Preliminary Geotechnical Soil Survey

Florida Department of Transportation

District 5

LPGA Boulevard PD&E Study

Limits of Project: From US 92 (SR 600) to Williamson Boulevard

Volusia County, Florida

Financial Management Number: 448456-1

ETDM Number: 14332

Date: November 2022

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022 and executed by the Federal Highway Administration and FDOT.

LPGA BOULEVARD FROM US 92 (SR 600) TO WILLIAMSON BOULEVARD PD&E STUDY

FPID: 448456-1-22-01

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November 2022

FDOT

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1.0 Introduction

1.1 Project Description

FDOT is conducting a Project Development and Environment (PD&E) Study of LPGA Boulevard from US 92 (International Speedway Boulevard) to Williamson Boulevard within the City of Daytona Beach in Volusia County (approximately 6.6 miles). The proposed improvements involve widening of LPGA Boulevard which will include the addition of bicycle and pedestrian facilities and modifications to the LPGA Boulevard/I-95 interchange.

A project location map is provided in **Figure 1**. Existing LPGA Boulevard is a two-lane roadway from US 92 to Tomoka Farms Road (east of the Tomoka River), a four-lane roadway from Tomoka Farms Road to the I-95 Southbound Ramps, and a six-lane roadway from the I-95 Southbound Ramps over I-95 to Williamson Boulevard. There are 14 intersections along the corridor including ramp terminals at the I-95 interchange, nine of which are signalized.

LPGA Boulevard is a county road maintained by Volusia County, except between Tomoka Farms Road and Technology Boulevard/Outlet Boulevard where FDOT maintains the limited access right-of-way to the I-95 interchange. Most of LPGA Boulevard does not have paved shoulders and sidewalks, and there are only limited areas of sidewalks between Tymber Creek Road and Williamson Boulevard.

I-95 is a six-lane, Strategic Intermodal System (SIS) facility and is a hurricane evacuation route. The I-95 interchange at LPGA Boulevard (Exit 265) is a partial cloverleaf interchange, or parclo interchange, with six on and off ramps. This interchange is located approximately 3.5 miles north of the I-95 and US 92 interchange and approximately 2.7 miles south of the I-95 and SR 40 interchange.

1.2 Purpose and Need

The purpose of this project is to accommodate existing and projected future travel demand, enhance safety, and improve operations for the LPGA Boulevard corridor and the I-95 interchange.

The need for the project is based on existing and future transportation demand and safety along the LPGA Boulevard corridor and at the interchange area. Improvements are necessary to address unacceptable levels of service (LOS) (below target LOS D and LOS E) and enhance the safety of travel conditions along LPGA Boulevard and at the I-95 interchange area.

Figure 1. Project Location Map

2.0 Scope of Services

The purpose of the geotechnical portion of the PD&E study is to obtain information on the existing subsurface conditions along the project alignment to assist in the preparation of the PD&E Report for the project. The following services were provided to achieve the preceding objective:

- Reviewed published soils information. This published information was obtained from the Web Soil Survey of Volusia County, Florida published by the United States Department of Agriculture (USDA) – Natural Resources Conservation Service (NRCS).
- Conducted a visual reconnaissance of the project site and located and coordinated utility clearance.
- Performed a geotechnical field study to evaluate the existing subsurface conditions along the roadway alignment consisting of borings, subsurface sampling and field-testing. We performed hand auger borings advanced to depths ranging from approximately 3 to 7 feet below the existing ground surface along the roadway alignment.
- Performed a geotechnical field study for the prefered pond site locations consisting of borings, subsurface sampling and field-testing.
- Visually classified and stratified the recovered soil samples in the laboratory. Performed laboratory tests on selected representative samples to develop the soil legend for the project in accordance with the American Association of State Highway and Transportation Officials (AASHTO) Soil Classification System.
- Prepared this Preliminary Soil Survey Study for the project.

3.0 Subsurface Conditions

3.1 Volusia County Soil Survey

Based on a review of the Volusia County Soil Survey published by USDA-NRCS, it appears that there are fifteen (15) soil-mapping units noted within the project limits. A detailed soil survey map is shown on the USDA Vicinity Map Sheet in the attachments. The general soil descriptions are presented in the sub-sections below, as described in the Web Soil Survey.

3.1.1 Basinger fine sand, frequently ponded, 0 to 1 percent slopes (Unit 8)

The Basinger component makes up 90 percent of the map unit. Slopes are 0 to 1 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during July, August, September, and October.

3.1.2 Daytona sand, 0 to 5 percent slopes (Unit 17)

The Daytona component makes up 85 percent of the map unit. Slopes are 0 to 5 percent. This component is on rises on marine terraces on coastal plains. The parent material consists of sandy marine deposits and/or eolian deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 50 inches during June, July, August, September, and October.

3.1.3 Farmton fine sand (Unit 23)

The Farmton, non-hydric component makes up 70 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, September, and October.

The Farmton, hydric component makes up 10 percent of the map unit. Slopes are 0 to 2 percent. This component is on flats on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 3 inches during June, July, August, and September.

3.1.4 Gator muck, 0 to 1 percent slopes, frequently flooded (Unit 25)

The Gator, frequently flooded component makes up 82 percent of the map unit. Slopes are 0 to 1 percent. This component is on flood plains on marine terraces on coastal plains. The parent material consists of herbaceous organic material over sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January through December. Organic matter content in the surface horizon is about 75 percent.

3.1.5 Immokalee sand (Unit 29)

The Immokalee, non-hydric component makes up 65 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during January, February, June, July, August, September, October, November and December.

The Immokalee, hydric component makes up 10 percent of the map unit. Slopes are 0 to 2 percent. This component is on flats on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 3 inches during July, August and September.

3.1.6 Orsino fine sand, 0 to 5 percent slopes (Unit 37)

The Orsino component makes up 82 percent of the map unit. Slopes are 0 to 5 percent. This component is on ridges on marine terraces on coastal plains. The parent material consists of sandy marine deposits and/or eolian deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is very high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 50 inches during June, July, August, September and October.

3.1.7 Pineda-Pineda, wet, fine sand, 0 to 2 percent slopes (Unit 45)

The Pineda component makes up 45 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, September, October and November.

The Pineda, wet component makes up 40 percent of the map unit. Slopes are 0 to 1 percent. This component is on flats on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during July, August, September and October.

3.1.8 Pits (Unit 47)

Soil and groundwater properties have not been provided within the USDA-NRCS Soil Survey. The pits complex consists of land which soil material and/or limestone or shell has been removed and consists of dumps where these materials have been piled, and miscellaneous areas where natural soil has been modified for urban development.

3.1.9 Pomona fine sand (Unit 49)

The Pomona, non-hydric component makes up 70 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 10 inches during June, July, August and September.

The Pomona, hydric component makes up 10 percent of the map unit. Slopes are 0 to 2 percent. This component is on flats on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 4 inches during June, July, August and September.

3.1.10 Pomona fine sand, depressional, 0 to 2 percent slopes (Unit 50)

The Pomona component makes up 80 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during June, July, August and September.

3.1.11 Pomona-St. Johns complex (Unit 51)

The Pomona, depressional component makes up 60 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on marine terraces on coastal plains, drainageways on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during June, July, August and September.

The St. Johns, depressional component makes up 30 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on marine terraces on coastal plains, drainageways on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, June, July, August, September, October, November and December.

3.1.12 Pompano-Placid complex (Unit 53)

The Pompano, depressional component makes up 55 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is very high. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during June, July, August, September, October, November and December.

The Placid component makes up 25 percent of the map unit. Slopes are 0 to 2 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, June, July, August, September, October, November and December.

3.1.13 Samsula muck, frequently ponded, 0 to 1 percent slopes (Unit 56)

The Pompano component makes up 80 percent of the map unit. Slopes are 0 to 2 percent. The Samsula component makes up 85 percent of the map unit. Slopes are 0 to 1 percent. This component is on depressions on marine terraces on coastal plains. The parent material consists of herbaceous organic material over sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, June, July, August, September, October, November and December. Organic matter content in the surface horizon is about 75 percent.

3.1.14 Smyrna-Smyrna, wet, fine sand, 0 to 2 percent slopes (Unit 60)

The Smyrna, non-hydric component makes up 76 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August and September.

The Smyrna, hydric component makes up 20 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 3 inches during June, July, August and September.

3.1.15 Wauchula fine sand (Unit 75)

The Wauchula, non-hydric component makes up 75 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during June, July, August and September.

The Wauchula, hydric component makes up 10 percent of the map unit. Slopes are 0 to 2 percent. This component is on flats on marine terraces on coastal plains. The parent material consists of sandy and loamy marine deposits. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 5 inches during June, July, August and September.

3.2 General Soil Properties

Table 3-1 | Volusia County USDA NRCS Soil Survey Hydrologic Information

Map No.	Soil Name	Hydrologic Soil Group	Depth to High Water Table (ft)	Typical Soil Types (Profile from Ground Surface to depth of approximately 80 inches)
8	Basinger fine sand, frequently ponded, 0 to 1 percent slopes	A/D	+2.0-0.0	Fine Sand
17	Daytona sand, 0 to 5 percent slopes	A	3.5-5.0	Sand
23	Farmton fine sand	B/D	0.0-1.5	Fine Sand to Fine Sandy Loam
25	Gator muck, 0 to 1 percent slopes, frequently flooded	C/D	+1.0-0.0	Muck to Sandy Clay Loam to Fine Sand
29	Immokalee sand	B/D	0.0-1.5	Sand
37	Orsino fine sand, 0 to 5 percent slopes	A	3.5-5.0	Fine Sand
45	Pineda-Pineda, wet, fine sand, 0 to 2 percent slopes	A/D	0.0-1.5	Fine Sand to Fine Sandy Loam

Table 3-1 **(Continued)** | Volusia County USDA NRCS Soil Survey Hydrologic Information

Map No.	Soil Name	Hydrologic Soil Group	Depth to High Water Table (ft)	Typical Soil Types (Profile from Ground Surface to depth of approximately 80 inches)
47	Pits	No Estimates Provided by USDA-NRCS		
49	Pomona fine sand	A/D	0.0-1.5	Fine Sand to Fine Sandy Loam
50	Pomona fine sand, depressional, 0 to 2 percent slopes	A/D	+2.0-0.0	Fine Sand to Fine Sandy Loam
51	Pomona-St. Johns complex	A/D	+2.0-0.0	Fine Sand to Fine Sandy Loam
53	Pompano-Placid complex	A/D	+2.0-0.0	Fine Sand
56	Samsula muck, frequently ponded, 0 to 1 percent slopes	A/D	+2.0-0.0	Muck to Sand
60	Smyrna-Smyrna, wet, fine sand, 0 to 2 percent slopes	A/D	0.0-1.5	Fine Sand to Loamy Fine Sand
75	Wauchula fine sand	A/D	0.0-1.5	Fine Sand to Loamy Fine Sand to Sandy Clay Loam

Table 3-2 | Volusia County USDA NRCS Soil Survey Information

Map No.	**Soil Name**	**Soil Classification**			**Permeability (in/hr)**
		Depth (in)	**USCS**	**AASHTO**	
8	Basinger fine sand, frequently ponded, 0 to 1 percent slopes	0-80	SP-SM, SM	A-3, A-2-4	6.0-20.0
17	Daytona sand, 0 to 5 percent slopes	0-5	SP, SP-SM	A-3, A-2-4	20.0-50.0
		5-36	SP, SP-SM	A-3	20.0-50.0
		36-47	SP-SM, SM	A-3, A-2-4	2.0-6.0
		47-80	SP, SP-SM	A-3, A-2-4	20.0-50.0
23	Farmton fine sand	0-7	SP, SP-SM, SM	A-3, A-2-4	6.0-20.0
		7-34	SP, SP-SM	A-3	6.0-20.0
		34-50	SP-SM, SM	A-3, A-2-4	0.6-2.0
		50-80	SM, SM-SC, SC	A-2-4, A-2-6	0.6-2.0
25	Gator muck, 0 to 1 percent slopes, frequently flooded	0-34	PT	A-8	6.0-20.0
		34-46	SM, SC, CL	A-4, A-6, A-7-6	0.1-0.2
		46-52	SM, SM-SC, SC	A-2-4, A-4, A-6	0.1-0.2
		52-80	SP-SM, SM	A-3, A-2-4	2.0-6.0

Table 3-1 **(Continued)** | Volusia County USDA NRCS Soil Survey Information

Map No.	Soil Name	Soil Classification			Permeability (in/hr)
		Depth (in)	USCS	AASHTO	
29	Immokalee sand	0-34	SP, SP-SM	A-3	6.0-20.0
		34-43	SP-SM, SM	A-3, A-2-4	0.6-2.0
		43-80	SP, SP-SM	A-3	6.0-20.0
37	Orsino fine sand, 0 to 5 percent slopes	0-80	SP-SM, SM	A-3, A-2-4	20.0-50.0
45	Pineda-Pineda, wet, fine sand, 0 to 2 percent slopes	0-36	SP-SM, SM	A-3, A-2-4	6.0-20.0
		36-54	SM-SC, SC, CL	A-2-4, A-4, A-6	2.0-6.0
		54-80	SP-SM, SM	A-3, A-2-4	2.0-6.0
47	Pits	No Estimates Provided by USDA-NRCS			
49	Pomona fine sand	0-18	SP, SP-SM	A-3, A-2-4	6.0-20.0
		18-45	SP-SM, SM	A-3, A-2-4	0.6-20.0
		45-50	SP, SP-SM	A-3, A-2-4	2.0-20.0
		50-80	SM, SM-SC, SC	A-2, A-4, A-6	0.2-2.0
50	Pomona fine sand, depressional, 0 to 2 percent slopes	0-14	SP-SM, SM	A-3, A-2-4	6.0-20.0
		14-33	SP-SM, SM	A-3, A-2-4	0.6-20.0
		33-53	SP-SM, SM	A-3, A-2-4	6.0-20.0
		53-61	SC	A-2-6, A-7-6	0.2-2.0
		61-80	SP-SM	A-3, A-2-4	0.2-2.0
51	Pomona-St. Johns complex	0-18	SP, SP-SM	A-3, A-2-4	6.0-20.0
		18-45	SP-SM, SM	A-3, A-2-4	0.6-20.0
		45-50	SP, SP-SM	A-3, A-2-4	6.0-20.0
		50-80	SM, SM-SC, SC	A-2, A-4, A-6	0.2-2.0
		0-27	SP, SP-SM	A-3	6.0-20.0
		27-45	SP-SM, SM	A-3, A-2-4	0.6-2.0
		45-80	SP, SP-SM	A-3	6.0-20.0
53	Pompano-Placid complex	0-80	SP, SP-SM	A-3	20.0-50.0
		0-80	SP, SP-SM, SM	A-3, A-2-4	6.0-20.0
56	Samsula muck, frequently ponded, 0 to 1 percent slopes	0-32	PT	A-8	6.0-20.0
		32-80	SP-SM, SM	A-3, A-2-4	6.0-20.0
60	Smyrna-Smyrna, wet, fine sand, 0 to 2 percent slopes	0-4	SP, SP-SM, SM	A-3, A-2-4	6.0-20.0
		4-17	SP, SP-SM	A-3, A-2-4	6.0-20.0
		17-27	SP-SM, SM	A-2-4	0.6-6.0
		27-80	SP, SP-SM	A-3, A-2-4	6.0-20.0
75	Wauchula fine sand	0-20	SP-SM	A-3, A-2-4	6.0-20.0
		20-29	SP-SM, SM	A-3, A-2-4	0.06-0.6
		29-34	SP-SM, SM	A-3, A-2-4	2.0-20.0
		34-80	SM, SM-SC, SC	A-2, A-4, A-6	0.6-6.0

3.3 Groundwater Conditions

According to the USDA-NRSC Soil Survey, much of the project corridor consists of poorly to very poorly drained soils. The seasonal high groundwater table is at or near the ground surface throughout much of the corridor.

Along most of the project corridor, the Seasonal High Groundwater Table (SHGWT) levels in their natural condition are estimated to range between above the natural ground surface to within 5 feet of the natural ground surface.

4.0 Preliminary Subsurface Exploration

4.1 Roadway Borings

To evaluate the subsurface conditions and groundwater table levels along the proposed project limits, hand auger borings were advanced to depths ranging from approximately 3 to 7 feet below the existing ground surface along the project corridor. The hand auger borings were performed by manually twisting and advancing a bucket auger into the ground, typically in 4 to 6 inch increments.

The location of the augers borings performed along the roadway alignments were determined using the recorded GPS coordinates obtained by Tierra in conjunction with the design files provided by HDR. The locations of these borings should be considered approximate. The ground surface elevations at the boring locations are referenced to the NAVD 1988 datum. The station and offset along with the soil profile of each boring performed are shown on the **Roadway Soil Profiles** sheets in the **Appendix**.

5.0 Laboratory Testing

5.1 General

Representative soil samples collected from the borings performed along the project alignments were classified and stratified in general accordance with the American Association of State Highway and Transportation Officials (AASHTO) Soil Classification System. Our classification was based on visual observations, using the results from the laboratory testing as confirmation. These tests included grain-size analyses, Atterberg Limits, organic content and natural moisture content determination. In addition, environmental corrosion tests were performed on selected soil samples to evaluate the corrosive nature of the subsurface soils encountered.

5.2 Test Designation

The following list summarizes the laboratory tests performed by Tierra and the respective test methods utilized.

- Grain-Size Analyses - The grain-size analyses were conducted in general accordance with the AASHTO test designation T-088 (ASTM test designation D-422).
- Atterberg Limits - The liquid limit and the plastic limit tests ("Atterberg Limits") were conducted in general accordance with the AASHTO test designations T-089 and T-090, respectively (ASTM test designation D-4318).
- Natural Moisture Content - The moisture content tests were conducted in general accordance with the AASHTO test designation T-265 (ASTM test designation D-2216).
- Organic Content - The organic content tests were conducted in general accordance with the AASHTO test designation T-267 (ASTM test designation D-2974).
- Environmental Corrosion - The environmental corrosion tests were conducted in general accordance with the FDOT test designations FM 5-550, FM 5-551, FM 5-552 and FM 5-553.

A summary of the laboratory test results for each soil stratum encountered along the project alignment is presented on the **Roadway Soil Survey** sheet in the **Appendix**. This sheet includes ranges of laboratory test results for different stratum soil samples collected from borings performed along the project alignments. A detailed summary of the laboratory test results performed for this report is presented in **Tables 2** and **3** of the **Appendix**.

6.0 Results of Subsurface Exploration

6.1 General Soil Conditions

Specific information of each boring performed is provided on the **Roadway Soil Profiles** sheets in the **Appendix**.

The soil types encountered during this exploration have been assigned a stratum number. The stratum number and soil types associated with this project to date are provided below.

Stratum Number	Typical Soil Description	AASHTO Classification
1	Gray to Brown SAND to Silty SAND (-200<15%)	A-3/A-2-4
2	Gray to Brown Silty SAND (-200≥15%)	A-2-4
3	Gray to Brown Clayey SAND	A-2-6
4	Dark Brown Organic SAND with Silt to Silty SAND	A-8

A geotechnical engineer bases soil stratification on a visual review of the recovered samples, laboratory testing and interpretation of the field boring logs. The boring stratification lines represent the approximate boundaries between soil types of significantly different engineering properties; however, the actual transition may be gradual. In some cases, small variations in properties within the same boring not considered pertinent to our engineering evaluation may have been abbreviated or omitted for clarity. The boring profiles represent the conditions at the particular boring location and variations do occur among the borings.

The results of the borings performed for this project along with the boring location plans are presented in the **Appendix** of this report.

6.2 Groundwater

The groundwater table was recorded, if encountered, at each of the boring locations during our field exploration. The depths to the groundwater table along the project alignment were found to range from approximately 6 inches below the existing ground surface to depths of 6.5 feet below the existing ground surface at the locations of the borings where the groundwater was encountered. The groundwater table measured at each of the boring locations is presented on the **Roadway Soil Profiles** sheets in the **Appendix**. The groundwater table was not encountered within the boring depths of some of the hand auger borings. GNE (groundwater not encountered) is indicated on the soil profiles of these borings.

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences (i.e., existing water management canals, swales, drainage ponds, underdrains, and areas of covered soils, such as paved parking lots and sidewalks).

6.3 Seasonal High Groundwater Estimates

Seasonal high groundwater table levels were estimated at the boring locations along the project alignment. The estimated seasonal high groundwater table depths at the borings range from at the existing ground surface to depths greater than 6.5 feet below the existing ground surface. A summary of these estimates is presented in **Table 1** in the **Appendix**.

In general, the seasonal high groundwater table levels estimated along the project alignments were based on soil stratigraphy, measured groundwater levels from the borings, the USDA Soil Survey information for Volusia County, Florida, and surrounding topography. In areas where subsurface soil conditions were disturbed, normal indications such as “stain lines” were not evident.

7.0 Preliminary Engineering Evaluation

7.1 General

Based upon the USDA-NRCS Soil Survey for Volusia County, sandy soils to depths of 80 inches below the natural ground surface are reported along the majority of the project corridor with areas of organic soils and/or plastic soils. In general, these soils are suitable for supporting proposed roadway embankments after proper subgrade preparation and removal of unsuitable materials.

Areas along the project corridor where clay, organics and/or groundwater conditions may impact the project are detailed below.

7.1.1 Shallow Groundwater

The Seasonal High Groundwater Table (SHGWT) for the soil units is reported to range from about 2 feet above the predevelopment natural grade to depths of 5 feet below the predevelopment natural grade within the project limits. The estimated SHGWT at the boring locations ranges between the existing ground surface to depths of 6.5 feet below grade.

Roadway base to groundwater clearance will need to be evaluated to ensure minimum separation between the base and the SHGWT is maintained or to determine if additional measures are required (ie, blackbase, underdrains, etc.). In areas where the existing SHGWT is above grade, the SHWGT will have to be established by the project biologist utilizing biological indicators.

7.1.2 Organic Soils

Organic/muck (A-8) soils were noted along the project alignment. The following soil mapping units noted organic/muck (A-8) soils between the ground surface to within approximately 2.5 to 3 feet of the ground surface:

- Gator muck, 0 to 1 percent slopes, frequently flooded (Unit 25)
- Samsula muck, frequently ponded, 0 to 1 percent slopes (Unit 56)

Organic/muck (A-8) soil, if encountered during construction, should be removed and replaced in accordance with FDOT Standard Plans Indices 120-002 and 120-001. As the project progresses beyond the PD&E phase, delineation of the reported organic soils will be required to determine the impact of the organic soils on the proposed design. Additional geotechnical services should be performed to identify the vertical and horizontal limits of the encountered organic soils within the project limits.

7.2 Roadway Construction

Site preparation should consist of normal clearing and grubbing followed by compaction of subgrade soils. Subgrade preparation should include the removal of plastic soils, top-soils and organic soils in accordance with FDOT Standard Plans, Index 120-002. Backfill embankment materials should consist of materials conforming to FDOT Standard Plans, Index 120-001. Clearing and grubbing and compaction should be accomplished in accordance with the latest FDOT Standard Specifications.

The overall site preparation and mechanical densification work for the construction of the proposed roadway improvements should be in accordance with the FDOT Standard Specifications and Standard Index requirements. In general, the existing subsurface soils appear capable of supporting the construction of the proposed roadway improvements subject to the above geotechnical considerations and after proper subgrade preparation.

8.0 Limitations

Our professional services have been performed, our findings obtained and our preliminary evaluations prepared in accordance with generally accepted geotechnical engineering principles and practices at the time of this report. Tierra is not responsible for the conclusions, opinions or recommendations made by others based on this data.

The scope of the geotechnical portion of the PD&E study is to provide information on the existing subsurface conditions along the project alignment based on a review of the Volusia County Soil Survey published by the USDA-NRCS and limited subsurface exploration to assist in the preparation of the PD&E Report for the project. The preliminary evaluations submitted in this report are based upon the data obtained from the published information and the limited subsurface exploration. Should subsoil variations become evident during the course of this project, a re-evaluation will be necessary after we have had an opportunity to observe the characteristics of the condition encountered. The applicability of the report should also be reviewed in the event significant changes occur in the design, nature or location of the proposed roadway construction.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of HDR, Inc. and the FDOT.

Tierra appreciates the opportunity to be of service to HDR, Inc. on this project. If you have any questions or comments regarding this report, please contact our office at your earliest convenience.

Respectfully Submitted,

TIERRA, INC.

