Geotechnical Technical Memorandum

US 41 at SR 54

SR 45 (US 41) at SR 54 from S. of Intersection to N. of Intersection

Pasco County, Florida

Financial Project ID: 419182-1-22-01 & 419182-2-32-01

Project Development and Environment Study

Florida Department of Transportation

May 2024

Tierra, Inc.
7351 Temple Terrace Highway • Tampa, Florida 33637
Phone (813) 989-1354

May 15, 2024

RS&H, Inc.
1715 N Westshore Boulevard, Suite 600
Tampa, FL 33607

Attn: Mr. Michael S. Dixon, P.E.

RE: Geotechnical Technical Memorandum
Project Development and Environment (PD&E) Soil Survey Study
SR 45 (US 41) at SR 54 from S. of SR 54 Intersection to N. of SR 54 Intersection
Pasco County, Florida
Districtwide FPID: 419182-1-22-01 & 419182-2-32-01
FAP No.: 3014-067-P
Tierra Project No.: 6511-11-537

Mr. Dixon:

Tierra, Inc. (Tierra) has completed preliminary geotechnical engineering services for the referenced project. The results of our review of published information and site reconnaissance are provided herein.

Tierra appreciates the opportunity to provide our services to RS&H and FDOT on this project. If you have any questions regarding this report, please contact us at (813) 989-1354.

Respectfully Submitted,

TIERRA, INC.

Nathan C. Binder, E.I.
Geotechnical Engineering Intern

Kevin H. Scott, P.E.
Senior Geotechnical Engineer
Florida License No.

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1.0 PROJECT INFORMATION

1.1 Project Description

The Florida Department of Transportation (FDOT) is conducting a Project Development and Environment (PD&E) Study to evaluate capacity and operational improvements at the intersection of State Road 45/U.S. Highway 41 (SR 45/US 41) and State Road 54 (SR 54) in Pasco County, FL. Each roadway is a six-lane divided facility intersecting at-grade with a box span traffic signal. US 41 is a major north-south arterial that provides access to Tampa, Lutz, Land O' Lakes, and Brooksville. SR 54 is a major east-west arterial that connects US 19 near New Port Richey to the west and US 301 in Zephyrhills to the east.

The length of the project is approximately 1.5 miles along US 41, with limits on SR 54 from approximately 1.2 miles east and 1.2 miles west of the intersection, including a 0.3-mile section of Dale Mabry Highway (SR 597). This intersection is located in the Land O' Lakes area of unincorporated Pasco County, Florida, as shown in Figure 1.1. This intersection is under the jurisdiction of FDOT.

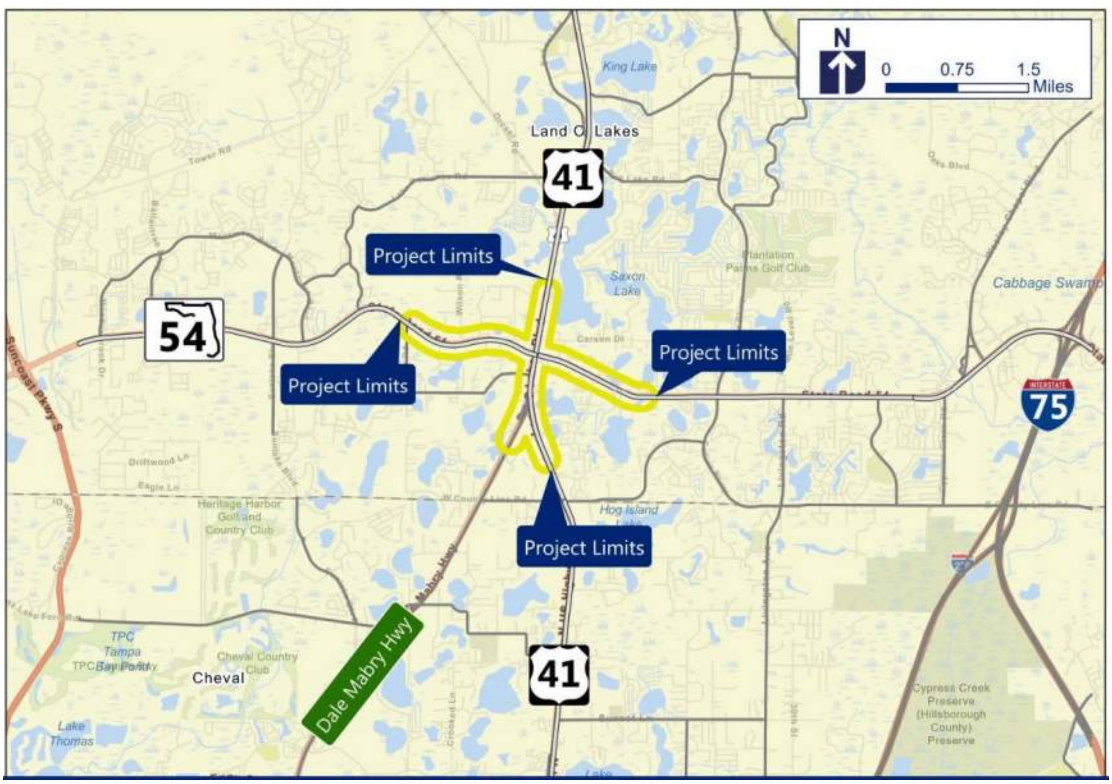


Figure 1.1: Project Location Map

1.2 General Site Conditions

The existing roadways for US 41 and SR 54 are typically supported on embankments utilized to separate the pavement section from the historical groundwater conditions. The areas of the alignment alternatives for the intersection improvements are both developed and undeveloped. Land use adjacent to the existing roadway alignments in the project area generally consists of urban land (residential and commercial developments), wetlands, and forested land.

2.0 PURPOSE AND SCOPE OF SERVICES

The purpose of the geotechnical portion of the PD&E study is to review published information with regard to the existing subsurface conditions along the project alignment to assist in the preparation of the PD&E Report for the project. Geotechnical explorations will be required during the design phase of this project. The following services were provided to achieve the preceding objective:

1. Reviewed published topographic information. This published information was obtained from the “Lutz, Florida” Quadrangle Map published by the USGS.

2. Reviewed published potentiometric surface information. This published information was obtained from the “Upper Floridan Aquifer Potentiometric Surface” maps published by the USGS.

3. Reviewed published soils information. This published information was obtained from the Web Soil Survey of Pasco County, Florida published by the USDA – NRCS.

4. Prepared this Geotechnical Technical Memorandum for the project.

3.0 REVIEW OF PUBLISHED DATA

3.1 USGS Quadrangle Map

Based on a review of the "Lutz, Florida” USGS Quadrangle Map, it appears that the project site elevations are on the order of approximately +65 to +75 feet, National Geodetic Vertical Datum of 1929 (NGVD 29). The quadrangle map depicts several wetland areas along the project alignments. The **USGS Quadrangle Map** of the project area is illustrated in the **Appendix**.

3.2 USDA Soil Survey

Based on a review of the Pasco County Soil Survey published by the USDA-NRCS, it appears that there are ten (10) soil-mapping units noted within the project limits. A detailed soil survey map is shown on the **USDA Soil Survey** sheet in the **Appendix**. The general soil descriptions are presented in the sub-sections and table below, as described in the Web Soil Survey.

