipes that are not operational should be either removed or plugged otherwise they may become conduits for subsurface erosion and cause settlements.

5.2 Temporary Groundwater Control

Groundwater level was encountered at the time of drilling at a depth ranging from 3.5 to 11.0 feet below the existing ground surface. Therefore, groundwater control should be anticipated. The groundwater level should be maintained at a minimum of two feet below the subgrade of the proposed inverts. Dewatering may be achieved by conventional open pumping using ditches graded to a sump or by using a well point system. Dewatering should continue until sufficient weight is placed over the proposed pipes to resist uplift.

5.3 Excavation Protection

All excavations should meet OSHA Excavation Standard Subpart P regulations for Type C soils. Temporary sheet pile walls are proposed in some areas where deep installation is required, but a trench box or braced sheet pile structures may also be required in other areas to support the open excavations. The soil support system should be designed by a Florida registered Professional Engineer.

5.4 Pipe Backfill and Compaction of Pipe Backfill

If the excavated suitable soils get mixed with unsuitable soils during construction, then the excavated material should be regarded as unsuitable for backfill purposes. We recommend that allowance be made for overruns in quantities of subsoil removal and replacement with select (A-3) backfill.

The backfill material within the excavation should be placed in thin loose lifts not exceeding 12 inches in thickness as required by JEA. The backfill material should be compacted by the use of hand-operated equipment. The backfill material should be granular (A-3) fill with less than 10

percent material passing the no. 200 mesh sieve and containing less than 3 percent organic matter. The backfill material should be compacted to a minimum density of 98% or 95% of maximum dry density obtained from the Modified Proctor compaction test (ASTM D1557), as required by JEA. The moisture content during compaction should be maintained within ± 3 percent of the optimum moisture content as obtained from the Modified Proctor compaction test.

Hand held compaction equipment should be used for the backfill placed around the pipe and to a height of 2 feet above the pipe. Heavier equipment may be used on the remaining backfill lifts placed above the 2 feet above the pipe. However, care should be taken not to damage the pipe below. The pipe should be designed to withstand the anticipated dead (overburden) and live loads.

6.0 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 locations of the proposed features are 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 Core Borings