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Appendix

Tables

Figures

Florida Department of Transportation District 5

Environmental Management Office

719 S. Woodland Blvd.

DeLand, FL 32720

TABLE 1
Summary of Seasonal High Groundwater Table Estimates for Roadway
Project Development and Environment (PD&E) Study - LPGA Boulevard from US 92 (SR 600) to Williamson Boulevard
Volusia County, Florida
FPN: 448456-1-22-01
Tierra Project No: 5511-21-038

Boring Number	Boring Location[1] C/L Construction		Boring Depth[2]	Ground Surface Elevation NAVD88[1]	Measured GWT		Date Groundwater Table Recorded	USDA Soil Survey		Estimated SHGWT[4]	
	Station (feet)	Offset (feet)	(feet)	(feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)		Soil Map Unit	SHGWT Depth[3] (feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)
SH - 2002L	2001+89	7' LT.	4.0	27.3	4.0	23.3	2/2/2022	49	0.0-1.5	2.0	25.3
SH - 2004R	2004+01	58' RT.	5.0	28.0	2.1	25.9	1/3/2022	56	+2.0-0.0	1.5	26.5
SH - 2006L	2005+92	7' LT.	3.5	27.7	0.5	27.2	2/2/2022	56	+2.0-0.0	0.0	27.7
SH - 2008R	2007+83	56' RT.	5.0	28.8	2.5	26.3	1/3/2022	56	+2.0-0.0	1.0	27.8
SH - 2010R	2009+95	4' RT.	4.5	29.1	3.0	26.1	2/2/2022	56	+2.0-0.0	1.5	27.6
SH - 2012R	2011+88	56' RT.	5.0	29.3	3.0	26.3	1/3/2022	50	+2.0-0.0	1.5	27.8
SH - 2014R	2013+90	8' RT.	4.5	30.5	4.5	26.0	2/2/2022	50	+2.0-0.0	3.0	27.5
SH - 2016R	2015+83	57' RT.	6.0	30.7	4.4	26.3	1/3/2022	50	+2.0-0.0	3.0	27.7
SH - 2018R	2017+86	21' RT.	4.5	31.4	4.5	26.9	2/2/2022	50	+2.0-0.0	3.5	27.9
SH - 2020R	2019+95	63' RT.	5.0	31.3	3.8	27.5	1/4/2022	50	+2.0-0.0	3.0	28.3
SH - 2022R	2021+87	19' RT.	4.5	30.6	4.5	26.1	2/2/2022	50	+2.0-0.0	3.0	27.6
SH - 2024R	2023+86	69' RT.	5.0	31.4	4.0	27.4	1/4/2022	49	0.0-1.5	3.0	28.4
SH - 2026R	2026+09	32' RT.	4.5	31.4	4.0	27.4	2/2/2022	49	0.0-1.5	3.0	28.4
SH - 2028R	2027+93	76' RT.	6.0	31.4	3.6	27.8	1/4/2022	53	+2.0-0.0	3.0	28.4
SH - 2030R	2030+10	11' RT.	4.5	28.4	1.0	27.4	2/2/2022	53	+2.0-0.0	0.5	27.9
SH - 2032R	2031+89	76' RT.	6.0	31.1	4.5	26.6	1/4/2022	53	+2.0-0.0	3.0	28.1
SH - 2034R	2033+82	29' RT.	5.0	31.2	4.5	26.7	2/2/2022	49	0.0-1.5	3.5	27.7
SH - 2036R	2036+02	76' RT.	6.0	31.2	4.2	27.0	1/4/2022	49	0.0-1.5	3.5	27.7
SH - 2038R	2037+97	28' RT.	5.0	31.0	4.5	26.5	2/2/2022	49	0.0-1.5	3.0	28.0
SH - 2040R	2039+98	75' RT.	6.0	31.0	4.4	26.6	1/4/2022	49	0.0-1.5	3.0	28.0
SH - 2042R	2042+03	22' RT.	5.0	31.8	4.5	27.3	2/2/2022	49	0.0-1.5	4.0	27.8
SH - 2044R	2044+11	69' RT.	6.0	31.6	4.8	26.8	1/4/2022	49	0.0-1.5	4.0	27.6
SH - 2046R	2045+88	15' RT.	5.0	30.9	4.5	26.4	2/2/2022	49	0.0-1.5	3.0	27.9
SH - 2048R	2047+77	61' RT.	5.0	31.6	4.6	27.0	1/4/2022	49	0.0-1.5	3.5	28.1
SH - 2050R	2049+89	14' RT.	6.0	32.5	5.4	27.1	2/2/2022	49	0.0-1.5	4.5	28.0
SH - 2052R	2051+98	62' RT.	4.5	31.1	4.0	27.1	1/3/2022	49	0.0-1.5	3.0	28.1
SH - 2054L	2053+90	2' LT.	4.0	31.5	3.8	27.7	2/2/2022	49	0.0-1.5	3.5	28.0
SH - 2056R	2055+89	64' RT.	5.0	29.8	4.0	25.8	1/9/2022	45	0.0-1.5	2.0	27.8

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	Station (feet)	Offset (feet)	(feet)	(feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)		Soil Map Unit	SHGWT Depth[3] (feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)
SH - 2058L	2057+92	8' LT.	4.0	30.5	3.5	27.0	2/2/2022	49	0.0-1.5	2.5	28.0
SH - 2061R	2060+87	76' RT.	5.0	28.9	2.5	26.4	1/9/2022	49	0.0-1.5	1.0	27.9
SH - 2062L	2062+03	6' LT.	4.0	30.1	3.5	26.6	2/2/2022	49	0.0-1.5	2.0	28.1
SH - 2064R	2063+96	54' RT.	5.0	30.9	4.5	26.4	1/3/2022	49	0.0-1.5	3.0	27.9
SH - 2066L	2065+99	16' LT.	4.0	29.6	3.5	26.1	2/2/2022	49	0.0-1.5	1.5	28.1
SH - 2068R	2067+98	58' RT.	4.0	30.5	4.0	26.5	1/3/2022	49	0.0-1.5	2.5	28.0
SH - 2070L	2070+02	5' LT.	4.0	30.5	4.0	26.5	2/2/2022	49	0.0-1.5	2.5	28.0
SH - 2072R	2071+92	57' RT.	6.0	32.7	5.4	27.3	1/4/2022	49	0.0-1.5	4.4	28.3
SH - 2074L	2073+99	4' LT.	4.0	31.2	4.0	27.2	2/2/2022	49	0.0-1.5	3.0	28.2
SH - 2076R	2076+05	72' RT.	5.0	31.5	4.4	27.1	1/4/2022	49	0.0-1.5	3.5	28.0
SH - 2078L	2078+01	12' LT.	4.0	28.6	1.0	27.6	2/2/2022	53	+2.0-0.0	0.5	28.1
SH - 2080R	2079+99	71' RT.	6.0	31.4	5.4	26.0	1/4/2022	53	+2.0-0.0	3.0	28.4
SH - 2082L	2082+01	12' LT.	4.5	31.4	4.5	26.9	2/2/2022	49	0.0-1.5	3.0	28.4
SH - 2084R	2083+89	85' RT.	4.5	29.6	4.0	25.6	1/4/2022	49	0.0-1.5	1.5	28.1
SH - 2086L	2086+01	7' LT.	4.0	30.2	3.0	27.2	2/2/2022	49	0.0-1.5	2.0	28.2
SH - 2088R	2087+94	78' RT.	5.0	30.3	3.4	26.9	1/4/2022	53	+2.0-0.0	2.0	28.3
SH - 2090L	2090+04	3' LT.	5.0	29.9	4.0	25.9	2/2/2022	49	0.0-1.5	2.0	27.9
SH - 2092R	2091+89	98' RT.	4.0	28.7	2.0	26.7	1/4/2022	49	0.0-1.5	0.5	28.2
SH - 2094R	2094+06	3' RT.	4.0	28.7	3.0	25.7	2/2/2022	49	0.0-1.5	1.0	27.7
SH - 2096R	2095+91	113' RT.	4.0	29.2	2.5	26.7	1/4/2022	49	0.0-1.5	1.0	28.2
SH - 2098L	2098+04	3' LT.	4.0	30.6	4.0	26.6	2/2/2022	49	0.0-1.5	2.5	28.1
SH - 2100R	2099+94	93' RT.	4.5	30.0	4.0	26.0	1/5/2022	53	+2.0-0.0	2.0	28.0
SH - 2102L	2102+04	1' LT.	4.0	27.2	1.0	26.2	2/2/2022	53	+2.0-0.0	0.0	27.2
SH - 2104R	2104+18	92' RT.	4.5	29.5	4.0	25.5	1/5/2022	53	+2.0-0.0	2.5	27.0
SH - 2106R	2106+04	4' RT.	4.0	27.5	3.5	24.0	2/2/2022	53	+2.0-0.0	1.5	26.0
SH - 2108R	2108+19	103' RT.	4.5	29.5	4.0	25.5	1/5/2022	60	0.0-3.5	3.8	25.7
SH - 2110L	2110+06	7' LT.	4.0	27.3	3.5	23.8	2/2/2022	56	+2.0-0.0	2.0	25.3
SH - 2112R	2112+05	87' RT.	6.5	29.2	GNE	< 22.7	1/13/2022	56	+2.0-0.0	5.0	24.2
SH - 2114L	2114+09	16' LT.	4.0	27.2	3.5	23.7	2/2/2022	53	+2.0-0.0	3.0	24.2

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SH - 2116R	2116+06	77' RT.	5.0	29.1	4.5	24.6	1/5/2022	53	+2.0-0.0	3.5	25.6
SH - 2118L	2118+07	7' LT.	4.0	28.2	3.5	24.7	2/2/2022	49	0.0-1.5	2.0	26.2
SH - 2120R	2120+12	68' RT.	4.5	29.2	4.0	25.2	1/5/2022	53	+2.0-0.0	2.5	26.7
SH - 2122L	2121+93	13' LT.	4.0	27.4	2.0	25.4	2/2/2022	53	+2.0-0.0	0.5	26.9
SH - 2124R	2124+08	62' RT.	4.5	30.0	4.0	26.0	1/5/2022	53	+2.0-0.0	3.0	27.0
SH - 2126L	2126+04	6' LT.	4.5	28.4	2.5	25.9	2/2/2022	53	+2.0-0.0	1.5	26.9
SH - 2128R	2128+03	56' RT.	5.0	30.5	4.5	26.0	1/5/2022	53	+2.0-0.0	3.0	27.5
SH - 2130L	2129+99	3' LT.	5.0	29.6	4.5	25.1	2/1/2022	53	+2.0-0.0	2.5	27.1
SH - 2132R	2132+03	61' RT.	6.0	31.1	5.5	25.6	1/6/2022	49	0.0-1.5	4.0	27.1
SH - 2134L	2134+04	5' LT.	4.0	28.6	3.5	25.1	2/1/2022	53	+2.0-0.0	1.5	27.1
SH - 2136R	2136+05	69' RT.	5.0	29.9	4.0	25.9	1/6/2022	49/53	0.0-1.5/+2.0-0.0	2.5	27.4
SH - 2138L	2138+03	3' LT.	4.0	28.4	3.5	24.9	2/1/2022	53	+2.0-0.0	1.5	26.9
SH - 2140R	2140+12	70' RT.	5.5	30.2	4.5	25.7	1/6/2022	53	+2.0-0.0	3.0	27.2
SH - 2142R	2141+94	1' RT.	4.0	28.1	3.0	25.1	2/1/2022	53	+2.0-0.0	1.0	27.1
SH - 2144R	2144+12	81' RT.	5.0	29.8	4.5	25.3	1/6/2022	49	0.0-1.5	2.5	27.3
SH - 2146R	2146+00	13' RT.	4.0	28.6	3.5	25.1	2/1/2022	49	0.0-1.5	1.5	27.1
SH - 2148R	2147+84	93' RT.	5.5	30.7	4.5	26.2	1/6/2022	49	0.0-1.5	3.5	27.2
SH - 2150R	2149+98	12' RT.	4.5	29.3	4.0	25.3	2/1/2022	49	0.0-1.5	2.0	27.3
SH - 2152R	2151+98	94' RT.	4.5	30.0	4.0	26.0	1/6/2022	49	0.0-1.5	3.0	27.0
SH - 2154R	2153+95	13' RT.	5.0	29.9	3.9	26.0	1/28/2022	49	0.0-1.5	2.8	27.1
SH - 2156R	2155+98	92' RT.	5.0	29.5	4.0	25.5	1/7/2022	49	0.0-1.5	2.5	27.0
SH - 2158R	2157+99	10' RT.	4.5	30.5	3.9	26.6	1/28/2022	49	0.0-1.5	3.0	27.5
SH - 2160R	2159+89	86' RT.	5.0	29.9	4.5	25.4	1/7/2022	49	0.0-1.5	3.0	26.9
SH - 2162R	2161+99	11' RT.	4.0	30.0	3.8	26.2	1/28/2022	49	0.0-1.5	3.0	27.0
SH - 2164R	2163+91	74' RT.	5.0	29.6	5.0	24.6	1/7/2022	49/53	0.0-1.5/+2.0-0.0	3.0	26.6
SH - 2166L	2165+96	8' LT.	4.0	29.9	3.3	26.6	1/28/2022	49	0.0-1.5	3.0	26.9
SH - 2168R	2167+98	74' RT.	5.0	28.2	4.5	23.7	1/7/2022	53	+2.0-0.0	2.5	25.7
SH - 2170L	2170+00	14' LT.	4.0	26.0	1.8	24.2	1/28/2022	53	+2.0-0.0	0.0	26.0
SH - 2172R	2171+95	65' RT.	5.0	29.0	4.5	24.5	1/7/2022	53	+2.0-0.0	3.0	26.0
SH - 2174L	2174+04	19' LT.	3.0	26.3	2.5	23.8	1/28/2022	53	+2.0-0.0	1.0	25.3
SH - 2176R	2175+81	60' RT.	5.0	29.2	4.0	25.2	1/7/2022	49/53	0.0-1.5/+2.0-0.0	3.5	25.7

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	Station (feet)	Offset (feet)	(feet)	(feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)		Soil Map Unit	SHGWT Depth[3] (feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)
SH - 2178L	2178+01	19' LT.	4.5	26.9	3.9	23.0	1/27/2022	49	0.0-1.5	1.5	25.4
SH - 2180R	2180+04	67' RT.	5.0	28.8	4.5	24.3	1/9/2022	49	0.0-1.5	3.5	25.3
SH - 2182L	2181+95	18' LT.	4.5	26.4	3.9	22.5	1/27/2022	49	0.0-1.5	1.0	25.4
SH - 2184R	2183+85	68' RT.	5.0	28.8	4.0	24.8	1/9/2022	49	0.0-1.5	3.5	25.3
SH - 2186L	2185+98	20' LT.	4.5	26.2	3.5	22.7	1/27/2022	49	0.0-1.5	1.0	25.2
SH - 2188R	2188+10	94' RT.	4.5	27.9	4.0	23.9	1/10/2022	49/53	0.0-1.5/+2.0-0.0	2.5	25.4
SH - 2190L	2189+96	17' LT.	4.0	25.4	2.0	23.4	1/27/2022	45	0.0-1.5	0.5	24.9
SH - 2192R	2191+91	75' RT.	4.5	27.5	4.0	23.5	1/10/2022	45	0.0-1.5	3.0	24.5
SH - 2194L	2193+99	12' LT.	4.0	26.2	2.0	24.2	1/25/2022	49	0.0-1.5	1.5	24.7
SH - 2196R	2195+95	83' RT.	4.0	27.3	4.0	23.3	1/10/2022	49	0.0-1.5	3.0	24.3
SH - 2198L	2198+03	1' LT.	4.0	25.1	2.0	23.1	1/25/2022	49	0.0-1.5	0.5	24.6
SH - 2200R	2200+26	104' RT.	4.0	25.1	3.5	21.6	2/25/2022	49	0.0-1.5	1.0	24.1
SH - 2202R	2202+00	9' RT.	4.0	25.4	2.0	23.4	1/25/2022	49/50	0.0-1.5/+2.0-0.0	1.5	23.9
SH - 2204R	2204+03	82' RT.	5.0	27.6	4.5	23.1	1/10/2022	50	+2.0-0.0	3.5	24.1
SH - 2206R	2005+87	13' RT.	4.0	24.9	2.0	22.9	1/25/2022	45	0.0-1.5	1.0	23.9
SH - 2208R	2207+78	83' RT.	4.5	27.8	4.0	23.8	1/10/2022	45	0.0-1.5	3.5	24.3
SH - 2210R	2209+98	14' RT.	4.0	25.6	3.5	22.1	1/25/2022	53	+2.0-0.0	1.5	24.1
SH - 2212R	2212+04	93' RT.	7.0	28.5	5.0	23.5	1/10/2022	53	+2.0-0.0	4.0	24.5
SH - 2214R	2213+98	5' RT.	4.0	25.2	2.0	23.2	1/24/2022	53	+2.0-0.0	1.0	24.2
SH - 2216R	2215+98	101' RT.	6.5	27.8	GNE	< 21.3	1/13/2022	53	+2.0-0.0	3.0	24.8
SH - 2218L	2217+98	1' LT.	4.0	25.7	1.5	24.2	1/24/2022	49/53	0.0-1.5/+2.0-0.0	1.0	24.7
SH - 2220R	2220+15	85' RT.	4.5	27.7	4.0	23.7	1/10/2022	49	0.0-1.5	3.5	24.2
SH - 2222	2221+96	C.L.	4.0	26.0	3.5	22.5	1/24/2022	49	0.0-1.5	2.0	24.0
SH - 2224R	2224+17	96' RT.	4.0	25.7	3.5	22.2	1/13/2022	49/53	0.0-1.5/+2.0-0.0	1.5	24.2
SH - 2226R	2226+07	4' RT.	4.5	25.2	3.0	22.2	1/24/2022	53	+2.0-0.0	1.0	24.2
SH - 2228R	2227+96	83' RT.	4.0	25.7	2.0	23.7	1/10/2022	49	0.0-1.5	1.0	24.7
SH - 2230L	2229+96	3' LT.	4.0	24.8	1.5	23.3	1/24/2022	49	0.0-1.5	0.5	24.3
SH - 2232R	2232+09	74' RT.	4.0	26.0	3.0	23.0	1/10/2022	49	0.0-1.5	1.5	24.5
SH - 2234L	2234+00	11' LT.	4.0	25.5	1.5	24.0	1/24/2022	49	0.0-1.5	1.0	24.5
SH - 2236R	2236+13	72' RT.	4.0	25.6	3.0	22.6	2/25/2022	49	0.0-1.5	2.0	23.6
SH - 2238L	2238+00	22' LT.	4.0	25.0	2.0	23.0	1/24/2022	49	0.0-1.5	1.5	23.5

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Project Development and Environment (PD&E) Study - LPGA Boulevard from US 92 (SR 600) to Williamson Boulevard
Volusia County, Florida
FPN: 448456-1-22-01
Tierra Project No: 5511-21-038

Boring Number	Boring Location[1] C/L Construction		Boring Depth[2]	Ground Surface Elevation NAVD88[1]	Measured GWT		Date Groundwater Table Recorded	USDA Soil Survey		Estimated SHGWT[4]	
	Station (feet)	Offset (feet)	(feet)	(feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)		Soil Map Unit	SHGWT Depth[3] (feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)
SH - 2240R	2240+11	64' RT.	4.5	24.9	4.0	20.9	1/10/2022	53	+2.0-0.0	3.0	21.9
SH - 2242L	2241+90	44' LT.	6.0	25.6	GNE	< 19.6	1/24/2022	53	+2.0-0.0	4.0	21.6
SH - 2244R	2244+01	61' RT.	4.0	22.2	3.5	18.7	1/11/2022	23	0.0-1.5	2.0	20.2
SH - 2246L	2246+13	52' LT.	5.0	24.8	GNE	< 19.8	1/24/2022	23	0.0-1.5	5.0	19.8
SH - 2248R	2248+07	59' RT.	4.0	20.1	2.0	18.1	1/11/2022	23	0.0-1.5	1.0	19.1
SH - 2250L	2250+00	33' LT.	4.0	19.9	1.5	18.4	1/21/2022	23	0.0-1.5	0.5	19.4
SH - 2252R	2252+06	40' RT.	4.0	19.0	1.5	17.5	1/11/2022	23	0.0-1.5	0.5	18.5
SH - 2254L	2253+98	35' LT.	4.0	19.0	1.5	17.5	1/21/2022	23	0.0-1.5	0.5	18.5
SH - 2256R	2256+12	42' RT.	4.0	19.8	3.0	16.8	1/11/2022	23	0.0-1.5	1.0	18.8
SH - 2258L	2257+94	34' LT.	4.0	17.2	1.5	15.7	1/21/2022	23	0.0-1.5	0.5	16.7
SH - 2260R	2260+19	37' RT.	4.0	18.3	3.5	14.8	2/25/2022	23	0.0-1.5	2.0	16.3
SH - 2262L	2262+01	32' LT.	6.0	18.7	GNE	< 12.7	1/21/2022	23/37	0.0-1.5/3.5-5.0	2.5	16.2
SH - 2264R	2263+95	43' RT.	4.0	18.2	3.0	15.2	1/12/2022	37	3.5-5.0	2.0	16.2
SH - 2266L	2265+94	40' LT.	6.0	25.8	GNE	< 19.8	1/21/2022	37	3.5-5.0	(6)	(6)
SH - 2272R	2271+96	41' RT.	5.0	17.1	GNE	< 12.1	1/12/2022	25	+1.0-0.0	3.0	14.1
SH - 2274L	2274+29	58' LT.	5.5	17.8	5.0	12.8	1/21/2022	29	0.0-1.5	3.5	14.3
SH - 2276R	2275+88	29' RT.	7.0	18.9	6.5	12.4	1/12/2022	17	3.5-5.0	4.5	14.4
SH - 2278L	2277+99	70' LT.	6.0	22.3	GNE	< 16.3	1/21/2022	17	3.5-5.0	(6)	(6)
SH - 2280R	2280+17	60' RT.	4.5	19.7	4.0	15.7	1/11/2022	17	3.5-5.0	3.5	16.2
SH - 2282L	2281+97	94' LT.	6.0	24.2	GNE	< 18.2	1/21/2022	29	0.0-1.5	(6)	(6)
SH - 2284R	2284+02	47' RT.	6.5	30.1	GNE	< 23.6	1/11/2022	29	0.0-1.5	(6)	(6)
SH - 2286L	2285+95	88' LT.	6.0	41.4	GNE	< 35.4	1/20/2022	29	0.0-1.5	(6)	(6)
SH - 2288R	2288+03	90' RT.	6.5	25.3	GNE	< 18.8	1/11/2022	29	0.0-1.5	(6)	(6)
SH - 2290L	2289+97	99' LT.	6.0	25.2	GNE	< 19.2	1/20/2022	29	0.0-1.5	(6)	(6)
SH - 2292R	2292+14	84' RT.	6.5	24.1	GNE	< 17.6	1/19/2022	29	0.0-1.5	5.5	18.6
SH - 2294L	2294+06	119' LT.	4.0	23.5	3.5	20.0	1/20/2022	49	0.0-1.5	3.0	20.5
SH - 2296R	2296+11	89' RT.	6.5	33.4	GNE	< 26.9	1/19/2022	51	+2.0-0.0	(6)	(6)
SH - 2298L	2297+98	92' LT.	4.5	23.2	3.5	19.7	1/20/2022	50	+2.0-0.0	3.0	20.2
SH - 2300R	2300+45	129' RT.	6.5	29.0	GNE	< 22.5	1/19/2022	50	+2.0-0.0	(6)	(6)
SH - 2302L	2301+84	56' LT.	6.5	27.7	GNE	< 21.2	1/20/2022	50	+2.0-0.0	(6)	(6)
SH - 2304R	2304+01	85' RT.	6.0	22.9	GNE	< 16.9	1/19/2022	49	0.0-1.5	4.5	18.4

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Volusia County, Florida
FPN: 448456-1-22-01
Tierra Project No: 5511-21-038

Boring Number	Boring Location[1] C/L Construction		Boring Depth[2]	Ground Surface Elevation NAVD88[1]	Measured GWT		Date Groundwater Table Recorded	USDA Soil Survey		Estimated SHGWT[4]	
	Station (feet)	Offset (feet)	(feet)	(feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)		Soil Map Unit	SHGWT Depth[3] (feet)	Depth Below Ground Surface (feet)	Elevation NAVD88 (feet)
SH - 2306L	2305+89	65' LT.	4.0	22.2	3.0	19.2	1/19/2022	51	+2.0-0.0	2.5	19.7
SH - 2308R	2307+90	71' RT.	4.0	24.2	3.5	20.7	1/19/2022	51	+2.0-0.0	3.0	21.2
SH - 2310L	2309+96	63' LT.	4.0	22.6	1.5	21.1	1/20/2022	49/51	0.0-1.5/+2.0-0.0	1.0	21.6
SH - 2313R	2313+43	73' RT.	4.0	23.7	2.5	21.2	1/19/2022	49	0.0-1.5	1.5	22.2
SH - 2315L	2315+02	65' LT.	4.0	22.8	1.0	21.8	1/20/2022	49	0.0-1.5	0.5	22.3
SH - 2317R	2317+18	74' RT.	4.0	24.8	2.5	22.3	1/19/2022	50	+2.0-0.0	2.0	22.8
SH - 2319L	2318+98	68' LT.	4.0	22.9	1.0	21.9	1/20/2022	50	+2.0-0.0	0.5	22.4
SH - 2321R	2321+09	76' RT.	4.0	24.3	2.5	21.8	1/19/2022	50	+2.0-0.0	2.0	22.3
SH - 2323L	2323+03	67' LT.	4.0	23.1	2.0	21.1	1/20/2022	50	+2.0-0.0	1.0	22.1

(1) Boring locations (station and offset) were based on design files provided by HDR and GPS coordinates obtained by Tierra at the time of fieldwork. Ground surface elevations were estimated using a Trimble TDC-150 GNSS device with a reported accuracy of 6 cm horizontal and 2 cm vertical.

(2) Depth below existing grades at time of field services.

(3) Seasonal high groundwater table depth reported in the Soil Survey of Volusia County, Florida published by the USDA/NRCS.

(4) Seasonal high groundwater table depth estimated based on soil stratigraphy, measured groundwater levels from the borings, the USDA NRCS Soil Survey information, and surrounding topography.

(5) GNE: Groundwater not encountered within the depth of the soil boring.

(6) Seasonal high groundwater table is not estimated within the explored depth of the boring.