Myakka-Myakka, wet, fine sands, 0 to 2 percent slopes (Soil Mapping Unit 5): The Myakka component makes up 70 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods, coastal plains. The parent material consists of sandy marine deposits. The 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 nor is it ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, September, October, and November. Organic matter content in the surface horizon is about 2 percent.

The Myakka, wet component makes up 15 percent of the map unit. Slopes are 0 to 2 percent. This component is on flatwoods, coastal plains. The parent material consists of sandy marine deposits. The 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 nor is it ponded. A seasonal zone of water saturation is at 6 inches during July, August, September, and October. Organic matter content in the surface horizon is about 2 percent.

Tavares sand, 0 to 5 percent slopes (Soil Mapping Unit 6): The Tavares component makes up 85 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 eolian or sandy marine deposits. The 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 nor is it ponded. A seasonal zone of water saturation is at 57 inches during June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 2 percent.

Sellers mucky loamy fine sand (Soil Mapping Unit 8): The Sellers component makes up 95 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. The 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 or above the natural ground surface during June, July, August, and September. Organic matter content in the surface horizon is about 8 percent.

Adamsville fine sand, 0 to 2 percent slopes (Soil Mapping Unit 11): The Adamsville component makes up 95 percent of the map unit. Slopes are 0 to 2 percent. This component is on rises, coastal plains. The parent material consists of sandy marine deposits. The depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly 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 nor is it ponded. A seasonal zone of water saturation is at 20 inches during June, July, August, September, October, and November. Organic matter content in the surface horizon is about 1 percent.

Smyrna fine sand (Soil Mapping Unit 21): The Smyrna, non-hydric component makes up 70 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. The 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 nor is it ponded. A seasonal zone of water saturation is at 12 inches during June, July, August, and September. Organic matter content in the surface horizon is about 3 percent.

The Smyrna, hydric component makes up 20 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. The 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 nor is it ponded. A seasonal zone of water saturation is at 3 inches during June, July, August, and September. Organic matter content in the surface horizon is about 3 percent.

Basinger fine sand, depressional, 0 to 1 percent slopes (Soil Mapping Unit 23): The Basinger, depressional component makes up 92 percent of the map unit. Slopes are 0 to 1 percent. This component is on depressions, coastal plains. The parent material consists of sandy marine deposits. The 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 or above the natural ground surface during January, February, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 5 percent.

Quartzipsamments, shaped, 0 to 5 percent slopes (Soil Mapping Unit 24): The Quartzipsamments component makes up 90 percent of the map unit. Slopes are 0 to 5 percent. This component is on fills on rises on marine terraces on coastal plains. The parent material consists of sandy marine deposits. The depth to a root restrictive layer is greater than 60 inches. The natural drainage class is 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 nor is it ponded. A seasonal zone of water saturation is at 72 inches during January, February, March, April, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 0 percent.

Narcoossee fine sand, 0 to 2 percent slopes (Soil Mapping Unit 26): The Narcoossee component makes up 90 percent of the map unit. Slopes are 0 to 2 percent. This component is on rises on marine terraces on coastal plains. The parent material consists of sandy marine deposits. The 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 nor is it ponded. A seasonal zone of water saturation is at 33 inches during

June, July, August, September, October, and November. Organic matter content in the surface horizon is about 4 percent.

Samsula muck, frequently ponded, 0 to 1 percent slopes (Soil Mapping Unit 52): 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. The 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 or above the natural ground surface during January, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 75 percent.

The Urban land map unit consists of areas where most of the surface is covered with impervious materials, such as buildings and paved areas. This land type consists of areas where the original soil has been modified through cutting, grading, filling, and shaping or has been generally altered for urban development.

Summary of USDA Soil Survey
Pasco County, Florida

USDA Map Symbol and Soil Name	Soil Classification				pH	Seasonal High Water Table	
	Depth (in)	USCS	AASHTO	Permeability (in/hr)		Depth (feet)	Months
(5) Myakka - Myakka, wet	0-6	SP-SM, SM	A-2-4, A-3	6.0 - 20.0	3.5-6.5	0.5-1.5	June-Nov
	6-20	SP-SM, SM	A-2-4, A-3	6.0 - 20.0	3.5-6.5		
	20-36	SP-SM, SM	A-2-4, A-3	0.6 - 6.0	3.5-6.5		
	36-80	SP-SM, SM	A-2-4, A-3	6.0 - 20.0	3.5-6.5		
	0-6	SP-SM, SM	A-3, A-2-4	6.0 - 20.0	3.5-6.5	0.3-1.5	July-Oct
	6-20	SP-SM, SM	A-3, A-2-4	6.0 - 20.0	3.5-6.5		
	20-36	SP-SM, SM	A-3, A-2-4	0.6 - 6.0	3.5-6.5		
	36-80	SP-SM, SM	A-3, A-2-4	6.0 - 20.0	3.5-6.5		
(6) Tavares	0-7	SP-SM, SM	A-3, A-2-4	6.0 - 50.0	3.5-6.0	3.5-6.0	June-Dec
	7-80	SP-SM, SM	A-3, A-2-4	6.0 - 50.0	3.5-6.0		
(8) Sellers	0-9	SP-SM, SM	A-2-4, A-3	6.0 - 20.0	3.5-5.5	+2.0-0.0	June-Sept, Oct-Nov
	9-24	SP-SM, SM	A-2-4, A-3	6.0 - 20.0	3.5-5.5		
	24-80	SP-SM, SM	A-2-4, A-3	6.0 - 20.0	3.5-5.5		
(11) Adamsville	0-7	SP-SM, SM, SP	A-3, A-2-4	6.0 - 20.0	4.5-7.8	1.5-3.5	June-Nov
	7-20	SP-SM, SM, SP	A-3, A-2-4	6.0 - 20.0	4.5-7.8		
	20-80	SP-SM, SM, SP	A-3, A-2-4	6.0 - 20.0	4.5-7.8		
(21) Smyrna, non-hydric - Smyrna, hydric	0-5	SP-SM, SP	A-2-4, A-3	6.0 - 20.0	3.5-5.0	0.5-1.5	June-Sept
	5-13	SP-SM, SP	A-2-4, A-3	6.0 - 20.0	3.5-5.0		
	13-25	SP-SM, SM	A-2-4, A-3	0.6 - 6.0	3.5-5.0		
	25-80	SP-SM, SP	A-3	6.0 - 20.0	4.5-5.5		
	0-5	SP-SM, SP	A-2-4, A-3	6.0 - 20.0	3.5-5.0	0.0-0.5	June-July, Aug, Sept
	5-13	SP-SM, SP	A-2-4, A-3	6.0 - 20.0	3.5-5.0		
	13-25	SP-SM, SM	A-2-4, A-3	0.6 - 6.0	3.5-5.0		
	25-80	SP-SM, SP	A-3	6.0 - 20.0	4.5-5.5		
(23) Basinger, depressional	0-3	SP-SM	A-2-4	6.0 - 50.0	3.5-7.3	+2.0-0.0	Jan-Feb, May-Dec
	3-8	SP-SM, SP	A-2-4, A-3	6.0 - 50.0	3.5-7.3		
	8-24	SP-SM, SP	A-2-4, A-3	6.0 - 50.0	3.5-7.3		
	24-80	SP-SM, SP	A-3	6.0 - 50.0	3.5-7.3		
(24) Quartzipsamments	0-80	SP-SM, SP	A-3	6.0 - 20.0	4.5-7.3	6.0	Jan-Dec
(26) Narcoossee	0-5	SP-SM, SM	A-2-4	6.0 - 20.0	3.5-6.0	2.0-3.5	June-Nov
	5-22	SP-SM, SM	A-2-4	6.0 - 20.0	3.5-6.0		
	22-26	SP-SM, SM	A-2-4, A-3	2.0 - 6.0	3.5-6.0		
	26-36	SP-SM, SM	A-2-4	6.0 - 20.0	3.5-6.0		
	36-80	SP-SM, SM	A-2-4	6.0 - 20.0	3.5-6.0		
(38) Urban land	USDA does not provide information for Urban Land.						
(52) Samsula	0-24	PT	A-8	6.0 - 20.0	3.5-4.4	+2.0-0.0	Jan, Feb-May, June-Dec
	24-32	PT	A-8	6.0 - 20.0	3.5-4.4		
	32-35	SP-SM, SM	A-3, A-2-4	6.0 - 20.0	3.5-6.0		
	35-44	SP-SM, SM	A-3, A-2-4	6.0 - 20.0	3.5-6.0		
	44-80	SP-SM, SM	A-3, A-2-4	6.0 - 20.0	3.5-6.0		

