CSIGeo

Geotechnical • CMT • CEI

# Geotechnical Exploration and Evaluation Report

## JEA Gate Parkway - Glen Kernan to T-Line
## Reclaimed Water Transmission Main
## Jacksonville, Florida

**CSI Geo Project No.: 71-17-166-10**
**Jacobs Subcontract No.: EEXI9900-S18-0004**
**Jacobs Project No.: EEXI9901**
**JEA Project No.: 8004189**

***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***

**Jacobs Engineering Group Inc.**

**June 19, 2018**

June 19, 2018

Ms. Christine Ellenberger P.E.
Jacobs Engineering Group, Inc.
200 W. Forsyth Street, Suite 1520
Jacksonville, FL 32202

**RE:** JEA Gate Parkway - Glen Kernan to T-Line Reclaimed Water Transmission Main
Jacksonville, Florida

**Subject:** Geotechnical Exploration and Evaluation Report
CSI Geo Project No.: 71-17-166-10
Jacobs Subcontract No.: EEXI9900-S18-0004
Jacobs Project No.: EEXI9901
JEA Project No.: 8004189

Dear Ms. Ellenberger:

CSI Geo, Inc. has performed the authorized geotechnical exploration and laboratory testing program for the proposed new reclaimed water transmission main in Jacksonville, Florida. This geotechnical exploration and evaluation 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.**

Digitally signed by Bruce Khosrozadeh
Date: 2018.06.19 13:30:23-04'00'

Nader Amer, Ph.D
Project Engineer

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

# TABLE OF CONTENTS


| SECTION | PAGE NUMBER |
|---|---|
| **1.0 Project Information** | **1** |
| 1.1 General Project Information | |
| 1.2 Project Description and Existing Conditions | |
| **2.0 Geotechnical Exploration** | **4** |
| 2.1 Field Exploration | |
| 2.2 Laboratory Testing | |
| 2.3 Environmental Classification Testing | |
| **3.0 General Subsurface Conditions** | **6** |
| 3.1 General | |
| 3.2 Soil Conditions | |
| 3.2.1 Open Cut Method of Pipe Installation | |
| 3.2.2 Jack & Bore Method of Pile Installation | |
| 3.2.3 Horizontal Directional Drilling Areas | |
| 3.3 Groundwater Conditions | |
| 3.4 Existing Pavement System Thickness | |
| 3.5 Environmental Classification Test Results | |
| **4.0 Design Recommendations** | **8** |
| 4.1 General | |
| 4.2 Open Cut Excavations | |
| 4.3 Recommended Design Soil Parameters for Jack & Bore | |
| 4.4 Recommended Design Soil Parameters for HDD | |
| **5.0 Site Preparation & Earthwork Recommendations** | **11** |
| 5.1 Existing Utilities | |
| 5.2 Temporary Groundwater Control | |
| 5.3 Excavation Protection | |
| 5.4 Pipe Backfill and Compaction of Pipe Backfill | |
| **6.0 Report Limitations** | **13** |

**APPENDIX**

- Site Location Map
- Field Exploration Plan
- Report of SPT Borings
- Summary of Laboratory Test Results
- Environmental Corrosion Test Results
- Recommended Design Soil Parameters for Horizontal Directional Drilling
- 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 JEA reclaimed water transmission main from Glen Kernan Parkway North to the existing stub-out in the JEA easement on the westside of I-295 in Jacksonville, Florida. The general site location is shown on the site location map included in the **Appendix**. This report describes the field and laboratory testing activities performed and presents the findings. The subsurface soil and groundwater conditions are presented in this report along with general site preparation recommendations and soil parameters for the proposed construction.

Information regarding this project was provided to CSI Geo, Inc. (CSI Geo) by Ms. Christine Ellenberger, P.E. of Jacobs Engineering Group Inc. (Jacobs). The following document was provided to us in electronic format.

- Construction Drawings (90% Submittal)
  Provided by: Jacobs
  Provided on: May 2018

## 1.2 Project Description and Existing Conditions

We understand that the existing 16-inch reclaimed main along Kernan Boulevard is limiting the reclaimed water flow supply in the area. Therefore, the project consists of installing a reclaimed water main with varying diameter sizes of 16 to 30-inches to improve the water flow and provide retail reclaimed water service to several residential developments, golf courses and commercial users. The reclaimed water main alignment begins just north of Glen Kernan Parkway and extends south along the northbound lane of Kernan Boulevard, crosses underneath J Turner Butler Boulevard (JTB), and then meanders west along the southern edge of JTB right of way before turning south along the east side of I-295 northbound off ramp. The alignment then crosses underneath I-295 from east to west. We understand that the majority of the pipe will be installed using the open cut method. Horizontal directional drilling (HDD) method will be utilized at two locations, one being the wetlands (1$^{st}$ Location) just south of JTB, and the other one being at I-295 (2$^{nd}$ Location) as shown on **Exhibit No. 1**. The proposed reclaimed water transmission main is shown on **Exhibit No. 1** and consists of the following segments:

- 30-inch ductile iron pipe (DIP) by open cut from just north of Glen Kernan Parkway N. to just south of the Kernan Boulevard and JTB intersection. A portion of the 30-inch DIP will be installed by Jack & Bore underneath existing box culverts at the intersection of Kernan Boulevard and Alumni Drive.
- 16-inch PVC by open cut heading west along the south side of JTB.
- 18-inch HDPE by HDD (1st location) south of JTB heading west towards east side of I-295.
- 16-inch PVC by open cut heading west then south along east side of I-295.
- 18-inch HDPE by HDD (2nd location) to go underneath I-295.
- Finally connect to a 16-inch reclaimed water main constructed by the development to the west side of I-295.

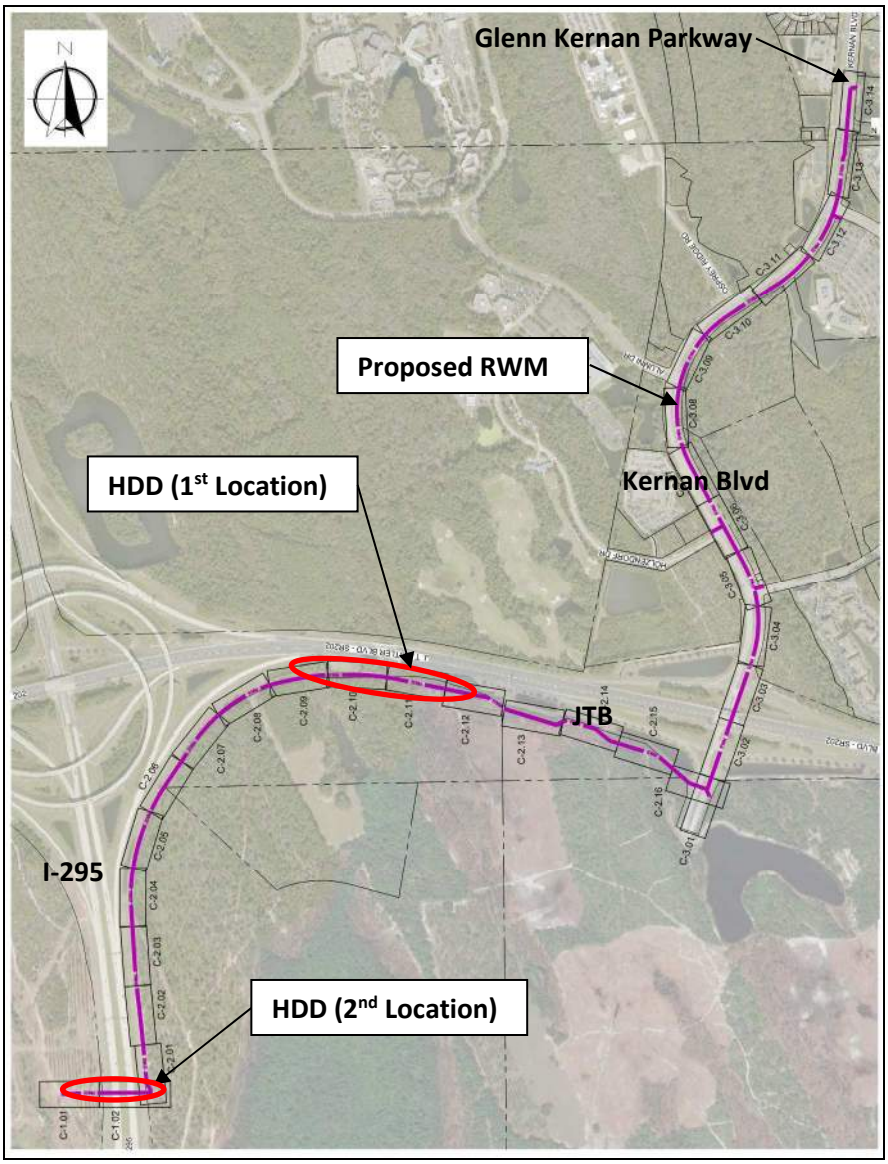



**Exhibit No. 1** – Reclaimed Water Main Alignment and HDD Locations

The existing site conditions along Kernan Boulevard consist of a four-lane urban roadway typical section with a grass median, grass shoulders curb and gutter and multi-use path. The existing conditions south of JTB and east of I-295 consists of an existing JEA easement adjacent to a dirt road which is bordered by heavily wooded areas and occasional wetlands. The site is generally flat to gently sloping. The site west of I-295, in the vicinity of the JEA easement, is an active construction site. The area is generally flat and was covered with loose fill at the time of our exploration.

## 2.0 GEOTECHNICAL EXPLORATION

### 2.1 Field Exploration

The project was explored by means of a total of 78 Standard Penetration Test (SPT) borings as follows:

- Five (5) SPT borings (D-1 through D-5) drilled to a depth of 75 feet below the existing ground surface. These borings were drilled in order to evaluate the subsurface conditions within the areas where the reclaimed water main will be installed using HDD method of installation.
- Two (2) SPT borings (M-1 and M-2) drilled to a depth of 40 feet below the existing ground surface. These borings were drilled in order to evaluate the subsurface conditions in the areas of the entry and exit points where HDD is expected to be initiated and/or terminated.
- Seventy-one (71) SPT borings (B-1 through B-67 and B-59-A through B-59-D) drilled to the depths of 10 and 15 feet below the existing ground surface. These borings were drilled in order to evaluate the subsurface conditions in the areas where the reclaimed water main will be installed using open cut excavation and Jack & Bore method of installation. It should be noted the four (4) borings B-59-A through B-59-D were drilled to delineate the limits of unsuitable wood encountered in boring B-59.

The boring locations and depths were determined by Jacobs and located in the field by personnel from CSI Geo. All borings were grouted to full depth after boring completion. Soil samples collected were visually classified in the field and then transported to our laboratory for re-classification and testing. Representative soil samples obtained during our field exploration program were visually classified using the American Association of State Highway and Transportation Officials (AASHTO) Soil Classification System. The approximate locations of the soil borings are shown on the Field Exploration Plan sheets included in the **Appendix**.

### 2.2 Laboratory Testing

Quantitative laboratory testing was performed on representative soil samples to better define their composition. Laboratory tests performed were percent fines, natural moisture content, Atterberg limits, and organic content. A Summary of Laboratory Test Results, and Field and Laboratory Test Procedures are included in the **Appendix**.

## 2.3 Environmental Classification Testing

A total of six (6) soil samples were collected from the borings along the DIP alignment along Kernan Boulevard for environmental classification testing. The test parameters included: pH, Chlorides, Sulfates, Sulfides, Resistivity, and Redox Potential.

## 3.0 GENERAL SUBSURFACE CONDITIONS

### 3.1 General

An illustrated representation of the subsurface conditions encountered in the proposed construction areas is shown on the Report of SPT Borings sheets presented in the **Appendix**. The soil conditions outlined below highlight the major subsurface stratification. The Report of SPT 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 SPT Borings, it should be understood that soil conditions may vary outside of the explored areas.

### 3.2 Soil Conditions

#### 3.2.1 Open Cut Method of Pipe Installation

Review of test borings B-1 through B-67 indicates that the reclaimed water main corridor is generally underlain by very loose to very dense sands and slightly silty sands (A-3) and loose to dense silty sands (A-2-4) until the borings termination depths of 15 feet below the existing grades. An isolated layer of medium dense clayey sands (A-2-6) was encountered in boring B-60.

It should be noted that several layers of unsuitable organic soils and wood pieces (A-8) were encountered in several borings at variable depths, but generally between 4 and 8 feet of depth in borings B-27, B-32, B-37, B-38, B-43, B-48 through B-51, B-56, B-59-B, B-59, B-64, and B-65.

#### 3.2.2 Jack & Bore Method of Pipe Installation

Review of test borings B-52 and B-53 indicates the area of the proposed Jack & Bore is generally underlain by loose to medium dense sands (A-3) until the borings termination depths of 15 feet below the existing grades.

#### 3.2.3 Horizontal Directional Drilling Areas

As discussed earlier, the reclaimed water main corridor where HDD method of installation is proposed was explored by means of test borings D-1 through D-5, offset 20 feet from the reclaimed water main alignment, and test borings M-1 and M-2, performed at the workspace entry point areas where HDD will be initiated and/or terminated. Review of the test borings

indicates areas of HDD is generally underlain by very loose to very dense sands, slightly silty sands (A-3), and silty sands (A-2-4) with varying amounts of shell content until the borings termination depth of 75 feet below the existing grades. Interbedded and isolated layers of sandy silt (A-4) and clayey sands (A-2-6) were encountered in borings D-2 and D-4, respectively.

## 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 location are marked on the Report of SPT Borings sheets presented in the **Appendix**. The depth of groundwater level measured at the time of drilling ranged from 2.0 to 14.5 feet below the existing ground surface. The estimated seasonal high groundwater table for the borings performed ranged from 1.0 to 9.0 feet below the existing ground surface. However, it is anticipated that seasonal high groundwater will be at the surface or higher in the wetland areas.

Determination of the estimated seasonal high groundwater table was made using the methodology described by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS). In sandy soils the method involves examining soil cuttings from the borings for subtle changes in root content and soil coloration. These subtle changes are indicators of the highest level the groundwater level has been for a prolonged period. 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

Pavement cores were conducted at of the SPT borings performed through the pavement along Kernan Boulevard to determine the thickness of the existing pavement system. Generally, the existing pavement system was found to consist of 1 ½ to 8 ½ inches of asphalt underlain by 4 to 14 inches of limerock. The results of the pavement cores are included in the **Appendix**.

## 3.5 Environmental Classification Test Results

The FDOT Structural Design guidelines were used to classify the soil samples collected, and the recommended environmental classification and results are presented in the Environmental Corrosion Test Results sheet 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.

### 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-6/A-7) should be considered plastic materials. Therefore, 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. It is cautioned that portions of the pipe alignment are underlain by organic and unsuitable soils (A-8). These soils should be replaced with select A-3 material prior to the installation of the reclaimed water main. When A-8 materials are encountered, they should be removed in their entirety from the locations presented in the table below. It is very likely that the excavated suitable soils will get mixed with organic unsuitable soils (A-8) during construction. Therefore, it is our opinion that some of the excavated material will get mixed with organic soils and, therefore, 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 backfill. It should be noted that unsuitable soils boundaries and limits are approximate and represent soils encountered at each boring location. Subsurface variance between borings may occur and should be anticipated.