TABLE 2

Summary of Laboratory Test Results for Soil Classification

Project Development and Environment (PD&E) Study - LPGA Boulevard from US 92 (SR 600) to Williamson Boulevard

Volusia County, Florida

FPID No.: 448456-1-22-01

Tierra Job No.: 5511-21-038

Boring Name	Depth (ft)	AASHTO Symbol	Stratum Number	Sieve Analysis					Atterberg Limits			Organic Content	Moisture Content
				#10	#40	#60	#100	#200	LL	PL	PI		
SH-2008R	4.5 - 5.0	A-3	1	100	97	86	42	3	-	-	-	-	-
SH-2014R	4.0 - 4.5	A-3	1	100	97	86	43	4	-	-	-	-	-
SH-2024R	2.5 - 3.0	A-3	1	100	96	81	29	9	-	-	-	-	-
SH-2054L	1.0 - 1.5	A-3	1	100	96	85	38	8	-	-	-	-	-
SH-2064R	3.0 - 3.5	A-3	1	100	96	81	30	8	-	-	-	-	-
SH-2084R	3.0 - 3.5	A-3	1	100	96	82	31	9	-	-	-	-	-
SH-2094R	3.5 - 4.0	A-3	1	100	96	82	29	8	-	-	-	-	-
SH-2104R	2.5 - 3.0	A-3	1	100	95	80	29	8	-	-	-	-	-
SH-2114L	3.0 - 3.5	A-3	1	100	96	77	28	9	-	-	-	-	-
SH-2134L	0.5 - 1.0	A-3	1	100	89	64	20	10	-	-	-	-	-
SH-2136R	3.0 - 3.5	A-3	1	99	92	67	20	9	-	-	-	3	22
SH-2144R	2.5 - 3.0	A-3	1	100	88	63	20	10	-	-	-	-	-
SH-2160R	4.0 - 5.0	A-3	1	100	91	67	20	7	-	-	-	3	20
SH-2174L	1.0 - 1.5	A-3	1	100	87	61	18	10	-	-	-	-	-
SH-2184R	1.0 - 1.5	A-3	1	100	86	57	16	7	-	-	-	-	-
SH-2204R	2.0 - 2.5	A-3	1	100	89	62	19	10	-	-	-	-	-
SH-2214R	2.5 - 3.0	A-3	1	100	92	63	17	6	-	-	-	-	-
SH-2224R	3.0 - 3.5	A-3	1	99	91	65	20	10	-	-	-	-	-
SH-2234L	2.0 - 2.5	A-3	1	100	93	63	13	3	-	-	-	-	-
SH-2254L	1.5 - 2.0	A-3	1	100	93	66	16	3	-	-	-	-	-
SH-2264R	2.0 - 2.5	A-3	1	100	96	83	25	6	-	-	-	-	-
SH-2278L	1.0 - 2.0	A-3	1	100	98	87	29	7	-	-	-	-	-
SH-2288R	3.0 - 3.5	A-3	1	98	92	78	28	9	-	-	-	-	-
SH-2298L	1.5 - 2.0	A-3	1	100	97	87	28	7	-	-	-	-	-
SH-2319L	1.0 - 1.5	A-3	1	100	95	79	26	5	-	-	-	-	-
SH-2010R	1.5 - 2.0	A-2-4	1	100	96	84	38	11	-	-	-	2	23
SH-2044R	2.0 - 2.5	A-2-4	1	100	96	85	42	11	-	-	-	-	-
SH-2074L	2.5 - 3.0	A-2-4	1	100	95	81	32	12	-	-	-	-	-
SH-2118L	3.5 - 4.0	A-2-4	1	100	95	76	29	12	NP	NP	NP	-	20
SH-2124R	1.5 - 2.0	A-2-4	1	100	89	66	22	11	-	-	-	-	-
SH-2124R	2.5 - 3.0	A-2-4	1	99	89	66	22	11	-	-	-	2	11
SH-2164R	1.0 - 1.5	A-2-4	1	100	84	56	20	14	-	-	-	-	-
SH-2192R	2.5 - 3.0	A-2-4	1	99	91	63	22	12	-	-	-	5	22
SH-2194L	3.5 - 4.0	A-2-4	1	100	91	64	22	13	-	-	-	-	-
SH-2308R	3.5 - 4.0	A-2-4	1	100	97	87	34	11	-	-	-	-	-

TABLE 2

Summary of Laboratory Test Results for Soil Classification

Project Development and Environment (PD&E) Study - LPGA Boulevard from US 92 (SR 600) to Williamson Boulevard

Volusia County, Florida

FPID No.: 448456-1-22-01

Tierra Job No.: 5511-21-038

Boring Name	Depth (ft)	AASHTO Symbol	Stratum Number	Sieve Analysis					Atterberg Limits			Organic Content	Moisture Content
				#10	#40	#60	#100	#200	LL	PL	PI		
SH-2020R	4.5 - 5.0	A-2-4	2	100	97	87	48	19	NP	NP	NP	-	14
SH-2082L	1.0 - 1.5	A-2-4	2	100	96	78	26	16	NP	NP	NP	-	13
SH-2096R	3.5 - 4.0	A-2-4	2	100	97	85	39	19	-	-	-	2	20
SH-2100R	4.0 - 4.5	A-2-4	2	97	93	79	35	18	-	-	-	-	-
SH-2152R	3.0 - 3.5	A-2-4	2	100	87	62	22	16	NP	NP	NP	-	18
SH-2238L	3.5 - 4.0	A-2-4	2	100	95	70	25	16	NP	NP	NP	-	21
SH-2244R	2.5 - 3.0	A-2-4	2	100	96	75	28	19	-	-	-	-	-
SH-2046R	1.0 - 1.5	A-2-6	3	100	97	89	49	29	-	-	-	-	23
SH-2012R	3.0 - 3.5	A-8	4	99	96	83	41	14	-	-	-	6	27
SH-2030R	2.5 - 3.0	A-8	4	100	96	84	40	16	-	-	-	13	33
SH-2034R	1.5 - 2.0	A-8	4	99	97	89	56	29	-	-	-	7	25
SH-2036R	4.5 - 5.0	A-8	4	95	92	82	46	25	-	-	-	7	31
SH-2108R	3.0 - 3.5	A-8	4	99	94	79	38	23	-	-	-	11	34
SH-2126L	3.0 - 3.5	A-8	4	100	93	75	39	28	-	-	-	7	37
SH-2132R	4.5 - 5.0	A-8	4	100	95	75	25	8	-	-	-	6	28
SH-2156R	4.5 - 5.0	A-8	4	100	91	69	23	9	-	-	-	7	34
SH-2180R	3.0 - 3.5	A-8	4	100	88	64	26	16	-	-	-	18	42

TABLE 3

Summary of Laboratory Test Results for Environmental Classification

Project Development and Environment (PD&E) Study - LPGA Boulevard from US 92 (SR 600) to Williamson Boulevard

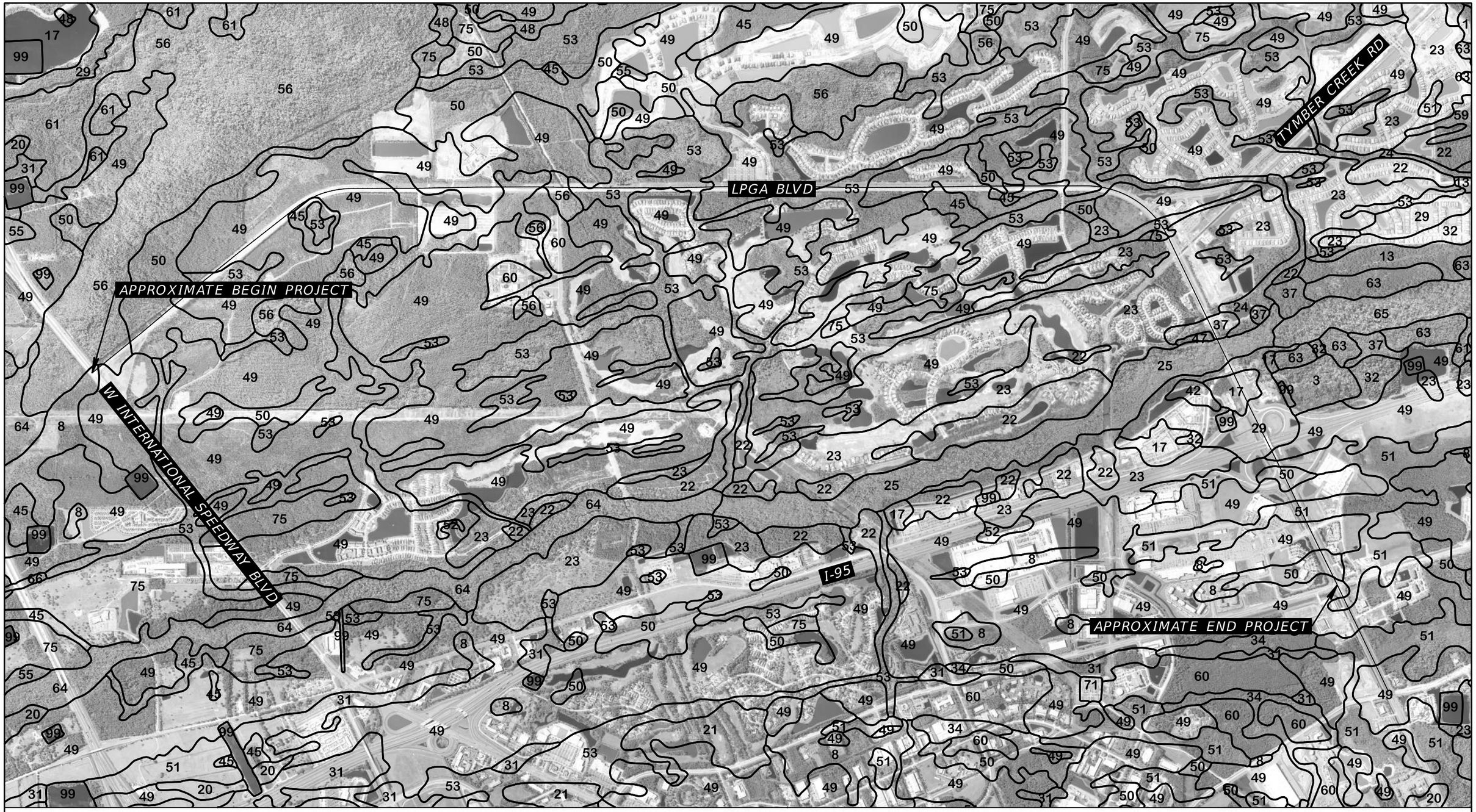
Volusia County, Florida

FPID No.: 448456-1-22-01

Tierra Job No.: 5511-21-038

Boring Name	Depth (ft)	Stratum No. /AASHTO Symbol	pH	Resistivity (ohm-cm)	Chlorides (ppm)	Sulfates (ppm)	Environmental Classification	
							Steel Substructure	Concrete Substructure
SH-2006L	2.5 - 3.5	1/A-3	7.9	23,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2022R	2.5 - 3.5	1/A-3	7.9	24,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2038R	2.0 - 3.0	1/A-3	4.6*	7,300	30	72	Extremely Aggressive	Extremely Aggressive
SH-2052R	1.0 - 2.5	1/A-3	8.1	15,000	60	< 5	Slightly Aggressive	Slightly Aggressive
SH-2066L	0.5 - 1.5	1/A-3	6.1*	26,000	30	9	Moderately Aggressive	Slightly Aggressive
SH-2082L	1.0 - 2.0	1/A-3	7.8	7,200	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2096R	1.0 - 2.0	1/A-3	8.6	19,000	30	6	Slightly Aggressive	Slightly Aggressive
SH-2112R	5.0 - 6.0	1/A-3	7.6	6,300	30	48	Slightly Aggressive	Slightly Aggressive
SH-2126L	2.0 - 3.0	1/A-3	6.3*	2,800*	30	< 5	Moderately Aggressive	Moderately Aggressive
SH-2142R	3.0 - 4.0	1/A-3	7.7	21,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2156R	2.0 - 3.5	1/A-3	7.1	2,700*	45	123	Moderately Aggressive	Moderately Aggressive
SH-2172R	3.0 - 4.5	1/A-3	6.6*	6,600	30	6	Moderately Aggressive	Slightly Aggressive
SH-2186L	0.0 - 1.5	1/A-3	7.5	13,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2202R	2.0 - 3.0	1/A-3	7.5	33,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2214R	1.0 - 2.5	1/A-3	7.4	12,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2230L	2.0 - 3.0	1/A-3	5.6*	11,000	30	24	Extremely Aggressive	Moderately Aggressive
SH-2244R	0.5 - 1.5	1/A-3	6.9*	54,000	30	< 5	Moderately Aggressive	Slightly Aggressive
SH-2258L	1.5 - 2.5	1/A-3	7.5	27,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2284R	0.5 - 2.0	1/A-3	7.7	10,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2298L	3.0 - 4.0	1/A-3	7.2	16,000	30	< 5	Slightly Aggressive	Slightly Aggressive
SH-2315L	2.5 - 4.0	1/A-3	7.3	13,000	30	< 5	Slightly Aggressive	Slightly Aggressive

* Indicates governing factor(s) for environmental classification.



REFERENCE: USDA SOIL SURVEY OF VOLUSIA COUNTY, FLORIDA

N

0 400 2000

Feet

FIGURE 2

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

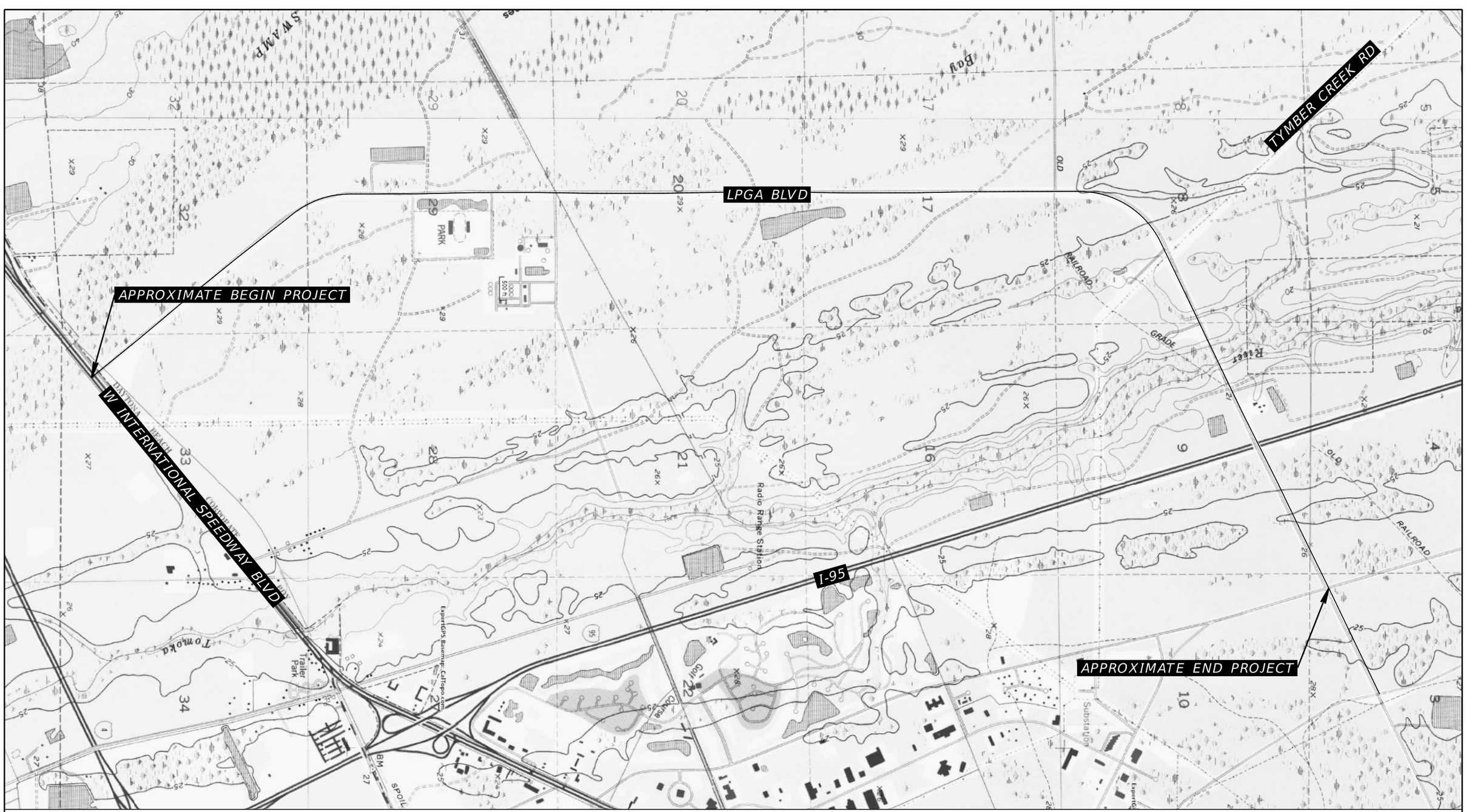
JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

USDA SOIL SURVEY MAP

SHEET NO.



REFERENCE: USGS QUADRANGLE MAP OF "DAYTONA BEACH, FLORIDA"

TOWNSHIP: 15S
RANGE: 32E
SECTION: 3,4,8,9,17,20,29,32,33

N

0 400 2000
Feet

FIGURE 3

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

USGS QUADRANGLE MAP

SHEET NO.

DATE OF SURVEY: JANUARY 2022 TO FEBRUARY 2022
SURVEY MADE BY: TIERRA, INC.
SUBMITTED BY: JEREMY A. SEWELL, P.E.

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH

DISTRICT: 5
ROAD NO.: N/A
COUNTY: VOLUSIA

FINANCIAL PROJECT ID : 448456-1-22-01
PROJECT NAME: LPGA BOULEVARD FROM US 92 (SR 600) TO WILLIAMSON BOULEVARD PD&E STUDY

CROSS SECTION SOIL SURVEY FOR THE DESIGN OF ROADS

SURVEY BEGINS STA. : 2000+00.00 SURVEY ENDS STA. : 2324+50.00 REFERENCE: CENTERLINE OF CONSTRUCTION OF LPGA BOULEVARD

	ORGANIC CONTENT		MOISTURE CONTENT		SIEVE ANALYSIS RESULTS PERCENT PASS (%)						ATTERBERG LIMITS (%)					CORROSION TEST RESULTS				
STRATUM NO.	NO. OF TESTS	% ORGANIC	NO. OF TESTS	MOISTURE CONTENT	NO. OF TESTS	10 MESH	40 MESH	60 MESH	100 MESH	200 MESH	NO. OF TESTS	LIQUID LIMIT	PLASTIC INDEX	AASHTO GROUP	DESCRIPTION	NO. OF TESTS	RESISTIVITY ohm-cm	CHLORIDE ppm	SULFATES ppm	pH
1	5	2-5	6	11-23	35	98-100	84-98	56-87	13-43	3-14	1	NP	NP	A-3/A-2-4	GRAY TO BROWN SAND TO SILTY SAND (-200<15%)	21	2,700-54,000	30-60	<5-123	4.6-8.6
2	1	2	5	13-21	7	97-100	87-97	62-87	22-48	16-19	4	NP	NP	A-2-4	GRAY TO BROWN SILTY SAND (-200≥15%)	--	--	--	--	--
3	--	--	1	23	1	100	97	89	49	29	--	--	--	A-2-6	GRAY TO BROWN CLAYEY SAND	--	--	--	--	--
4	9	6-18	9	25-42	9	95-100	88-97	64-89	23-56	8-29	--	--	--	A-8	DARK BROWN ORGANIC SAND WITH SILT TO SILTY SAND	--	--	--	--	--

NOTES:

1. STRATA 1 AND 2 SHALL BE TREATED AS SELECT (S) IN ACCORDANCE WITH STANDARD PLANS, INDEX 120-001.
2. STRATUM 3 SHALL BE TREATED AS PLASTIC (P) IN ACCORDANCE WITH STANDARD PLANS, INDEX 120-001.
3. STRATUM 4 SHALL BE TREATED AS MUCK (M) IN ACCORDANCE WITH STANDARD PLANS, INDEX 120-001.
4. STRATUM 2 MAY CONTAIN EXCESS MOISTURE AND MAY BE DIFFICULT TO DRY AND COMPACT.

EMBANKMENT AND SUBGRADE MATERIAL

STRATA BOUNDARIES ARE APPROXIMATE. MAKE FINAL CHECK AFTER GRADING.

▼ - WATER TABLE ENCOUNTERED

▽ - ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

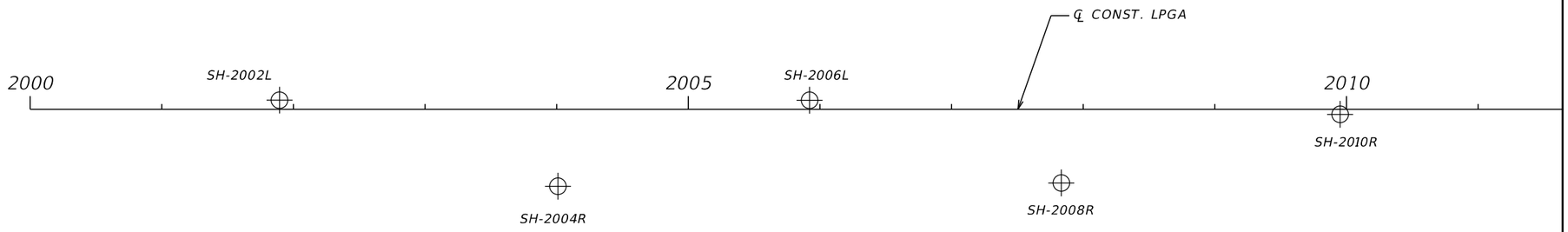
GNE - GROUNDWATER NOT ENCOUNTERED

NP - NON-PLASTIC

THE "--" INDICATES AN UNMEASURED PARAMETER.

FIGURE 4

REVISIONS				ENGINEER OF RECORD	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			ROADWAY SOIL SURVEY	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	JEREMY A. SEWELL, P.E. LICENSE NUMBER: 62951 TIERRA, INC. 591 SUSAN B. BRITT COURT WINTER GARDEN, FLORIDA 34787	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
					N/A	VOLUSIA	448456-1-22-01		



LEGEND

⊕ APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 5

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

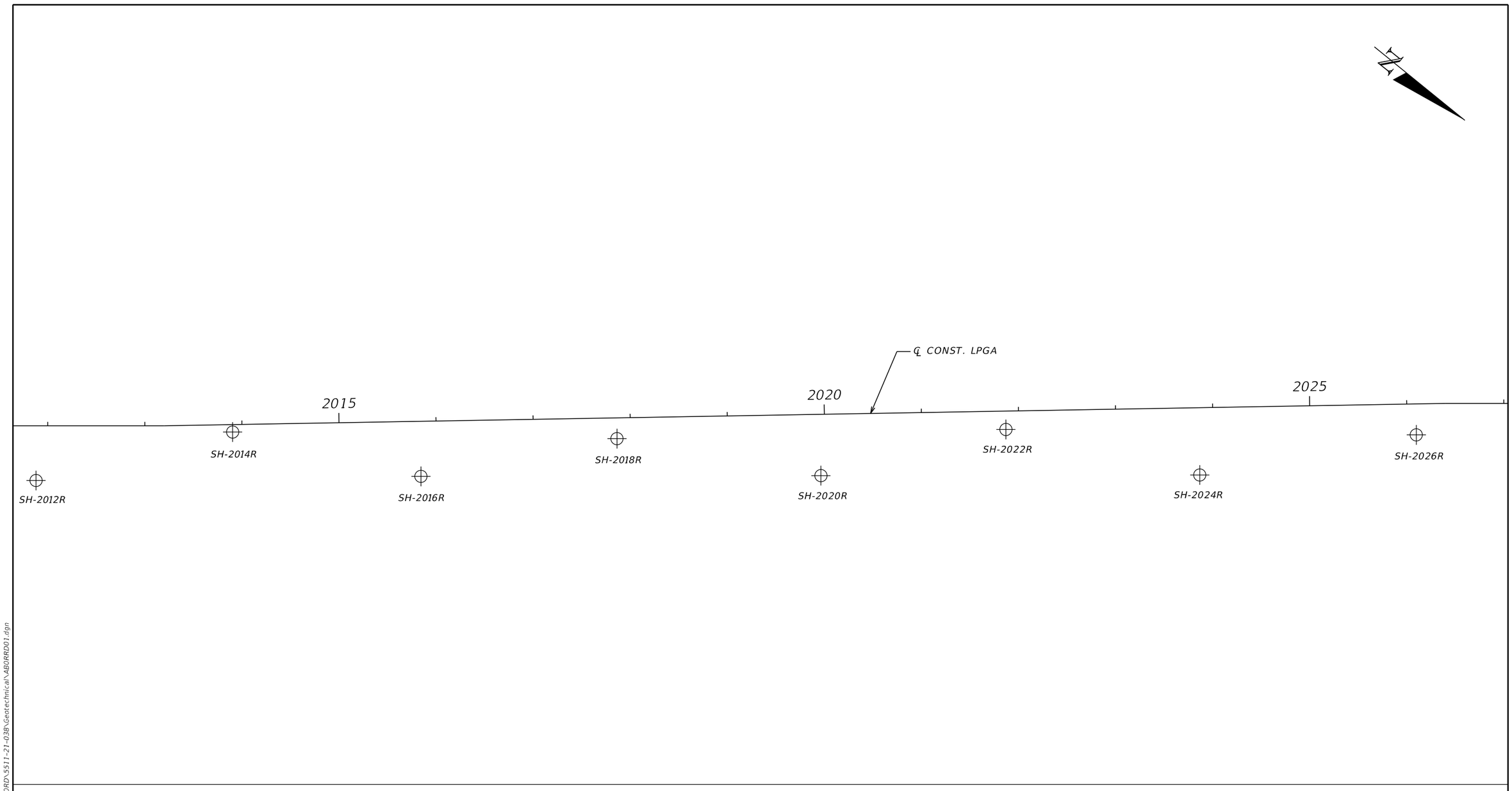
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (1)

SHEET NO.

12/5/2022 11:39:05 AM bgarcia
L:\5511\2021\2021 Projects\5511-21-038 LPGA Blvd PDE\ORD\5511-21-038\Geotechnical\ABORRD01.dgn



LEGEND

⊕ APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 6

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (2)

SHEET NO.