It should be noted that information contained in the USDA-NRCS Soil Survey may not be reflective of current soil and groundwater conditions, particularly if recent development in the project vicinity has modified existing soils or surface/subsurface drainage.

3.3 Review of Potentiometric Surface Information

Based on a review of the "Upper Floridan Aquifer Potentiometric Surface" maps published by the USGS, the potentiometric surface elevation of the Upper Floridan Aquifer within the project limits ranges from approximately +50 to +70 feet, NGVD 29. As indicated in Section 3.1, the project site elevations range from approximately +65 to +75 feet, NGVD 29.

3.4 Geological Hazards

The project site is within a region of Pasco County and West-Central Florida that can be characterized as having a moderate potential for sinkhole development. Depending on final alignment and site layout details, geotechnical explorations consisting of SPT borings may be warranted to further evaluate and characterize the nature of the site for geological hazards.

4.0 PRELIMINARY ENGINEERING EVALUATIONS

4.1 General

Based upon the USDA-NRCS Soil Survey for Pasco County, sandy soils (SP, SP-SM, and SM) soils are reported along the majority of the project corridor to depths of 80 inches below the natural ground surface. Isolated surficial organic material/muck soils (Soil Units 8 and 52) are reported in close proximity to the project corridor.

In general, the sandy soils are suitable for supporting proposed roadway embankments after proper subgrade preparation including removal and replacement of unsuitable materials. Areas along the project corridor where shallow groundwater conditions and/or organics may impact the project are detailed below.

4.1.1 Shallow Groundwater

The Seasonal High Groundwater Table (SHGWT) along the project alignment is expected to range from at or above the predevelopment natural grade to a depth of approximately 6 feet below the predevelopment natural grade within the project limits. Grades for the roadway should be set in accordance with FDOT Specifications to provide a minimum separation between the bottom of the base and the estimated seasonal high groundwater levels. Correspondingly, the base should remain equally above sustained water treatment levels in roadside ditches/swales, making positive drainage of the ditches/swales important. The choice of base material would depend upon the relationship of final roadway improvement grades and the bottom of the base to the estimated seasonal high groundwater table levels.

In areas where the existing SHGWT is above grade, the SHWGT will have to be established by the project biologist utilizing biological indicators. Additionally, drainage design will need to consider the impact of shallow groundwater levels on stormwater management facilities.

4.1.2 Organic Soils

According to the USDA Soil Survey, organic soils are anticipated within two soil mapping units along the proposed roadway alignment. The following soil mapping units noted organic/muck (A-8) soils from the predevelopment natural ground surface to 32 inches below the ground surface within the project limits:

- Sellers mucky loamy fine sand (Unit 8)
- Samsula muck, frequently ponded, 0 to 1 percent slopes (Unit 52)

Tierra reviewed previous geotechnical reports developed by others for previous projects including the SR 54 Roadway Depression (441658-1) and Pavement Distress – along SR 54 300 Feet NE of Osprey Lane (441658-1). The previous geotechnical reports include soil and groundwater data for a portion of the proposed roadway improvements along SR 54. Based on our review, it appears that the previous geotechnical studies encountered organics soils within their SPT borings to depths ranging from approximately 13½ to 23 feet below the existing ground surface. The previous geotechnical reports developed by others are included in the **Appendix.**

Organic/muck (A-8) soil should be removed in accordance with FDOT Standard Plans, Index 120-002 and replaced with backfill in accordance with Index 120-001. In areas where removal and replacement are not feasible, other ground improvement techniques will need to be considered.

A muck delineation program should be performed as part of the design phase scope of this project. A muck delineation program will assist in determining the impact of these materials and in developing a remediation plan for the organic soils.

4.2 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, organic soils, and unsuitable materials in accordance with FDOT Standard Plans, Index 120-002. Backfill embankment materials should consist of materials conforming to the FDOT Standard Plans, Index 120-001. Clearing and grubbing and compaction should be accomplished in accordance with the FDOT Standard Specifications.

FDOT Standard Indices 120-001 and 120-002 of the Design Standards should be consulted to determine the specific use/suitability of the soil types present within the project limits.

The proposed roadway improvements should be in accordance with FDOT Standard Specifications and Standard Plans 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.

4.3 Geological hazards

The project site is within a region of Pasco County and West-Central Florida that can be characterized as having a moderate to high potential for sinkhole development. Based on the soil survey, three (3) soil mapping units located along the roadway alignments are associated with depressions. Based on previous geotechnical experience in this region of Pasco County, these map units can be associated with relic sinkhole conditions which include variable depths of organics and variable depths to competent limestone.

Based on our review of the previous geotechnical reports referenced in **Section 4.1.2**, it appears that the previous geotechnical studies encountered anomalies along SR 54 where depressions in the pavement were observed. The subsurface exploration concluded the encountered anomalies were indicative of sinkhole activity and a possible relic sinkhole condition. A remedial plan consisting of compaction grouting was recommended for the anomalies encountered. The previous geotechnical reports developed by others are included in the **Appendix.**

A site-specific geotechnical exploration will be performed during the design phase of the project to further characterize the potential impacts of sinkhole activity to the project. The geotechnical exploration should include geophysical surveys along with test borings that extend into the Limestone bedrock to evaluate for the presence of subsurface raveling zones that could be indicative of karst activity and to develop recommendations for pre-construction remediation, as needed.

5.0 REPORT LIMITATIONS

The scope of the geotechnical portion of the PD&E study is to provide preliminary information on the existing subsurface conditions along the project alignment based on a review of the Soil Surveys, published by the USDA-NRCS to assist in the preparation of the PD&E Report for this project. The preliminary evaluations submitted in this report are based upon the data obtained from the published information. Additional geotechnical explorations will be required during the design phase of this project should adhere to the FDOT Soils and Foundation handbook guidelines. 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 conditions 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 and stormwater management areas.

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 RS&H and Florida's Turnpike Enterprise.