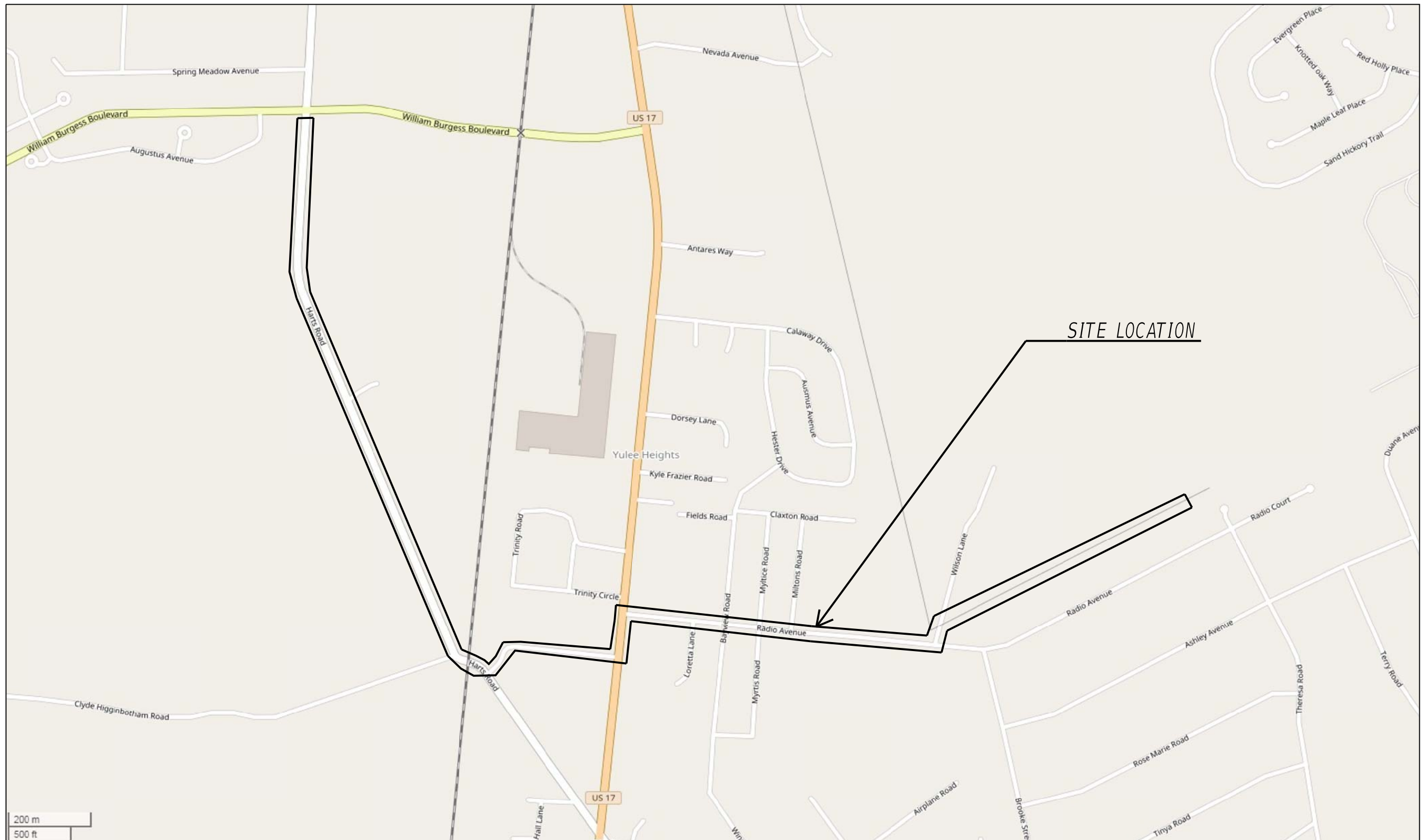
Summary of Laboratory Testing Results

Existing Pavement System Thickness

Key to Soil Classification

Field and Laboratory Test Procedures

Site Location Map



Field Exploration Plan



CSI Geo
GEOTECHNICAL · CMT · CEI
 2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
 JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
 CONSTRUCTION MATERIAL TESTING
 CONSTRUCTION ENGINEERING INSPECTION

FIELD EXPLORATION PLAN
 NASSAU RECLAIMED WATER MAIN
 FROM RADIO AVENUE TO HARTS ROAD
 NASSAU COUNTY, FLORIDA

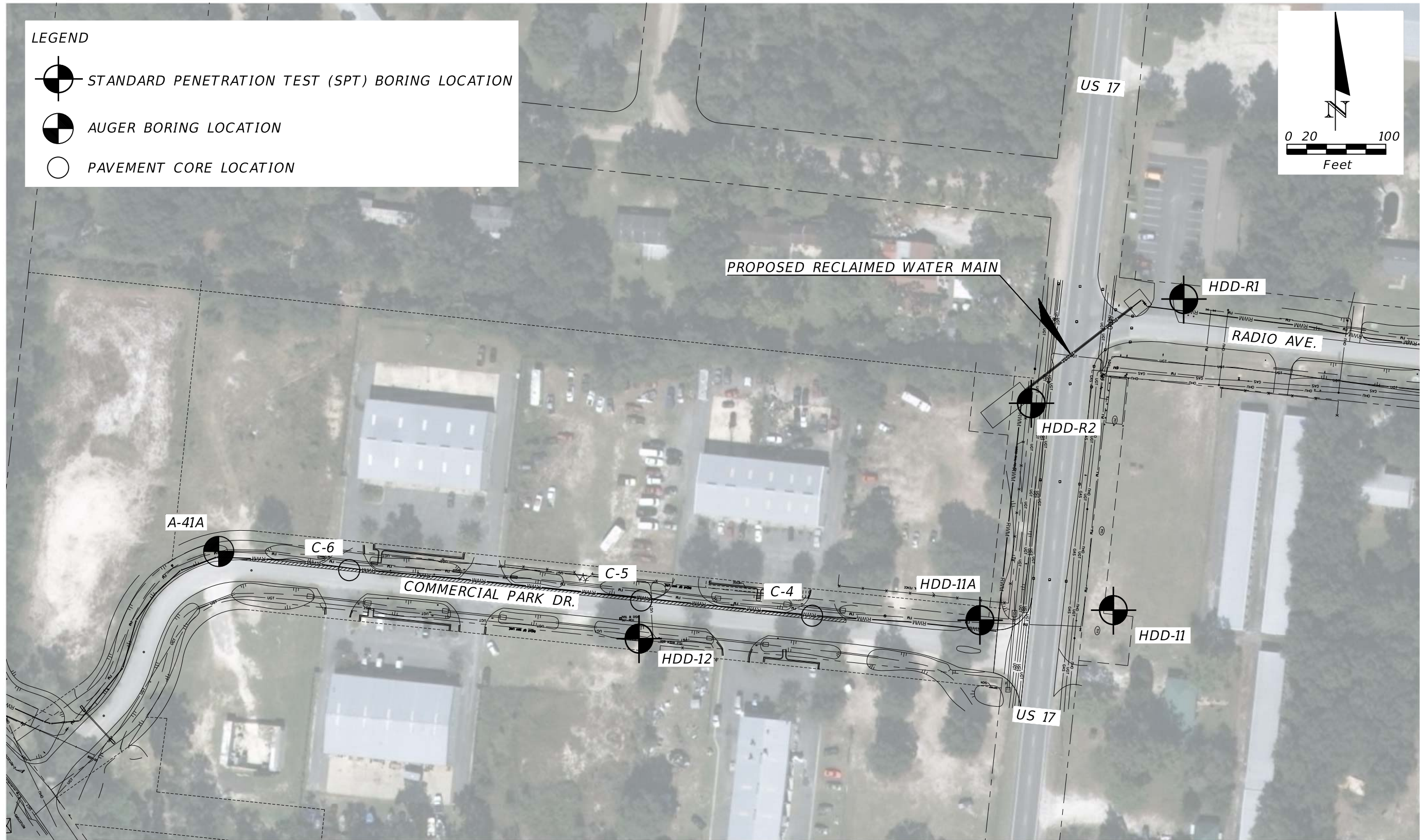


CSIGeo
GEOTECHNICAL·CMT·CEI
 2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
 JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
 CONSTRUCTION MATERIAL TESTING
 CONSTRUCTION ENGINEERING INSPECTION