12/5/2022 11:39:05 AM bgarcia
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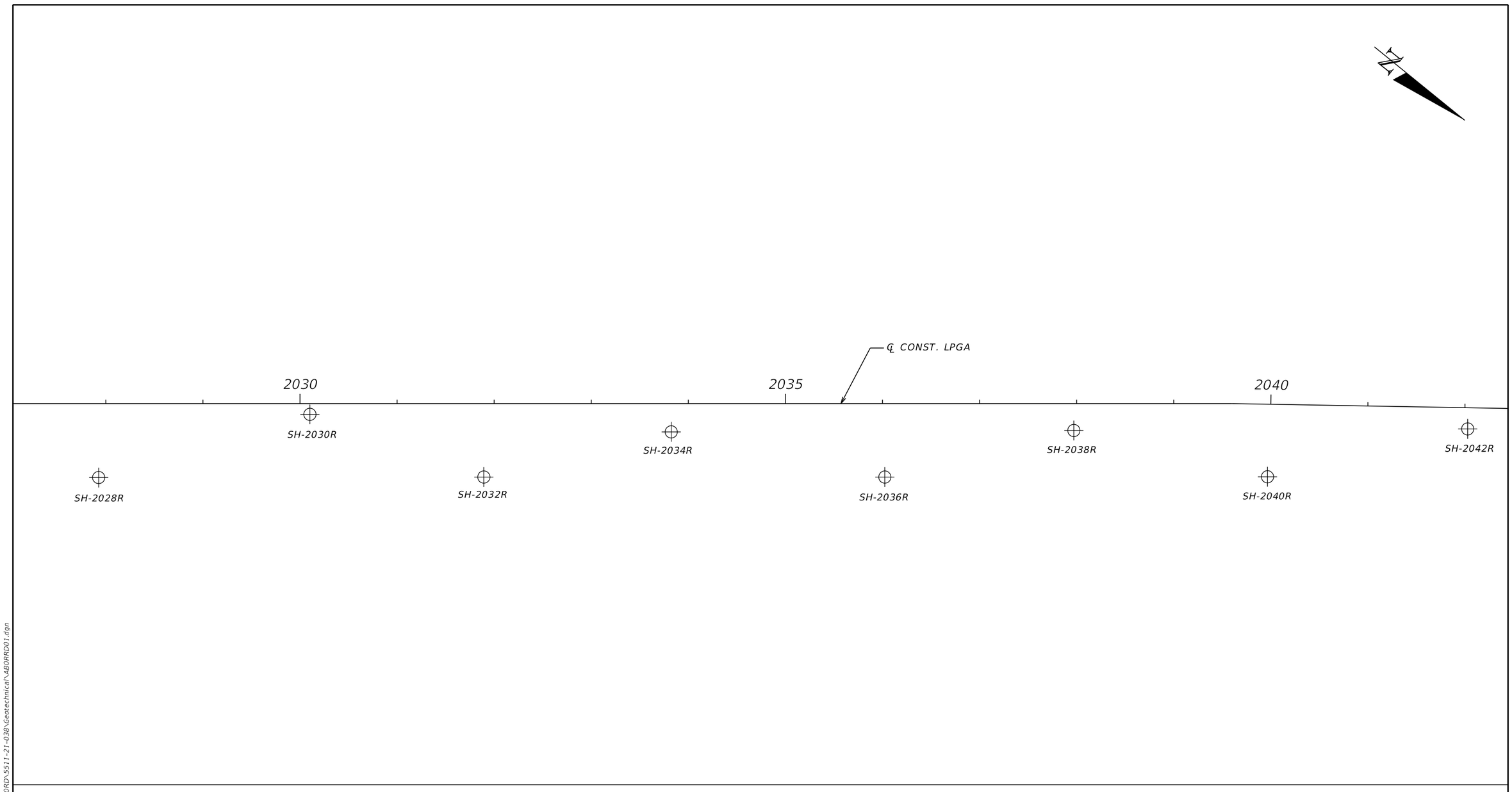

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 7

REVISIONS				JEREMY A. SEWELL, P.E.	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			BORING LOCATION PLAN (3)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	P.E. LICENSE NUMBER 62951	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				TIERRA, INC.	N/A	VOLUSIA	448456-1-22-01		
				591 SUSAN B. BRITT COURT WINTER GARDEN, FLORIDA 34787					

12/5/2022 11:39:06 AM bgarcia
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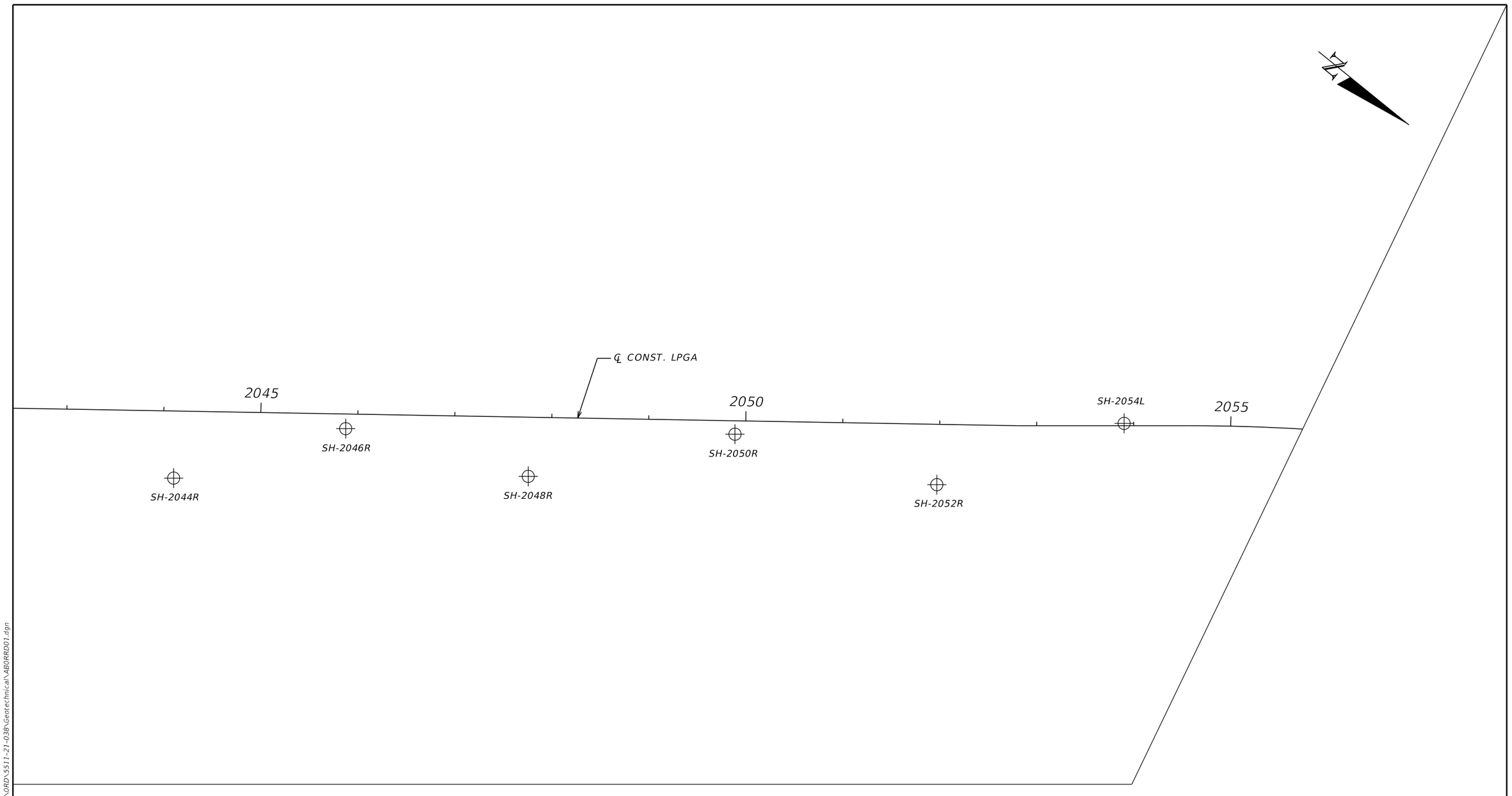

FIGURE 8

REVISIONS				JEREMY A. SEWELL, P.E. P.E. LICENSE NUMBER 62951 TIERRA, INC. 591 SUSAN B. BRITT COURT WINTER GARDEN, FLORIDA 34787	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			BORING LOCATION PLAN (4)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
					N/A	VOLUSIA	448456-1-22-01		

12/5/2022 11:39:06 AM bgarcia
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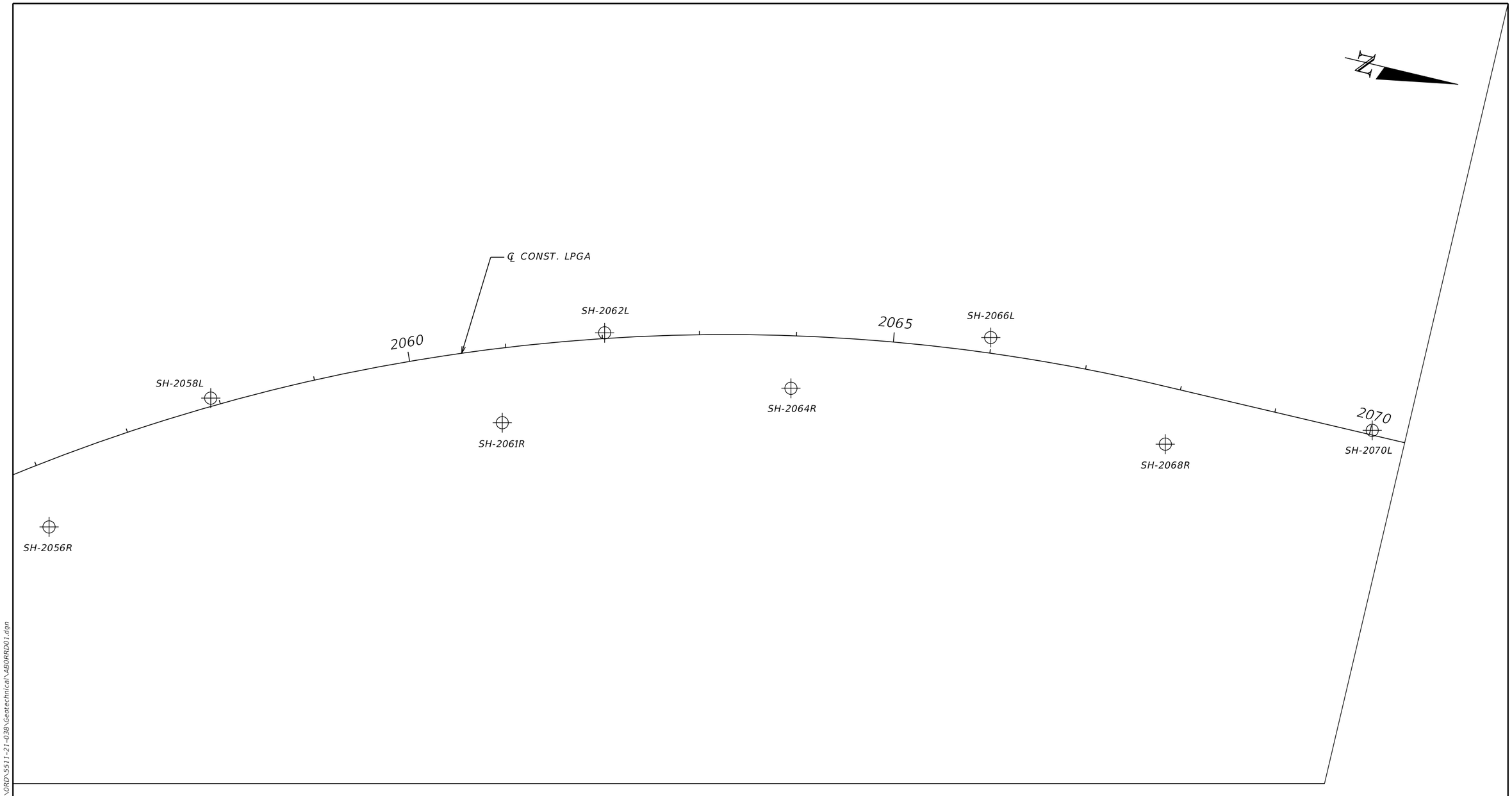

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100

Feet

FIGURE 9

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (5)

SHEET NO.

12/5/2022 11:39:07 AM bgarcia
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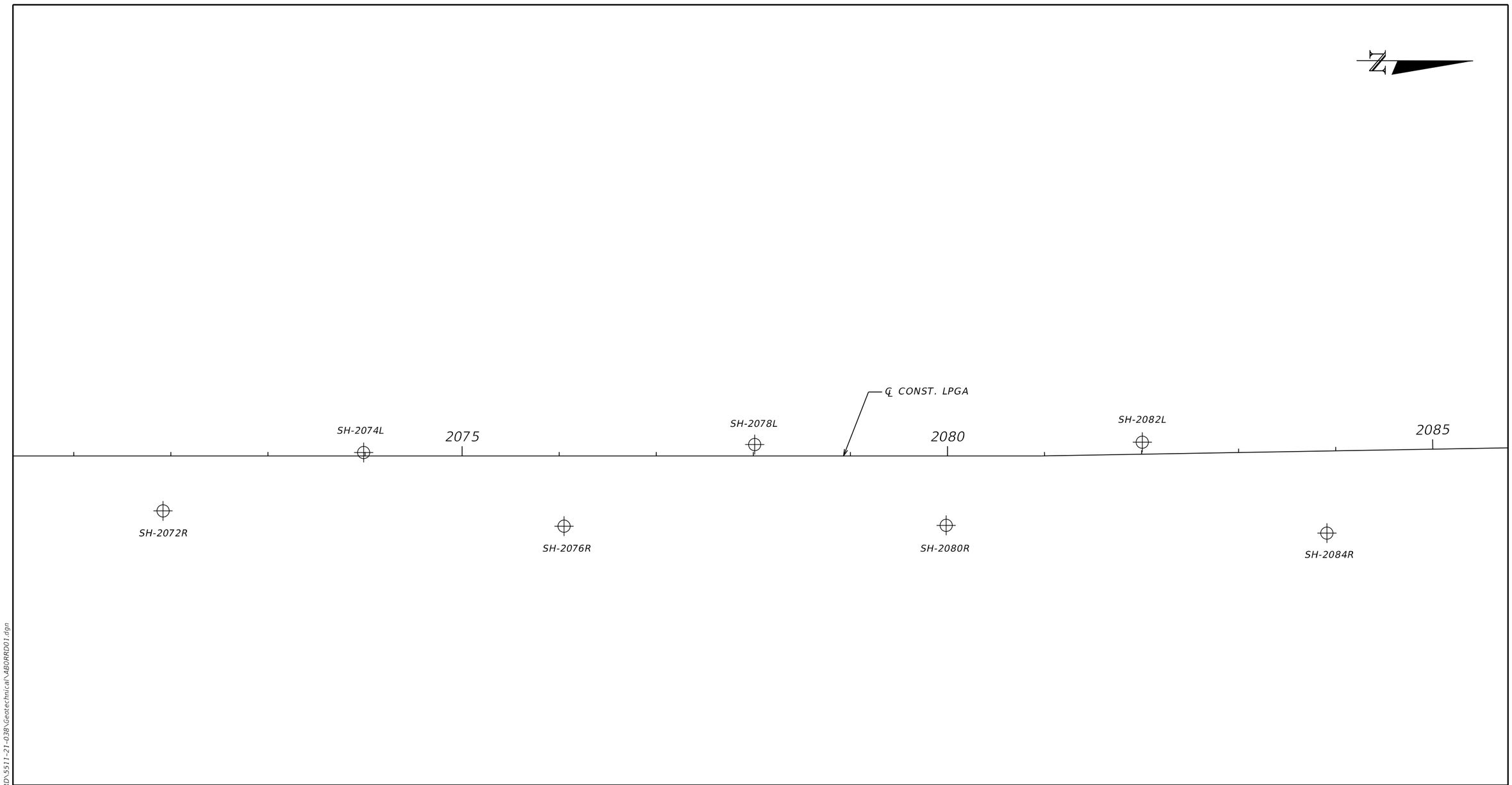

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 10

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (6)

SHEET NO.

12/5/2022 11:39:07 AM bgarcia
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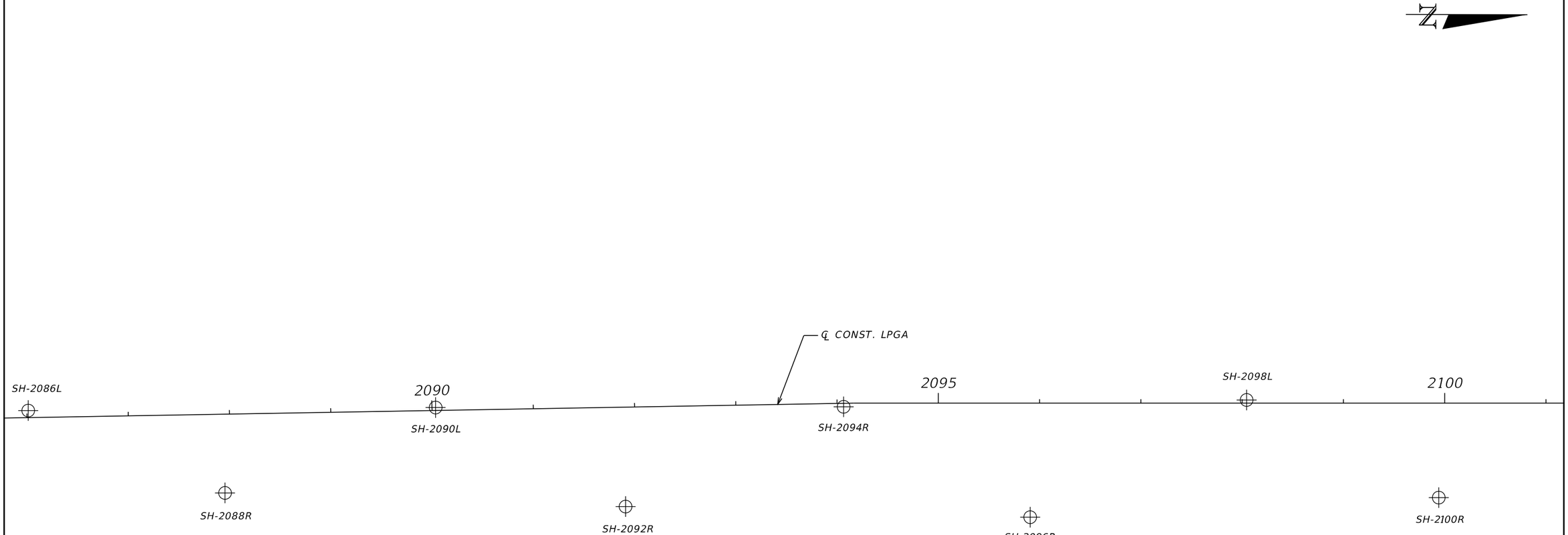

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 11

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (7)

SHEET NO.

12/5/2022 11:39:08 AM bgarcia
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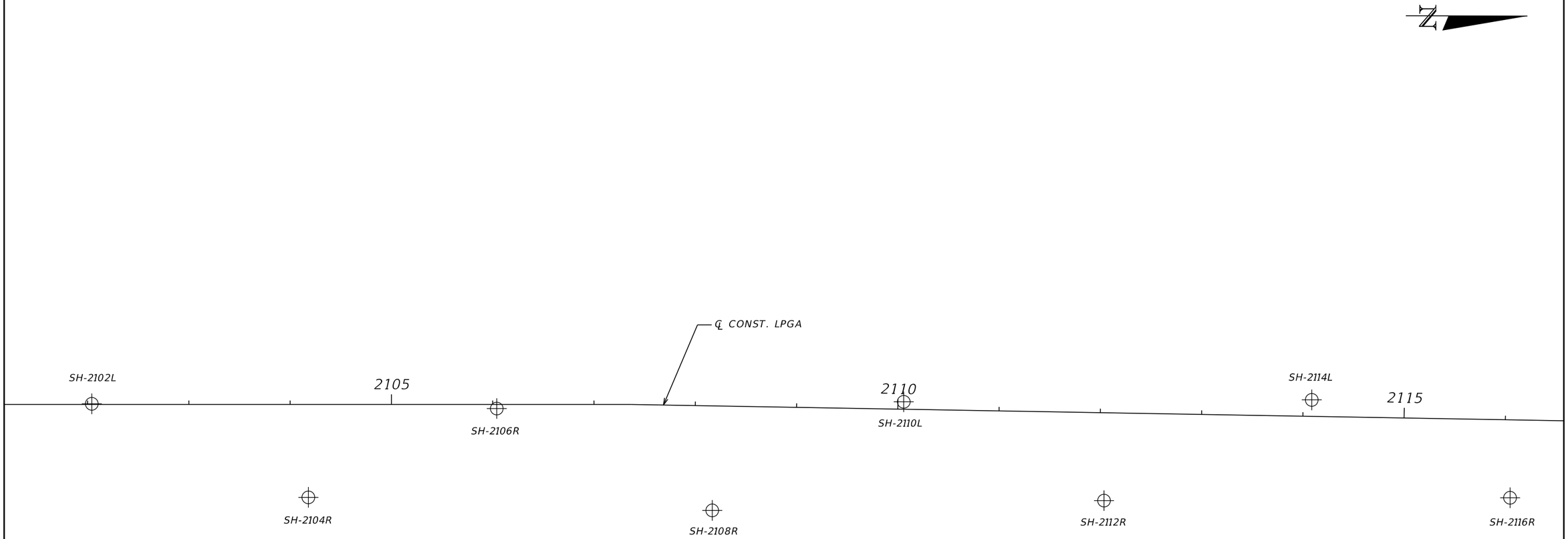

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 12

REVISIONS				JEREMY A. SEWELL, P.E. P.E. LICENSE NUMBER 62951 TIERRA, INC. 591 SUSAN B. BRITT COURT WINTER GARDEN, FLORIDA 34787	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			BORING LOCATION PLAN (8)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
					N/A	VOLUSIA	448456-1-22-01		

12/5/2022 11:39:09 AM bgarcia
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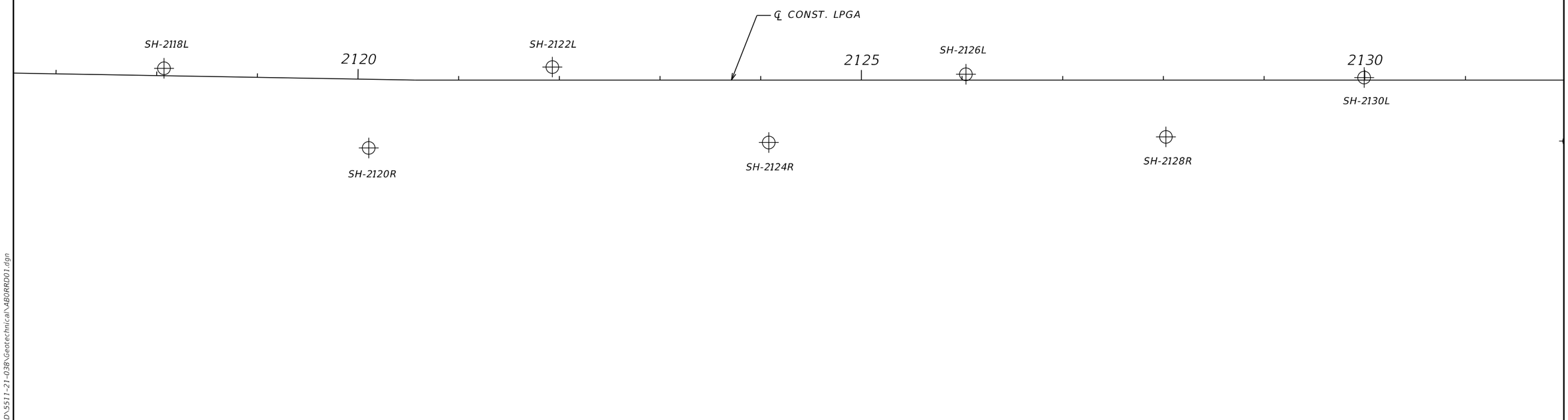

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 13

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (9)

SHEET NO.

12/5/2022 11:39:09 AM bgarcia
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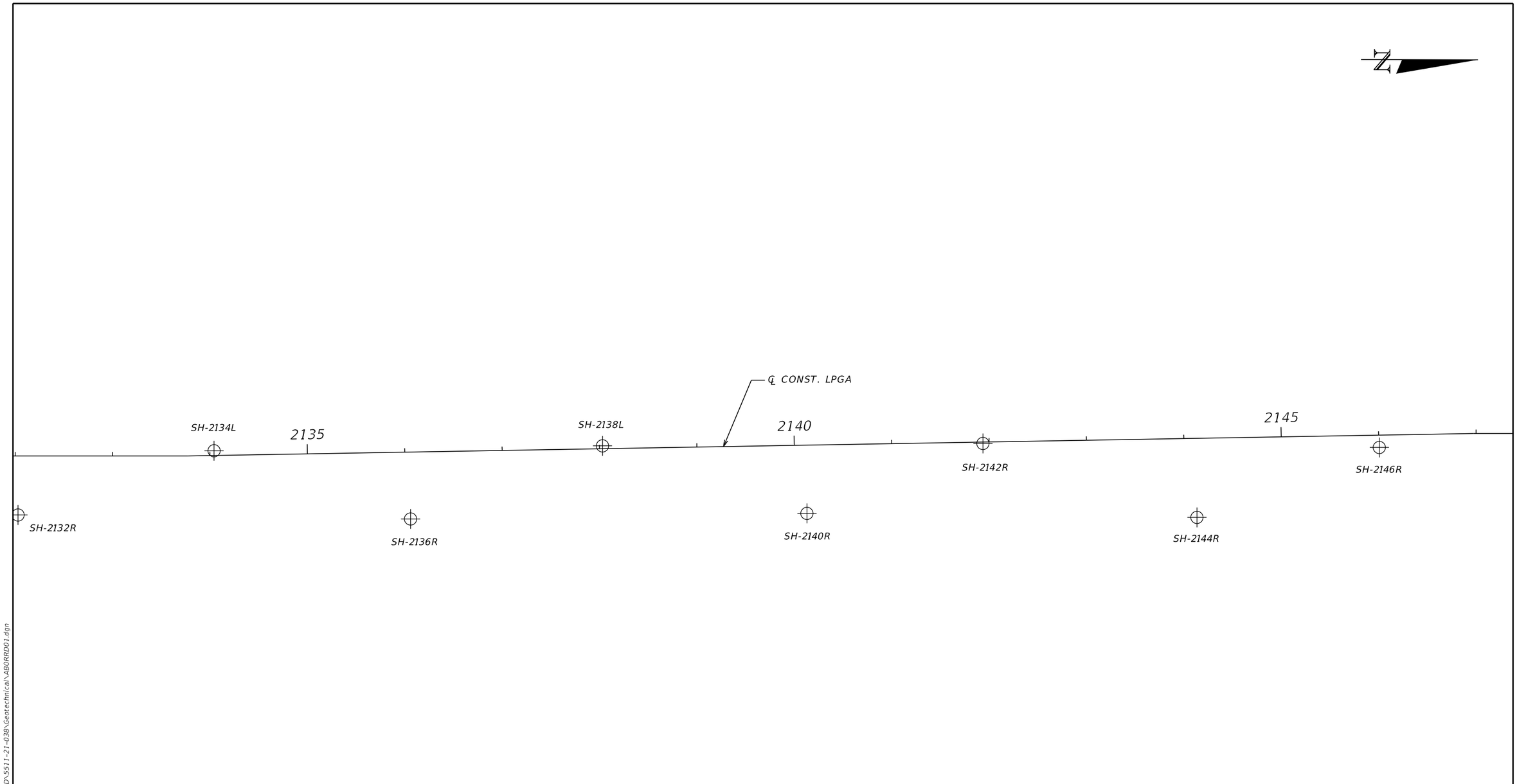

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 14

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (10)

SHEET NO.

12/5/2022 11:39:10 AM tgarcia
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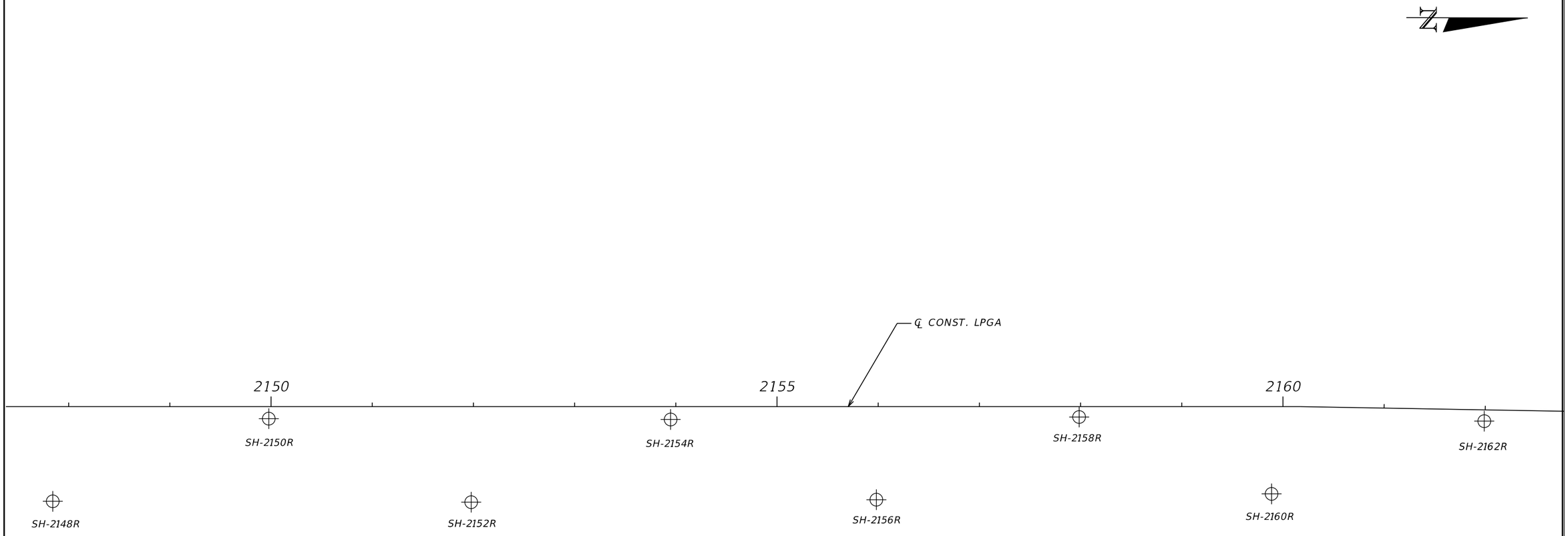

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 15

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (11)

SHEET NO.