Location and Approximate Depth and Thickness of Unsuitable Material

| Boring No. | Approximate Boring Station | Depth Encountered (ft) | Thickness of Unsuitable Material (ft) |
|---|---|---|---|
| B-27 | 269+00 | 6 | 2 |
| B-32 | 279+00 | 2 | 2 |
| B-37 | 310+60 | 4 | 2 |
| B-38 | 313+80 | 4 | 2 |
| B-43 | 324+80 | 8 | 2 |
| B-48 | 333+80 | 6 | 2 |
| B-49 | 335+80 | 6 | 2 |
| B-50 | 337+80 | 4 | 2.5 |
| B-51 | 339+80 | 6 | 2 |
| B-56 | 349+80 | 8 | 3 |
| B-59-B | 355+40 | 5 | 1 |
| B-59 | 355+70 | 6 | 2 |
| B-64 | 366+80 | 2 | 2 |
| B-65 | 368+80 | 2 | 2 |

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 line 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 Recommended Design Soil Parameters for Jack & Bore

Jack & Bore will be used to install a 30-inch DIP reclaimed water main with a 48-inch steel casing underneath existing box culverts at the intersection of Kernan Boulevard and Alumni Drive.

Pipes installed using Jack & Bore should follow the latest JEA Water & Wastewater Standards Manual. We recommend that soil parameters and assumptions for the Jack & Bore design to follow the information provided in the table as follows:

Recommended Design Soil Parameters for Jack & Bore

| Soil Parameter | Loose to Medium Dense Sands |
|---|---|
| Depth (ft) | 0.0 to 15.0 |
| Saturated Unit Weight – $\gamma$ (pcf) | 110 |
| Submerged Unit Weight – $\gamma'$ (pcf) | 48 |
| Angle of Internal Friction – $\phi$ (degrees) | 31 |
| Cohesion – C (psf) | --- |
| At Rest Earth Pressure Coefficient – $K_o$ | 0.48 |
| Active Earth Pressure Coefficient - $K_a$ | 0.32 |
| Passive Earth Pressure Coefficient - $K_p$ | 3.12 |

## 4.4 Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)

Horizontal Directional Drilling will be used to install the reclaimed water main below wetland along JTB and below I-295. Pipes installed using HDD should follow the latest JEA Water & Wastewater Standards Manual. We recommend that soil parameters assumptions and interpretations for the horizontal directional drilling design follow the information provided in the Recommended Design Soil Parameters for Horizontal Directional Drilling tables included in the **Appendix**. Soil parameters provided in the tables are representative of the soil conditions at the variable depths and have been generated based on N-values that were corrected for hammer efficiency and overburden pressure.

## 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 2.0 to 14.5 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. Similarly, dewatering at the Jack & Bore location should be maintained at two feet below the 48-inch casing invert elevation and below the jacking & receiving pits. 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. A trench box or braced sheet pile structures may be considered to support open excavations. The soil support system shall be designed according to OSHA by a Florida registered Professional Engineer.

### 5.4 Pipe Backfill and Compaction of Pipe Backfill

The A-3 and (A-2-4) type soils are considered select material and suitable for use as backfill. Some of the excavated soils during pipe installations are anticipated to consist of plastic clayey sands (A-2-6), sandy clays (A-6/A-7), and organic soils (A-8), which should be considered unsuitable for backfilling and compaction purposes. As mentioned earlier, some of the excavated suitable soils will likely get mixed with organic/unsuitable soils during construction. Therefore, some of 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 6 inches in thickness. The backfill material shall be compacted by the use of hand-operated equipment. The backfill material shall 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 shall be maintained within $\pm$ 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 2 feet. 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 project location 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

Environmental Corrosion Test Results

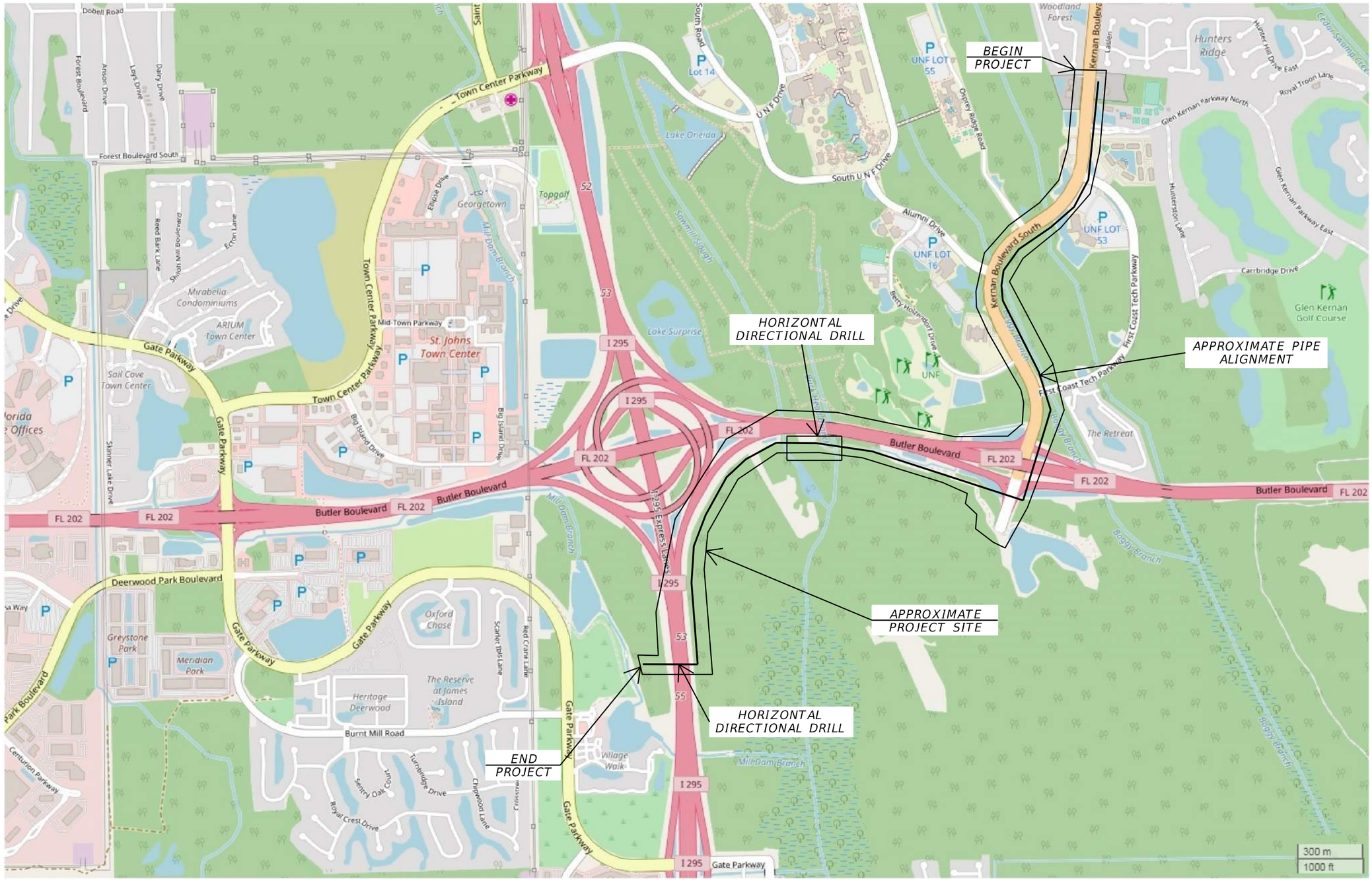
Recommended Design Soil Parameters for Horizontal Directional Drilling

Existing Pavement System Thickness

Key to Soil Classification

Field and Laboratory Test Procedures

# Site Location Map



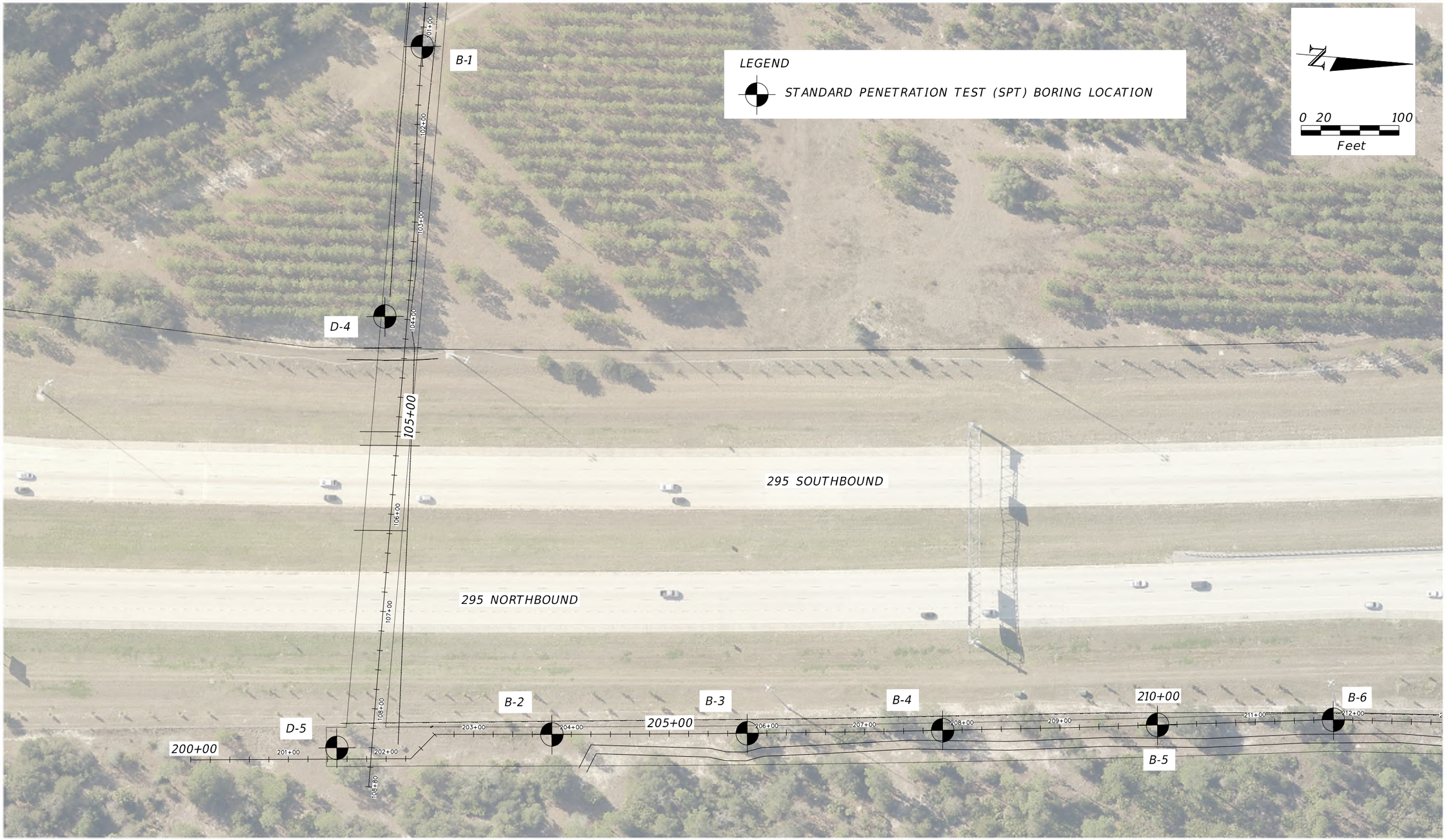

CSIGeo
GEOTECHNICAL·CMT·CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# SITE LOCATION MAP

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

# Field Exploration Plan




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

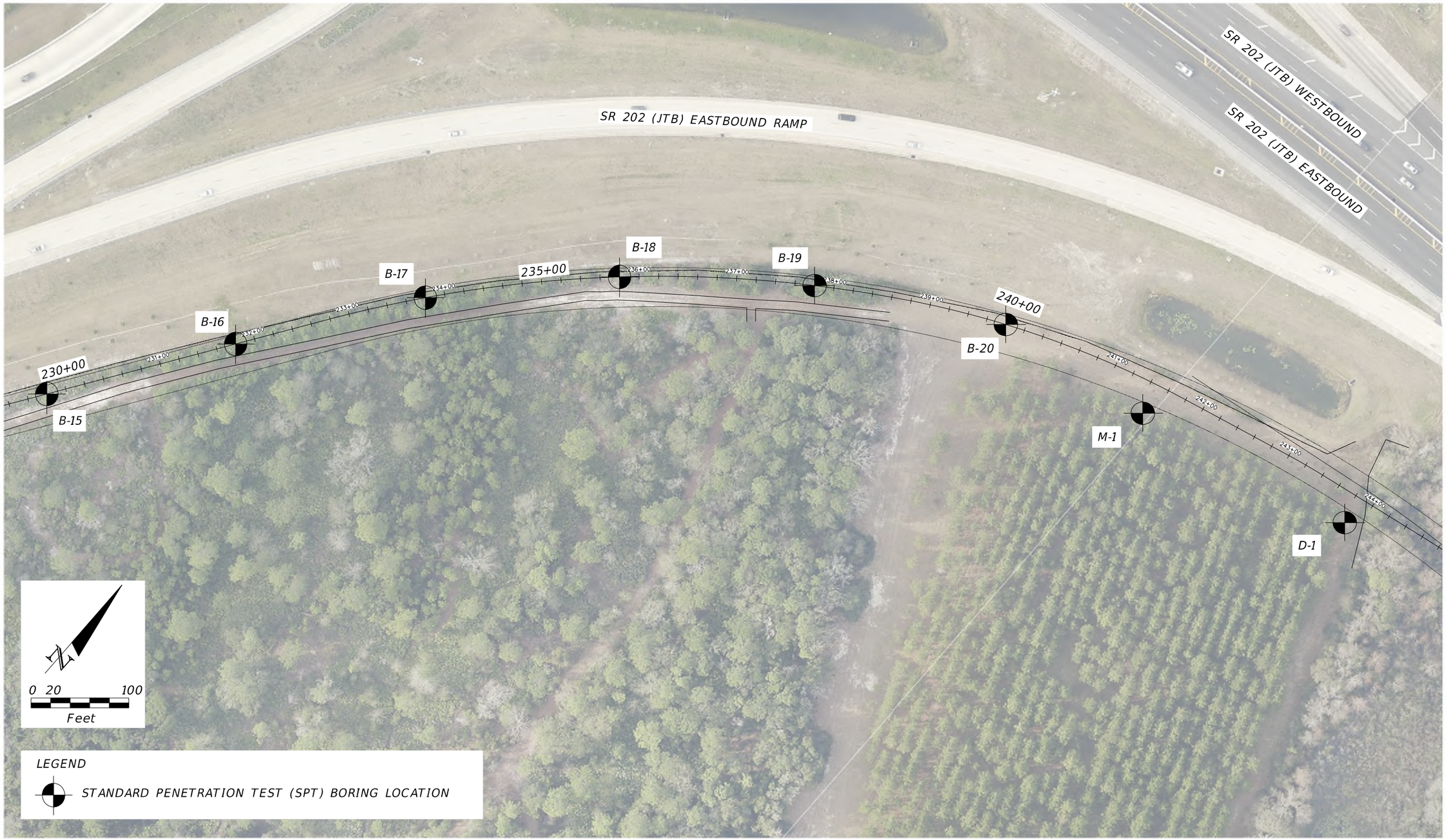
JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA


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

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

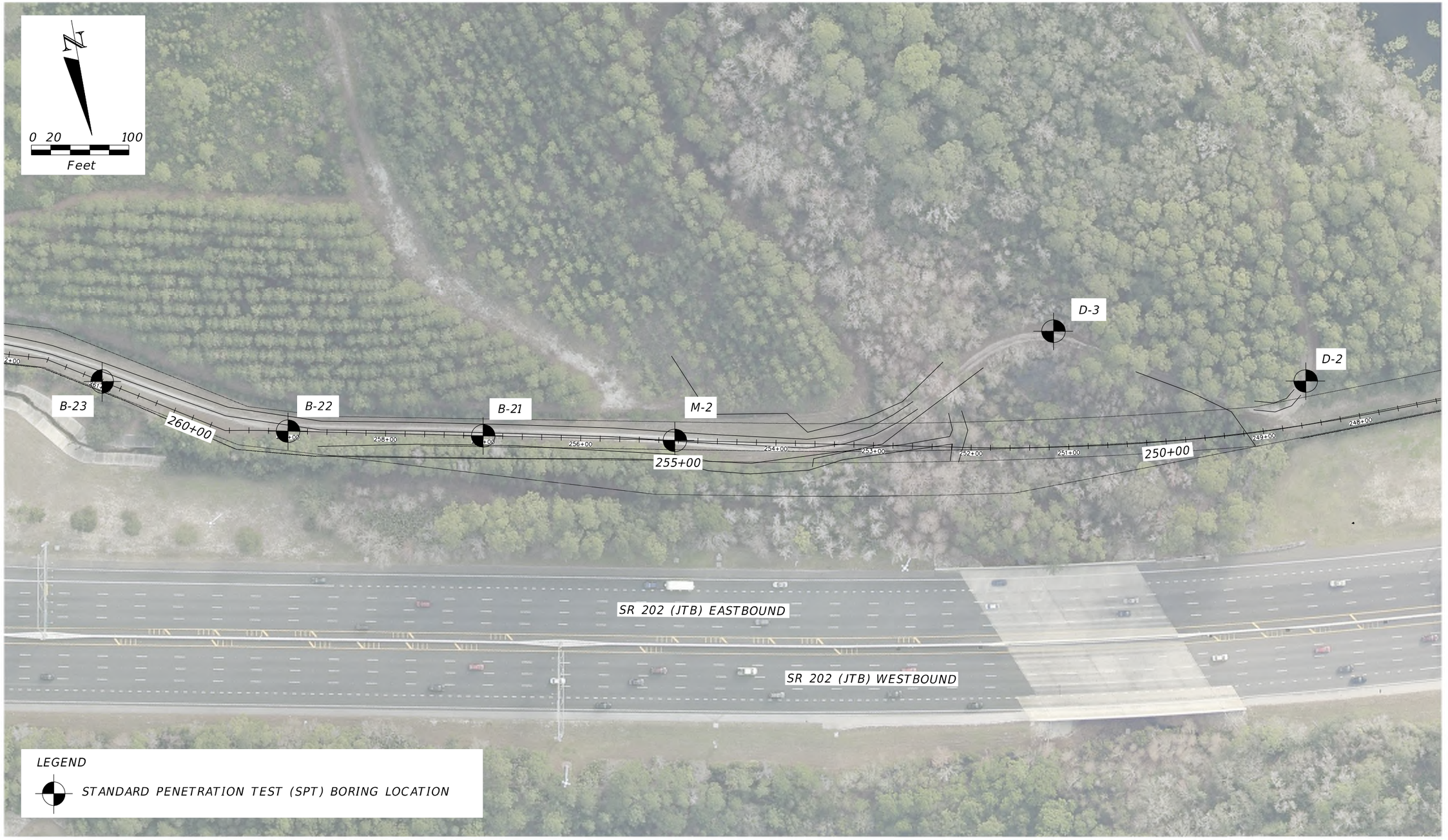



CSIGeo
GEOTECHNICAL·CMT·CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# FIELD EXPLORATION PLAN

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

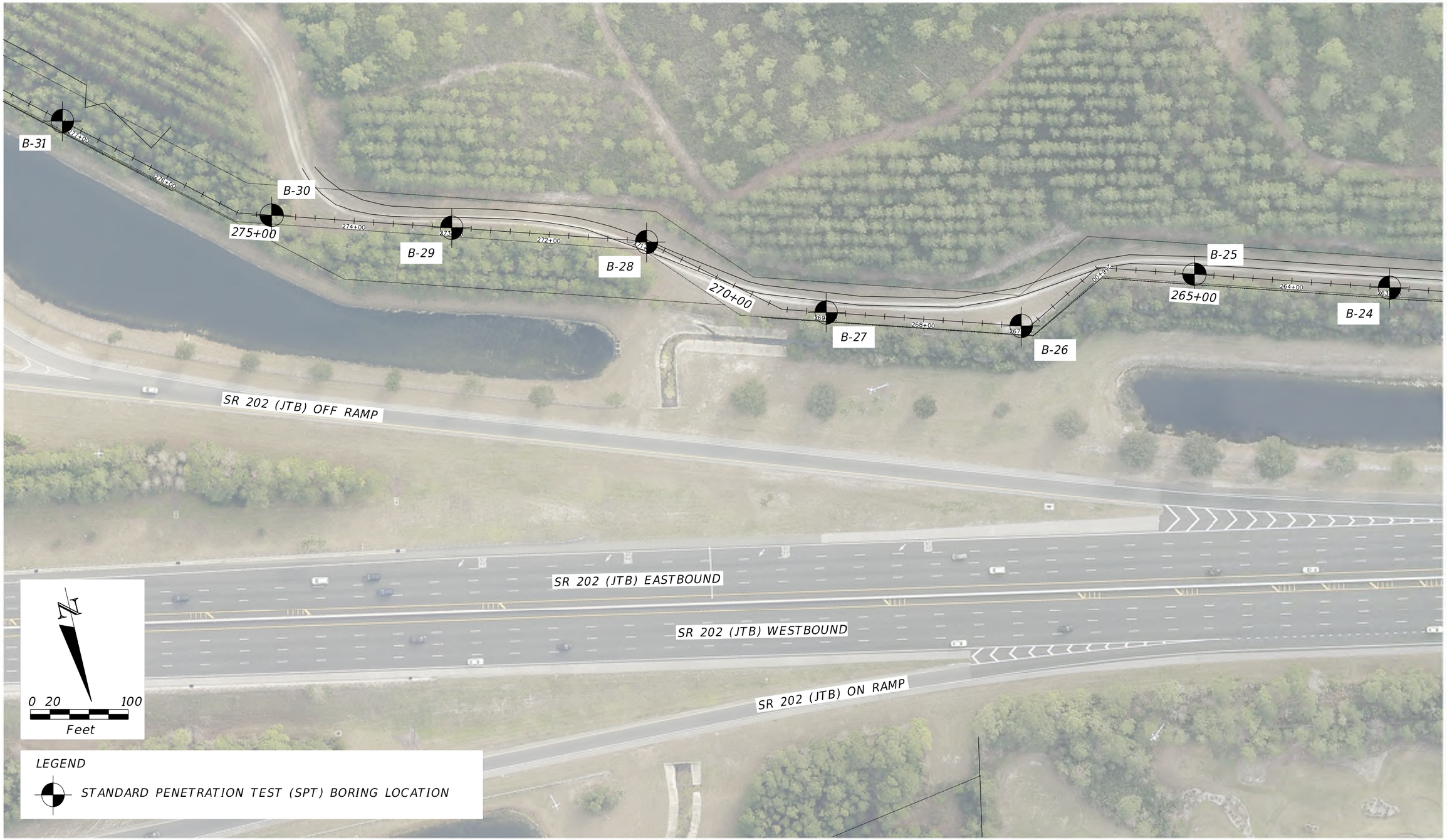



CSIGeo
GEOTECHNICAL·CMT·CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# FIELD EXPLORATION PLAN

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

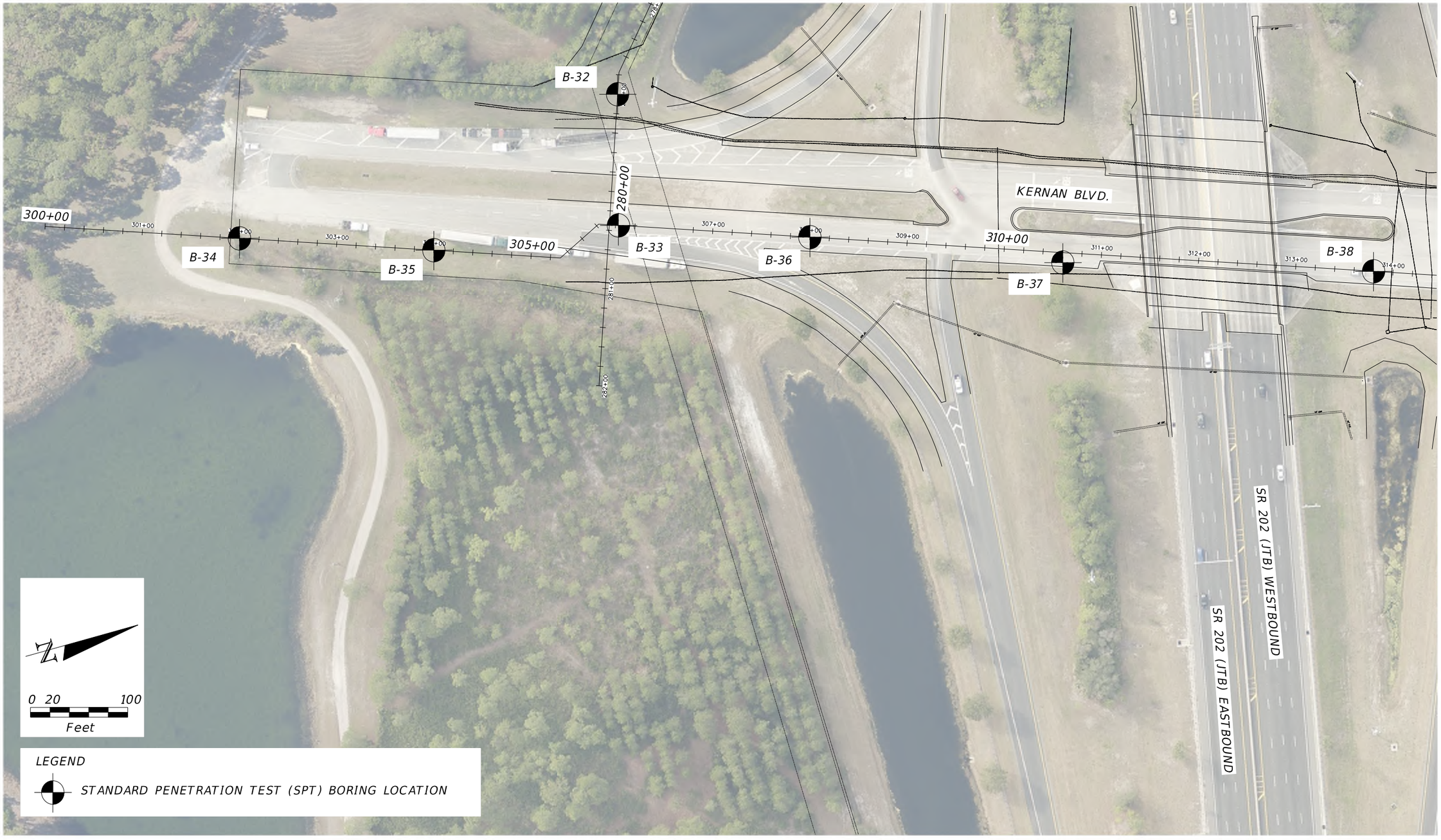



CSIGeo
GEOTECHNICAL·CMT·CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# FIELD EXPLORATION PLAN

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

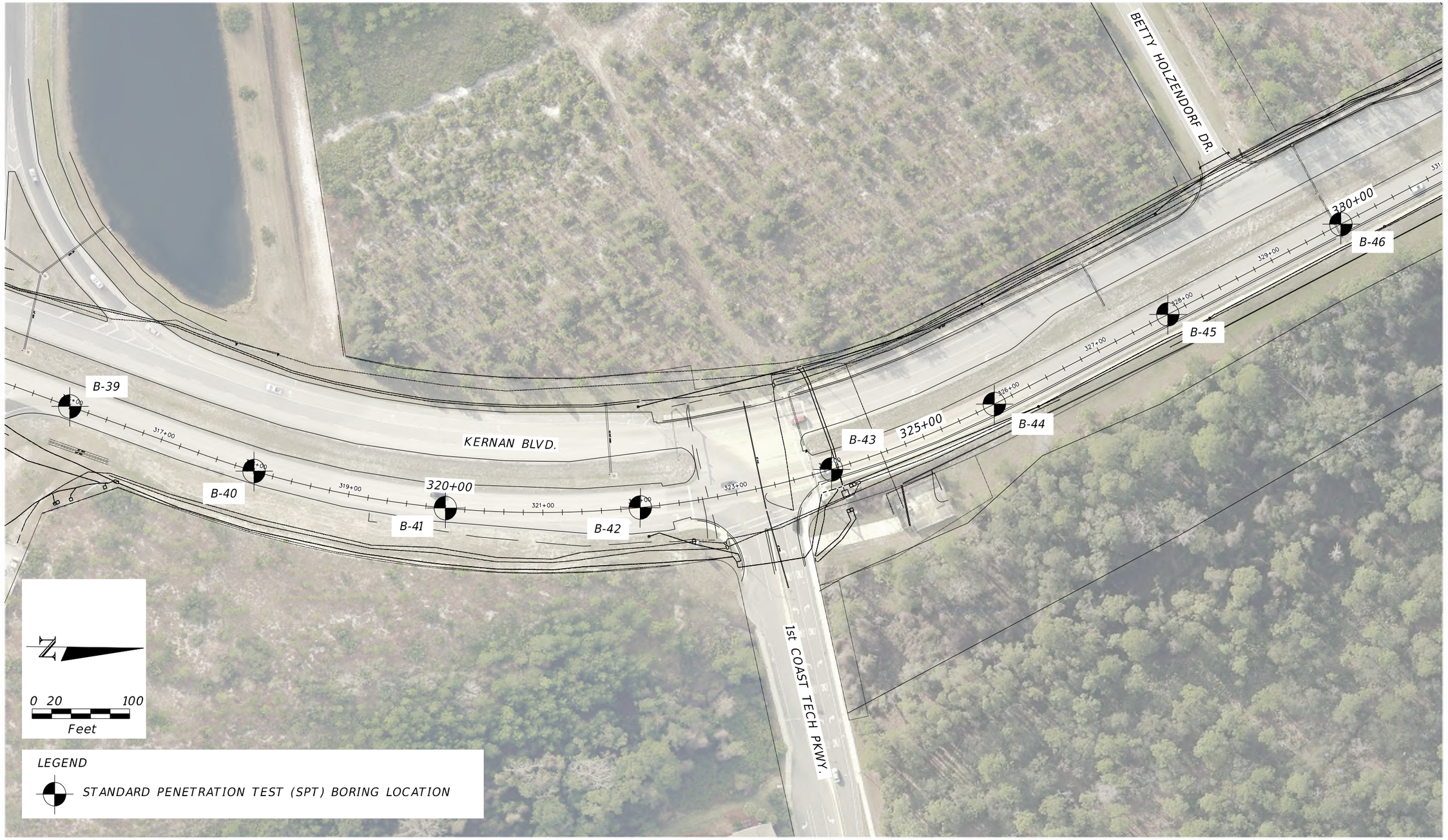



CSIGeo
GEOTECHNICAL·CMT·CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# FIELD EXPLORATION PLAN