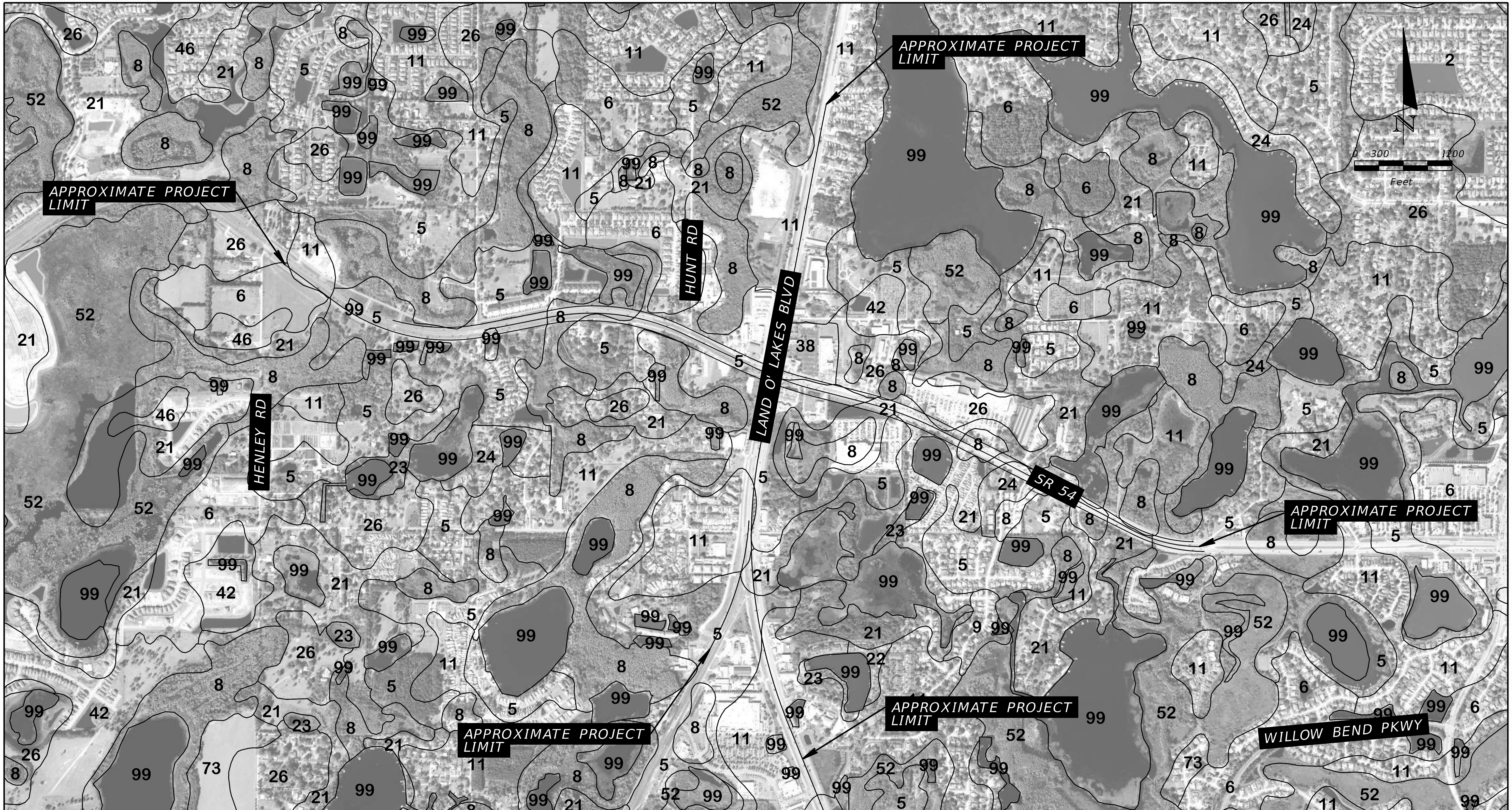
Our services have been performed, our findings obtained, and our preliminary evaluations prepared in accordance with generally accepted geotechnical engineering principles and practices at the time of this report. Tierra is not responsible for the conclussions, opinions, or recommendations made by others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

APPENDIX

USDA Soil Survey Map

USGS Quadrangle Map

Previous Geotechnical Reports Developed by Others



REFERENCE: USDA SOIL SURVEY OF PASCO COUNTY, FLORIDA

TOWNSHIP:	26S	26S
RANGE:	18E	19E
SECTION:	25, 26, 35, 36	30, 31

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

KEVIN H. SCOTT, P.E.
P.E. LICENSE NUMBER 65514
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	419182-1-22-01 419182-2-32-01

USDA SOIL SURVEY

SHEET NO.

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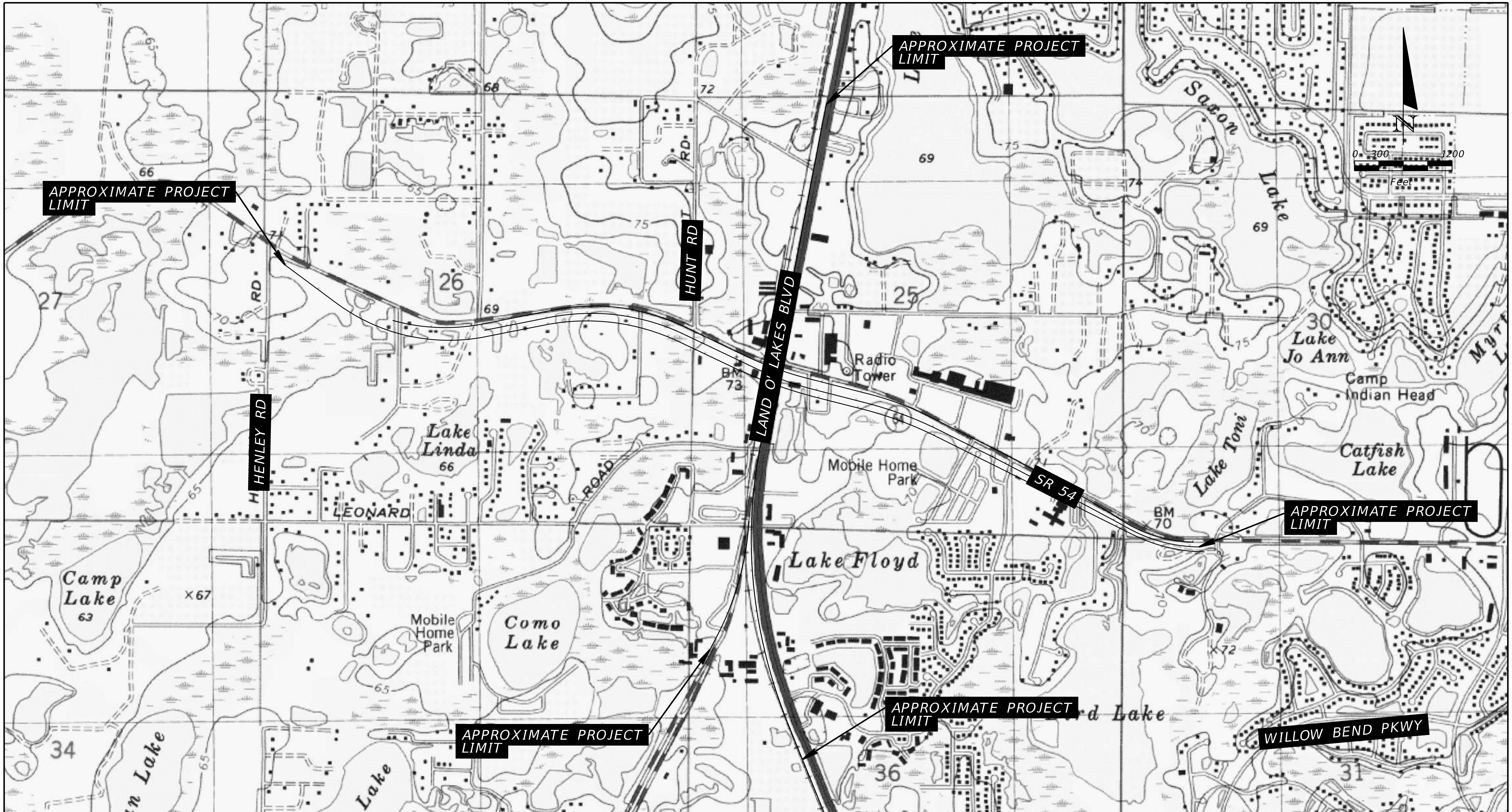