12/5/2022 11:39:10 AM bgarcia
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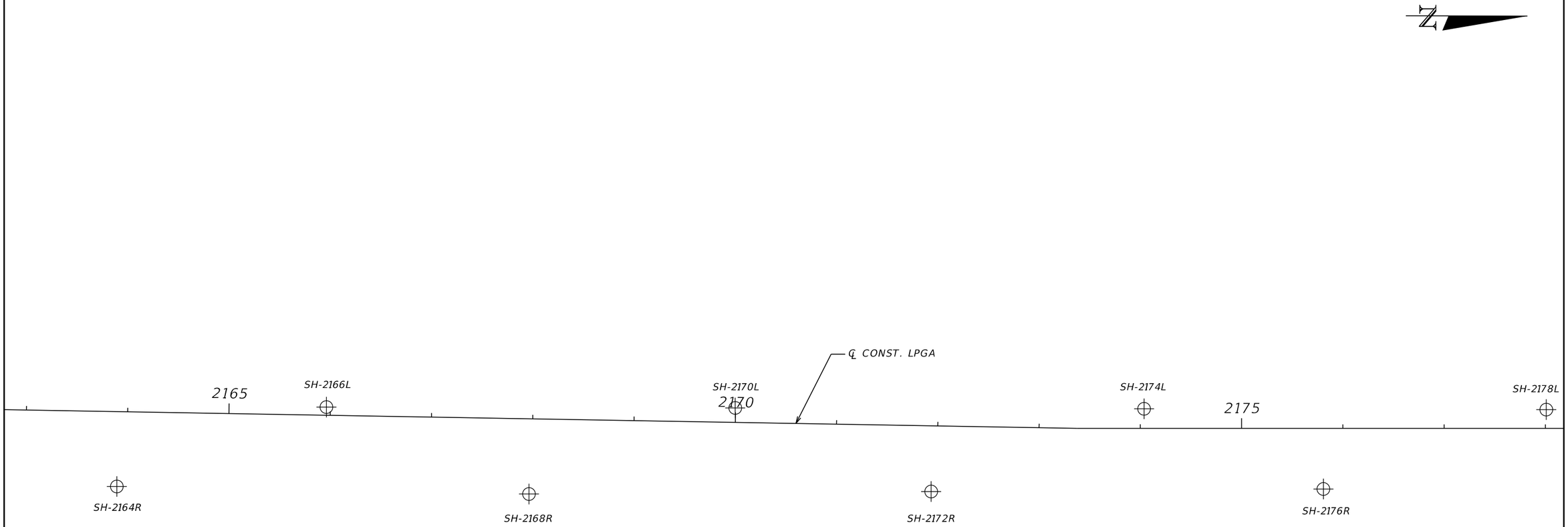

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 16

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (12)

SHEET NO.

12/5/2022 11:39:11 AM bgarcia
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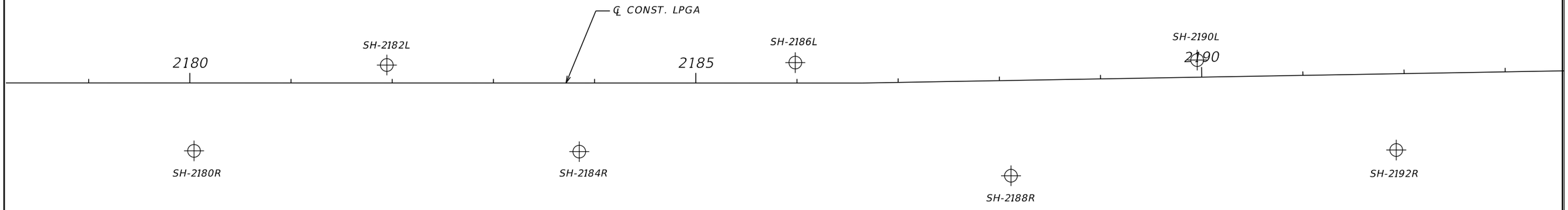

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 17

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (13)

SHEET NO.

12/5/2022 11:39:12 AM bgarcia
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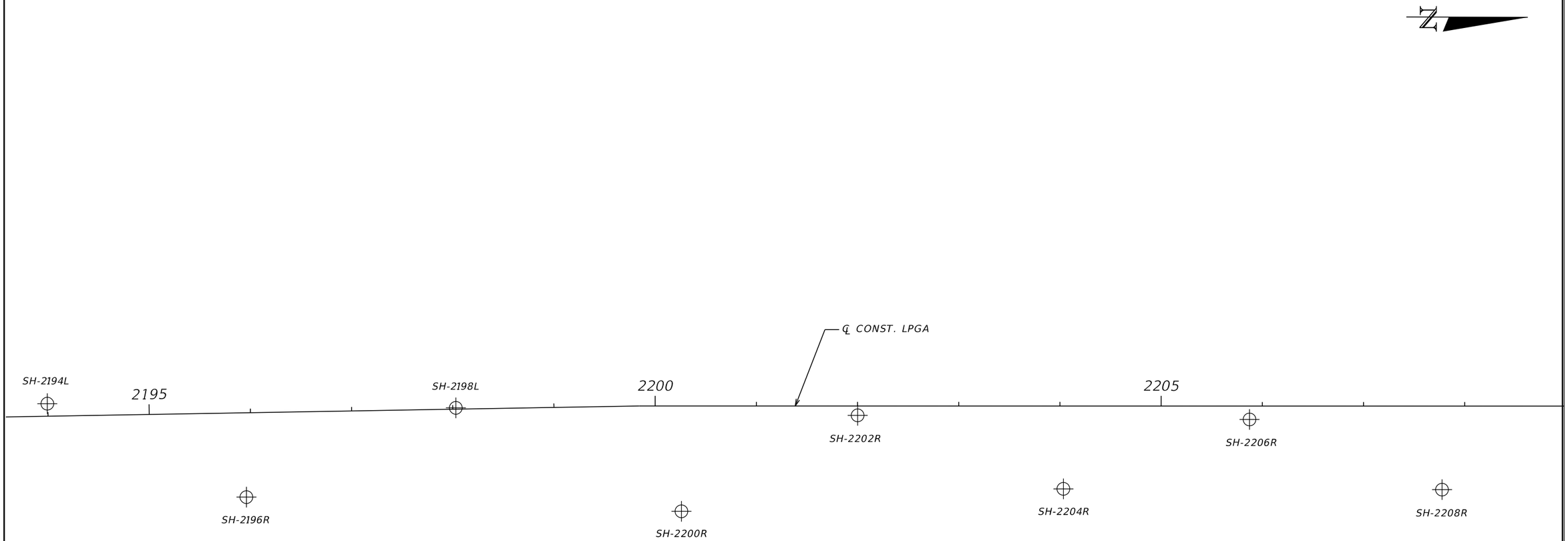

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 18

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (14)

SHEET NO.

12/5/2022 11:39:12 AM bgarcia
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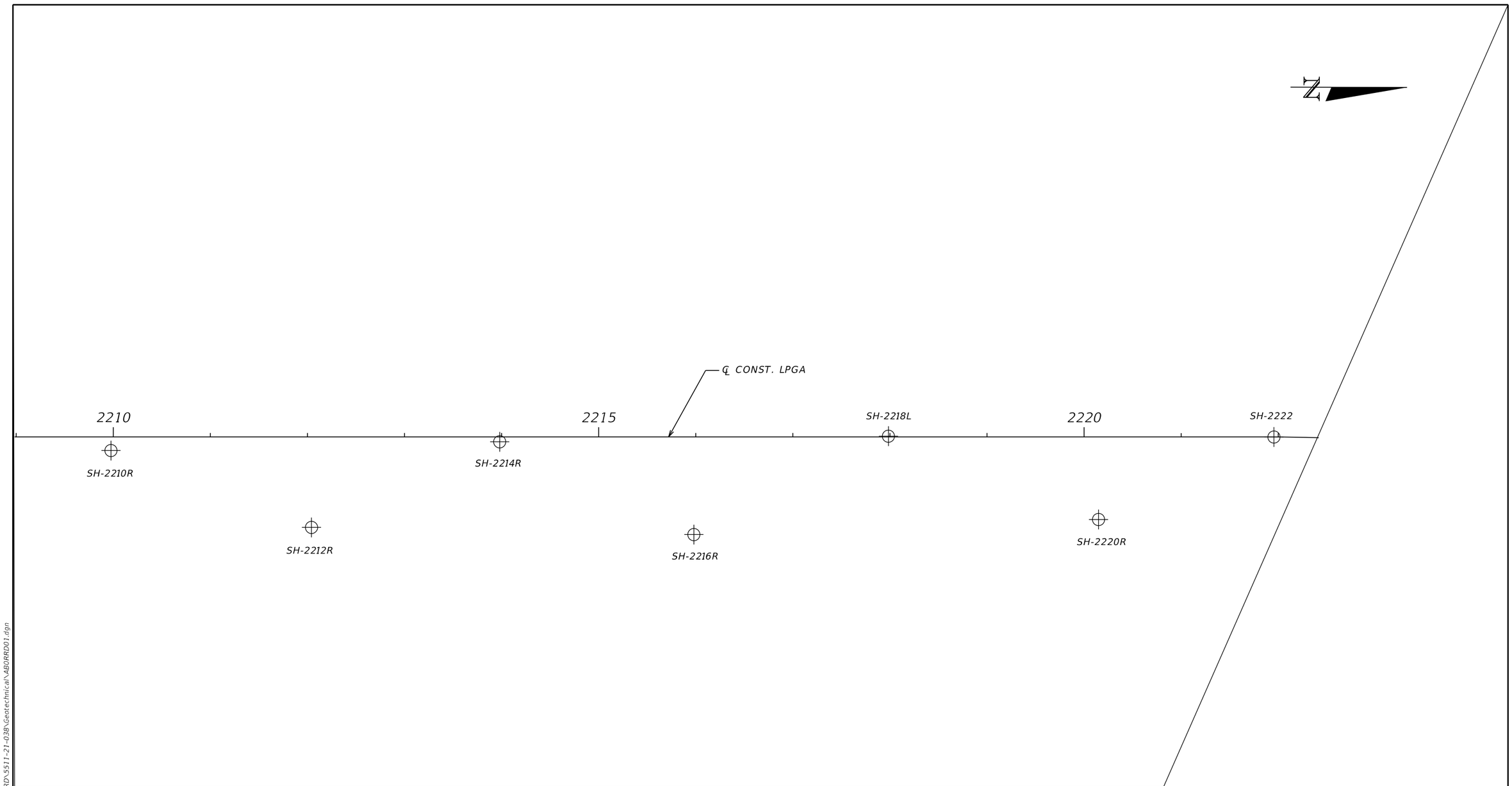

FIGURE 19

REVISIONS				JEREMY A. SEWELL, P.E. P.E. LICENSE NUMBER 62951 TIERRA, INC. 591 SUSAN B. BRITT COURT WINTER GARDEN, FLORIDA 34787	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			BORING LOCATION PLAN (15)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
					N/A	VOLUSIA	448456-1-22-01		

12/5/2022 11:39:13 AM bgarcia
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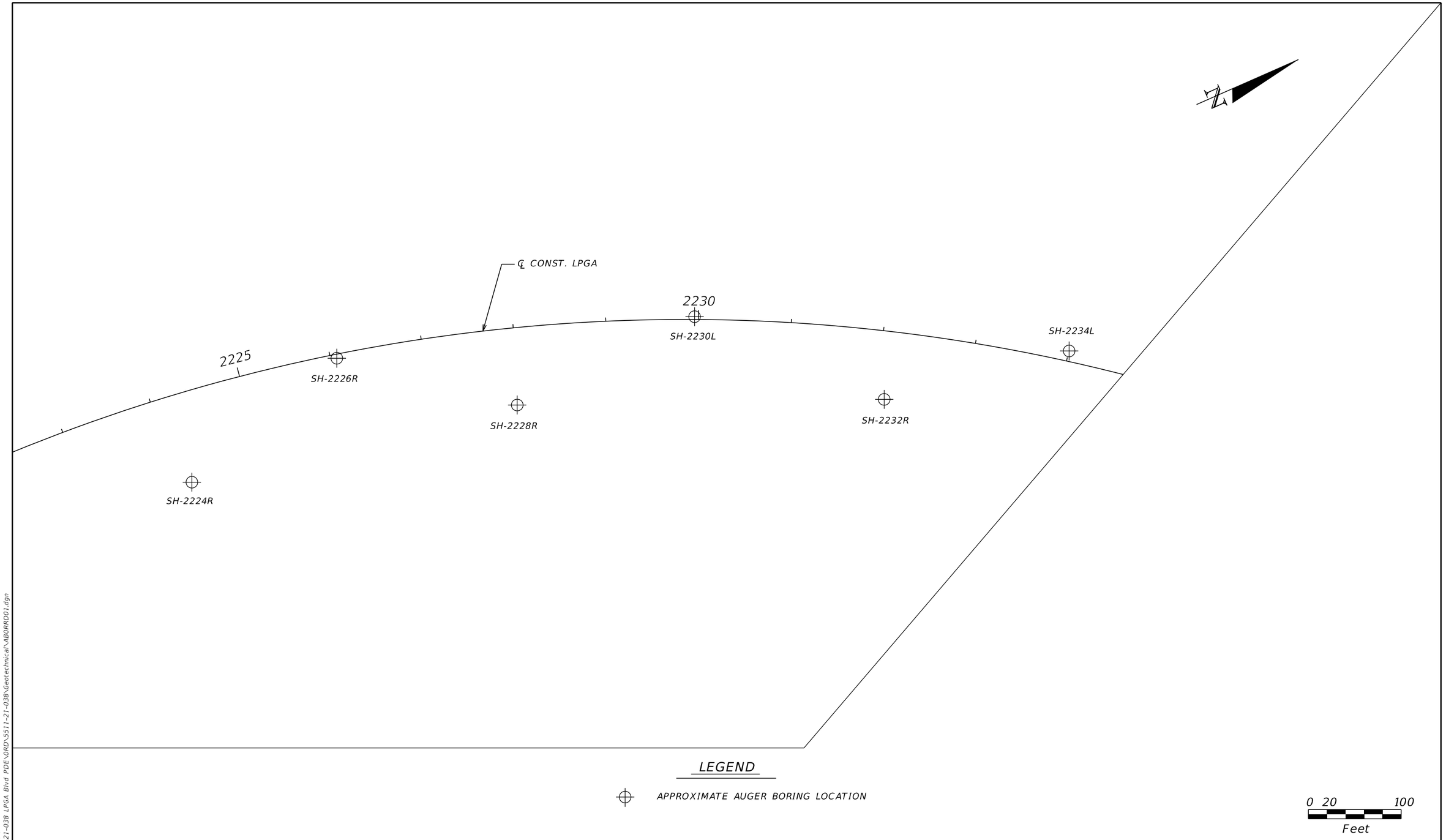

FIGURE 20

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (16)

SHEET NO.

12/5/2022 11:39:13 AM bgarcia
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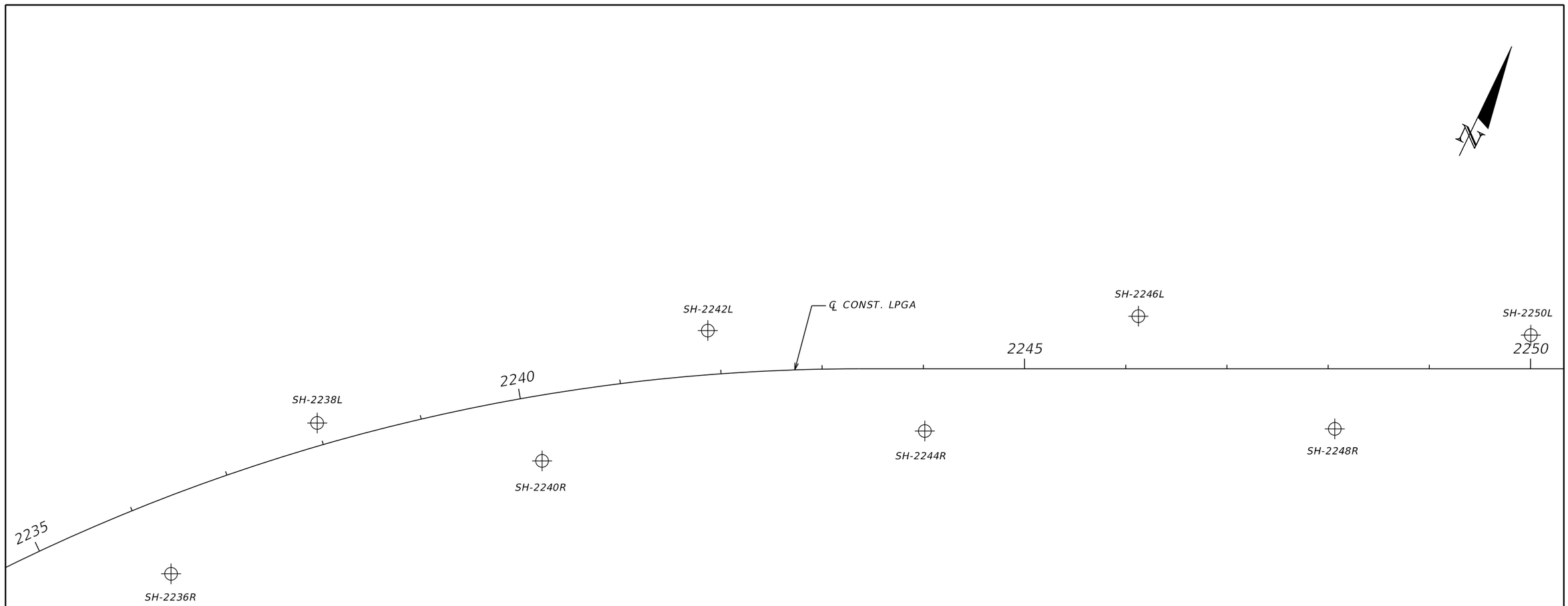

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 21

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (17)

SHEET NO.

12/5/2022 11:39:14 AM bgarcia
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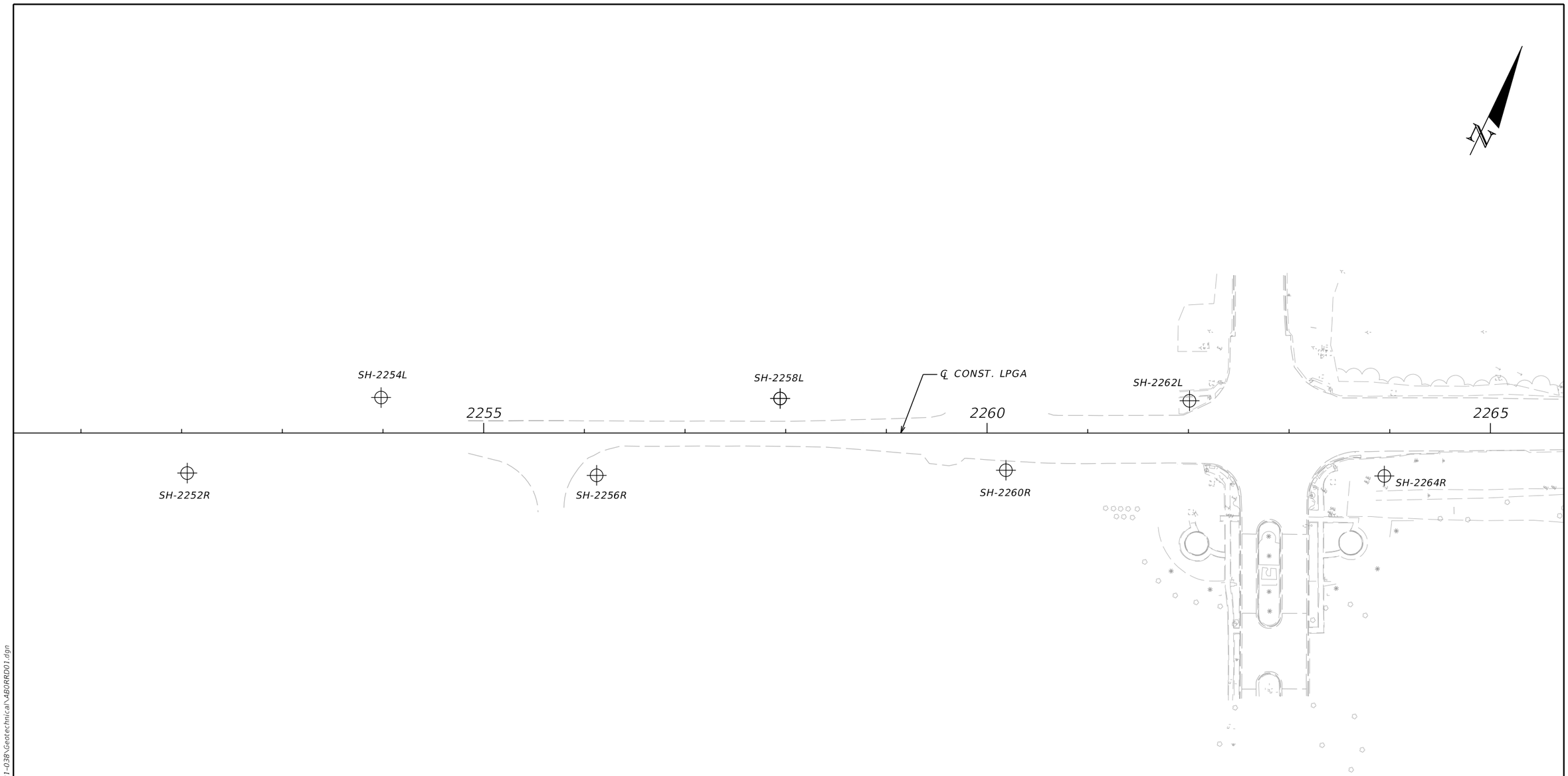

LEGEND

⊕ APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 22

REVISIONS				JEREMY A. SEWELL, P.E. P.E. LICENSE NUMBER 62951 TIERRA, INC. 591 SUSAN B. BRITT COURT WINTER GARDEN, FLORIDA 34787	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			BORING LOCATION PLAN (18)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
					N/A	VOLUSIA	448456-1-22-01		

12/5/2022 11:39:14 AM bgarcia
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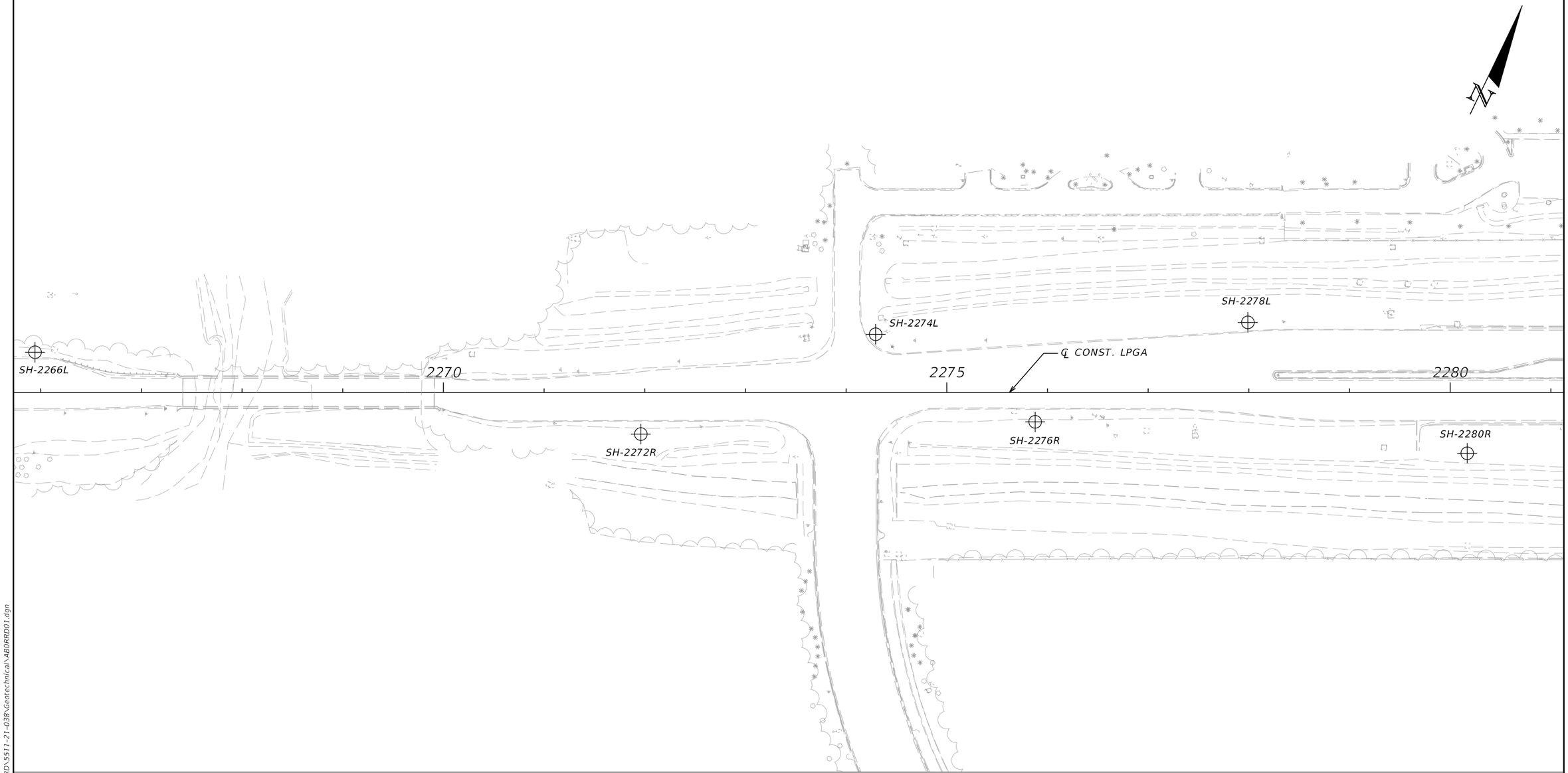