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

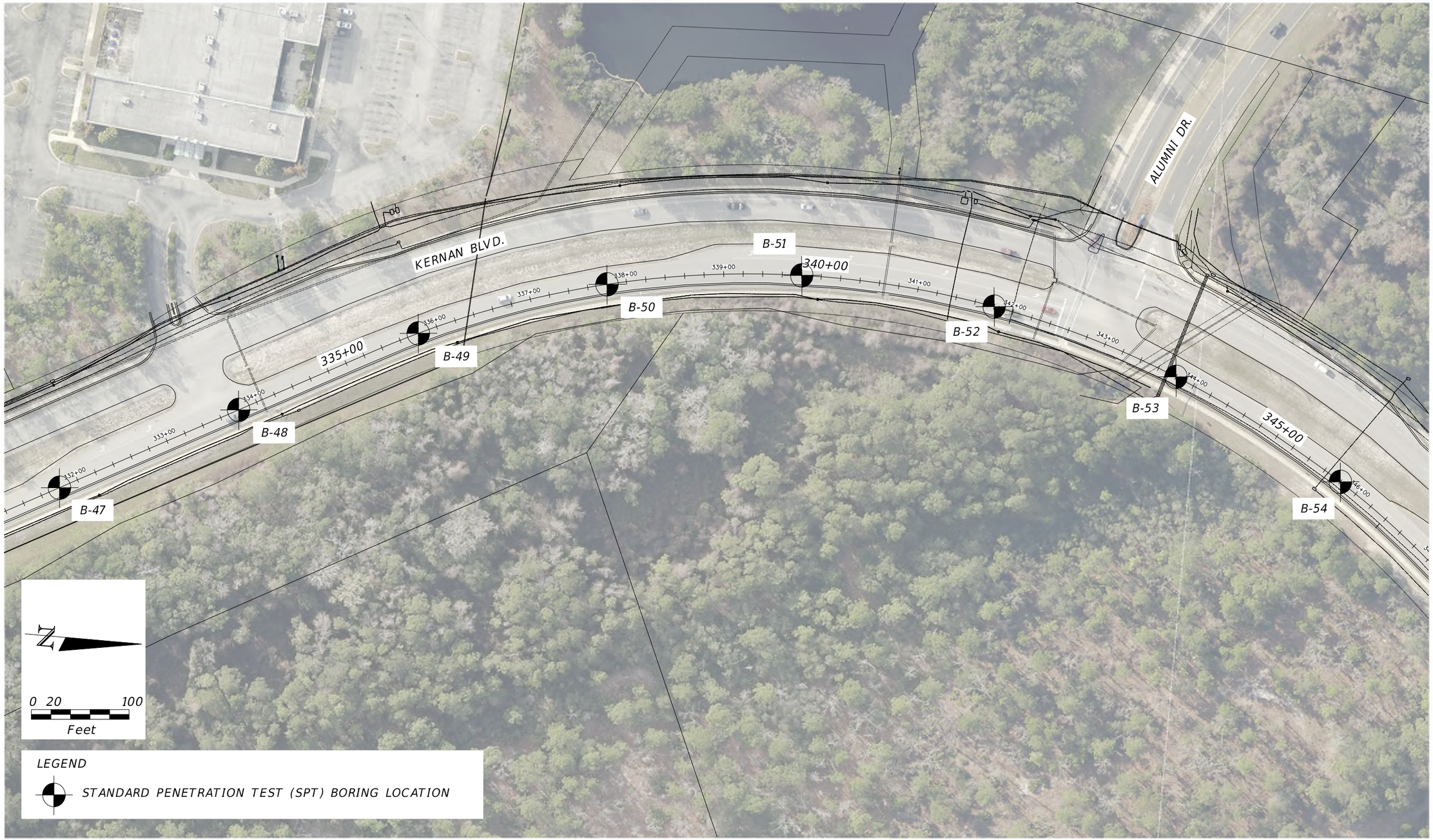



CSIGeo
GEOTECHNICAL·CMT·CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# FIELD EXPLORATION PLAN

JEA GATE PARKWAY–GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

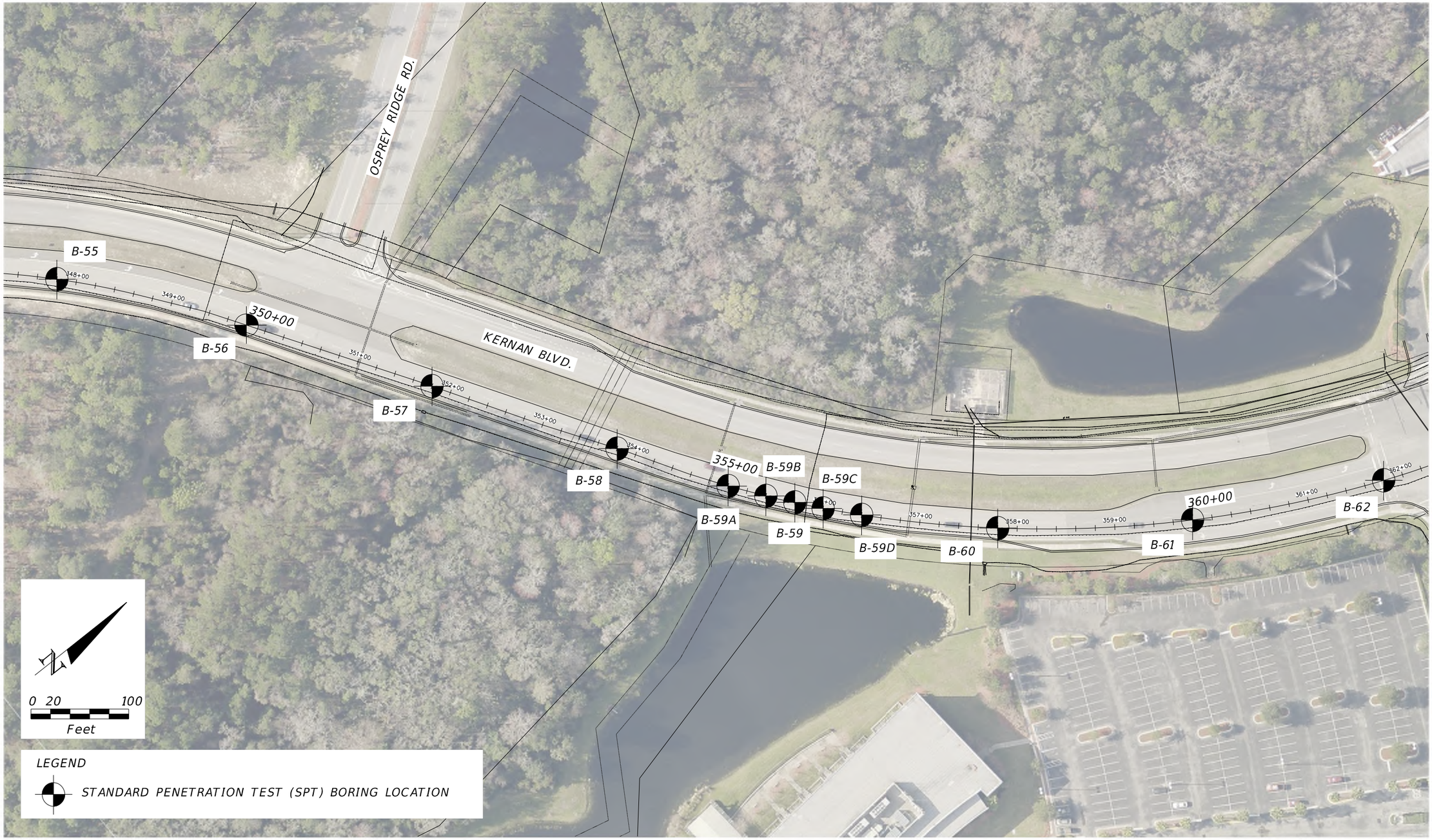



CSIGeo
GEOTECHNICAL·CMT·CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# FIELD EXPLORATION PLAN

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

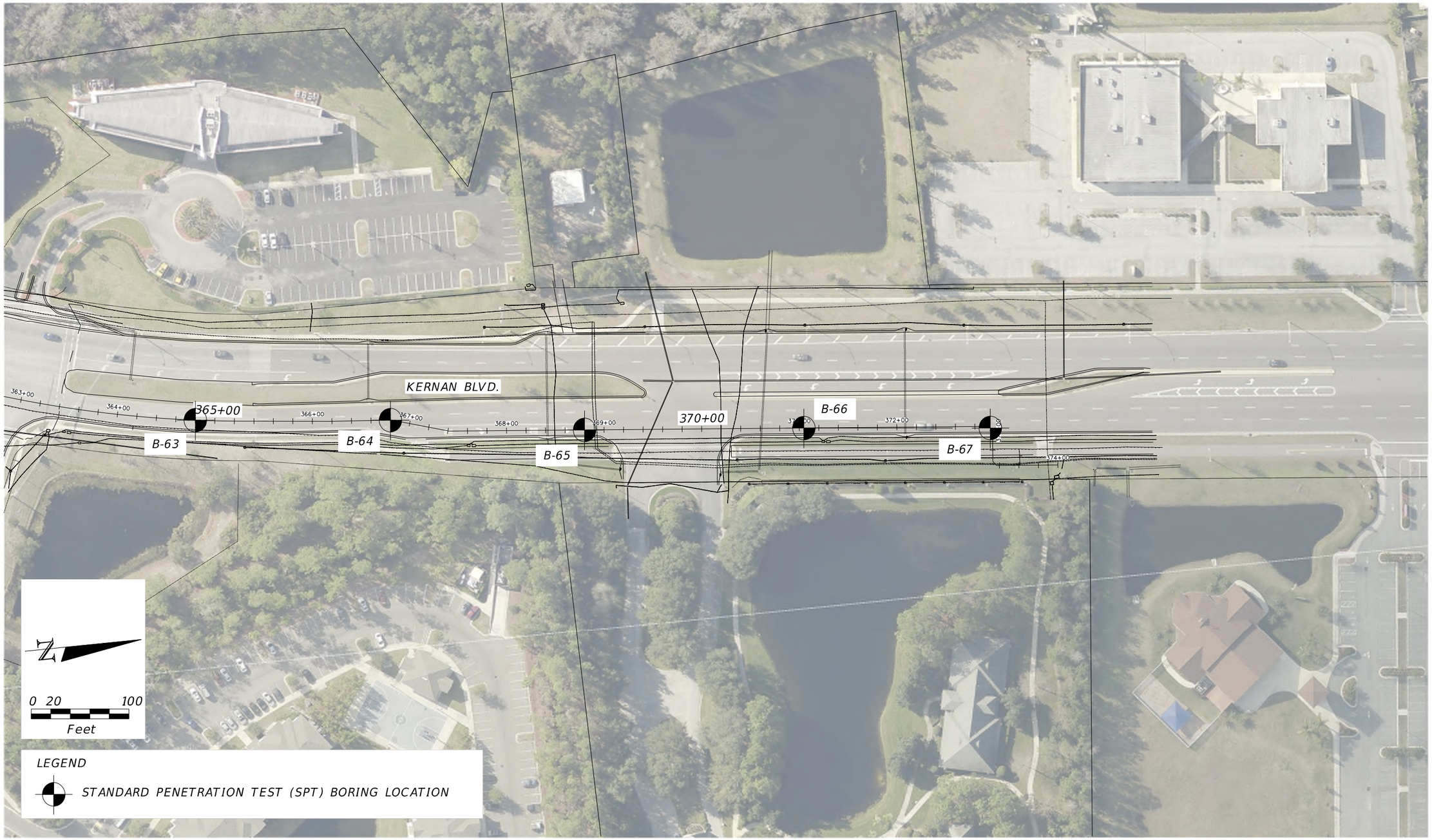



CSIGeo
GEOTECHNICAL·CMT·CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# FIELD EXPLORATION PLAN

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, 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

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

# Report of SPT Borings

LEGEND

FINE SAND (A–3);
SLIGHTLY SILTY FINE SAND (A–3)

SILTY FINE SAND (A–2–4)

CLAYEY FINE SAND (A–2–6)

SANDY SILT (A–4)

ORGANIC SAND;
WOOD (A–8)

SHELL FRAGMENTS

(A–3) AASHTO SOIL CLASSIFICATION SYSTEM

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

ESTIMATED SEASONAL HIGH GROUNDWATER LEVEL

GROUNDWATER LEVEL AT TIME OF DRILLING

B.T. STANDARD PENETRATION TEST BORING TERMINATION

W.O.H. WEIGHT OF HAMMER

W NATURAL MOISTURE CONTENT (%)
−200 FINES PASSING NO. 200 SIEVE (%)
OC% ORGANIC CONTENT (%)
LL LIQUID LIMIT
PI PLASTICITY INDEX

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 |

SILT 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

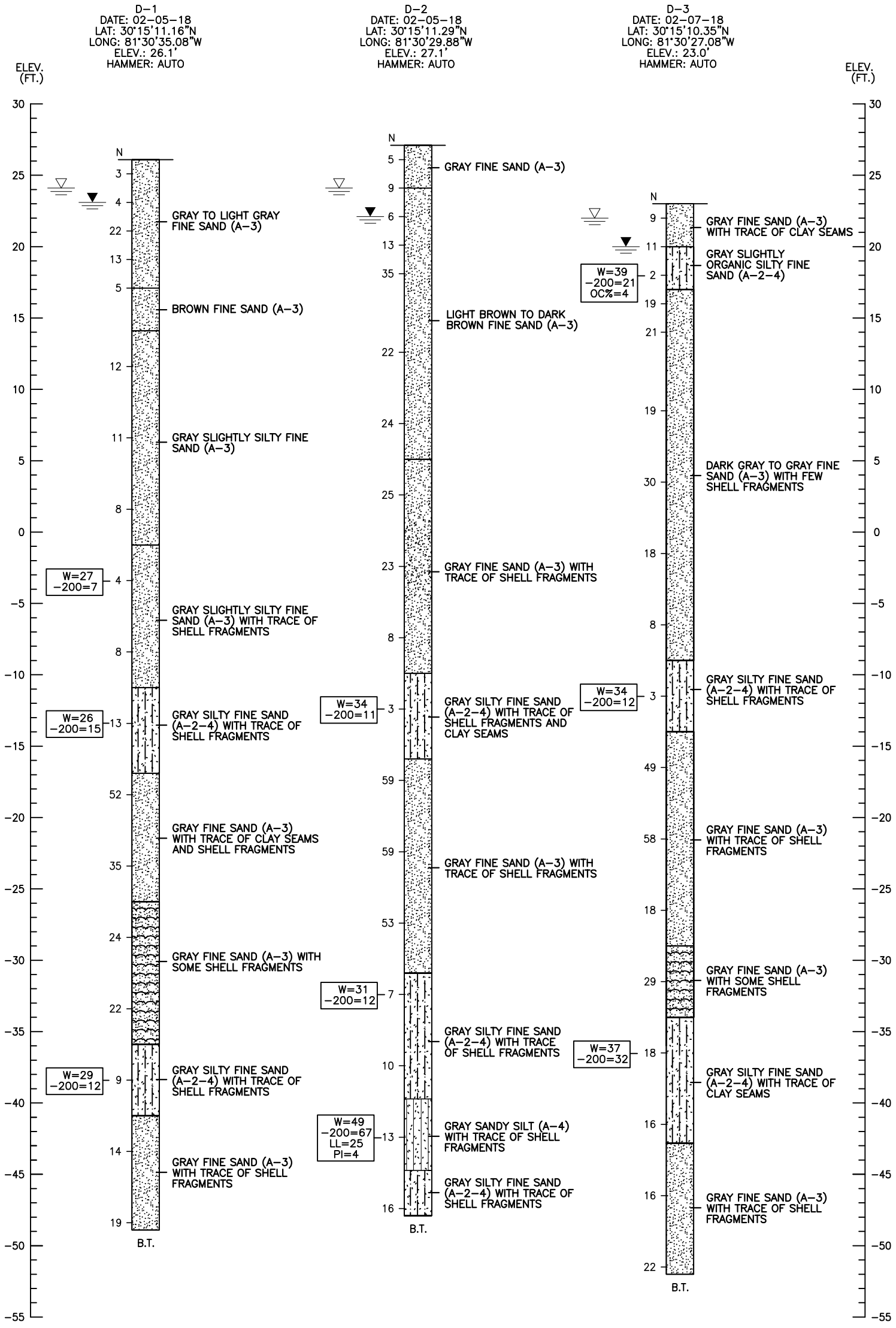
SPOON INSIDE DIA. 1.44 INCHES
SPOON OUTSIDE DIA. 2.0 INCHES
ASTM STANDARD DROP HAMMER, AUTO.

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.