REFERENCE: USGS QUADRANGLE MAP OF "LUTZ, FLORIDA"

TOWNSHIP:	26S	26S
RANGE:	18E	19E
SECTION:	25, 26, 35, 36	30, 31

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

KEVIN H. SCOTT, P.E.
P.E. LICENSE NUMBER 65514
TIERRA, INC.
7351 TEMPLE TERRACE HIGHWAY
TAMPA, FLORIDA 33637

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	419182-1-22-01 419182-2-32-01

USGS QUADRANGLE MAP

SHEET NO.

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Updated December 15, 2023

Florida Department of Transportation
District VII
MS7-800
11201 N. McKinley Drive
Tampa, Florida 33612

Attention: Mr. Kisan Patel, P.E.

RE: **SR 54 Roadway Depression**
2,000 Feet East of US 41
Pasco County, Florida
FDOT FPIN 198296-1-32-12
FDOT FPID 441658-1
FDOT Contract No. CAD65
Task Work Order No. 2.007S
PSI Project No. 07753545R1

Dear Mr. Patel:

In accordance with your authorization, **Professional Service Industries, Inc. (PSI), an Intertek Company**, has provided geotechnical engineering services at the referenced site. The following presents the results of our field activities and recommendations. This report has been updated to reflect discussions which took place over conference calls between FDOT District Materials Office, Construction Office, Maintenance Office, CEI, Project Designer and PSI on December 13, 2023.

BACKGROUND

PSI was contacted by the FDOT in the morning of August 24, 2023, regarding a pair of surface depressions observed within the roadway of SR 54 approximately 1/3 of a mile east of its intersection with US 41 in Land O' Lakes, Pasco County, Florida. The larger depression was reported to span across all three eastbound lanes located around mile post (MP) 0.410, while the smaller depression was reported to be located within the right and middle, eastbound travel lanes located around MP 0.530. It should be noted the smaller depression falls within an area of the roadway which was previously explored with remediation work consisting of both compaction grouting ground improvement and the placement of structurally supporting geosynthetic reinforcement planned to take place early 2024. For this reason, exploratory efforts discussed herein were focused upon the depression located outside of the formerly explored area. Please refer to the vicinity map included in **Appendix A** showing the approximate locations of the depressions addressed in this area.

PSI arrived on site on the afternoon of August 24, 2023, to perform a site visit of the reported distressed area. While on site, the reported depression was observed to be slight, primarily apparent when heavy vehicular traffic traversed across the subject area. The entire eastbound roadway (three travel lanes) appear to be slightly depressed compared to the surrounding area with the middle travel lane generally exhibiting relatively more settlement. Reviewing the Google Earth aerial imagery maps for this area, the subject pavement distress also appears to be visible via localized staining along the roadway compared to the surrounding roadway pavements indicating stormwater may collect in these portions of the roadway during and following precipitation events. Evidence of possible staining appears to date back as far as 2006. It should be noted there are significant gaps in relatively clear Google Earth aerial imagery dating back to the early 2000's and the most recent relatively clear image of the roadway where these staining conditions do not appear to be present dates back to the year 2002. The images presented below outline these apparent conditions.

Figure A: Aerial Imagery of Subject Site Image Date April 2002 (Source: Google Earth)

Figure B: Aerial Imagery of Subject Site Image Date September 2006 (Source: Google Earth)

Figure C: Aerial Imagery of Subject Site Image Date February 2015 (Source: Google Earth)

Figure D: Aerial Imagery of Subject Site Image Date May 2023 (Source: Google Earth)

It is also apparent the SR 54 alignment is located directly over a historic closed circular depression which given the history of the general project area (Pasco County) is likely a relic sinkhole feature. An aerial photograph preceding the year 2000 shows the previous alignment of SR 54 was formerly north of this depression and more recent aerial photographs indicate the approximately 35-foot diameter depression is at approximately station 52+00 which corresponds with the location of the observed depression. At this time, no as-built information is presently available with regard to the means and methods of SR 54 roadway construction in this area specifically pertaining to what, if any, remedial measures were undertaken to stabilize the soil column in this area. Based on the relative age of the roadway, it is likely minimal to no remedial measures were undertaken to stabilize compromised soil conditions at depth in this location and it is likely the lower lying area was infilled with no further action at the time of construction.

Based on utility markings present on the asphalt pavement surface, a buried gas utility line appears to run parallel with the roadway in the center of the middle eastbound lane and the GPR survey indicates there is also a perpendicular running buried utility crossing the roadway in the area. Access to the general area of distress was limited due to heavy vehicle traffic requiring Maintenance of Traffic (MOT) with night lane closures.

Photographs taken by PSI of the distressed area are presented in **Appendix C** of this report. The approximate site location is presented on **The Report of Core Borings Sheet** located in **Appendix A**.

FIELD EXPLORATION

Ground Penetrating Radar (GPR) Surveying

A geophysical evaluation program consisting of ground penetrating radar (GPR) surveying was performed in the roadway to evaluate shallow geological conditions in the vicinity of the subject distressed area. Two relatively continuous sets of GPR reflectors were identified at approximate depth ranges of 2 to 3 feet and 5 to 7 feet bls. These reflector sets were deemed to most likely be associated with lithological transitions within those depth ranges. The GPR reflector sets identified in the GPR investigation were relatively continuous across the accessible areas of the project site, which resulted in the collection of inconclusive data with regard to explaining the observed settlement in the project area. One of the limitations of GPR is that it is only effective so far as the radar signal can penetrate through the soil column which is typically on the order of eight to 15 feet below the existing ground surface. In this manner, GPR is ineffective at identifying broad, deep seated, anomalous features underground which is why further exploratory work in the form of both soil borings and advanced geophysical investigation were recommended and performed.

On the same evening of and after the GPR surveying efforts in the field were completed, a Standard Penetration Test (SPT) soil boring was performed in the roadway approximately in the center of the depression. The decision to undertake soil boring and GPR efforts in the same evening was based on prior the experience in the immediate area from the year before, and in an effort to reduce traffic impacts along the busy SR 54 roadway. The soil boring revealed deeper indications of prior sinkhole activity including very loose subsurface conditions, losses of drilling fluid circulation and an approximately 15-foot layer of organic soil (Peat) from approximately 6 to 20 feet below current grade. Organic soils are often associated with natural infilling of a depression formed by a relic sinkhole. After a review of historical aerial imagery, the subject area of distress was most likely attributed to a relic sinkhole feature.