FIELD EXPLORATION PLAN
 NASSAU RECLAIMED WATER MAIN
 FROM RADIO AVENUE TO HARTS ROAD
 NASSAU COUNTY, FLORIDA







CSIGeo
GEOTECHNICAL·CMT·CEI
 2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
 JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
 CONSTRUCTION MATERIAL TESTING
 CONSTRUCTION ENGINEERING INSPECTION

FIELD EXPLORATION PLAN
 NASSAU RECLAIMED WATER MAIN
 FROM RADIO AVENUE TO HARTS ROAD
 NASSAU COUNTY, FLORIDA



CSIGeo
GEOTECHNICAL·CMT·CEI
 2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
 JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
 CONSTRUCTION MATERIAL TESTING
 CONSTRUCTION ENGINEERING INSPECTION

FIELD EXPLORATION PLAN
 NASSAU RECLAIMED WATER MAIN
 FROM RADIO AVENUE TO HARTS ROAD
 NASSAU COUNTY, FLORIDA



CSI Geo
GEOTECHNICAL·CMT·CEI
 2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
 JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
 CONSTRUCTION MATERIAL TESTING
 CONSTRUCTION ENGINEERING INSPECTION

FIELD EXPLORATION PLAN
 NASSAU RECLAIMED WATER MAIN
 FROM RADIO AVENUE TO HARTS ROAD
 NASSAU COUNTY, FLORIDA

Report of Core Borings

AUGER BORINGS PERFORMED IN 2010 FOR THE YULEE OUTFALL AND FORCE MAIN PROJECT

LEGEND

FINE SAND;
SLIGHTLY SILTY FINE SAND;
SLIGHTLY CLAYEY FINE SAND; (A-3)

SILTY FINE SAND (A-2-4)

CLAYEY FINE SAND (A-2-6)

SANDY CLAY (A-6)