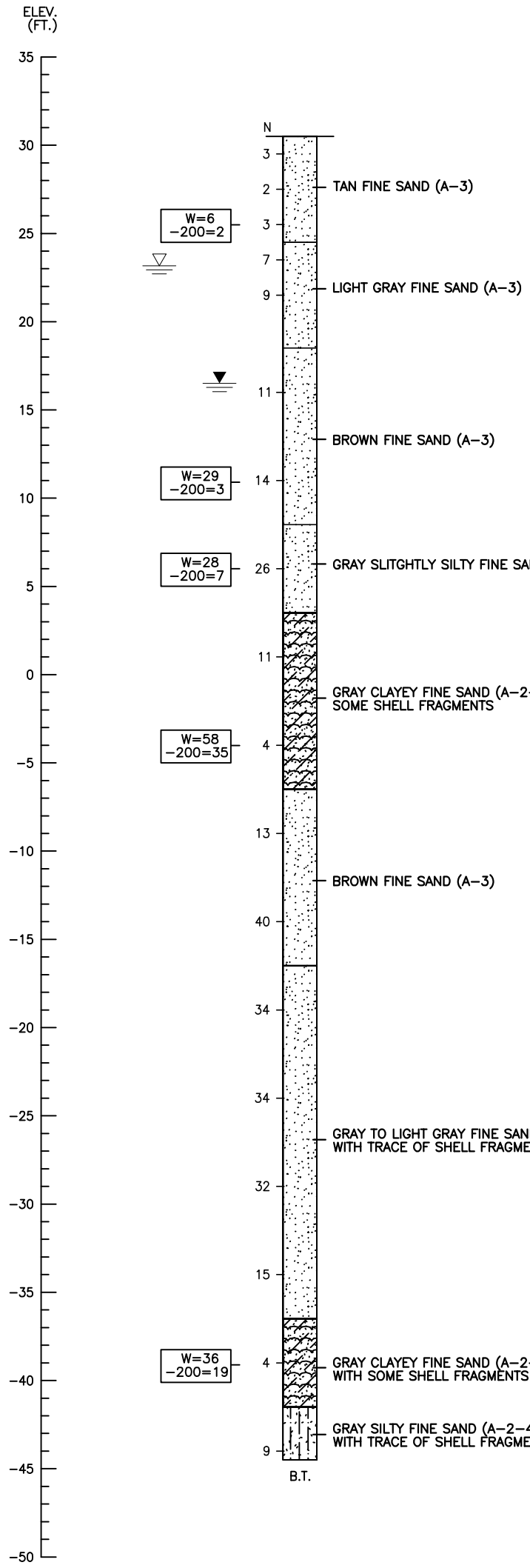
CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246


GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

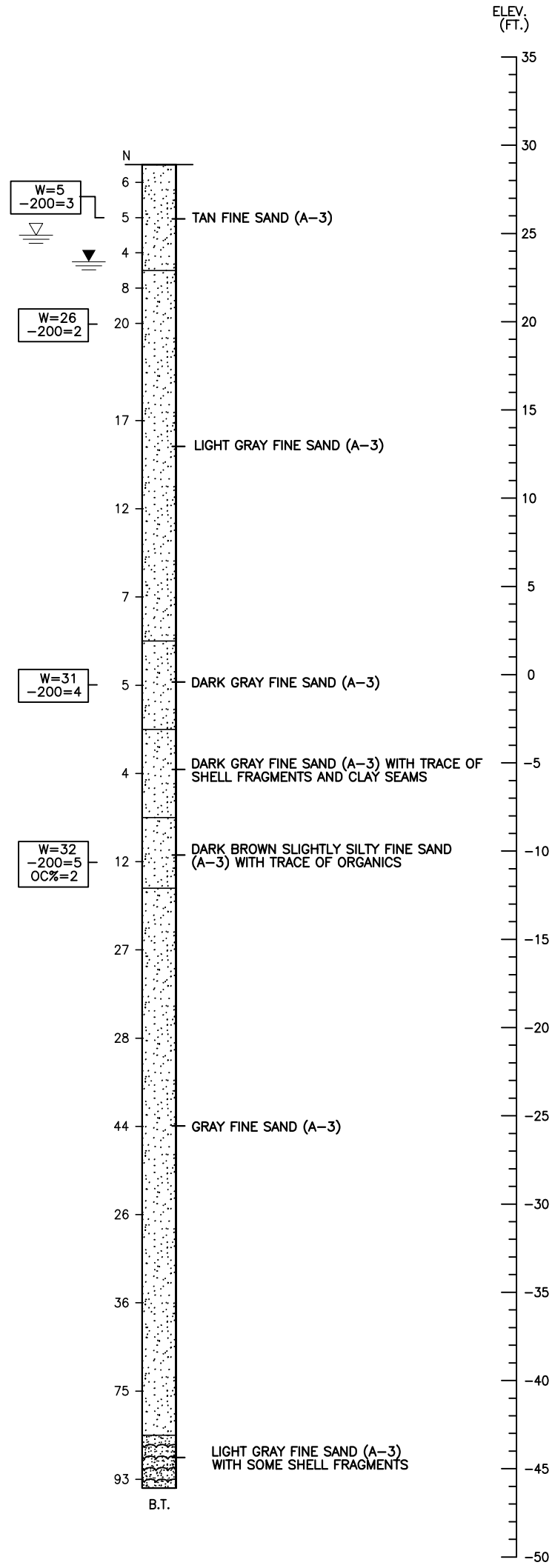
# REPORT OF SPT BORINGS

JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

D–4
DATE: 02–20–18
LAT: 30°14'36.47"N
LONG: 81°30'54.67"W
ELEV.: 30.5'
HAMMER: AUTO



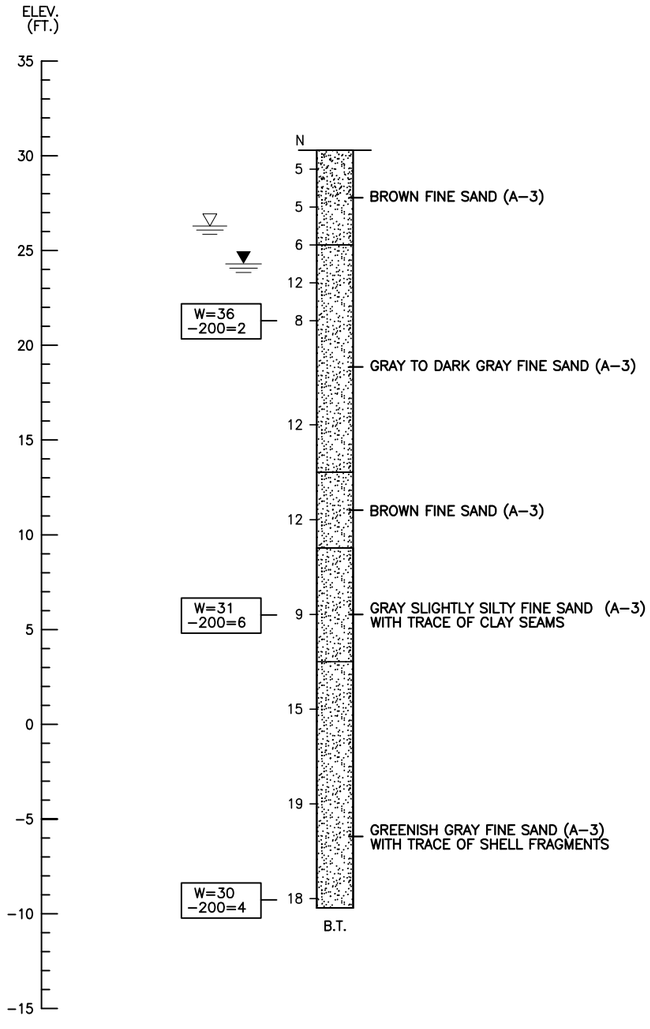

D–5
DATE: 02–19–18
LAT: 30°14'36.39"N
LONG: 81°30'49.60"W
ELEV.: 28.9'
HAMMER: AUTO

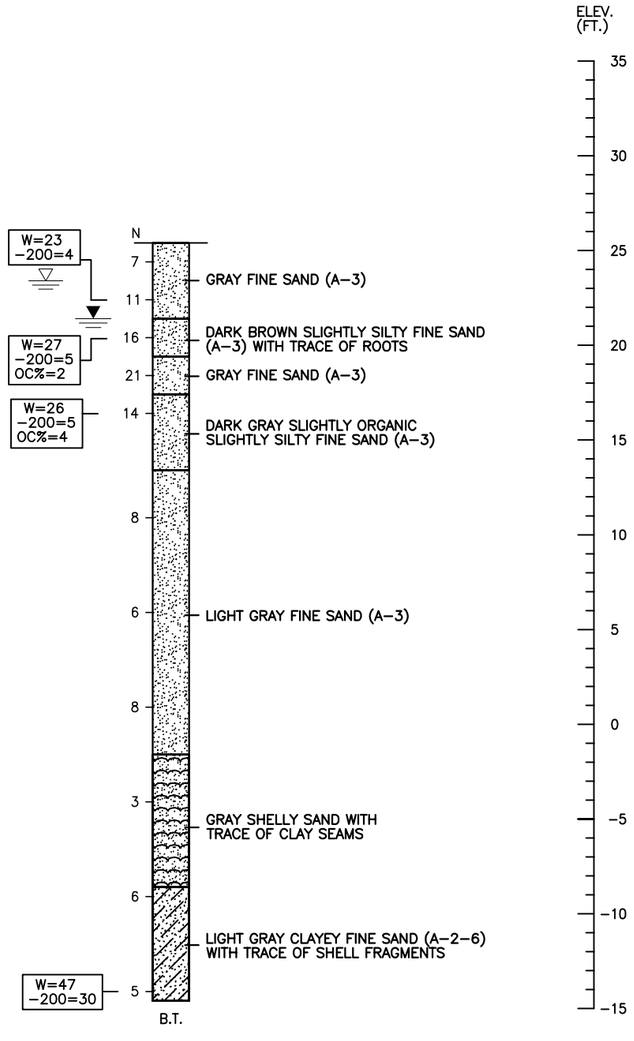



CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

**REPORT OF SPT BORINGS**
JEA GATE PARKWAY–GLEN KERNAN TO T–LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA



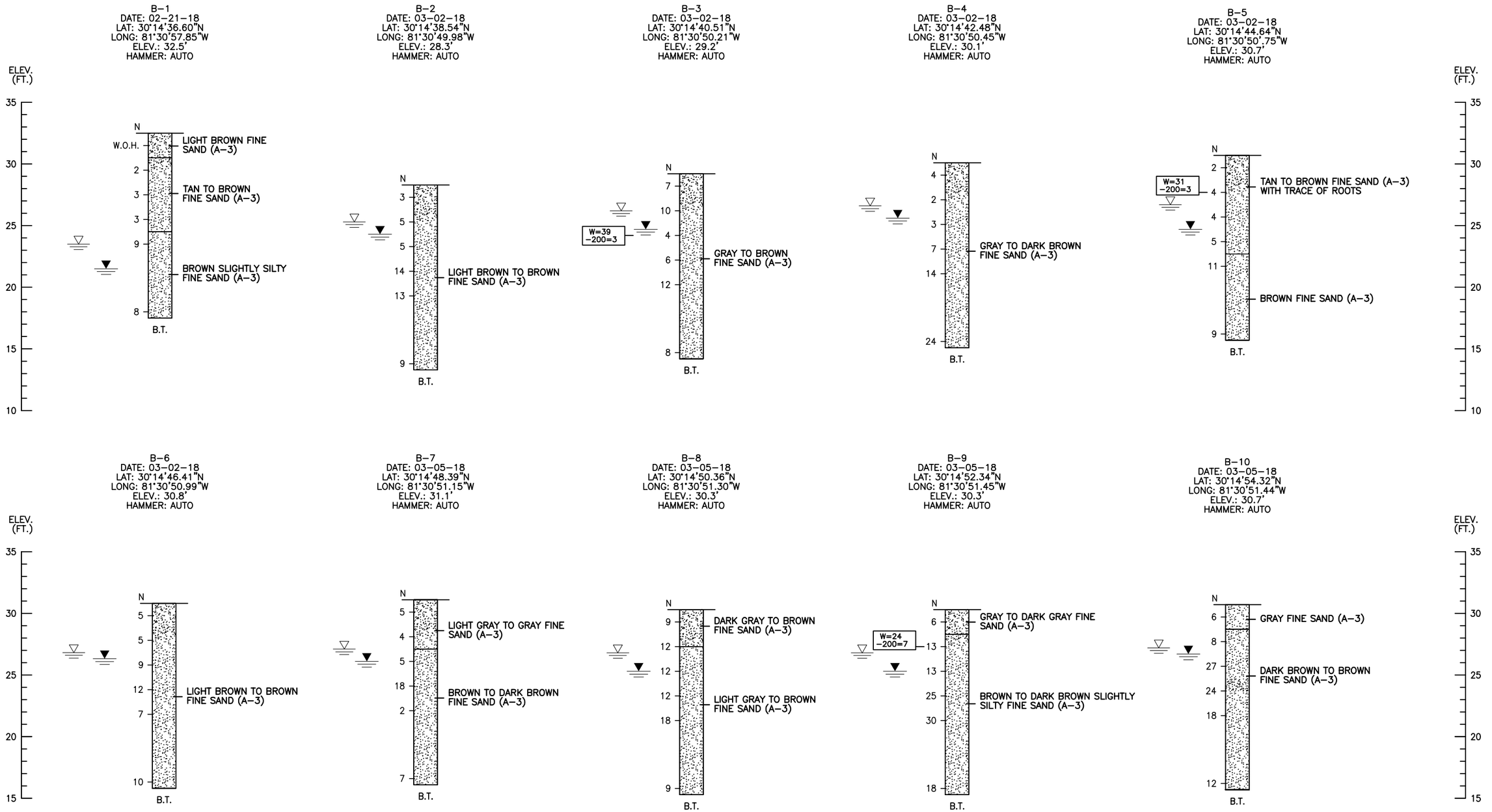




CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

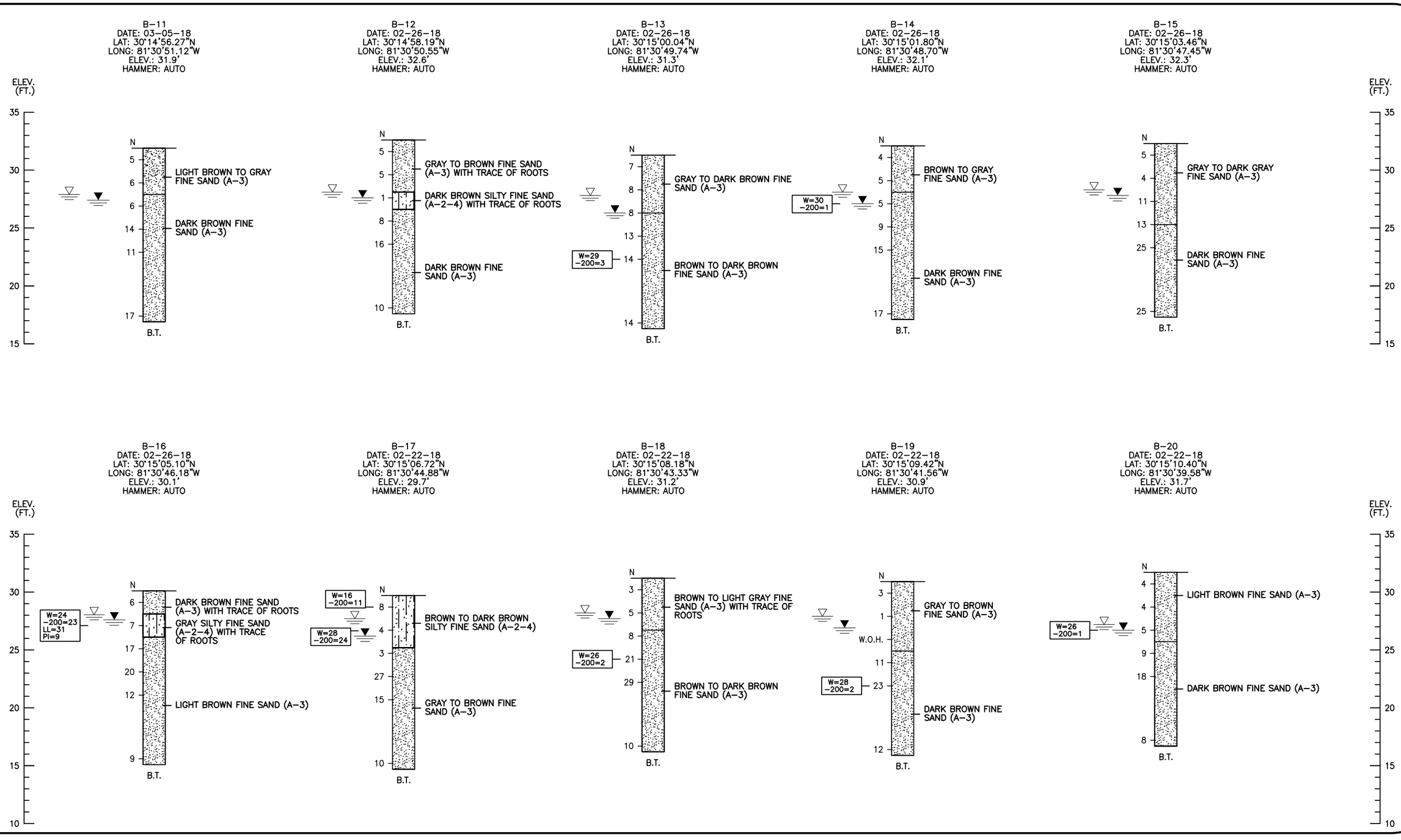



CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

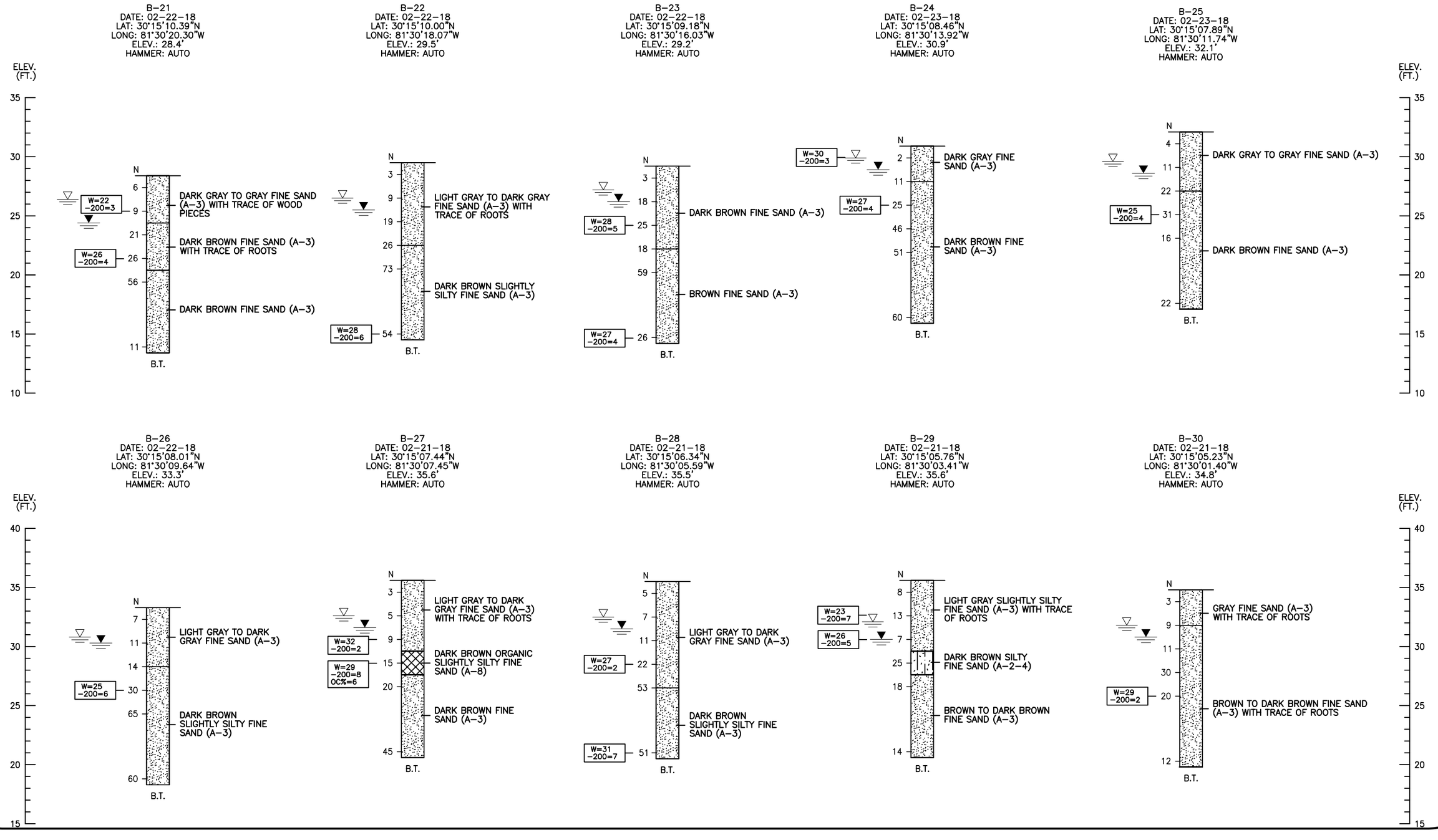



CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

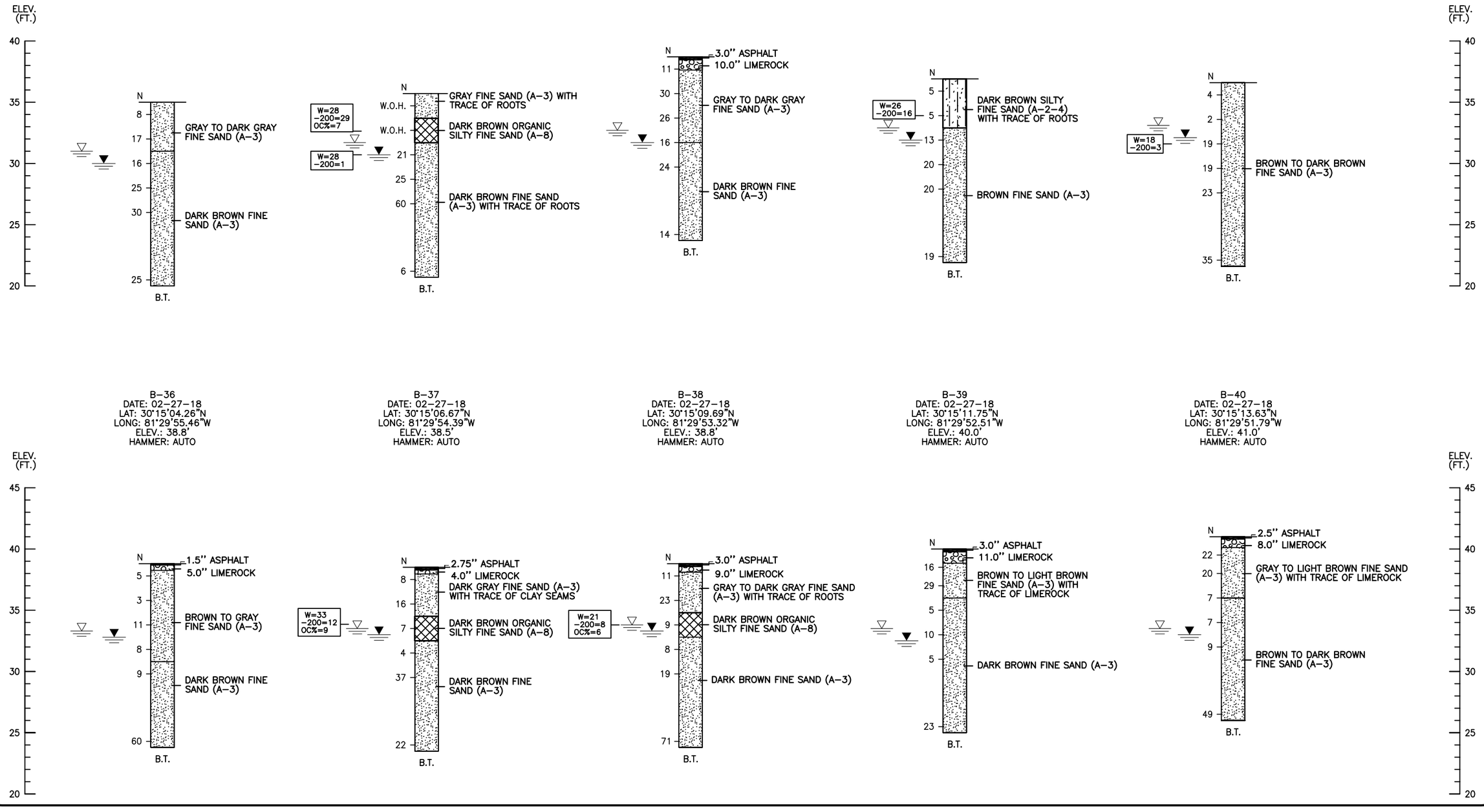



CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

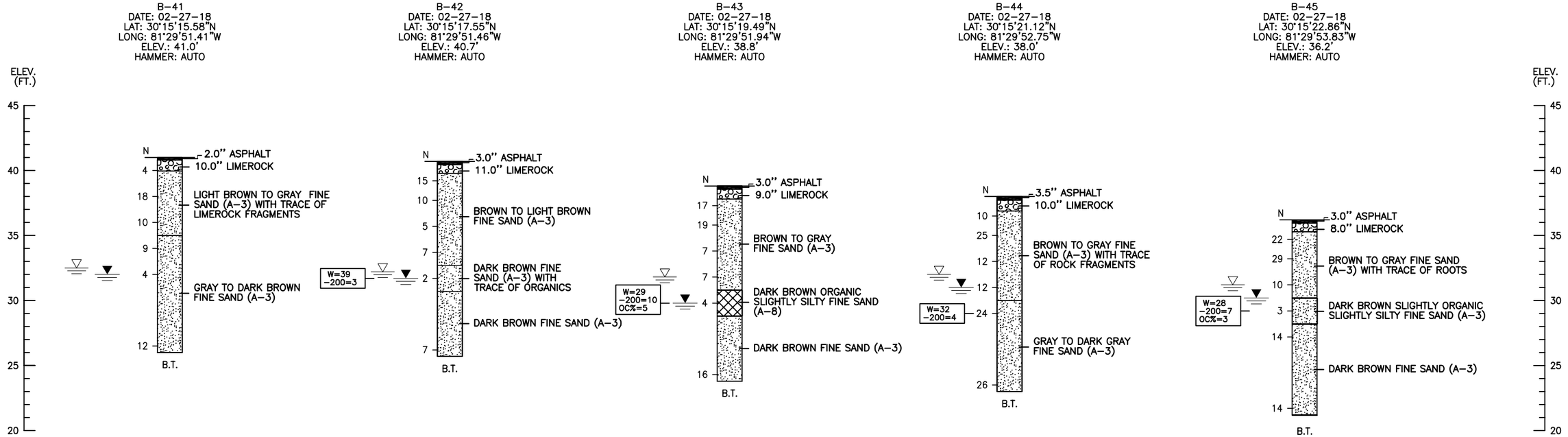



CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

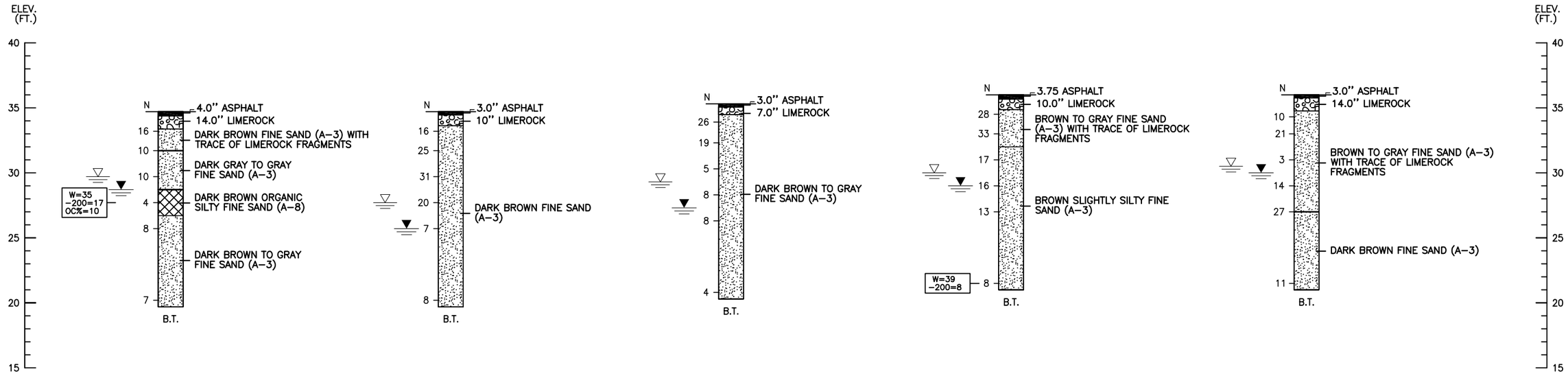



CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

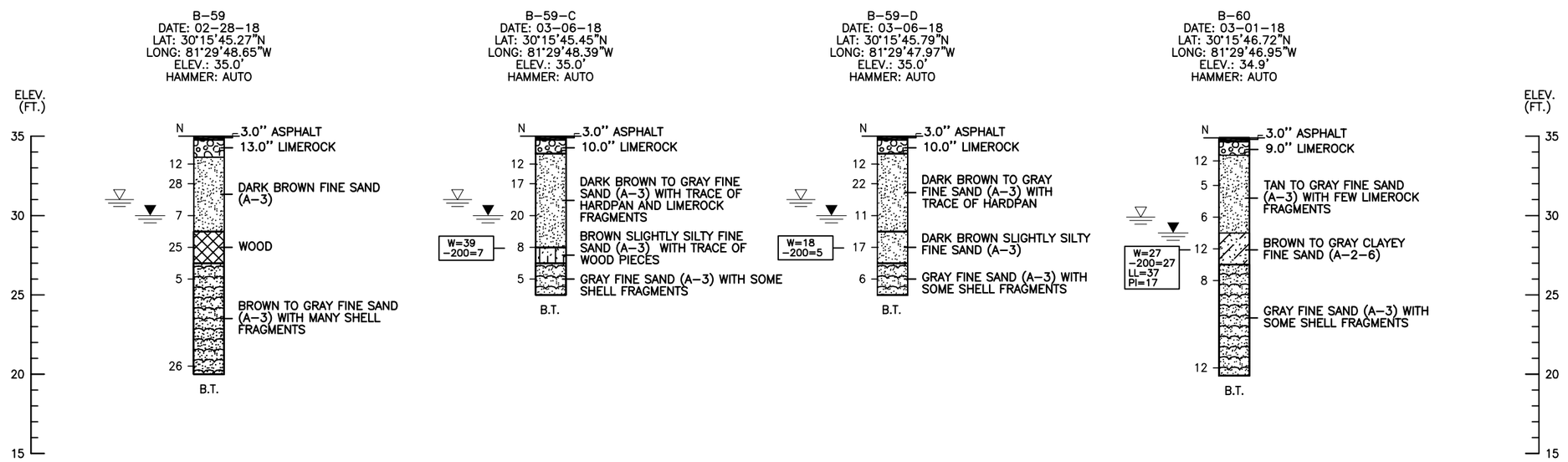



CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

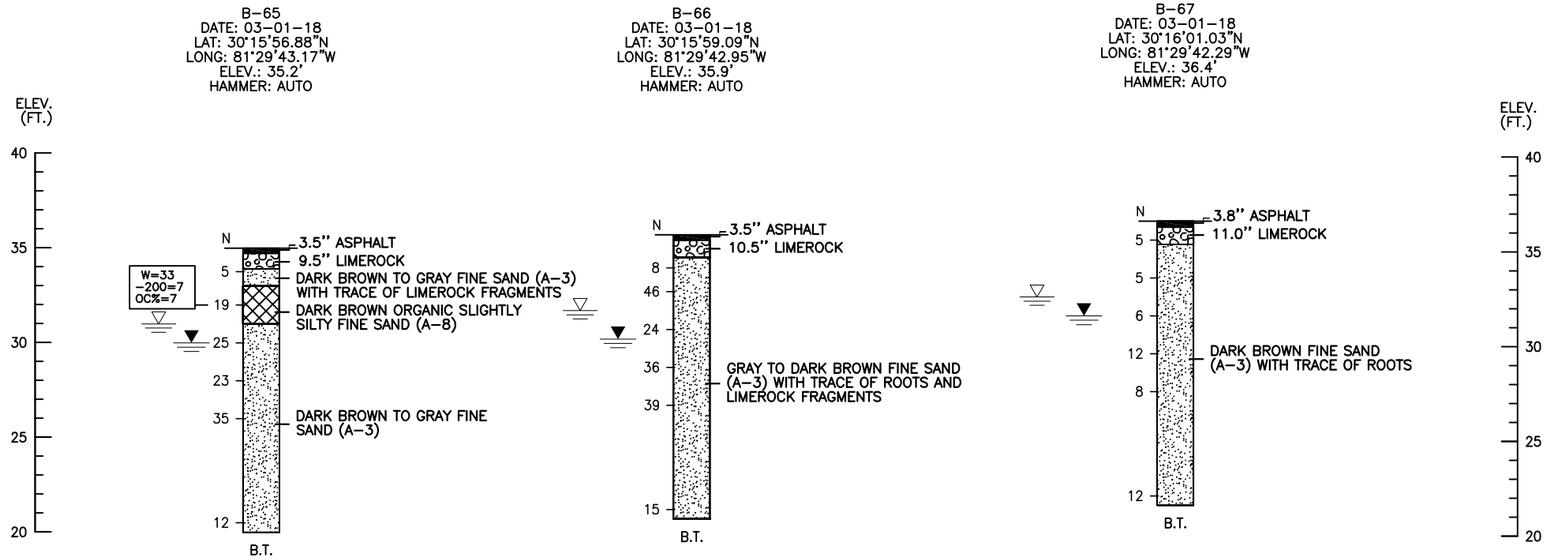



CSIGeo
GEOTECHNICAL · CMT · CEI
2394 ST. JOHNS BLUFF ROAD, S. SUITE 200
JACKSONVILLE, FLORIDA 32246

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA




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

GEOTECHNICAL ENGINEERING
CONSTRUCTION MATERIAL TESTING
CONSTRUCTION ENGINEERING INSPECTION

# REPORT OF SPT BORINGS

GATE PARKWAY-GLEN KERNAN TO T-LINE
RECLAIMED WATER TRANSMISSION MAIN
JACKSONVILLE, FLORIDA

# Summary of Laboratory Test Results

# SUMMARY OF LABORATORY TEST RESULTS

**JEA Gate Pkwy - Glen Kernan to T-Line Reclaimed Water Transmission Main**
**Jacksonville, Florida**

| Boring No. | Sample No. | Approximate Depth (ft) | Natural Moisture Content (%) | Organic Content (%) | Percent Passing Sieve Size (%) | | | | | | Atterberg Limits | | AASHTO Soil Classification Symbol |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | #4 | #10 | #40 | #60 | #100 | #200 | LL | PI | |
| D-1 | 9 | 28.5 - 30.0 | 27 | | | | | | | 7 | | | A-3 |
| D-1 | 11 | 38.5 - 40.0 | 26 | | | | | | | 15 | | | A-2-4 |
| D-1 | 16 | 63.5 - 65.0 | 29 | | | | | | | 12 | | | A-2-4 |
| D-2 | 11 | 38.5 - 40.0 | 34 | | | | | | | 11 | | | A-2-4 |
| D-2 | 15 | 58.5 - 60.0 | 31 | | | | | | | 12 | | | A-2-4 |
| D-2 | 17 | 68.5 - 70.0 | 49 | | | | | | | 67 | 25 | 4 | A-4 |
| D-3 | 3 | 4.0 - 6.0 | 39 | 4 | | | | | | 21 | NP | NP | A-2-4 |
| D-3 | 10 | 33.5 - 35.0 | 34 | | | | | | | 12 | | | A-2-4 |
| D-3 | 15 | 58.5 - 60.0 | 37 | | | | | | | 32 | | | A-2-4 |
| D-4 | 3 | 4.0 - 6.0 | 6 | | | | | | | 2 | | | A-3 |
| D-4 | 7 | 18.5 - 20.0 | 29 | | | | | | | 3 | | | A-3 |
| D-4 | 8 | 23.5 - 25.0 | 28 | | | | | | | 7 | | | A-3 |
| D-4 | 10 | 33.5 - 35.0 | 58 | | | | | | | 35 | | | A-2-6 |
| D-4 | 17 | 68.5 - 70.0 | 36 | | | | | | | 19 | | | A-2-6 |
| D-5 | 2 | 2.0 - 4.0 | 5 | | | | | | | 3 | | | A-3 |
| D-5 | 5 | 8.0 - 10.0 | 26 | | | | | | | 2 | | | A-3 |
| D-5 | 9 | 28.5 - 30.0 | 31 | | | | | | | 4 | | | A-3 |
| D-5 | 11 | 38.5 - 40.0 | 32 | 2 | | | | | | 5 | | | A-3 |
| M-1 | 5 | 8.0 - 10.0 | 36 | | | | | | | 2 | | | A-3 |
| M-1 | 8 | 23.5 - 25.0 | 31 | | | | | | | 6 | | | A-3 |
| M-1 | 11 | 38.5 - 40.0 | 30 | | | | | | | 4 | | | A-3 |
| M-2 | 2 | 2.0 - 4.0 | 23 | | | | | | | 4 | | | A-3 |
| M-2 | 3 | 4.0 - 6.0 | 27 | 2 | | | | | | 5 | | | A-3 |
| M-2 | 5 | 8.0 - 10.0 | 26 | 4 | | | | | | 5 | | | A-3 |
| M-2 | 11 | 38.5 - 40.0 | 47 | | | | | | | 30 | | | A-2-6 |

# SUMMARY OF LABORATORY TEST RESULTS

**JEA Gate Pkwy - Glen Kernan to T-Line Reclaimed Water Transmission Main**
**Jacksonville, Florida**

| Boring No. | Sample No. | Approximate Depth (ft) | Natural Moisture Content (%) | Organic Content (%) | Percent Passing Sieve Size (%) | | | | | | Atterberg Limits | | AASHTO Soil Classification Symbol |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | #4 | #10 | #40 | #60 | #100 | #200 | LL | PI | |
| B-3 | 3 | 4.0 - 6.0 | 39 | | | | | | | 3 | | | A-3 |
| B-5 | 2 | 2.0 - 4.0 | 31 | | | | | | | 3 | | | A-3 |
| B-9 | 2 | 2.0 - 4.0 | 24 | | | | | | | 7 | | | A-3 |
| B-13 | 5 | 8.0 - 10.0 | 29 | | | | | | | 3 | | | A-3 |
| B-14 | 3 | 4.0 - 6.0 | 30 | | | | | | | 1 | | | A-3 |
| B-16 | 2 | 3.0 - 5.0 | 24 | | | | | | | 23 | 31 | 9 | A-2-4 |
| B-17 | 1 | 0.0 - 2.0 | 16 | | | | | | | 11 | | | A-2-4 |
| B-17 | 2 | 2.0 - 4.0 | 28 | | | | | | | 24 | | | A-2-4 |
| B-18 | 4 | 6.0 - 8.0 | 26 | | | | | | | 2 | | | A-3 |
| B-19 | 5 | 8.0 - 10.0 | 28 | | | | | | | 2 | | | A-3 |