In light of this, additional geophysical surveying in the form of Electrical Resistivity Imaging (ERI) was conducted along accessible portions of the roadway median to better evaluate the deeper subsurface conditions and two additional SPT borings were also performed within the interior southbound travel lane of the roadway based on the approval from the FDOT District Materials Office in order to identify approximate limits of the impacted areas.

Geophysical Surveying using Electrical Resistivity Imaging (ERI)

An ERI geophysical survey was conducted on October 27, 2023 across accessible portions of the SR 54 roadway median. The survey consisted of a single ERI transect consisting of an approximate length of 550 feet. Along the length of the ERI survey a total of three ERI anomaly features (A, B, and C) were identified along the length of the ERI transect. Additionally, the three anomalies are suspected to be associated with a deeper, single, relatively broad anomaly feature which may extend to depths of up to around 100 feet below grade.

For more information with regard to the geophysical surveys completed for this project please refer to the **Geophysical Investigation** reports prepared by GeoView Inc. which have been included in **Appendix B** of this report.

SPT Soil Borings

The first of the three completed SPT soil borings (B-1) was conducted on September 7, 2023 with a night lane closure following the conclusion of GPR surveying activities that evening. The remaining two SPT borings (B-2 and B-3) were completed on October 23 and October 24, 2023 following the conclusion of ERI activities with night lane closures. Overall, these borings were advanced to depths ranging from 55 to 90 feet below the existing ground surface with each located within the interior travel lane of the southbound SR 54 roadway. Boring B-1 was performed toward the center of the subject area whereas borings B-2 and B-3 were performed toward the western and eastern extents of the distressed area respectively.

The borings were not surveyed by a professional surveyor; therefore, the locations presented in **Appendix A** should be considered approximate.

Borings B-2 and B-3 revealed relatively consistent subsurface conditions comprising initially of loose to very loose relatively clean to slightly silty (SP/SP-SM) sands starting immediately below the observed pavement section and extending to approximate depths of 18 feet below existing grade. Below the upper relatively clean sands, the borings revealed loose to medium dense clayey sands (SC) extending to depths on the order of 28 to 33 feet below grade. The clayey sands were generally observed to be underlain by soft to very soft high plastic clays (CH) extending to an approximate depth of 42 feet below grade. Beyond 42 feet in depth, the borings encountered a mixed matrix of limestone and calcareous clays appearing to be poorly to moderately cemented based on SPT N-Values obtained through testing. Complete (100%) losses of drilling fluid was observed in both boring B-2 and B-3 in the vicinity of approximately 45 feet depth.

Boring B-1, performed approximately in the center of the distressed area, revealed moderately dense relatively clean to slightly silty sand (SP/SP-SM) materials from below the bottom of the existing pavement section to an approximate depth of 6 feet below existing grade. Thereafter, the boring B-1 revealed soft to very soft and highly organic peat (PT) materials extending to a depth of approximately 22 feet below grade. Laboratory testing on representative samples of this material revealed measured organic contents in the range of 6% to 42% while the measured natural moisture content of the sampled materials varies between 37% and 150%. These elevated levels of both organic content and natural moisture content indicate the organic materials extending to intermediate depths in the project area are highly compressible in addition to being prone to long term decomposition and settlement.

Beyond 22 feet in depth, boring B-1 encountered very loose sands grading relatively clean to slightly silty (SP/SP-SM) and clayey sands (SC) extending to an approximate depth of 68 feet below grade. From 68 feet to 83 feet below grade the boring revealed a mixed matrix of very soft calcareous clay and very soft high plastic clay (CH). Thereafter, the boring revealed moderately cemented to well cemented limestone extending to boring termination at approximately 90 feet below grade. It should be noted that partial and complete losses of drilling fluid circulation were observed throughout drilling and sampling operations in boring B-1.

The boring locations and respective soil profiles are presented on the **Report of Core Borings Sheets** located in **Appendix A.**

CONCLUSIONS

The results of the geophysical surveying efforts, a review of historical ariel imagery, and the soil borings performed for this project, it is apparent the subject area of distress is being impacted by underlying karstic sinkhole conditions in addition to the long-term degradation of shallow to intermediately deep very soft organic soils.

REMEDIAL RECOMMENDATIONS

We recommend a program of compaction grouting remediation be undertaken to address the area of observed distress including the apparent relic karst conditions which do not appear to have been addressed during the original construction of the existing roadway.

Compaction grouting is a method of ground improvement where a low slump grout is injected under pressure to fill possible voids within the underlying limestone and permeate into the surrounding soils, thereby densifying them.

For compaction grouting, the following program should be implemented. A low slump, sand-cement grout should be pumped, under pressure, into the ground at grout injection pipe locations established in advance. It is our opinion that the soils within and around the subject area of distress be treated with subsurface grouting to fill any voids or loose/soft soil conditions.

In addition to compaction grouting, complete removal of the observed organic soils revealed in our exploratory boring program is also recommended. However, undertaking such an endeavor is not expected to be deemed practical. Therefore, the shallow remedial measures presented herein have been devised to reduce, but not completely eliminate the risks associated with differential settlement due to leaving some to significant amounts of the organic soils in place.

Following the compaction grouting process and considering some level of inherent risk for differential settlement, we recommend the area be over-excavated to a target depth of at least 8-feet below the existing pavement surface resulting in the removal and replacement of organic materials within the excavation limits prior to the reconstruction of the roadway with controlled lifts of layered backfill in accordance with FDOT Specifications. In the event excavation to 8-feet is also deemed impractical, we recommend over-excavation reach a target depth of 5-feet below the existing ground surface at a minimum. Options for over-excavation to each of these potential target depths have been graphically prepared for consideration and are included in **Appendix D.** In general, it should be noted that more robust over-excavation and removal will allow for the placement of an additional layer of structurally supporting geosynthetic replacement which will help to lesson the impacts of differential settlement movement leading to comparatively less frequent expected maintenance efforts along the roadway.

In order to reduce the risk of differential settlement due to the shallower saturated and unsuitable organic soils (peat/muck) which appear to extend to depths on the order of up to 20+ feet below existing grade, a layer of biaxial geotextile (Type R2 - with a minimum tensile strength of 1,315 pounds/foot) should be placed across the base of the excavation area. Depending on the chosen excavation target depth (8-feet versus 5-feet below grade) we recommend additional layers of similar geosynthetic reinforcement by placed at depths of either 4 & 6 feet below grade (for the 8-foot target excavation) or 3 feet below grade (for the 5-foot target excavation).

All earthwork operations including backfilling should be performed in accordance with FDOT Standards for Road and Bridge Construction. Considering the extents and breadth of anticipated earthwork operations the implementation of excavatable flowable fill in lieu of conventional backfill may be considered provided it is approved for use by the District Geotechnical Engineer.

Following the conclusion of all remediation measures, it is recommended the project site be regularly monitored for a period of six months. Thereafter, the area should be occasionally monitored for signs of additional settlement distress resulting from leaving some to significant portions of the underlying highly organic materials in place. These materials will continue to decompose and compress with time and as a result the more frequent maintenance and monitoring of the area should be expected.