ESTIMATED SEASONAL HIGH WATER LEVEL

GROUND WATER LEVEL AT TIME OF DRILLING

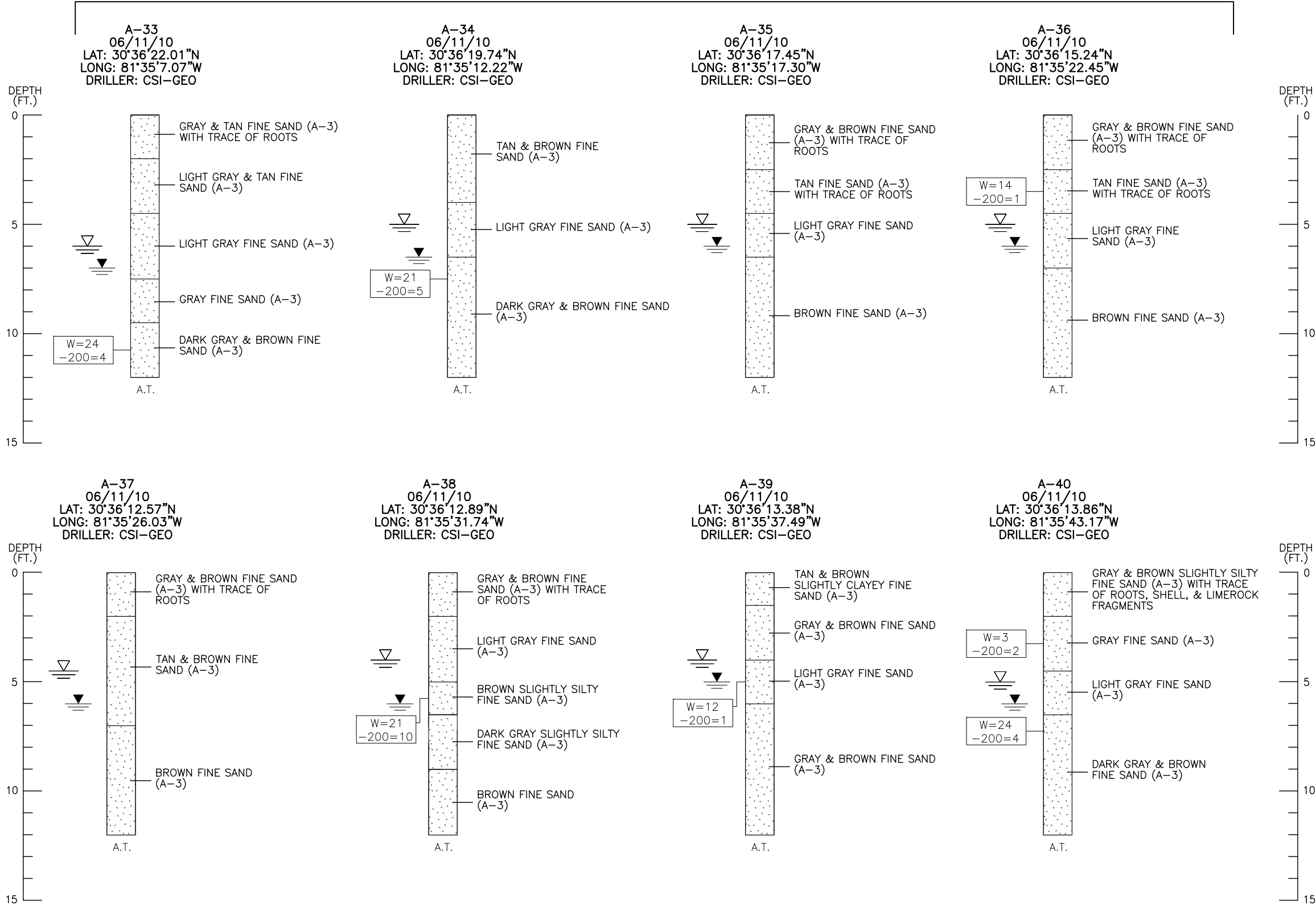
A.T. AUGER TERMINATION DEPTH

(A-3) AASHTO CLASSIFICATION SYMBOL

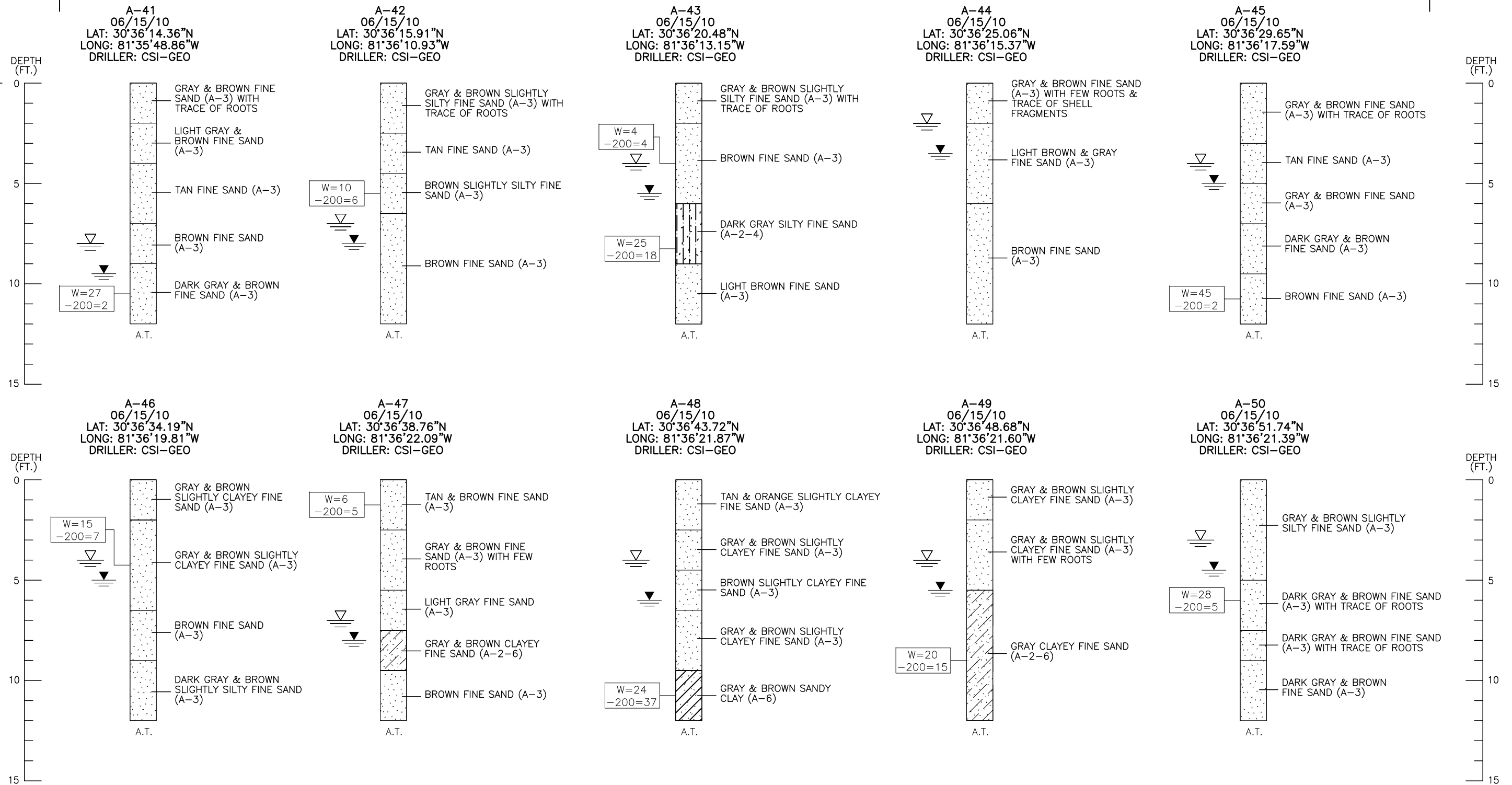
W
-200 NATURAL MOISTURE CONTENT (%)
FINES PASSING NO. 200 SIEVE (%)

NOTES:

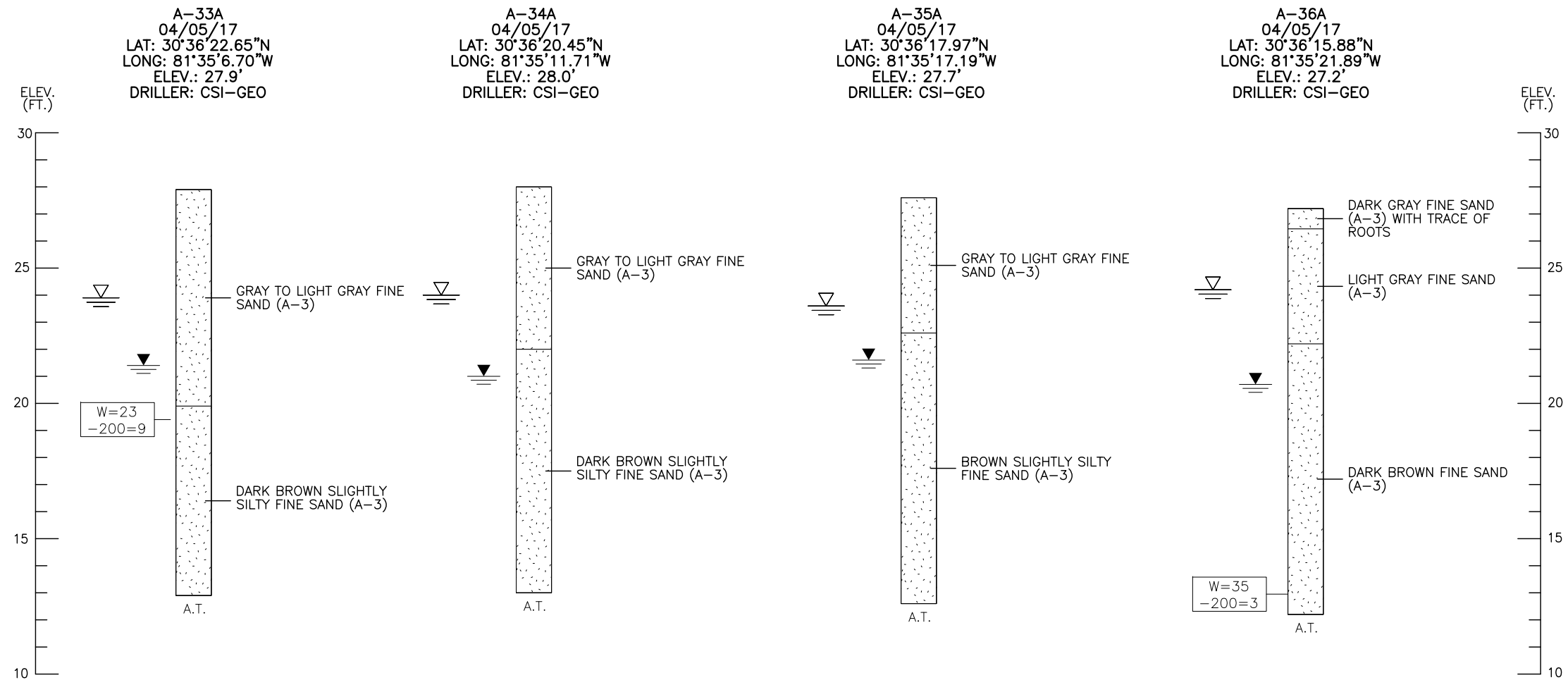
1) LAYER BOUNDARIES ARE APPROXIMATE
AND MAY VARY BETWEEN OR AWAY FROM
BORING LOCATIONS.



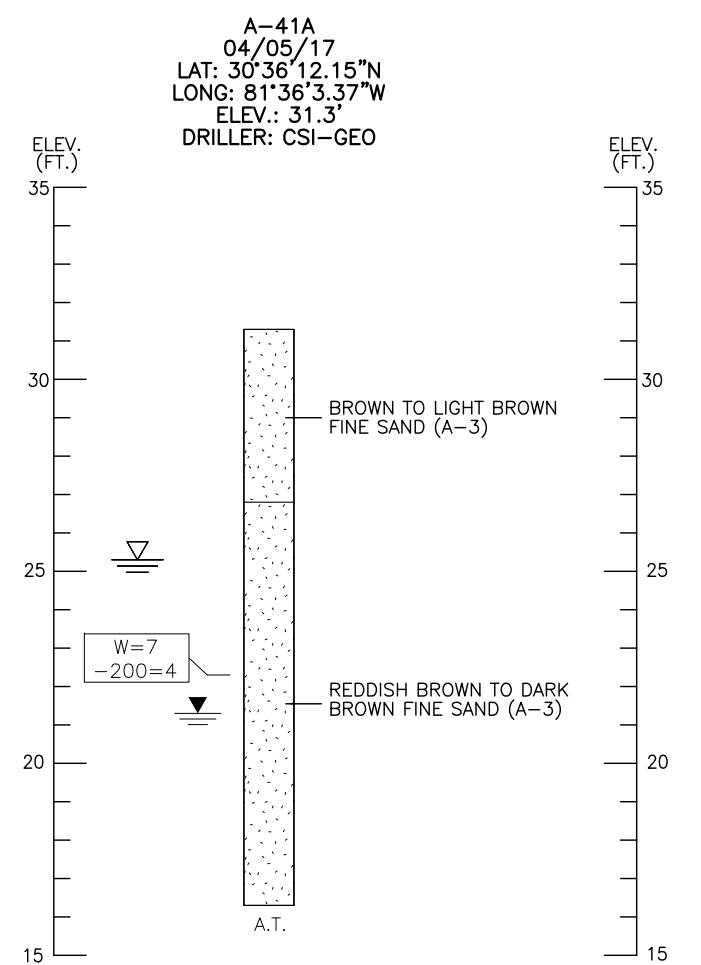
AUGER BORINGS PERFORMED IN 2010 FOR THE YULEE OUTFALL AND FORCE MAIN PROJECT



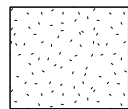
SUPPLEMENTAL AUGER BORINGS EAST OF ART WILSON LANE PERFORMED IN 2017



SUPPLEMENTAL AUGER BORING AT COMMERCIAL PARK DR. PERFORMED IN 2017



LEGEND



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

W
OC
-200

NATURAL MOISTURE CONTENT (%)
ORGANIC CONTENT (%)
FINES PASSING NO. 200 SIEVE (%)