LEGEND

⊕ APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 23

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (19)

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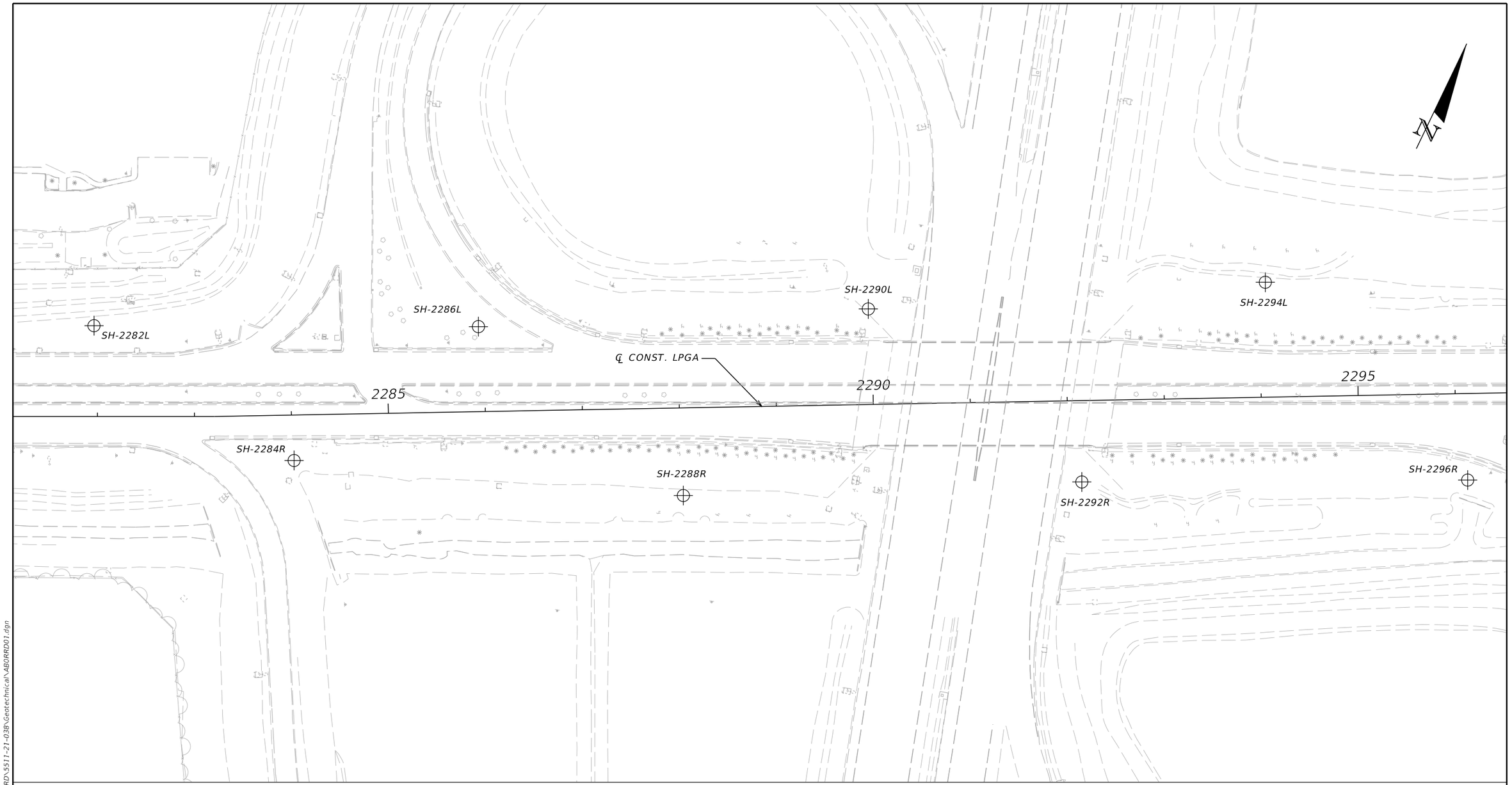

LEGEND

⊕ APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 24

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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BORING LOCATION PLAN (20)

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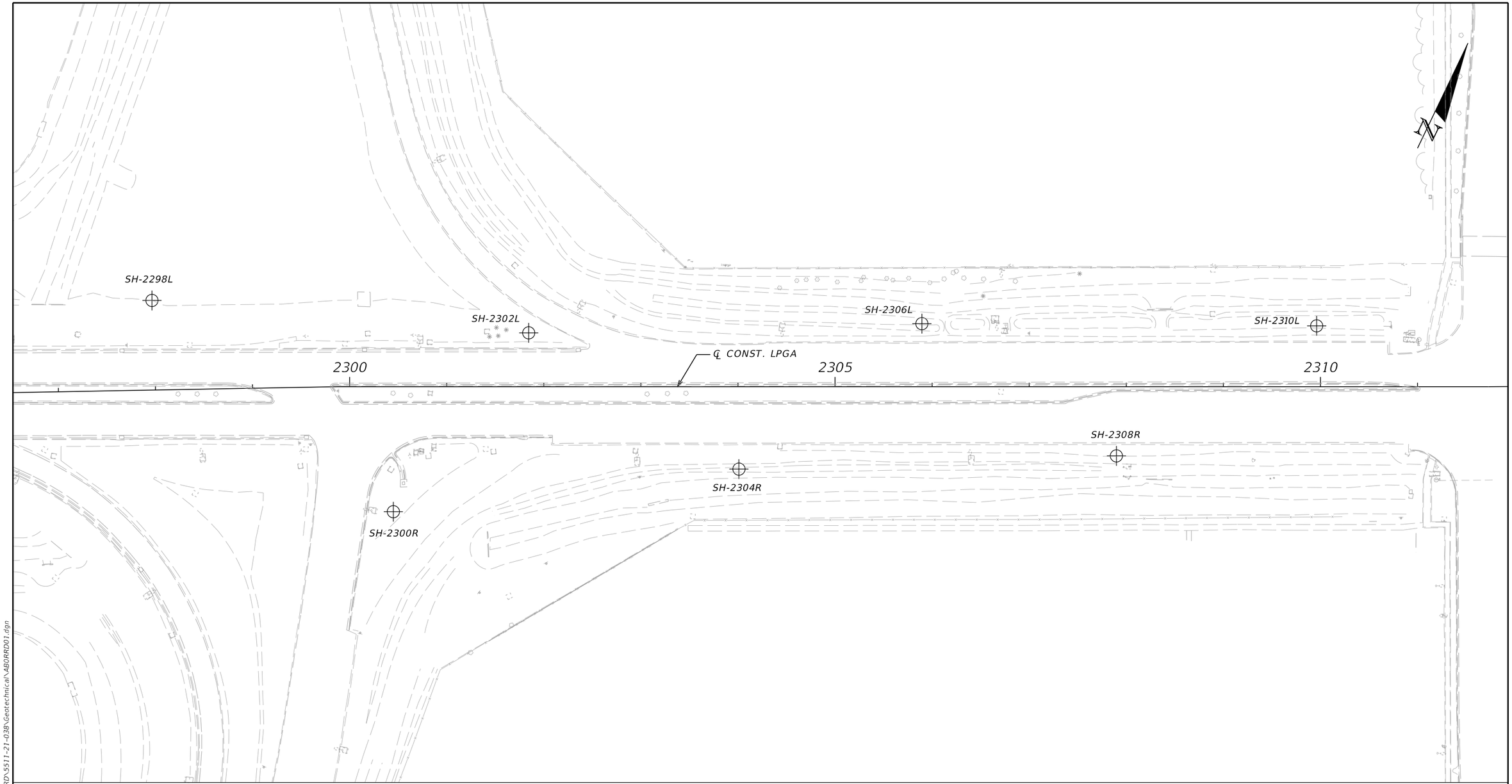

LEGEND

APPROXIMATE AUGER BORING LOCATION

0 20 100
Feet

FIGURE 25

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (21)

SHEET NO.

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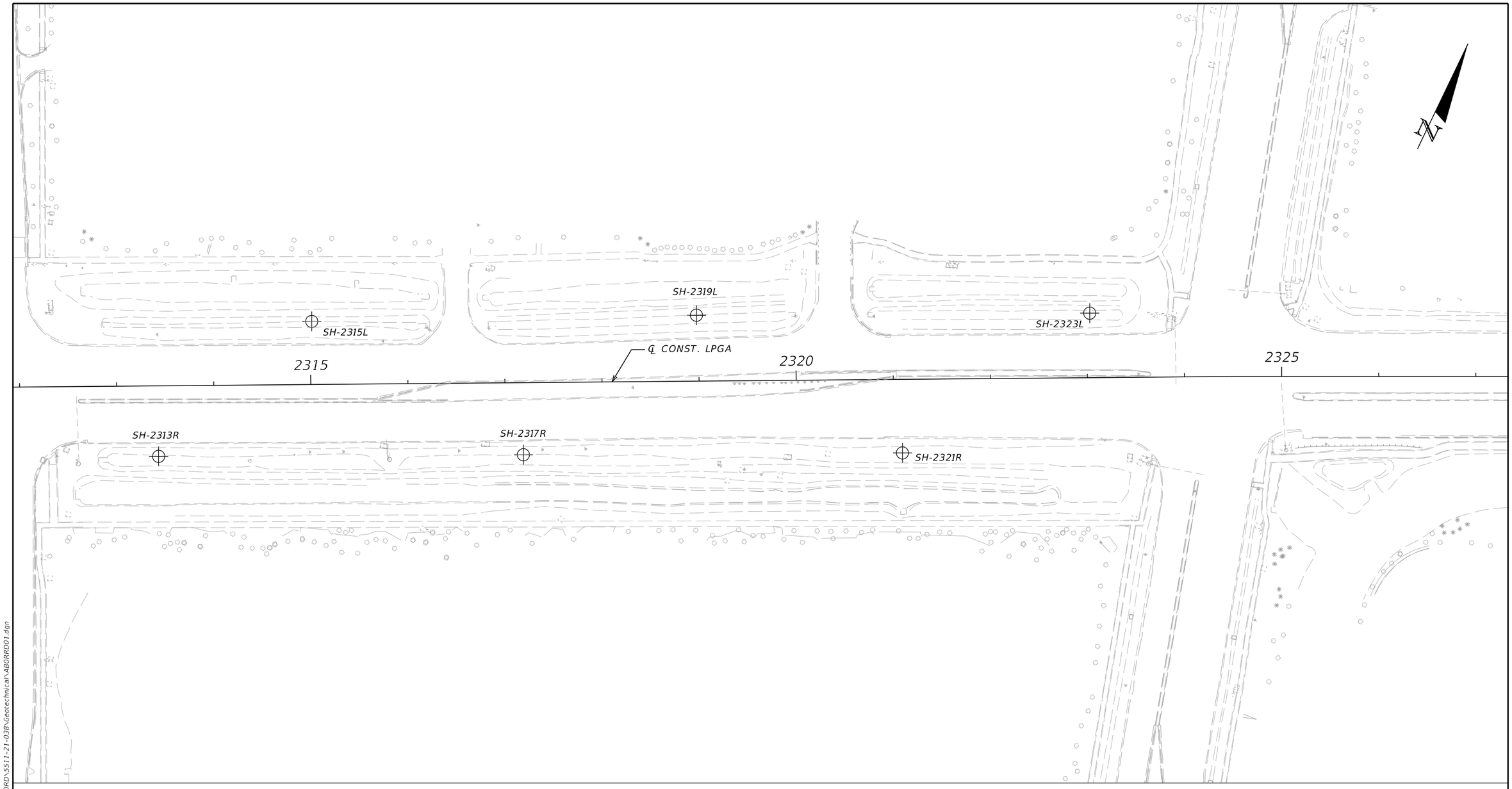

LEGEND

⊕ *APPROXIMATE AUGER BORING LOCATION*

0 20 100
Feet

FIGURE 26

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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N/A	VOLUSIA	448456-1-22-01

BORING LOCATION PLAN (22)

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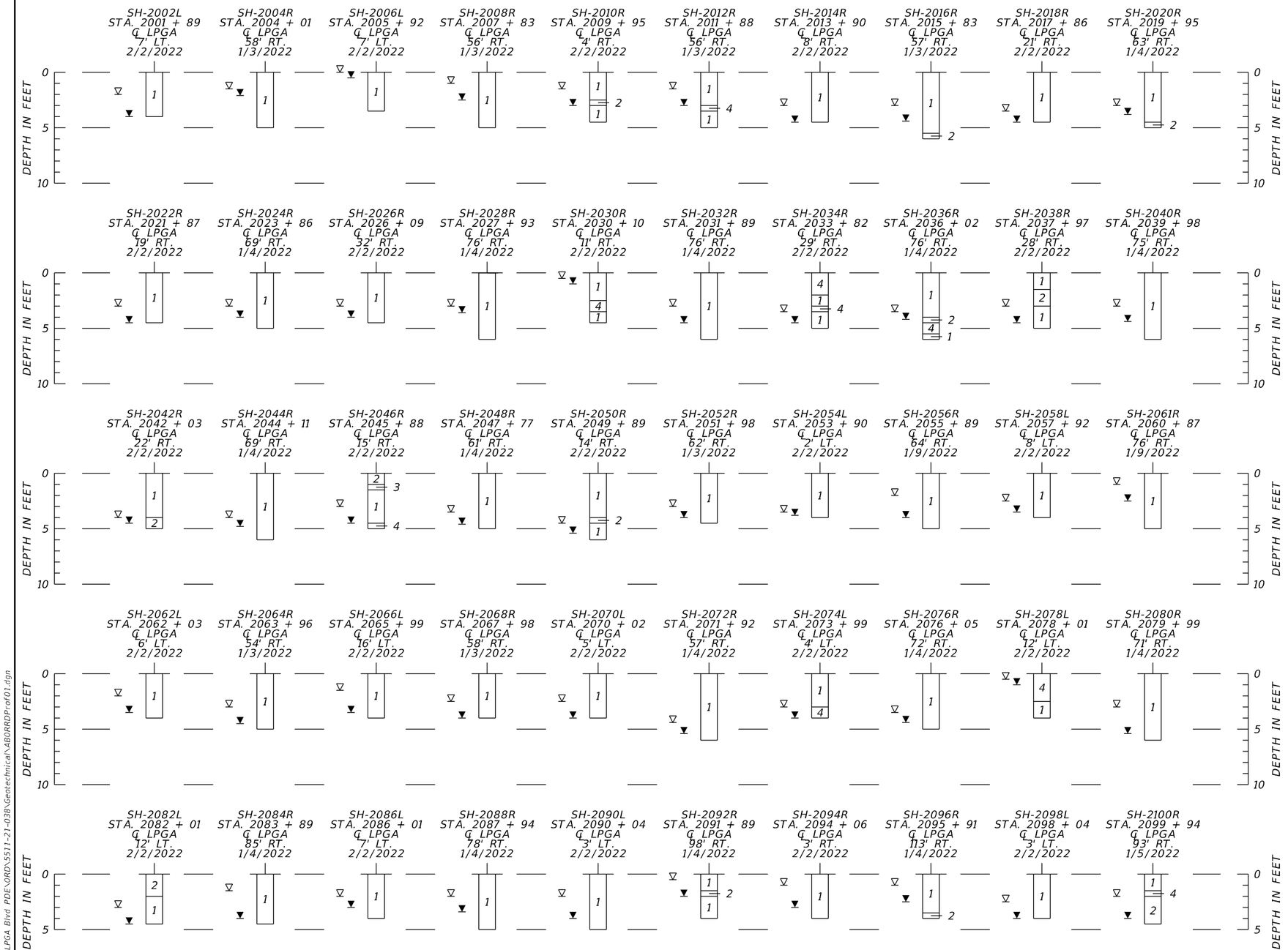

LEGEND

1. GRAY TO BROWN SAND TO SILTY SAND (-200<15%) (A-3/A-2-4)
2. GRAY TO BROWN SILTY SAND (-200≥15%)(A-2-4)
3. GRAY TO BROWN CLAYEY SAND (A-2-6)
4. DARK BROWN ORGANIC SAND WITH SILT TO SILTY SAND (A-8)

A-3 AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.

▽ ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

▼ GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS

GNE GROUNDWATER NOT ENCOUNTERED

FIGURE 27

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
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ROADWAY SOIL PROFILES (1)

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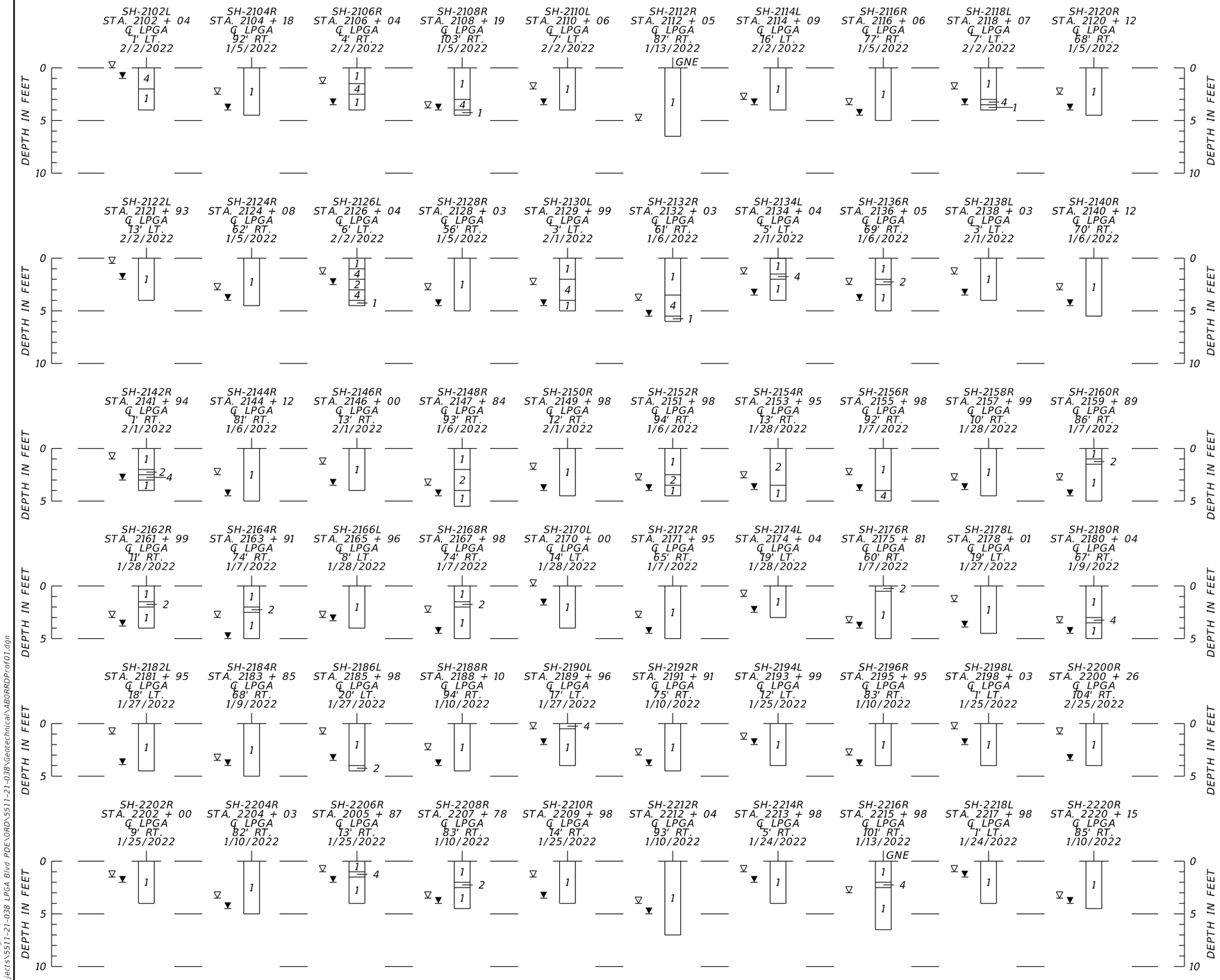

LEGEND

1. GRAY TO BROWN SAND TO SILTY SAND (-200<15%) (A-3/A-2-4)
2. GRAY TO BROWN SILTY SAND (-200≥15%)(A-2-4)
3. GRAY TO BROWN CLAYEY SAND (A-2-6)
4. DARK BROWN ORGANIC SAND WITH SILT TO SILTY SAND (A-8)

A-3 AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.

▽ ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

▼ GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS

GNE GROUNDWATER NOT ENCOUNTERED

FIGURE 28

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

ROADWAY SOIL PROFILES (2)

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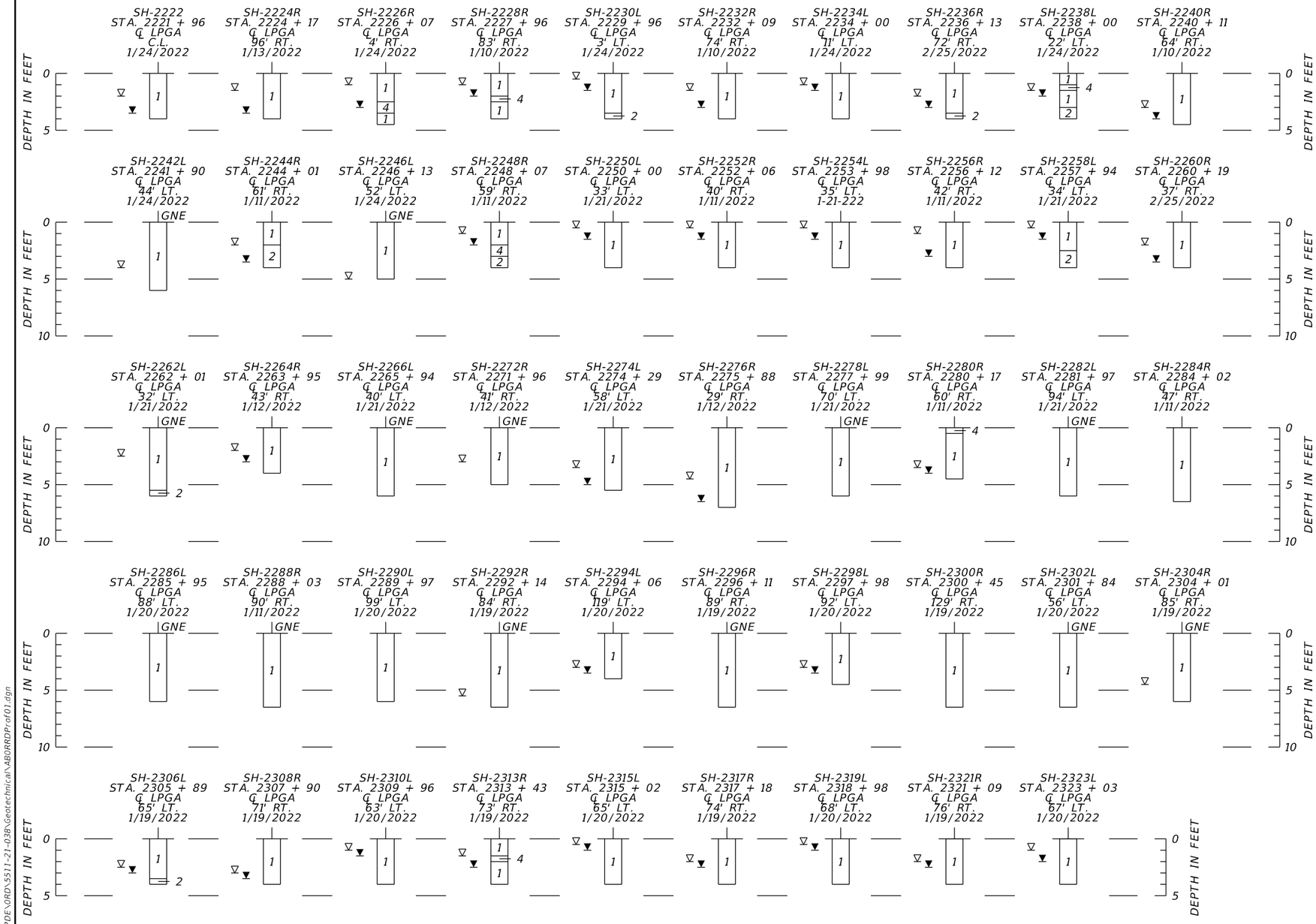

LEGEND

1. GRAY TO BROWN SAND TO SILTY SAND (-200<15%) (A-3/A-2-4)
2. GRAY TO BROWN SILTY SAND (-200≥15%)(A-2-4)
3. GRAY TO BROWN CLAYEY SAND (A-2-6)
4. DARK BROWN ORGANIC SAND WITH SILT TO SILTY SAND (A-8)

A-3 AASHTO GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.

▽ ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

▼ GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS

GNE GROUNDWATER NOT ENCOUNTERED

FIGURE 29

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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N/A	VOLUSIA	448456-1-22-01

ROADWAY SOIL PROFILES (3)

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LPGA BOULEVARD FROM US 92 (SR 600) TO WILLIAMSON BOULEVARD PD&E STUDY

FPID: 448456-1-22-01

Geotechnical Data Report for Bridge Structures

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022, and executed by the Federal Highway Administration and FDOT.

November 2022

FDOT

CONTENTS

FIGURES

TABLES

1.0 Introduction

1.1 Project Description

FDOT is conducting a Project Development and Environment (PD&E) Study of LPGA Boulevard from US 92 (International Speedway Boulevard) to Williamson Boulevard within the City of Daytona Beach in Volusia County (approximately 6.6 miles). The proposed improvements involve widening of LPGA Boulevard which will include the addition of bicycle and pedestrian facilities and modifications to the LPGA Boulevard/I-95 interchange.

A project location map is provided in **Figure 1**. Existing LPGA Boulevard is a two-lane roadway from US 92 to Tomoka Farms Road (east of the Tomoka River), a four-lane roadway from Tomoka Farms Road to the I-95 Southbound Ramps, and a six-lane roadway from the I-95 Southbound Ramps over I-95 to Williamson Boulevard. There are 14 intersections along the corridor including ramp terminals at the I-95 interchange, nine of which are signalized.