In recognition that the impacted area targeted for treatment on this project is relatively large, the following alternatives may be considered for the compaction grout and geotextile remediation program:

- ***Option 1 – Grouting & Geotextile Remediation for Immediate Area of Concern***
  At a minimum, we recommend the immediate area of apparent distress centered around boring B-1 be remediated with compaction grouting and the strategic placement of geosynthetic reinforcement as presented under Option 1 in **Appendix D**. In order to implement the recommendation for Option 1, a total of 13 primary grout injection points should be installed. It should be noted this option represents the minimum recommended remediation approach and the subsurface information available in the project area in combination with the apparent history of the project site indicate there is an atypically significant likelihood for elevated grout takes during compaction grouting operations as well as the potential need for secondary and tertiary grout injection points.

  If this option is selected, we would recommend the nearby area be continuously monitored for any changes along the roadway surface conditions and the development of subsidence at the ground surface. The implementation of compaction grouting operations introduces a dynamic change to the equilibrium of the soil column in the vicinity of its implementation. There is some historical correlated data which suggests that undertaking compaction grout remediation may play a role in the manifestation of additional subsidence events as a result of these dynamic conditions. The project team should be adequately prepared to overcome additional subsidence events during remediation operations within the subject area of treatment and in the areas surrounding the treatment area.

- ***Option 1A – Alternate#1 Grouting & Geotextile Remediation for Immediate Area of Concern***
  Based on a request of FDOT representatives and in considering of constructability concerns associated with targeting relatively deeper excavations which may require temporary shoring system(s), a modified remediation method, Option 1A, has been provided in this section which allows for the reduction of the target excavation depth to 5 feet from the ground surface. This modified Option 1A remediation method will include the same number of grout points as recommended under option 1 and a total of two (2) layers of geosynthetic reinforcement placed at 3 feet and 5 feet depths respectively below the ground surface. The geosynthetic reinforcement placement details are graphically presented in Option 1A in **Appendix D**.

  Please note that this modified remediation method will include comparatively additional inherent risk associated with differential settlements from the decomposition and compression of organic materials which will remain a long-term maintenance concern. All other recommendations as addressed in Option 1 would remain the same for this option except the excavation depths and number of geosynthetic reinforcement layers.

- ***<u>Option 1B – Alternate #2 Grouting & Geotextile Remediation for Immediate Area of Concern</u>***
  Based on a request of FDOT representatives in a conference call on December 13, 2023; Option 1B has been provided in this section which is intended to slightly expand addressing the area of immediate concern to encompass a hybrid treatment area covering the Option 1 series of recommendations and the Option 2 series of recommendations presented herein. The goal in undertaking Option 1B would be to accomplish the southeastern portion of the recommended Option 2 series of remediation plans on an immediate basis with the remainder of work recommended in those remediation plans to be undertaken at a later date in the short to intermediate (12-to-18-month period of time) future depending on the construction schedule and MOT rerouting plans.

  Option 1B allows for a target excavation depth of 5 feet from the existing ground surface and the placement of two (2) layers of geosynthetic reinforcement at 3-foot and 5-foot depths respectively. It also includes the installation and completion of a planned 35 compaction grout remediation points. The geosynthetic reinforcement placement details and approximate Option 1B primary compaction grout injection point location plan are graphically presented in Option 1B in **Appendix D**.

  Please note that this modified remediation method will include inherent risks associated with differential settlements from the decomposition and compression of organic materials which will remain a long-term maintenance concern.

<u>Option 2 – Grouting & Geotextile Remediation of Apparent Historical Depression Feature</u>

- In order to offer an intermediate level remediation for the impacted areas of the project, we recommend consideration be given to addressing the entire footprint of the apparent historical depression feature in the subject area. A graphical representation of this option is presented in **Appendix D**. In order to implement the recommendation for Option 2, a total of 88 primary grout injection points should be installed throughout the treatment area. For this option, over-excavation and geosynthetic placement recommendations are identical to those which apply to the minimum recommendation presented as Option 1.

  Similar to the first option, it should be noted this option represents a minimum recommended remediation approach and the subsurface information available in the project area in combination with the apparent history of the project site indicate there is an atypically significant likelihood for elevated grout takes during compaction grouting operations as well as the potential need for secondary and tertiary grout injection points. Please note that the remediation area for Option 2 can be fine-tuned if additional soil borings are performed along the westbound lanes of SR 54.

<u>Option 2A–Grouting & Geotextile Remediation of Apparent Historical Depression Feature Alt.</u>

Based on a request of FDOT representatives and in considering of constructability concerns associated with targeting relatively deeper excavations which may require temporary shoring system(s), a modified remediation method, Option 2A, has been provided in this section which allows for the reduction of the target excavation depth to 5 feet from the ground surface. This modified Option 2A remediation method will include the same number of grout points as recommended under Option 2 and a total of two (2) layers of geosynthetic reinforcement placed at 3 feet and 5 feet depths respectively below the ground surface. The geosynthetic reinforcement placement details are graphically presented in Option 2A in **Appendix D**.

Please note that this modified remediation method will include comparatively additional inherent risk associated with differential settlements from the decomposition and compression of remaining organic materials which will remain a long-term maintenance concern. All other recommendations as addressed in Option 2 would remain the same for this option except the excavation depths and number of geosynthetic reinforcement layers.

- ***Option 3 – Grouting and Geotextile Remediation Comprehensive Across ERI Anomalies***
  In order to offer a more complete remediation for the impacted areas and considering the historical presence of a relatively large depression feature in the subject area, we recommend both the eastbound and westbound SR 54 travel lanes be remediated with compaction grouting and geotextile support placement as presented under Option 3 graphically depicted in **Appendix D**. In so doing, compaction grouting operations will extend across the entirety of the SR 54 roadway across the footprint of the historical relatively large depression feature as well as across the ERI anomaly features identified in the ERI geophysical report. In order to implement the recommendation for Option 3, a total of 207 primary grout injection points should be installed throughout the treatment area. Please note that the remediation area for Option 3 can be fine-tuned if additional soil borings are performed along the westbound lanes of SR 54.

Regardless of the option selected from the above and depending on grout takes at the initial points, secondary or tertiary points may be recommended or needed. Generally, we recommend the spacing between grout injection point locations be on the order of 10 to 15 feet center-to-center (CTC) compared to one another and it should be noted there is some room for adjusting injection point locations to improve the feasibility of physically performing the work within constraints of the project.

Anticipated depths for injection points are estimated to range from 50 to 100 feet below the current ground surface with locations toward the center of the subject area of distress likely requiring deeper installation. Considering the relatively deep anticipated installation depths, it is recommended that careful consideration be given to the development of a suitable grout mix for this project. It is our experience that certain components and ratios of materials within grout mixes are critical to maintaining pumpability during the compaction grouting process particularly at relatively deep injection depths. The implementing contractor should ensure that the sourced grout mix material is suitable in this regard.

For preliminary planning and budgeting purposes, we anticipate grout takes will be on the order of 40 to 50 cubic yards of grout per pin for Options 1 & 2 (including alternate options 1A, 1B, and 2A) and likely on the order of 30 to 35 cubic yards per pin for Option 3 based on experience in the project area and the geologic conditions observed in our study. It should be noted actual grout takes will be entirely dependent upon the progress of the grouting program and historically have been exceedingly difficult to estimate due to the highly variable nature of the subsurface conditions being addressed. The embedment depths of grout injection points located near the center of the observed depressions and anomaly features may extend deeper than anticipated. Recommended primary grout injection point locations are presented in

Appendix D for all three proposed options which have been recommended for consideration.