| B-20 | 3 | 4.0 - 6.0 | 26 | | | | | | | 1 | | | A-3 |
| B-21 | 2 | 2.0 - 4.0 | 22 | | | | | | | 3 | | | A-3 |
| B-21 | 4 | 6.0 - 8.0 | 26 | | | | | | | 4 | | | A-3 |
| B-22 | 6 | 13.5 - 15.0 | 28 | | | | | | | 6 | | | A-3 |
| B-23 | 3 | 4.0 - 6.0 | 28 | | | | | | | 5 | | | A-3 |
| B-23 | 6 | 13.5 - 15.0 | 27 | | | | | | | 4 | | | A-3 |
| B-24 | 1 | 0.0 - 2.0 | 30 | | | | | | | 3 | | | A-3 |
| B-24 | 3 | 4.0 - 6.0 | 27 | | | | | | | 4 | | | A-3 |
| B-25 | 4 | 6.0 - 8.0 | 25 | | | | | | | 4 | | | A-3 |
| B-26 | 4 | 6.0 - 8.0 | 25 | | | | | | | 6 | | | A-3 |
| B-27 | 3 | 4.0 - 6.0 | 32 | | | | | | | 2 | | | A-3 |
| B-27 | 4 | 6.0 - 8.0 | 29 | 6 | | | | | | 8 | | | A-8 |
| B-28 | 4 | 6.0 - 8.0 | 27 | | | | | | | 2 | | | A-3 |
| B-28 | 6 | 13.5 - 15.0 | 31 | | | | | | | 7 | | | A-3 |
| B-29 | 2 | 2.0 - 4.0 | 23 | | | | | | | 7 | | | A-3 |
| B-29 | 3 | 4.0 - 6.0 | 26 | | | | | | | 5 | | | A-3 |

# SUMMARY OF LABORATORY TEST RESULTS

**JEA Gate Pkwy - Glen Kernan to T-Line Reclaimed Water Transmission Main**
**Jacksonville, Florida**

| Boring No. | Sample No. | Approximate Depth (ft) | Natural Moisture Content (%) | Organic Content (%) | Percent Passing Sieve Size (%) | | | | | | Atterberg Limits | | AASHTO Soil Classification Symbol |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | #4 | #10 | #40 | #60 | #100 | #200 | LL | PI | |
| B-30 | 5 | 8.0 - 10.0 | 29 | | | | | | | 2 | | | A-3 |
| B-32 | 2 | 2.0 - 4.0 | 28 | 7 | | | | | | 29 | | | A-8 |
| B-32 | 3 | 4.0 - 6.0 | 28 | | | | | | | 1 | | | A-3 |
| B-34 | 2 | 2.0 - 4.0 | 26 | | | | | | | 16 | | | A-2-4 |
| B-35 | 3 | 4.0 - 6.0 | 18 | | | | | | | 3 | | | A-3 |
| B-37 | 3 | 4.0 - 6.0 | 33 | 9 | | | | | | 12 | | | A-8 |
| B-38 | 3 | 4.0 - 6.0 | 21 | 6 | | | | | | 8 | | | A-8 |
| B-42 | 5 | 8.0 - 10.0 | 39 | | | | | | | 3 | | | A-3 |
| B-43 | 5 | 8.0 - 10.0 | 29 | 5 | | | | | | 10 | | | A-8 |
| B-44 | 5 | 8.0 - 10.0 | 32 | | | | | | | 4 | | | A-3 |
| B-45 | 4 | 6.0 - 8.0 | 28 | 3 | | | | | | 7 | | | A-3 |
| B-49 | 4 | 6.0 - 8.0 | 45 | 9 | | | | | | 11 | | | A-8 |
| B-50 | 3 | 4.0 - 6.0 | 26 | 5 | | | | | | 14 | | | A-8 |
| B-50 | 4 | 6.0 - 8.0 | 49 | | | | | | | 7 | | | A-3 |
| B-51 | 4 | 6.0 - 8.0 | 35 | 10 | | | | | | 17 | | | A-8 |
| B-54 | 6 | 13.5 - 15.0 | 39 | | | | | | | 8 | | | A-3 |
| B-56 | 3 | 4.0 - 6.0 | 21 | | | | | | | 17 | 25 | 5 | A-2-4 |
| B-56 | 5 | 8.0 - 10.0 | 101 | 22 | | | | | | 17 | | | A-8 |
| B-59-B | 4 | 6.0 - 8.0 | 33 | | | | | | | 11 | | | A-2-4 |
| B-59-C | 4 | 6.0 - 8.0 | 39 | | | | | | | 7 | | | A-3 |
| B-59-D | 4 | 6.0 - 8.0 | 18 | | | | | | | 5 | | | A-3 |
| B-60 | 4 | 6.0 - 8.0 | 27 | | | | | | | 27 | 37 | 17 | A-2-6 |
| B-61 | 6 | 13.5 - 15.0 | 37 | | | | | | | 11 | | | A-2-4 |
| B-62 | 6 | 13.5 - 15.0 | 48 | 10 | | | | | | 9 | | | A-8 |
| B-64 | 2 | 2.0 - 4.0 | 31 | 8 | | | | | | 7 | | | A-8 |
| B-65 | 2 | 2.0 - 4.0 | 33 | 7 | | | | | | 7 | | | A-8 |

# Environmental Corrosion Test Results

## ENVIRONMENTAL CORROSION TEST RESULTS

### JEA Gate Pkwy - Glen Kernan to T-Line Reclaimed Water Transmission Main
### Jacksonville, Florida

| Sample No. | Depth (ft) | pH (S.U.)[a] | Resistivity (ohm-cm) | Sulfates (ppm) | Chlorides (ppm) | Environmental Classification (Substructures) | | Redox Potential (mV) | Sulfides |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Steel | Concrete | | |
| B-38 | 6.0 - 15.0 | 7.6 | 19,710 | 12 | 180 | Slightly Aggressive | Slightly Aggressive | 370-390 | Negative |
| B-44 | 4.0 - 10.0 | 4.4 | 1,960 | 1,020 | 180 | Extremely Aggressive | Extremely Aggressive | 320-330 | Negative |
| B-52 | 8.0 - 15.0 | 4.6 | 1,342 | U | 180 | Extremely Aggressive | Extremely Aggressive | 400-410 | Negative |
| B-53 | 6.0 - 15.0 | 6.6 | 29,980 | U | 180 | Moderately Aggressive | Slightly Aggressive | - | Negative |
| B-60 | 4.0 - 15.0 | 7.4 | 1,830 | 930 | 180 | Moderately Aggressive | Moderately Aggressive | 290-310 | Trace |
| B-67 | 2.0 - 15.0 | 8.4 | 9,750 | 1,020 | 180 | Slightly Aggressive | Slightly Aggressive | 270-300 | Negative |

Notes: [a]S.U. : pH standard units
[b]U: Compound tested for but not detected

# Recommended Design Soil Parameters for Horizontal Directional Drilling

# Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)

## JEA Gate Parkway – Glen Kernan to T-Line Reclaimed Water Transmission Main

**Boring M-1**

| Soil Parameter* | Loose Sands | Loose to Med. Dense Sands |
|---|---|---|
| Depth (ft) | 0.0 to 6.0 | 6.0 to 40.0 |
| Saturated Unit Weight – $\gamma$ (pcf) | 105 | 115 |
| Submerged Unit Weight – $\gamma$' (pcf) | 43 | 53 |
| Angle of Internal Friction – $\phi$ (degrees) | 30 | 33 |
| Cohesion – C (psf) | - | - |
| At Rest Earth Pressure Coefficient – $K_o$ | 0.50 | 0.46 |
| Active Earth Pressure Coefficient - $K_a$ | 0.33 | 0.29 |
| Passive Earth Pressure Coefficient - $K_p$ | 3.00 | 3.39 |