GROUND WATER LEVEL AT TIME OF DRILLING

B.T. BORING TERMINATION DEPTH

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

(SP) UNIFIED SOIL CLASSIFICATION
SYMBOL

H.A. HAND AUGER

STANDARD PENETRATION TEST DATA

SPOON INSIDE DIA. 1.44 INCHES
SPOON OUTSIDE DIA. 2.0 INCHES
ASTM STANDARD DROP HAMMER, AUTOMATIC

AVG. HAMMER DROP 30.0 INCHES
HAMMER WEIGHT 140.0 LBS

NOTES:

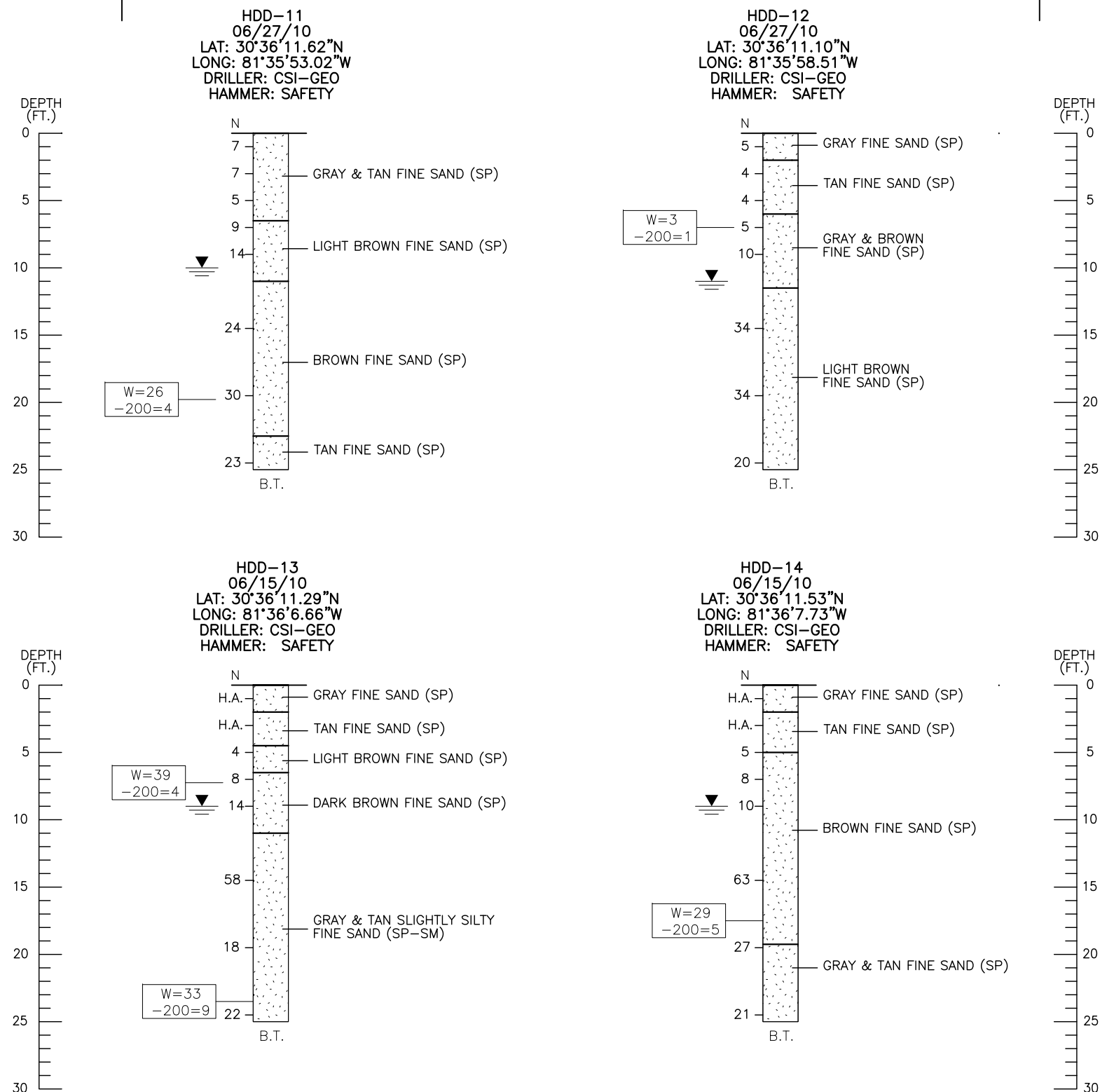
1) DRILL AND PENETRATION TESTING
WAS PERFORMED IN ACCORDANCE WITH
ASTM D-1586.