LPGA Boulevard is a county road maintained by Volusia County, except between Tomoka Farms Road and Technology Boulevard/Outlet Boulevard where FDOT maintains the limited access right-of-way to the I-95 interchange. Most of LPGA Boulevard does not have paved shoulders and sidewalks, and there are only limited areas of sidewalks between Tymber Creek Road and Williamson Boulevard.

I-95 is a six-lane, Strategic Intermodal System (SIS) facility and is a hurricane evacuation route. The I-95 interchange at LPGA Boulevard (Exit 265) is a partial cloverleaf interchange, or parclo interchange, with six on and off ramps. This interchange is located approximately 3.5 miles north of the I-95 and US 92 interchange and approximately 2.7 miles south of the I-95 and SR 40 interchange.

1.2 Purpose and Need

The purpose of this project is to accommodate existing and projected future travel demand, enhance safety, and improve operations for the LPGA Boulevard corridor and the I-95 interchange.

The need for the project is based on existing and future transportation demand and safety along the LPGA Boulevard corridor and at the interchange area. Improvements are necessary to address unacceptable levels of service (LOS) (below target LOS D and LOS E) and enhance the safety of travel conditions along LPGA Boulevard and at the I-95 interchange area.

Figure 1. Project Location Map

2.0 Purpose and Scope of Services

The purpose of this study is to provide factual geotechnical data (i.e. subsurface soil conditions and related engineering properties) for the proposed LPGA Boulevard Bridge over the Tomoka River. The following services were provided in order to achieve the preceding objective:

1. Reviewed published soil information from the "Soil Survey of Volusia County, Florida" published by the United States Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS). Reviewed topographic and potentiometric information obtained from "Daytona Beach, Florida" USGS Quadrangle map and the "Potentiometric Surface of the Upper Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida" maps published by the United States Geological Survey (USGS).

2. Executed a program of subsurface exploration consisting of two (2) test borings and subsurface sampling. Tierra has performed two (2) Standard Penetration Test (SPT) borings advanced to depth of approximately 100 to 110 feet below the existing grade.

3. Visually classified and stratified the samples in the laboratory using the Unified Soil Classification System (USCS) in general accordance with the American Society of Testing and Materials (ASTM) test designation D-2487 and D-2488. Conducted laboratory testing on selected soil samples to confirm the visual classification.

4. Conducted environmental corrosion tests on recovered soil and water samples obtained from the bridge site to provide a basis for environmental classification.

5. Prepared this geotechnical data report, which summarizes the course of study pursued, the field and laboratory data generated, and the subsurface conditions encountered within the area of the proposed bridge structures.

3.0 Review of Publish Data

3.1 Regional Geology

Volusia County Geology was paraphrased from the Florida Geological Survey, Open-File Report 80, 2001 and other geologic references.

The near surface geologic deposits and formations from youngest to oldest in Volusia County include: Holocene Sediment (Qh), Undifferentiated sediments (Qu), Beach ridge and dune sediments (Qbd), the Anastasia Formation (Qa), Shelly sediments (TQsu), and Cypresshead Formation (Tc).

The Holocene sediments generally occur near the coastline and with river flood plains and includes; quartz sands, carbonate sand and muds with organics. The Undifferentiated sediments and Beach ridge and dunes are siliciclastics that are light gray, tan, brown to black, unconsolidated to poorly consolidated, clean to clayey silty, unfossiliferous, variably organic-bearing sands to blue green to olive green, poorly to moderately consolidated, sandy, silty clays.

The Anastasia Formation is found within 20 miles of the Atlantic coast and is composed of interbedded sands and coquinoid limestones. The most common facies is an orangish brown, unindurated to moderately indurated, coquina of whole and fragmented mollusk shells in a matrix of sand often cemented by sparry calcite. Sands occur as light gray to tan and orangish brown, unconsolidated to moderately indurated, unfossiliferous to very fossiliferous beds. The Anastasia Formation forms part of the surficial aquifer system.

The Shelly sediments are variably calcareous and fossiliferous quartz sands to well indurated, sandy, fossiliferous limestones with clayey sands and sandy clays present. The Shelly sediments, the Anastasia Formation and undifferentiated sediments form the surficial aquifer system in the county and are typically 75 to 100 feet thick.

The Cypresshead Formation occurs above 100 feet mean sea level in the western half of the county and consists of reddish brown to reddish orange, unconsolidated to poorly consolidated, fine to very coarse grained, clean to clayey sands.

3.2 USDA Soil Survey

Based on review of the published information, it appears that there are two (2) primary soil-mapping unit noted within the vicinity of the bridge. A reproduction of the **USDA Vicinity Map** is included in the **Appendix** and the soil mapping units are summarized in the summary table below.

Table 3-1 | Volusia County USDA NRCS Soil Survey Information

SUMMARY OF USDA SOIL SURVEY VOLUSIA COUNTY, FLORIDA							
USDA Map Unit and Soil Name	**Depth (in)**	**Soil Classification**		**Permeability (in/hr)**	**pH**	**Seasonal High Water Table**	
		USCS	**AASHTO**			**Depth (feet)**	**Months**
(25) Gator muck, 0 to 1 percent slopes, frequently flooded	0-34	PT	A-8	6.0 – 20.0	3.5-6.0	+1.0-0.0	Jan-Apr Jun-Dec
	34-46	SM, SC, CL	A-4, A-6, A-7-6	0.1 – 0.2	4.5-7.9		
	46-52	SM, SM-SC, SC	A-2-4, A-4, A-6	0.1 – 0.2	5.1-8.4		
	52-80	SP-SM, SM	A-3, A-2-4	2.0 – 6.0	5.1-8.4		
(37) Orsino fine sand, 0 to 5 percent slopes	0-2	SP-SM, SM	A-3, A-2-4	20.0 – 50.0	3.5-5.5	3.5-5.0	Jun-Oct
	2-23	SP-SM, SM	A-3, A-2-4	20.0 – 50.0	3.5-6.0		
	23-43	SP-SM, SM	A-3, A-2-4	20.0 – 50.0	3.5-5.5		
	43-80	SP-SM, SM	A-3, A-2-4	20.0 – 50.0	4.5-6.0		

3.3 USGS Quadrangle Map

A review of the "Daytona Beach, Florida" Quadrangle Map indicates that the natural ground surface elevations within the vicinity of the bridge ranges from +0 to +20 feet National Geodetic Vertical Datum of 1929 (NGVD). A reproduction of the **USGS Vicinity Map** is illustrated in the **Appendix**.

3.4 Review of Potentiometric Surface Information

Based on a review of the "Potentiometric Surface of the Upper Floridan Aquifer in the St. Johns River Management District and Vicinity, Florida" maps published by the USGS, the potentiometric surface elevation of the Upper Floridan Aquifer at the bridge location appears to range from approximately elevation +0 to +10 feet, NGVD29. Artesian flow conditions were not encountered during the field exploration.

4.0 Subsurface Exploration

4.1 Boring Location Plan and Utility Clearance

Prior to commencing our subsurface explorations, a boring location plan for the proposed bridge structure was produced. This boring location plan was generated based on a review of the design information supplied by HDR Engineering, Inc. and general guidance provided in the FDOT "Soils and Foundations Handbook" along with our engineering judgment.

Utility clearances were coordinated by Tierra and updated as required prior to performing the soil borings in order to reduce the potential for damage to any underground utilities during the drilling process.

4.2 Soil Borings

Subsurface conditions were explored at the bridge site with two (2) SPT borings to depths of approximately 100 to 110 feet below the existing grade. The results and location of the SPT borings are presented on the **Report of Core Borings** sheets in the **Appendix**.

The SPT borings were performed with the use of a track-mounted drill rig using Bentonite Mud drilling procedures. The soil sampling was performed in general accordance with the ASTM test designation D-1586. The initial 6 feet of the borings was manually augered to verify utility clearance. SPT resistance N-values were taken on intervals of 2 feet thereafter to a depth of 16 feet. Then, SPT resistance N-values were taken on intervals of 2.5 feet thereafter to the boring termination depth. Representative portions of these soil samples were sealed in glass jars, labeled and transferred to our Winter Garden laboratory for classification and analyses.

Soil stratification was determined based on a review of recovered samples, laboratory test results, and interpretation of field boring logs. Stratification lines represent approximate boundaries between soil layers of different engineering properties; however actual transitions between layers may be gradual. In some cases, small variations in properties that were not considered pertinent to our engineering evaluation may have been abbreviated or omitted for clarity. The soil profile represents the conditions at the particular boring location. Specific details about subsurface conditions and materials encountered at the test location can be obtained from the soil profile presented on the **Report of Core Borings** sheets in the **Appendix** of this report.

5.0 Laboratory Testing

5.1 General

Representative soil samples collected from the SPT borings were classified and stratified in general accordance with the USCS. Our classification was based on visual observations, using the results from the laboratory testing as confirmation. Laboratory testing consisting of fines content (percentage passing the No. 200 sieve) determination were performed on representative materials encountered. In addition, Environmental Corrosion tests were performed to evaluate the corrosive nature of the soil and water encountered at the bridge site. The results of the laboratory tests are presented on the **Report of Core Borings** sheets in the **Appendix**.

5.2 Test Designation

The following list summarizes the laboratory tests performed and respective test methods.

- Fines Content – The fines content tests and full grain size tests were conducted in general accordance with the AASHTO test designation T-088 (ASTM test designation D-1140).
- Environmental Corrosion – The Environmental corrosion tests were conducted in general accordance with the FDOT test designations FM 5-550, FM 5-551, FM 5-552, and FM 5-553.

6.0 Results of Subsurface Exploration

6.1 General Subsurface Conditions

The subsurface conditions encountered are shown on the **Report of Core Boring** sheet in the **Appendix**. The soil descriptions and classifications associated with this project are as follows.

Table 6-1 | Soil Descriptions and Classifications

Soil Description	Unified Soil Classification System Symbol
Brown to Gray-Brown SAND to SAND with Silt	SP/SP-SM
Green-Gray to Gray Shelly SAND to SAND with Silt	SP/SP-SM
Green-Gray to Gray Silty SAND, occasionally with some shell	SM
Green-Gray to Gray Clayey SAND	SC
Green-Gray to Gray Sandy Silt	ML
Limestone	---*

* USCS nomenclature does not have a classification for limestone

6.2 Groundwater

The groundwater table was recorded at each of the boring locations during our field exploration. The groundwater table within the vicinity of the bridge structures was found to range from 5 to 7 feet below the existing ground surface at the locations of the borings performed. The groundwater table measured at each of the boring locations is presented on the **Report of Core Borings** sheets in **Appendix A**.

7.0 Evaluation of Bridge Foundation Alternatives

Evaluations of foundation alternatives for the proposed bridge were based on the results of our field study at the location of the proposed bridge structures. The following foundation alternatives were considered.

- Shallow Foundations
- Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS)
- Steel Pipe Pile and Steel H-Pile
- 18 and 24-inch Pre-Cast Pre-Stressed Square Concrete (PPSC) Piles
- Drilled Shafts

The following paragraphs discuss each of these alternatives briefly:

7.1 Shallow Foundations

With shallow foundation systems, the structure loads are supported by the bearing capacity of the foundation soils. The design of shallow foundations is typically governed by the soil bearing capacity and the total and differential settlement criteria. Based on the results of the borings, loose soil zones were encountered at relatively shallow depths in the borings. Therefore, the surficial soils at the bridge site will require soil improvement to achieve an adequate bearing resistance and minimize the potential for differential settlements. The soil improvement will require excavation with densification techniques that will significantly increase construction costs. In addition, maintenance of traffic impacts, prolonged construction timing and staging requirements for construction adjacent to existing traffic usually interfere with the efficiencies of soil improvement operations. Therefore, considering impacts of the soil improvement operations and associated high costs, shallow foundations were not considered further for this Geotechnical Data Report for Bridge Structures.

7.2 Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS)

GRS-IBS consists of a shallow foundation combined with a retaining wall system to provide support for single span bridges which are not at risk of movement due to transverse loading, uplift, etc., or multi-span bridges with simply supported end spans. The use of GRS-IBS abutments on an Interstate or Major Multi-Lane Highway would require the approval of the State Structures Design Engineer. Additionally, the reasons discussed in Section 7.1 that preclude the use of shallow foundations also apply to the use of GRS-IBS. For the reasons discussed herein, it is recommended that a GRS-IBS be precluded as a foundation alternative for support of the proposed bridge. Therefore, a GRS-IBS was not analyzed for this Geotechnical Data Report for Bridge Structures.

7.3 Steel Piles

Steel pile types include pipe piles and H-sections. Steel Pipe Piles and H-Piles are feasible foundation alternatives for support of the proposed bridge structure; however, steel piles do not develop as much capacity for similar penetration depths as PPSC piles. Steel piles are well suited to soil conditions with high variability and where frequent pile splicing is expected. Steel piles may more easily penetrate dense layers if necessary to achieve a desired penetration depth. Steel H-Piles are low displacement piles, and therefore vibrations associated with installations are minimized due to the low-displacement nature of the piles.

7.4 Pre-Cast Pre-Stressed Square Concrete (PPSC) Piles

PPSC pile foundations are a feasible foundation alternative. They are a widely used and proven foundation system in central Florida. PPSC pile foundations are readily available and generally have a lower cost per ton of capacity than other pile types. It should be noted that concrete piles are not as easily spliced as steel piles. The minimum size for PPSC pile foundations for this type of bridge application should be 18 inches as referenced in the Structures Design Guidelines (SDG). Analyses were performed for 18 and 24-inch wide PPSC piles for this Geotechnical Data Report for Bridge Structures and are presented on the **Driven Pile Axial Capacity Curves** in the **Appendix**.

7.5 Drilled Shafts

Drilled, cast-in-place, straight-sided, concrete shafts have the ability to develop high axial and lateral capacities. One drilled shaft could potentially take the place of several driven piles. However, the quality control of drilled shaft installation requires more engineering judgment and precaution compared with driven piles to ensure that the construction is in accordance with the FDOT Specifications. This type of foundation system is often the chosen alternative for sites where competent limestone or very dense bearing strata are present at a relatively shallow depth with a sufficient thickness. Drilled shafts are a feasible foundation alternative depending on final design loading.

8.0 Report Limitations

Our services have been performed and our findings obtained, in accordance with generally accepted geotechnical engineering principles and practices at the time of this report. This company is not responsible for the conclusions, opinions or recommendations made by others based on these data.

The scope of the exploration was intended to evaluate soil conditions within the influence of the proposed bridge structure for foundation design by others. This report presents the geotechnical conditions based on the data obtained from the soil borings performed at the locations indicated in this report and does not reflect any variations which may occur between these borings. If any variations become evident during the course of design and/or construction, a re-evaluation of the conditions contained in this report is recommended.

The scope of services, included herein, did not include any environmental assessment for the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, air, on the site, below, and around the site. Any statements in this report or on the boring logs regarding odors, colors, unusual or suspicious items and conditions are strictly for the information of HDR Engineering, Inc. and FDOT.

Tierra appreciates the opportunity to be of service to HDR Engineering, Inc. on this project. If you have any questions or comments regarding this report, please contact our office at your earliest convenience.

Respectfully Submitted,

TIERRA, INC.

Luis A. Almodovar, P.E.
Geotechnical Engineer
Florida License No. 93273

Jeremy A. Sewell, P.E.
Senior Geotechnical Engineer
Florida License No. 62951

Appendix

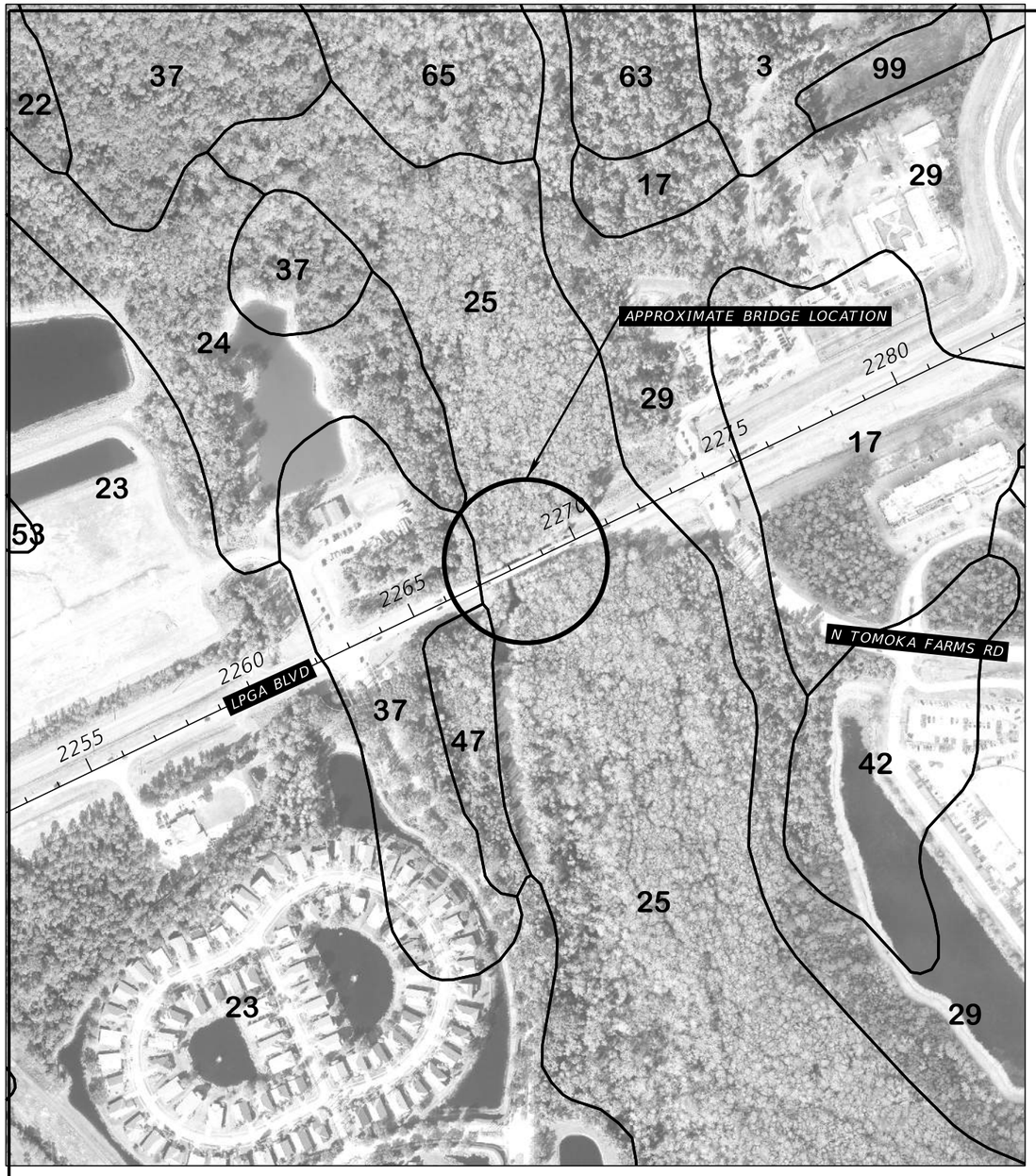
Figures

Florida Department of Transportation District 5

Environmental Management Office

719 S. Woodland Blvd.

DeLand, FL 32720



REFERENCE: USDA SOIL SURVEY OF VOLUSIA COUNTY, FLORIDA

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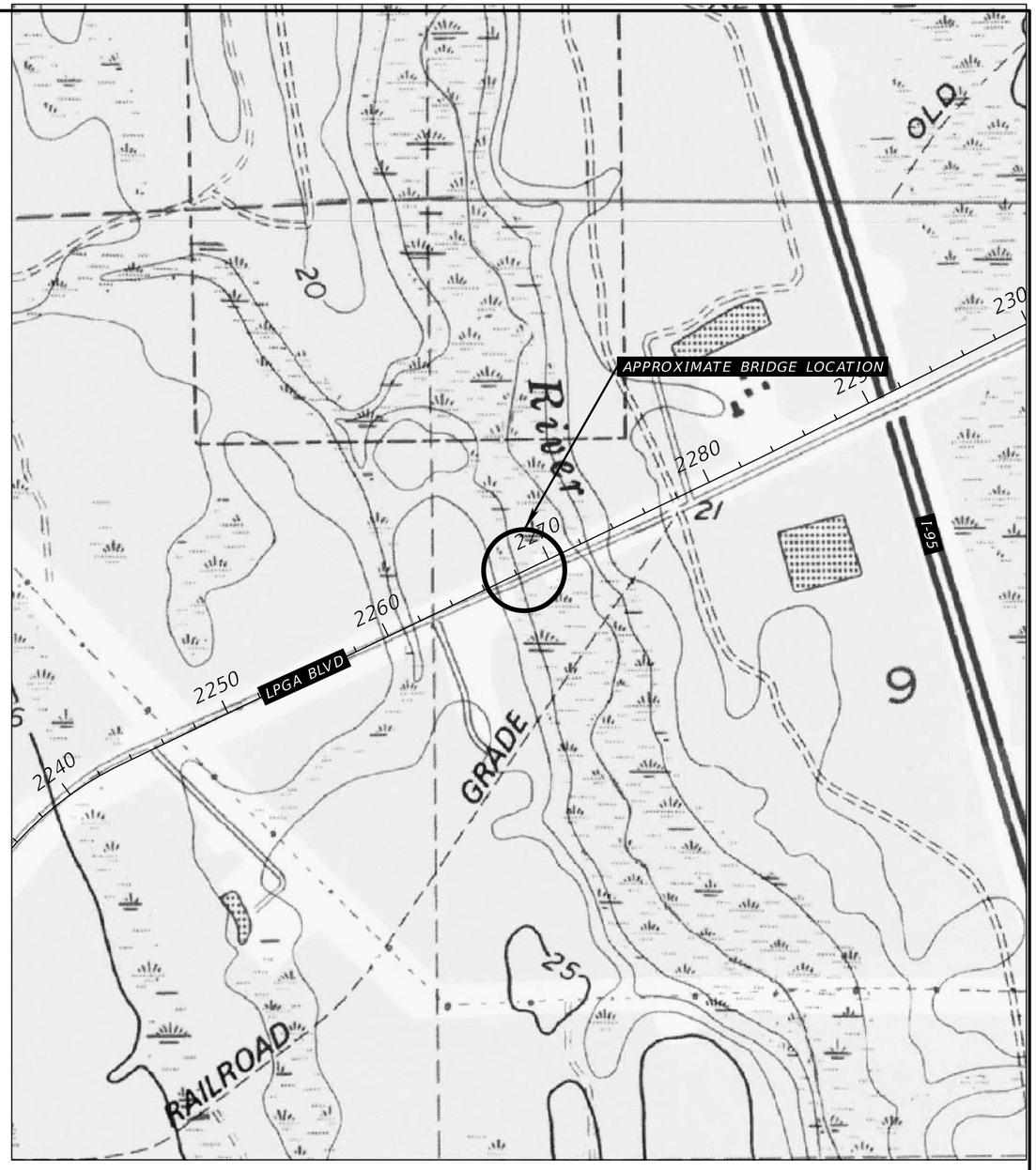


REFERENCE: USGS QUADRANGLE MAP OF "DAYTONA BEACH, FLORIDA"

TOWNSHIP: 15S
RANGE: 32E
SECTION: 9

0 200 800
Feet

FIGURE 2

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

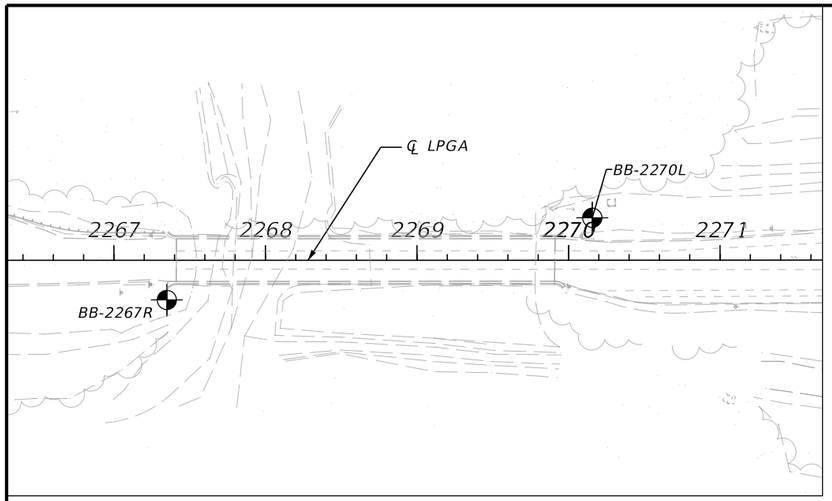
JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

DRAWN BY: BMG
CHECKED BY: LA
DESIGNED BY: BMG
CHECKED BY: JAS

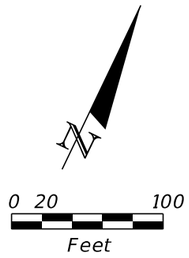
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

SHEET TITLE: USDA SOIL SURVEY & USGS QUADRANGLE MAPS
REF. DWG. NO.
PROJECT NAME: LPGA BOULEVARD OVER TOMOKA RIVER
SHEET NO.