* Representative soil parameters based on N-values corrected for hammer efficiency and overburden

# Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)

**JEA Gate Parkway – Glen Kernan to T-Line Reclaimed Water Transmission Main**

**Boring M-2**

| Soil Parameter* | Loose to Med. Dense Sands & Silty Sands | Loose Sands | Very loose to Loose Sands & Clayey Sands |
|---|---|---|---|
| Depth (ft) | 0.0 to 12.0 | 12.0 to 27.0 | 27.0 to 40.0 |
| Saturated Unit Weight – $\gamma$ (pcf) | 115 | 105 | 100 |
| Submerged Unit Weight – $\gamma$' (pcf) | 53 | 43 | 38 |
| Angle of Internal Friction – $\phi$ (degrees) | 32 | 30 | 27 |
| Cohesion – C (psf) | - | - | - |
| At Rest Earth Pressure Coefficient – $K_o$ | 0.47 | 0.50 | 0.55 |
| Active Earth Pressure Coefficient - $K_a$ | 0.31 | 0.33 | 0.38 |
| Passive Earth Pressure Coefficient - $K_p$ | 3.25 | 3.00 | 2.66 |

* Representative soil parameters based on N-values corrected for hammer efficiency and overburden

# Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)

**JEA Gate Parkway – Glen Kernan to T-Line Reclaimed Water Transmission Main**

**Boring D-1**

| Soil Parameter* | Loose to Med. Dense Sands | Loose Sands | Med. Dense Silty Sands | Med. Dense to Very Dense Sands | Loose Silty Sands | Med. Dense Sands |
|---|---|---|---|---|---|---|
| Depth (ft) | 0.0 to 27.0 | 27.0 to 37.0 | 37.0 to 43.0 | 43.0 to 62.0 | 62.0 to 67.0 | 67.0 to 75.0 |
| Saturated Unit Weight – $\gamma$ (pcf) | 115 | 105 | 115 | 130 | 105 | 110 |
| Submerged Unit Weight – $\gamma$' (pcf) | 48 | 43 | 48 | 58 | 43 | 48 |
| Angle of Internal Friction – $\phi$ (degrees) | 30 | 29 | 30 | 34 | 28 | 32 |
| Cohesion – C (psf) | - | - | - | - | - | - |
| At Rest Earth Pressure Coefficient – $K_o$ | 0.50 | 0.52 | 0.50 | 0.44 | 0.53 | 0.47 |
| Active Earth Pressure Coefficient - $K_a$ | 0.33 | 0.35 | 0.33 | 0.28 | 0.36 | 0.31 |
| Passive Earth Pressure Coefficient - $K_p$ | 3.00 | 2.88 | 3.00 | 3.54 | 2.77 | 3.25 |

* Representative soil parameters based on N-values corrected for hammer efficiency and overburden

# Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)

**JEA Gate Parkway – Glen Kernan to T-Line Reclaimed Water Transmission Main**

**Boring D-2**

| Soil Parameter* | Loose Sands | Med. Dense Sands | Very Loose to Loose Sands & Silty Sands | Very Dense Sands | Loose to Med. Dense Silty Sands & Silts |
|---|---|---|---|---|---|
| Depth (ft) | 0.0 to 6.0 | 6.0 to 33.0 | 33.0 to 43.0 | 43.0 to 58.0 | 58.0 to 75.0 |
| Saturated Unit Weight – $\gamma$ (pcf) | 110 | 120 | 100 | 120 | 105 |
| Submerged Unit Weight – $\gamma$' (pcf) | 48 | 58 | 38 | 58 | 43 |
| Angle of Internal Friction – $\phi$ (degrees) | 31 | 34 | 26 | 36 | 28 |
| Cohesion – C (psf) | - | - | - | - | - |
| At Rest Earth Pressure Coefficient – $K_o$ | 0.48 | 0.44 | 0.56 | 0.41 | 0.53 |
| Active Earth Pressure Coefficient - $K_a$ | 0.32 | 0.28 | 0.39 | 0.26 | 0.36 |
| Passive Earth Pressure Coefficient - $K_p$ | 3.12 | 3.54 | 2.56 | 3.85 | 2.77 |

* Representative soil parameters based on N-values corrected for hammer efficiency and overburden

# Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)

**JEA Gate Parkway – Glen Kernan to T-Line Reclaimed Water Transmission Main**

**Boring D-3**

| Soil Parameter* | Med. Dense Sands | Very Loose Silty Sands | Medium Dense Sands | Loose to Very Loose Sands & Silty Sands | Med. Dense to Very Dense Sands | Med. Dense Sands & Silty Sands |
|---|---|---|---|---|---|---|
| Depth (ft) | 0.0 to 3.0 | 3.0 to 6.0 | 6.0 to 32.0 | 32.0 to 37.0 | 37.0 to 57.0 | 57.0 to 75.0 |
| Saturated Unit Weight – $\gamma$ (pcf) | 115 | 100 | 120 | 100 | 120 | 115 |
| Submerged Unit Weight – $\gamma$' (pcf) | 53 | 38 | 58 | 38 | 58 | 53 |
| Angle of Internal Friction – $\phi$ (degrees) | 30 | 26 | 34 | 26 | 36 | 30 |
| Cohesion – C (psf) | - | - | - | - | - | - |
| At Rest Earth Pressure Coefficient – $K_o$ | 0.50 | 0.56 | 0.44 | 0.56 | 0.41 | 0.50 |
| Active Earth Pressure Coefficient - $K_a$ | 0.33 | 0.39 | 0.28 | 0.39 | 0.26 | 0.33 |
| Passive Earth Pressure Coefficient - $K_p$ | 3.00 | 2.56 | 3.54 | 2.56 | 3.85 | 3.00 |

* Representative soil parameters based on N-values corrected for hammer efficiency and overburden

# Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)

**JEA Gate Parkway – Glen Kernan to T-Line Reclaimed Water Transmission Main**

**Boring D-4**

| Soil Parameter* | Very Loose Sands | Loose to Med. Dense Sands | Loose to Med. Dense Clayey Sands | Med. Dense to Dense Sands | Loose to Med. Dense Clayey & Silty Sands |
|---|---|---|---|---|---|
| Depth (ft) | 0.0 to 6.0 | 6.0 to 27.0 | 27.0 to 37.0 | 37.0 to 67.0 | 67.0 to 75.0 |
| Saturated Unit Weight – $\gamma$ (pcf) | 100 | 115 | 100 | 120 | 100 |
| Submerged Unit Weight – $\gamma$' (pcf) | 38 | 53 | 38 | 58 | 38 |
| Angle of Internal Friction – $\phi$ (degrees) | 29 | 33 | 27 | 34 | 27 |
| Cohesion – C (psf) | - | - | - | - | - |
| At Rest Earth Pressure Coefficient – $K_o$ | 0.52 | 0.46 | 0.55 | 0.44 | 0.55 |
| Active Earth Pressure Coefficient - $K_a$ | 0.35 | 0.29 | 0.38 | 0.28 | 0.38 |
| Passive Earth Pressure Coefficient - $K_p$ | 2.88 | 3.39 | 2.66 | 3.54 | 2.66 |

* Representative soil parameters based on N-values corrected for hammer efficiency and overburden

# Recommended Design Soil Parameters for Horizontal Directional Drilling (HDD)

**JEA Gate Parkway – Glen Kernan to T-Line Reclaimed Water Transmission Main**

**Boring D-5**

| Soil Parameter* | Loose Sands | Med. Dense Sands | Loose Sands | Med. Dense to Very Dense Sands |
|---|---|---|---|---|
| Depth (ft) | 0.0 to 8.0 | 8.0 to 22.0 | 22.0 to 41.0 | 41.0 to 75.0 |
| Saturated Unit Weight – $\gamma$ (pcf) | 105 | 120 | 105 | 120 |
| Submerged Unit Weight – $\gamma$' (pcf) | 43 | 58 | 43 | 58 |
| Angle of Internal Friction – $\phi$ (degrees) | 30 | 34 | 29 | 36 |
| Cohesion – C (psf) | - | - | - | - |
| At Rest Earth Pressure Coefficient – $K_o$ | 0.50 | 0.44 | 0.52 | 0.41 |
| Active Earth Pressure Coefficient - $K_a$ | 0.33 | 0.28 | 0.35 | 0.26 |
| Passive Earth Pressure Coefficient - $K_p$ | 3.00 | 3.54 | 2.88 | 3.85 |

* Representative soil parameters based on N-values corrected for hammer efficiency and overburden

# Existing Pavement System Thickness

## EXISTING PAVEMENT SYSTEM THICKNESS

### JEA Gate Parkway - Glen Kernan to T-Line Reclaimed Water Transmission Main
### Jacksonville, Florida

| Road Name | Core No. | Location | | Material Layer Thickness | | Description & AASHTO Classification of Soil Beneath Pavement / Base |
|---|---|---|---|---|---|---|
| | | LAT | LONG | Asphalt (in) | Limerock (in) | |
| Kernan Blvd S. (South of SR 202) | B-33 | 30° 15' 02.41"N | 81° 29' 56.19"W | 3 | 10 | Gray to Dark Gray Fine SAND (A-3) |
| Kernan Blvd S. (South of SR 202) | B-36 | 30° 15' 04.26"N | 81° 29' 55.46"W | 1 1/2 | 5 | Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (South of SR 202) | B-37 | 30° 15' 06.67"N | 81° 29' 54.39"W | 2 3/4 | 4 | Dark Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of SR 202) | B-38 | 30° 15' 09.69"N | 81° 29' 53.32"W | 3 | 6 | Gray to Dark Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of SR 202) | B-39 | 30° 15' 11.75"N | 81° 29' 52.51"W | 3 | 11 | Brown to Light Brown Fine SAND (A-3) |
| Kernan Blvd S. (North of SR 202) | B-40 | 30° 15' 13.63"N | 81° 29' 51.79"W | 2 1/2 | 8 | Gray to Light Brown Fine SAND (A-3) |
| Kernan Blvd S. (North of SR 202) | B-41 | 30° 15' 15.58"N | 81° 29' 51.41"W | 2 | 10 | Light Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of SR 202) | B-42 | 30° 15' 17.55"N | 81° 29' 51.46"W | 3 | 11 | Brown to Light Brown Fine SAND (A-3) |
| Kernan Blvd S. (North of 1st Coast Tech Pkwy) | B-43 | 30° 15' 19.49"N | 81° 29' 51.94"W | 3 | 9 | Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of 1st Coast Tech Pkwy) | B-44 | 30° 15' 21.12"N | 81° 29' 52.75"W | 3 1/2 | 10 | Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of 1st Coast Tech Pkwy) | B-45 | 30° 15' 22.86"N | 81° 29' 53.83"W | 3 | 8 | Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Betty Holzendorf Dr) | B-46 | 30° 15' 24.60"N | 81° 29' 54.93"W | 4 | 6 | Gray to Light Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Betty Holzendorf Dr) | B-47 | 30° 15' 26.34"N | 81° 29' 56.02"W | 3 1/2 | 9 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Betty Holzendorf Dr) | B-48 | 30° 15' 28.07"N | 81° 29' 57.12"W | 8 1/2 | 9 | Gray to Light Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Betty Holzendorf Dr) | B-49 | 30° 15' 29.81"N | 81° 29' 58.20"W | 3 | 11 | Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Betty Holzendorf Dr) | B-50 | 30° 15' 31.67"N | 81° 29' 58.97"W | 3 | 10 | Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Betty Holzendorf Dr) | B-51 | 30° 15' 33.63"N | 81° 29' 59.29"W | 4 | 14 | Dark Brown Fine SAND (A-3) |
| Kernan Blvd S. (North of Betty Holzendorf Dr) | B-52 | 30° 15' 35.60"N | 81° 29' 59.13"W | 3 | 10 | Dark Brown Fine SAND (A-3) |

## EXISTING PAVEMENT SYSTEM THICKNESS

### JEA Gate Parkway - Glen Kernan to T-Line Reclaimed Water Transmission Main
### Jacksonville, Florida

| Road Name | Core No. | Location | | Material Layer Thickness | | Description & AASHTO Classification of Soil Beneath Pavement / Base |
|---|---|---|---|---|---|---|
| | | LAT | LONG | Asphalt (in) | Limerock (in) | |
| Kernan Blvd S. (North of Alumni Dr) | B-53 | 30° 15' 37.50"N | 81° 29' 58.51"W | 3 | 7 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Alumni Dr) | B-54 | 30° 15' 39.26"N | 81° 29' 57.47"W | 3 3/4 | 10 | Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Alumni Dr) | B-55 | 30° 15' 40.79"N | 81° 29' 56.02"W | 3 | 14 | Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Alumni Dr) | B-56 | 30° 15' 42.01"N | 81° 29' 54.23"W | 2 1/2 | 12 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-57 | 30° 15' 43.10"N | 81° 29' 52.33"W | 2 3/4 | 9 | Brown to Dark Gray Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-58 | 30° 15' 44.18"N | 81° 29' 50.42"W | 3 1/2 | 10 | Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-59-A | 30° 15' 44.84"N | 81°29' 49.27"W | 3 1/2 | 11 | Dark Brown Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-59-B | 30° 15' 45.19"N | 81°29' 48.74"W | 3 | 11 | Light to Dark Gray Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-59 | 30° 15' 45.26"N | 81° 29' 48.64"W | 3 | 13 | Dark Brown Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-59-C | 30° 15' 45.45"N | 81°29' 48.39"W | 3 | 10 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-59-D | 30° 15' 45.79"N | 81°29' 47.97"W | 3 | 10 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-60 | 30° 15' 46.72"N | 81° 29' 46.94"W | 3 | 9 | Tan to Gray Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-61 | 30° 15' 48.32"N | 81° 29' 45.61"W | 3 | 10 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (Northeast of Osprey Ridge Rd) | B-62 | 30° 15' 50.09"N | 81° 29' 44.59"W | 3 1/2 | 9 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of 1st Coast Tech Pkwy) | B-63 | 30° 15' 52.95"N | 81° 29' 43.71"W | 3 | 10 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of 1st Coast Tech Pkwy) | B-64 | 30° 15' 54.92"N | 81° 29' 43.50"W | 2 3/4 | 9 1/2 | Dark Brown Fine SAND (A-3) |
| Kernan Blvd S. (North of 1st Coast Tech Pkwy) | B-65 | 30° 15' 56.87"N | 81° 29' 43.17"W | 3 1/2 | 9 1/2 | Dark Brown to Gray Fine SAND (A-3) |
| Kernan Blvd S. (North of Glen Kernan Pkwy N.) | B-66 | 30° 15' 59.09"N | 81° 29' 42.94"W | 3 1/2 | 10 1/2 | Gray to Dark Brown Fine SAND (A-3) |
| Kernan Blvd S. (North of Glen Kernan Pkwy N.) | B-67 | 30° 16' 01.03"N | 81° 29' 42.29"W | 3 3/4 | 11 | Dark Brown Fine SAND (A-3) |

# 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 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 or plastic bags and transported to our laboratory. The samples were then examined by a geotechnical engineer to confirm the 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 ASTM D2974.

**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 D1140.

**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 D2216.

**Plasticity (Atterberg Limits)** – The soil's Plastic Index (PI) is bracketed by the Liquid Limit (LL) and Plastic Limit (PL). The LL is the moisture content at which the soil flows as a heavy viscous fluid and is determined in general accordance with FM 1-T 089. The PL is the moisture content at which the soil begins to crumble when rolled into a small thread and is also determined in general accordance with FM 1-T 090. The water-plasticity ratio is computed from the above test data. This ratio is an expression comparing the relative natural state of soil with its liquid and plastic consolidation characteristics.