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

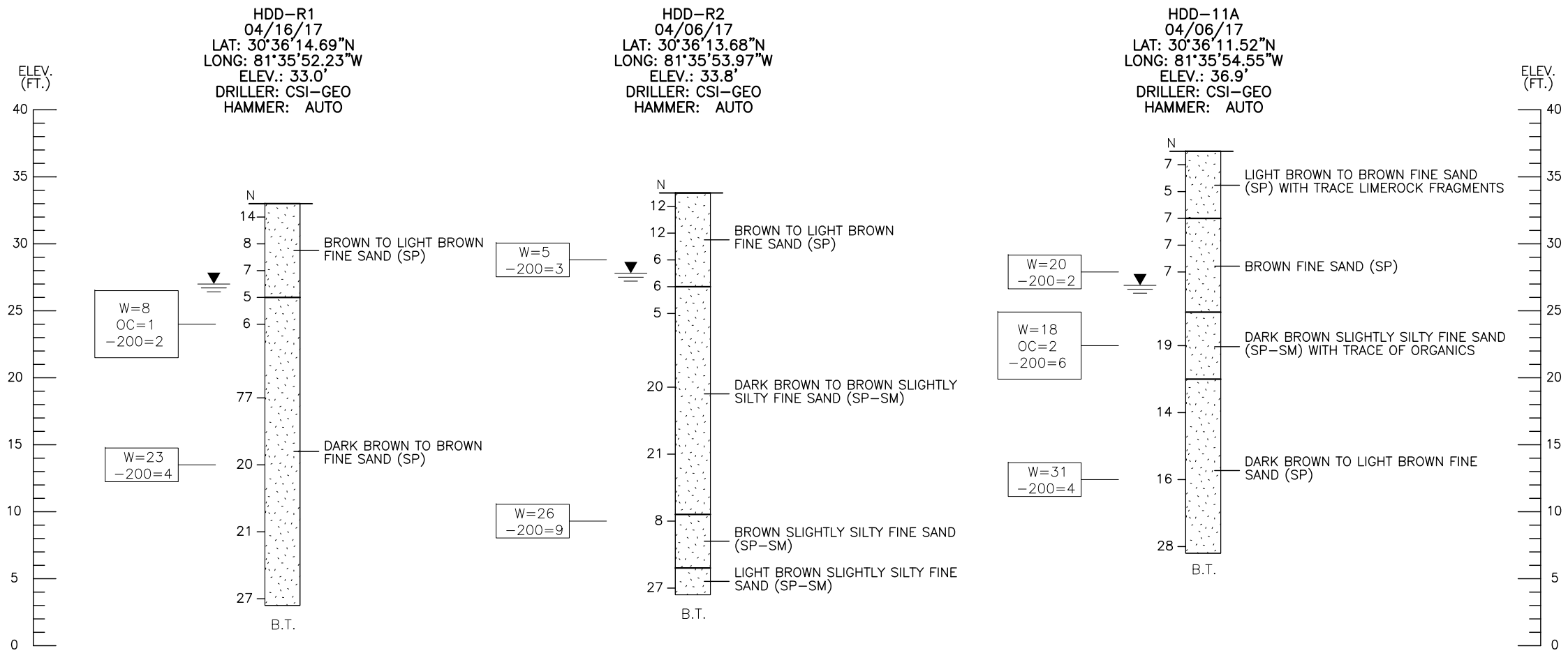
| GRANULAR MATERIAL | | |
|-------------------|---|--|
| RELATIVE DENSITY | SAFETY HAMMER SPT N-VALUE (BLOWS/FT) | AUTOMATIC HAMMER SPT N-VALUE (BLOWS/FT) |
| VERY LOOSE | LESS THAN 4 | LESS THAN 3 |
| LOOSE | 4-10 | 3-8 |
| MEDIUM DENSE | 10-30 | 8-24 |
| DENSE | 30-50 | 24-40 |
| VERY DENSE | GREATER THAN 50 | GREATER THAN 40 |

| SILTS AND CLAYS | | |
|-----------------|---|--|
| CONSISTENCY | SAFETY HAMMER SPT N-VALUE (BLOWS/FT) | AUTOMATIC HAMMER SPT N-VALUE (BLOWS/FT) |
| VERY SOFT | LESS THAN 2 | LESS THAN 1 |
| SOFT | 2-4 | 1-3 |
| FIRM | 4-8 | 3-6 |
| STIFF | 8-15 | 6-12 |
| VERY STIFF | 15-30 | 12-24 |
| HARD | GREATER THAN 30 | OVER 24 |

HORIZONTAL DIRECTIONAL DRILLING SPT BORINGS PERFORMED IN 2010 FOR THE YULEE OUTFALL AND FORCE MAIN PROJECT



SUPPLEMENTAL HORIZONTAL DIRECTIONAL DRILLING SPT BORINGS PERFORMED IN 2017



Summary of Laboratory Testing Results

SUMMARY OF LABORATORY TEST RESULTS

Nassau Reclaimed Water Main From Radio Avenue to Harts Road
Nassau County, 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 | |
| A-33A | 3 | 8.0 - 9.0 | 23 | | | | | | | 9 | | | A-3 |
| A-36A | 4 | 13.5 - 15.0 | 35 | | | | | | | 3 | | | A-3 |
| A-41A | 4 | 10.0 - 12.0 | 7 | | | | | | | 4 | | | A-3 |
| HDD-11A | 5 | 8.0 - 10.0 | 20 | | | | | | | 2 | | | SP |
| HDD-11A | 6 | 13.5 - 15.0 | 18 | 2 | | | | | | 6 | | | SP-SM |
| HDD-11A | 8 | 23.5 - 25.0 | 31 | | | | | | | 4 | | | SP |
| HDD-R1 | 5 | 8.0 - 10.0 | 8 | 1 | | | | | | 2 | | | SP |
| HDD-R1 | 7 | 18.5 - 20.0 | 23 | | | | | | | 4 | | | SP |
| HDD-R2 | 3 | 4.0 - 6.0 | 5 | | | | | | | 3 | | | SP |
| HDD-R2 | 8 | 24.0 - 24.5 | 26 | | | | | | | 9 | | | SP-SM |