BORING LOCATION PLAN



ENVIRONMENTAL CLASSIFICATION:

SUBSTRUCTURE	CONCRETE: SLIGHTLY AGGRESSIVE
SUBSTRUCTURE	STEEL: MODERATELY AGGRESSIVE
SUPERSTRUCTURE	SLIGHTLY AGGRESSIVE

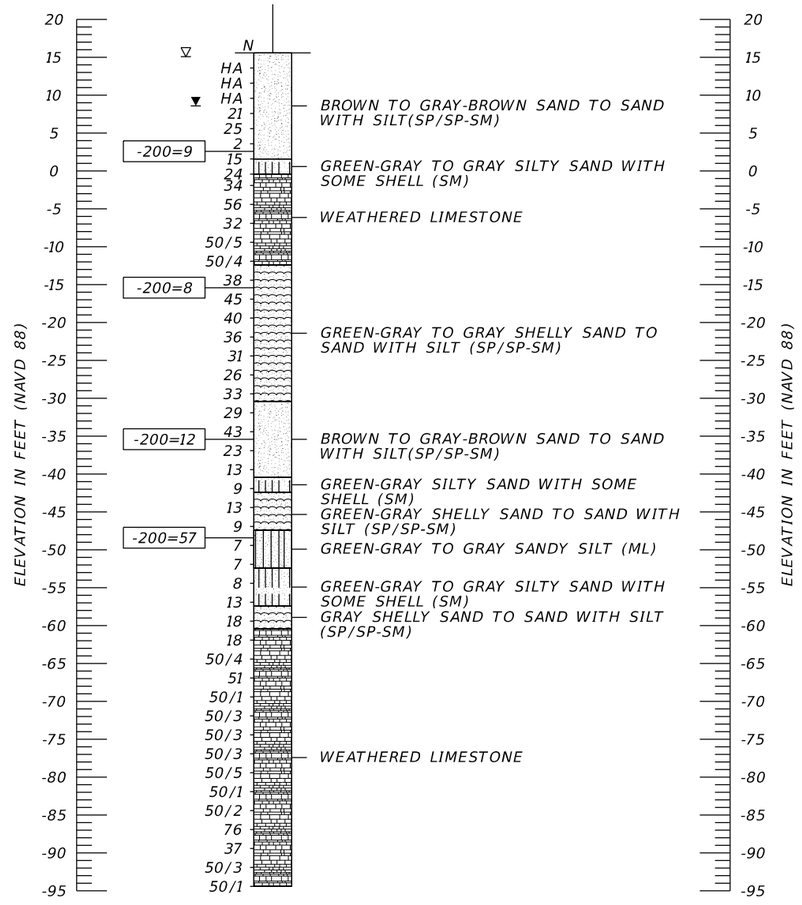
SOIL TEST RESULTS:

RESISTIVITY	10,000 TO 14,000 OHM-CM
CHLORIDES	30 PPM
SULFATES	<5 PPM
pH	7.6 TO 7.8

WATER TEST RESULTS:

RESISTIVITY	3,200 OHM-CM
CHLORIDES	150 PPM
SULFATES	<5 PPM
pH	7.2

BOR #	BB-2267R
STA.	2267+35
REF.	℄ LPGA
OFF.	26' RT.
ELEV.	15.6
DATE	5/11/2022
DRILLER	G. SMITH
HAMMER	AUTOMATIC
RIG	D-25



BORING TERMINATED AT
ELEVATION -94.4 FT (NAVD 88)

LATITUDE: N 29.21698
LONGITUDE: W 81.10981

LEGEND

SAND
CLAYEY SAND
SHELLY SAND
SANDY SILT
SILTY SAND
WEATHERED LIMESTONE

SP	UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487) GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.
N	NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).
50/4	NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION
HA	HAND AUGERED TO VERIFY UTILITY CLEARANCE
-200	PERCENT PASSING #200 SIEVE
NAVD 88	NORTH AMERICAN VERTICAL DATUM OF 1988

APPROXIMATE SPT BORING LOCATION
ESTIMATED SEASONAL HIGH GROUNDWATER TABLE
GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS
CASING

	SAFETY HAMMER	AUTOMATIC HAMMER
GRANULAR MATERIALS-RELATIVE DENSITY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY LOOSE	LESS THAN 4	LESS THAN 3
LOOSE	4 to 10	3 to 8
MEDIUM DENSE	10 to 30	8 to 24
DENSE	30 to 50	24 to 40
VERY DENSE	GREATER THAN 50	GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	SPT N-VALUE (BLOWS/FT.)	SPT N-VALUE (BLOWS/FT.)
VERY SOFT	LESS THAN 2	LESS THAN 1
SOFT	2 to 4	1 to 3
FIRM	4 to 8	3 to 6
STIFF	8 to 15	6 to 12
VERY STIFF	15 to 30	12 to 24
HARD	GREATER THAN 30	GREATER THAN 24

FIGURE 3

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

DRAWN BY:	BMG
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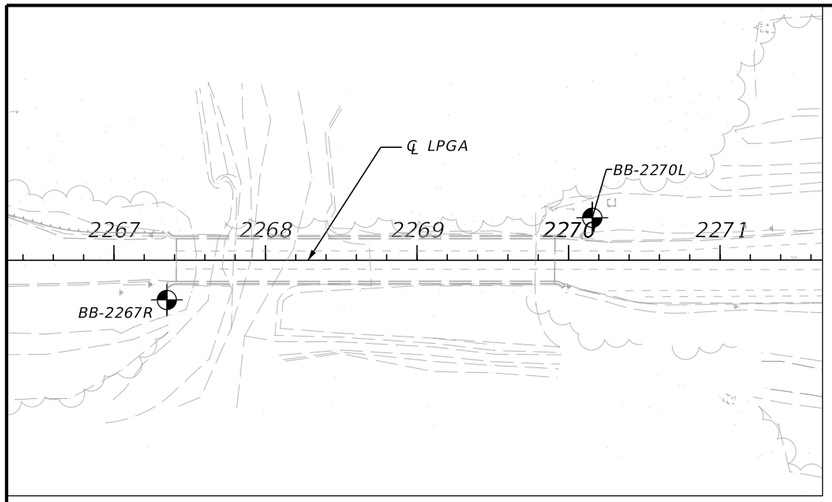
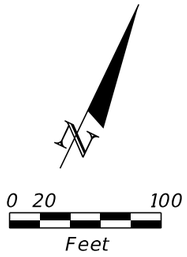
DESIGNED BY:	BMG
CHECKED BY:	JAS

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

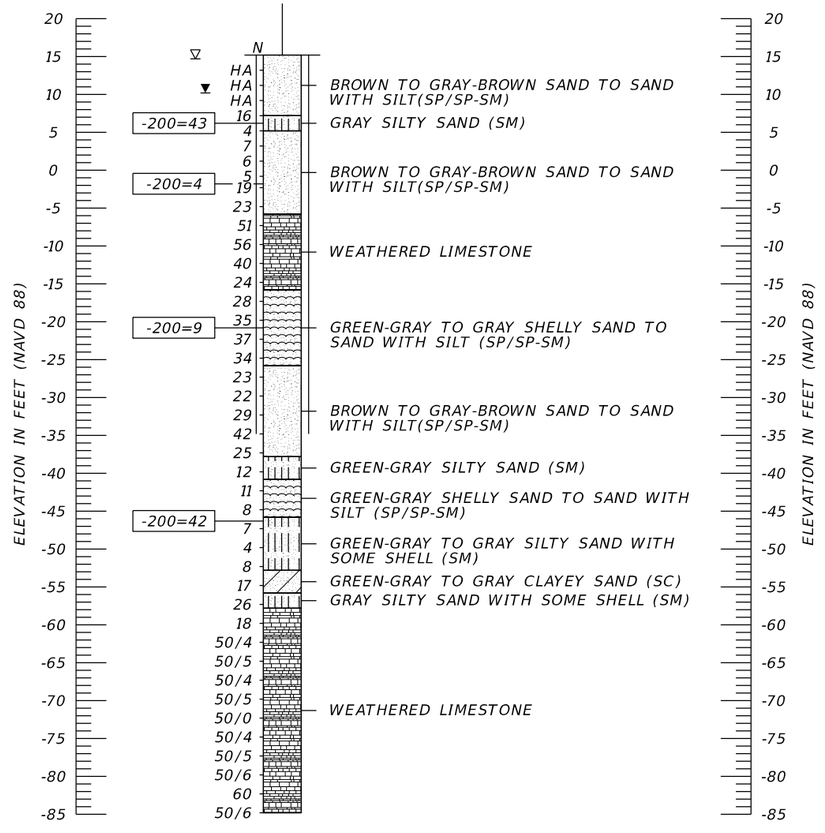
SHEET TITLE: REPORT OF CORE BORINGS (1)
REF. DWG. NO.
PROJECT NAME: LPGA BOULEVARD OVER TOMOKA RIVER
SHEET NO.





BORING LOCATION PLAN

BOR #	BB-2270L
STA.	2270+16
REF.	℄ LPGA
OFF.	28' LT.
ELEV.	15.2
DATE	5/5/2022
DRILLER	G. SMITH
HAMMER	AUTOMATIC
RIG	D-25



BORING TERMINATED AT
ELEVATION -84.8 FT (NAVD 88)

LATITUDE: N 29.21745
LONGITUDE: W 81.10909

LEGEND

- SAND
- CLAYEY SAND
- SHELLY SAND
- SANDY SILT
- SILTY SAND
- WEATHERED LIMESTONE

SP	UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487) GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW AND LABORATORY TESTING ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW.
N	NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).
50/4	NUMBER OF BLOWS FOR 4 INCHES OF PENETRATION
HA	HAND AUGERED TO VERIFY UTILITY CLEARANCE
-200	PERCENT PASSING #200 SIEVE
NAVD 88	NORTH AMERICAN VERTICAL DATUM OF 1988

- APPROXIMATE SPT BORING LOCATION
- ESTIMATED SEASONAL HIGH GROUNDWATER TABLE
- GROUNDWATER LEVEL ENCOUNTERED DURING FIELD EXPLORATIONS
- CASING

ENVIRONMENTAL CLASSIFICATION:

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CHLORIDES	30 PPM
SULFATES	<5 PPM
pH	7.6 TO 7.8

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RESISTIVITY	3,200 OHM-CM
CHLORIDES	150 PPM
SULFATES	<5 PPM
pH	7.2

	SAFETY HAMMER	AUTOMATIC HAMMER
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VERY SOFT	LESS THAN 2	LESS THAN 1
SOFT	2 to 4	1 to 3
FIRM	4 to 8	3 to 6
STIFF	8 to 15	6 to 12
VERY STIFF	15 to 30	12 to 24
HARD	GREATER THAN 30	GREATER THAN 24

FIGURE 4

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

JEREMY A. SEWELL, P.E.
P.E. LICENSE NUMBER 62951
TIERRA, INC.
591 SUSAN B. BRITT COURT
WINTER GARDEN, FLORIDA 34787

DRAWN BY: BMG
CHECKED BY: LA
DESIGNED BY: BMG
CHECKED BY: JAS

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
N/A	VOLUSIA	448456-1-22-01

SHEET TITLE: REPORT OF CORE BORINGS (2)

REF. DWG. NO.

PROJECT NAME: LPGA BOULEVARD OVER TOMOKA RIVER

SHEET NO.

LPGA Boulevard over Tomoka River
18-inch PPSC Pile (End Bents)

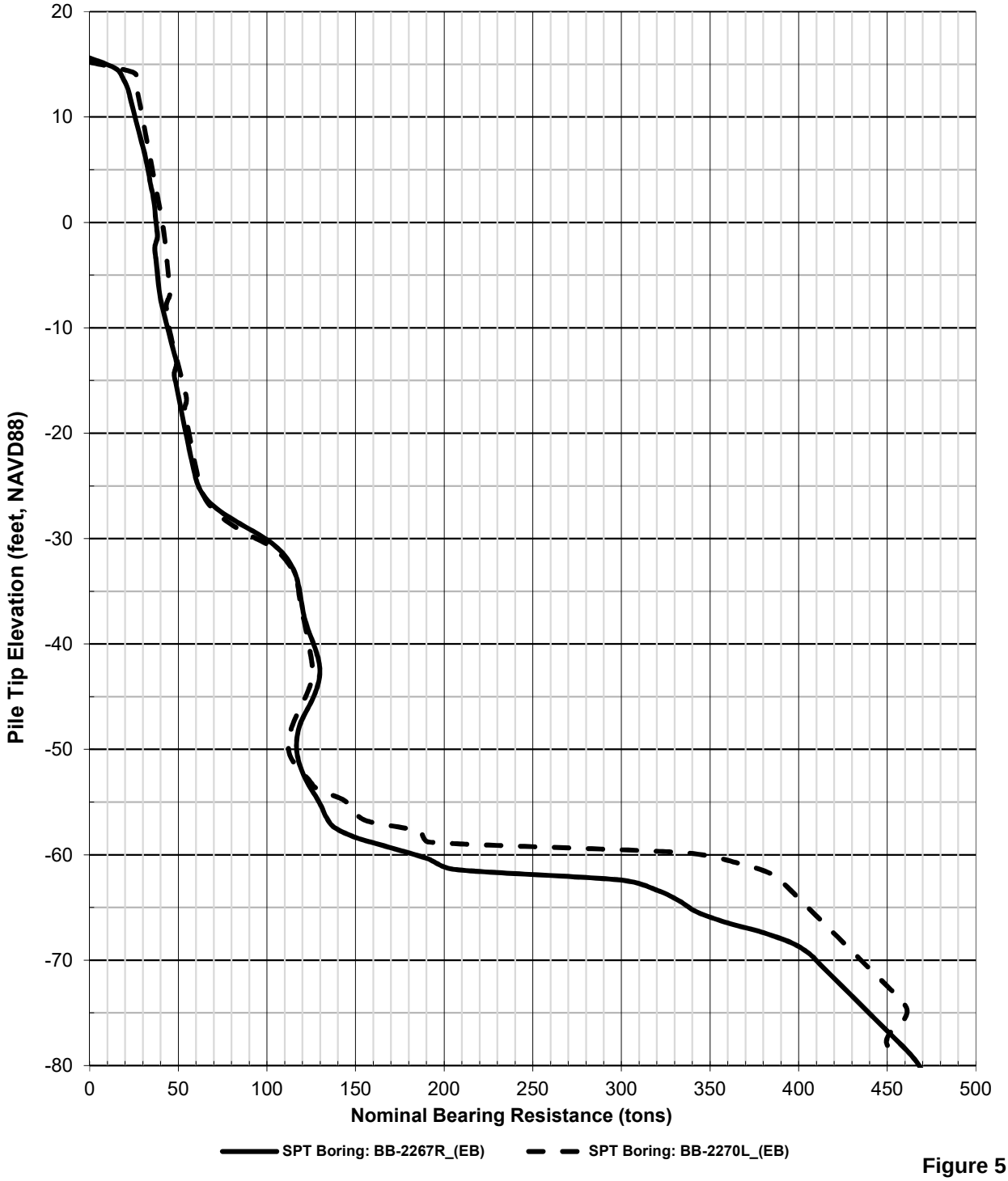

Figure 5

TIERRA
GEOTECHNICAL • MATERIALS
ENVIRONMENTAL • ENGINEERING

DRAWN BY:	SCALE:	PROJECT NO.
LAA	Noted	5511-21-038
CHECKED BY:	DATE:	
JAS	May 2022	

LPGA Boulevard over Tomoka River
LPGA Boulevard PD&E Study from
US 92 (SR 600) to Williamson Boulevard
Volusia County
FPID No. 448456-1-22-01

LPGA Boulevard over Tomoka River
24-inch PPSC Pile (End Bents)

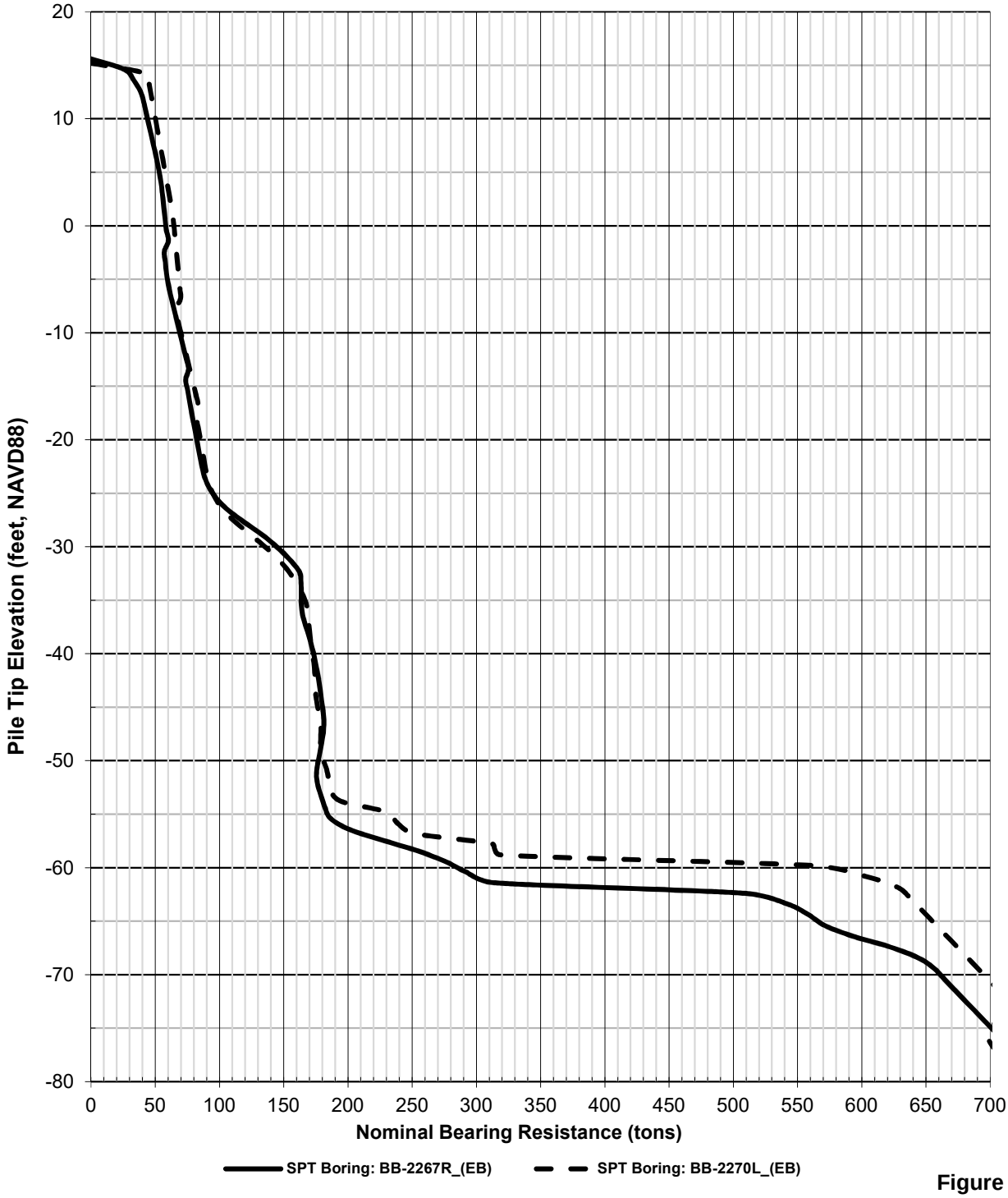

Figure 6

TIERRA
GEOTECHNICAL • MATERIALS
ENVIRONMENTAL • ENGINEERING

DRAWN BY:	SCALE:	PROJECT NO.
LAA	Noted	5511-21-038
CHECKED BY:	DATE:	
JAS	May 2022	

LPGA Boulevard over Tomoka River
LPGA Boulevard PD&E Study from
US 92 (SR 600) to Williamson Boulevard
Volusia County
FPID No. 448456-1-22-01

LPGA Boulevard over Tomoka River
18-inch PPSC Pile (Intermediate Bents)

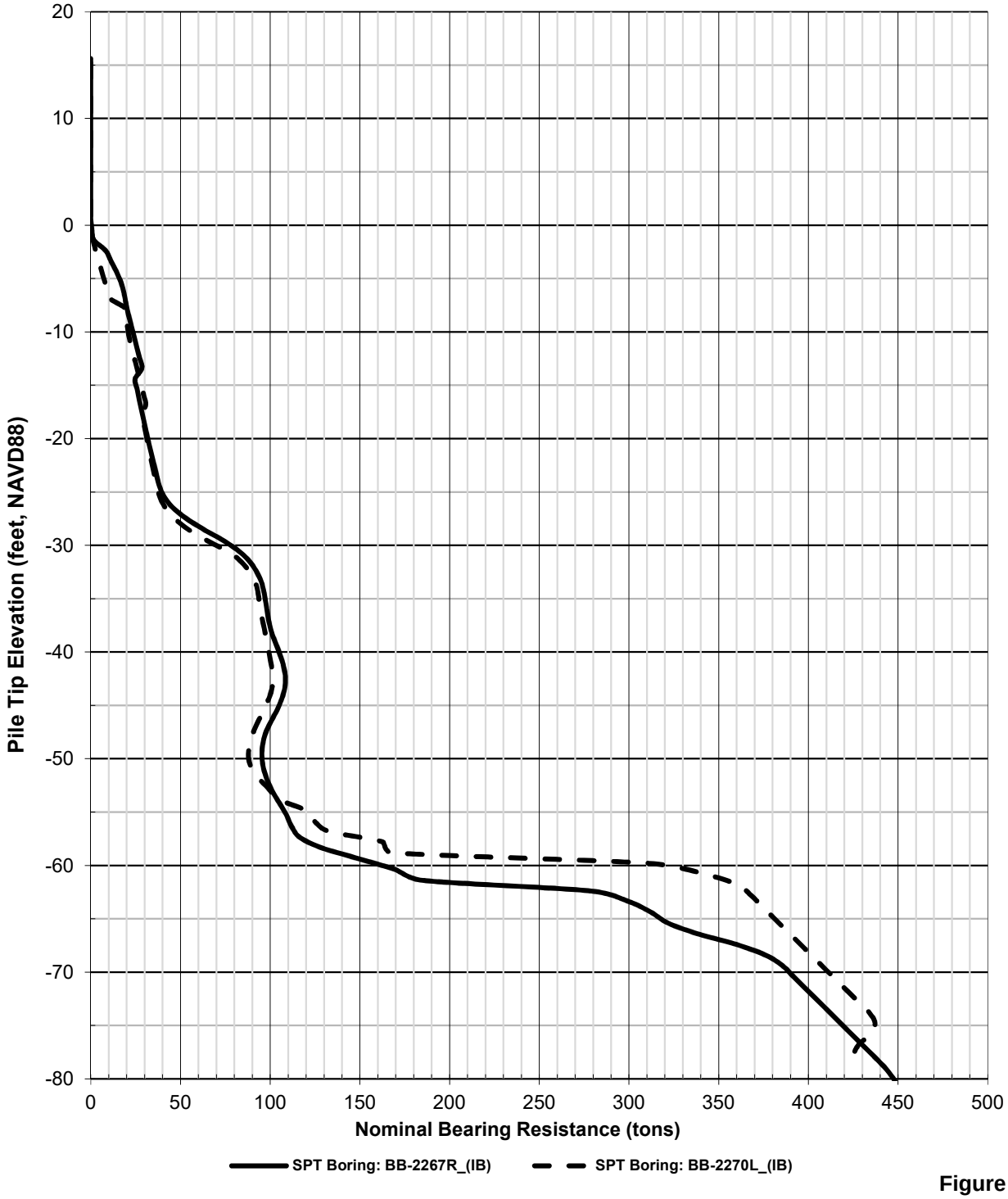

Figure 7

TIERRA
GEOTECHNICAL • MATERIALS
ENVIRONMENTAL • ENGINEERING

DRAWN BY:	SCALE:	PROJECT NO.
LAA	Noted	5511-21-038
CHECKED BY:	DATE:	
JAS	May 2022	

LPGA Boulevard over Tomoka River
LPGA Boulevard PD&E Study from
US 92 (SR 600) to Williamson Boulevard
Volusia County
FPID No. 448456-1-22-01

LPGA Boulevard over Tomoka River
24-inch PPSC Pile (Intermediate Bents)

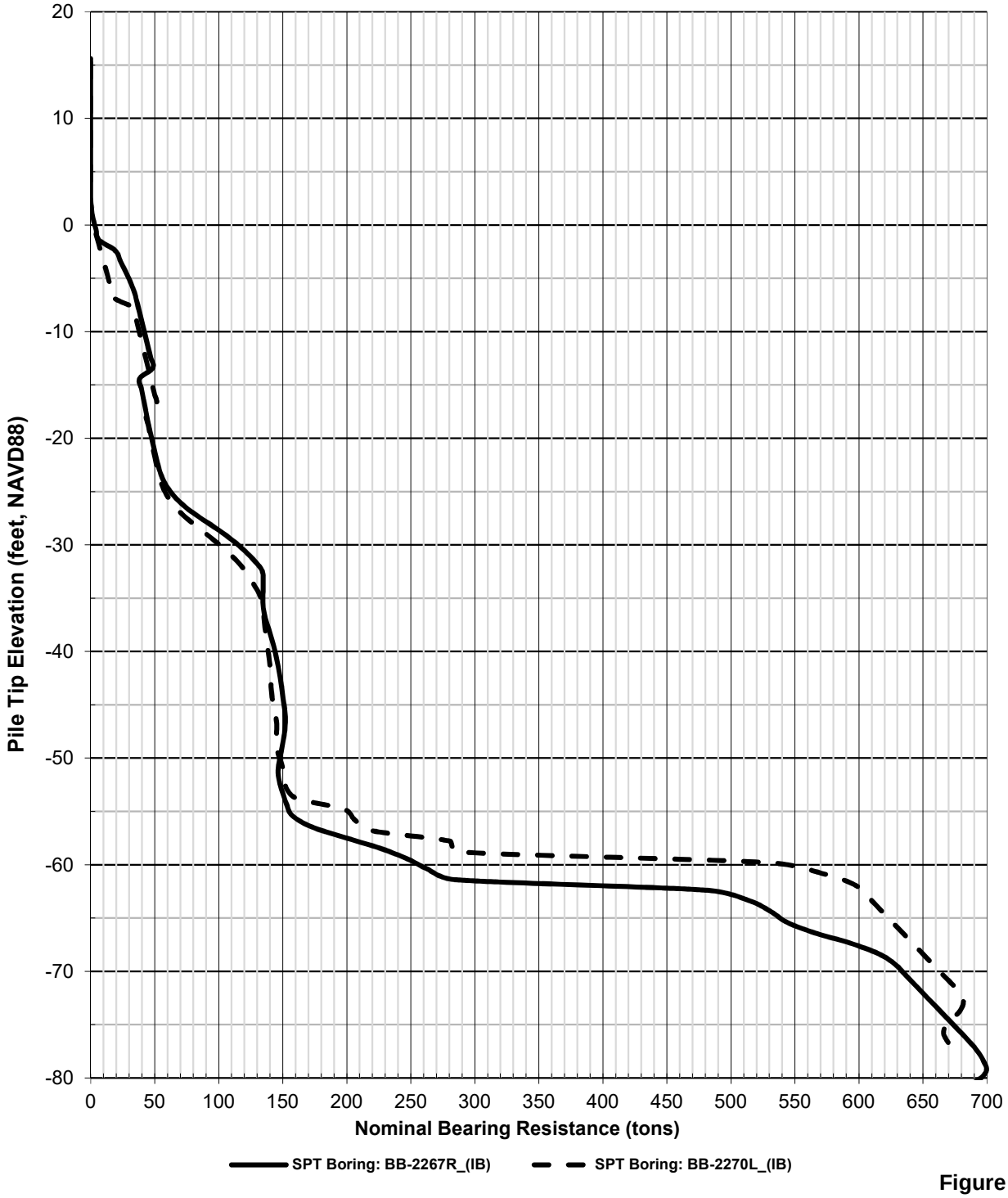

Figure 8

TIERRA
GEOTECHNICAL • MATERIALS
ENVIRONMENTAL • ENGINEERING

DRAWN BY:	SCALE:	PROJECT NO.
LAA	Noted	5511-21-038
CHECKED BY:	DATE:	
JAS	May 2022	

LPGA Boulevard over Tomoka River
LPGA Boulevard PD&E Study from
US 92 (SR 600) to Williamson Boulevard
Volusia County
FPID No. 448456-1-22-01