Existing Pavement System Thickness

EXISTING PAVEMENT SYSTEM THICKNESS

Nassau Reclaimed Water Main From Radio Avenue to Harts Road Nassau County, Florida

| Core No. | Road / Intersection | Location | | Material Layer Thickness | |
|----------|---------------------------------|-----------------|-----------------|--------------------------|------------------|
| | | Latitude | Longitude | Asphalt (in) | Limerock (in) |
| C-1 | Radio Ave at Milton Rd | N30° 36' 36.89" | W81° 36' 21.03" | 2 | 3 |
| C-2 | Radio Ave at Myrtice Rd | N30° 36' 30.10" | W81° 36' 17.70" | 3 | 3 |
| C-3 | Radio Ave at Bayview Rd | N30° 36' 23.28" | W81° 36' 14.36" | 2 | 3 |
| C-4 | Commercial Park Dr at Driveway | N30° 36' 16.48" | W81° 36' 11.05" | 1 1/2 | 7 |
| C-5 | Commercial Park Dr | N30° 36' 11.58" | W81° 36' 08.69" | 2 | 8 |
| C-6 | Commercial Park Dr at Driveway | N30° 36' 12.00" | W81° 36' 01.86" | 1 1/2 | 4 |
| C-7 | N Harts Rd | N30° 36' 11.55" | W81° 35' 56.52" | 2 1/2 | 9 1/2 |
| C-8 | N Harts Rd | N30° 36' 11.71" | W81° 35' 58.48" | 1 1/2 | 6 |
| C-9 | N Harts Rd | N30° 36' 13.85" | W81° 35' 44.42" | 1 | 7 |
| C-10 | N Harts Rd | N30° 36' 13.59" | W81° 35' 41.41" | 1 1/2 | 8 1/2 |
| C-11 | N Harts Rd at Lumber Creek Blvd | N30° 36' 13.31" | W81° 35' 38.62" | 2 1/2 | 9 |
| C-12 | N Harts Rd | N30° 36' 44.20" | W81° 36' 22.30" | 1 1/2 | 6 1/2 |

Key to Soil Classification

KEY TO SOIL CLASSIFICATION

Correlation of Penetration Resistance with Relative Density and Consistency

| <u>Granular Materials</u> | | | <u>Silts and Clays</u> | | |
|---------------------------|---|--|------------------------|---|--|
| <u>Relative Density</u> | <u>Safety Hammer SPT N-Value (Blows/foot)</u> | <u>Automatic Hammer SPT N-Value (Blows/foot)</u> | <u>Consistency</u> | <u>Safety Hammer SPT N-Value (Blows/foot)</u> | <u>Automatic Hammer SPT N-Value (Blows/foot)</u> |
| Very Loose | Less than 4 | Less than 3 | Very Soft | Less than 2 | Less than 1 |
| Loose | 4 – 10 | 3 – 8 | Soft | 2 – 4 | 1 – 3 |
| Medium Dense | 10 - 30 | 8 - 24 | Firm | 4 - 8 | 3 - 6 |
| Dense | 30 - 50 | 24 - 40 | Stiff | 8 - 15 | 6 - 12 |
| Very Dense | Greater than 50 | Greater than 40 | Very Stiff | 15 - 30 | 12 - 24 |
| | | | Hard | Greater than 30 | 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

5% Fines 12%
12% Fines 30%
30% Fines 50%

Modifiers

Slightly silty or slightly clayey
Silty or clayey
Very silty or very clayey

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

Approximate Content, By Weight

< 5%
5% to 10%
15% to 25%
30% to 45%
50% to 100%

Modifiers

Trace
Few
Little
Some
Mostly

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

Organic Content

1% to 3%
3% to 5%
5% to 20%
20% to 75%
> 75%

Modifiers

Trace
Slightly Organic
Organic
Highly Organic (Muck)
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 D1586, "Penetration Test and Split-Barrel Sampling of Soils". The borings were advanced by continuous driving the split spoon sampler to a depth of 10 feet below the existing ground surface. Below 10 feet and until boring termination depths, split spoon sampling was performed at a spacing of 5 feet. 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.

Auger Borings – The auger borings were advanced by the use of a truck mounted auger drill rig. The soils encountered were identified in the field from the cuttings brought to the surface by the augering process. Representative soil samples were placed in glass jars and transported to our laboratory where they were examined by a geotechnical engineer to confirm field classifications.

LABORATORY TEST PROCEDURES

Percent Organic Content – This test is based on the percent of organics by weight of the total sample. This test was conducted in accordance with FM I - T 267.

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.

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 FM 1-T 265.



SERVICES OFFERED

Geotechnical & Foundations Engineering

Construction Materials Testing (CMT)

Construction Engineering & Inspection (CEI)

2394 St. Johns Bluff Road, Suite 200. • Jacksonville, FL 32246
(904) 641-1993 Phone • (904) 645-0057 Fax
www.csi-geo.com