Through our exploratory efforts and discussions with the project team, it is our understanding that there are buried utility networks in and around the recommended treatment area. It shall be the responsibility of the grouting contractor to perform the grouting operations without detrimentally impacting existing underground utilities in the area while taking proper safety measures. In addition, please note that using a vibratory compactor, completing the recommended compaction grouting remediation program(s), introducing a dewatering effort, and other variable construction activities which impose vibrations in the area, may trigger the formation of new surface distress and/or subsidence events. For this reason, it is recommended that the entire subject area be continuously monitored for additional signs of distress until the conclusion of remediation and construction activities in the project area. We recommend not to use a vibratory compactor in the vicinity of this depression area (approximate station limit: STA 50+00 to STA 54+00) before completion of the grouting remediation for the area of immediate concern as identified in Option 1). It is also recommended that the construction contractor have a pre-developed plan for dealing with subsidence events should they occur during remediation and construction activities.

Technical Specifications for Compaction Grouting are presented in **Appendix E.**

CLOSING

We trust you will find this information suitable for your immediate needs. Please contact us if you have any questions regarding this report. Thank you for the opportunity to be of service to you.

Sincerely,
Professional Service Industries, Inc.

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY:

ON THE DATE ADJACENT TO THE SEAL

PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED. THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES

*PROFESSIONAL SERVICE INDUSTRIES, INC.
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CERTIFICATE OF AUTHORIZATION 3684
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Nayan Saha, P.E.
Senior Geotechnical Engineer
Florida License No. 81635

Lloyd T. Lasher Jr., P.E.
Principal Consultant
Florida License No. 56794

Cannon Gilbert, E.I.
Staff Engineer Intern

Attachments: Appendix A – Report of Core Borings
Appendix B - Geophysical Reports by GeoView
Appendix C - Site Photographs
Appendix D - Recommended Grout Injection Plan(s) & Geosynthetic Details
Appendix E - Technical Specifications for Compaction Grouting

APPENDIX A

SHEETS

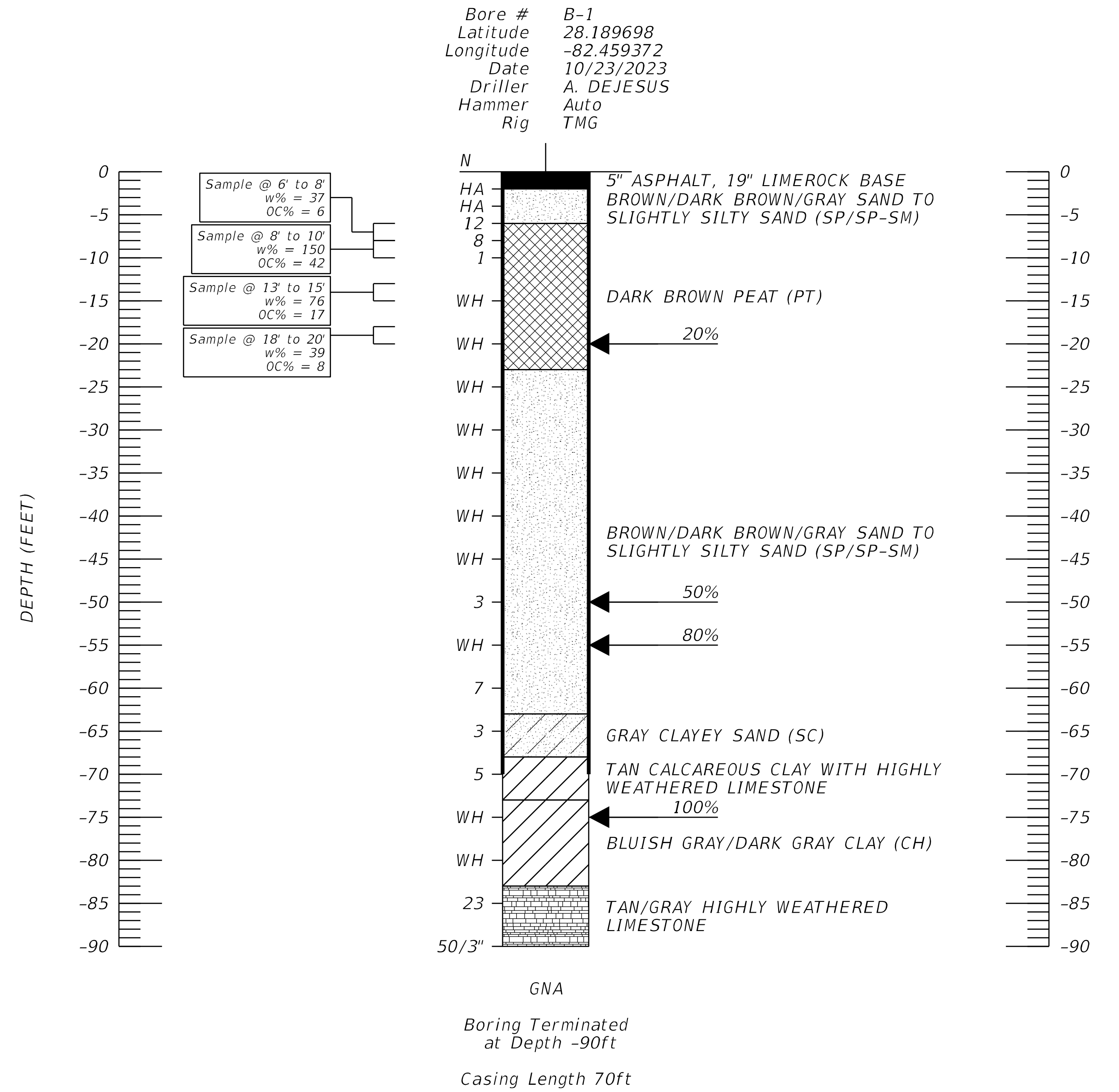
LEGEND

- ASPHALT
- SAND
- SILTY SAND
- CLAYEY SAND
- CLAY
- PEAT
- LIMESTONE

▽	GROUNDWATER TABLE
GNA	GROUNDWATER TABLE NOT APPARENT
N	NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).
HA	HAND AUGER
WH	FELL UNDER WEIGHT OF ROD AND HAMMER
WR	FULL UNDER WEIGHT OF ROD
50/6"	FIFTY BLOWS FOR SIX INCHES
◀—	LOSS OF CIRCULATION (%)
| |	CASING USED
w%	NATURAL MOISTURE CONTENT (%)
OC	ORGANIC CONTENT (%)
⊕	APPROXIMATE SPT BORING LOCATION

GRANULAR MATERIALS- RELATIVE DENSITY	SPT (BLOWS/FT.)
VERY LOOSE	LESS THAN 3
LOOSE	3-8
MEDIUM DENSE	8-24
DENSE	24-40
VERY DENSE	GREATER THAN 40

SILTS AND CLAYS CONSISTENCY	SPT (BLOWS/FT.)
VERY SOFT	LESS THAN 1
SOFT	1-3
FIRM	3-6
STIFF	6-12
VERY STIFF	12-24
HARD	GREATER THAN 24



REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD

COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

REPORT OF CORE BORINGS

SHEET NO.

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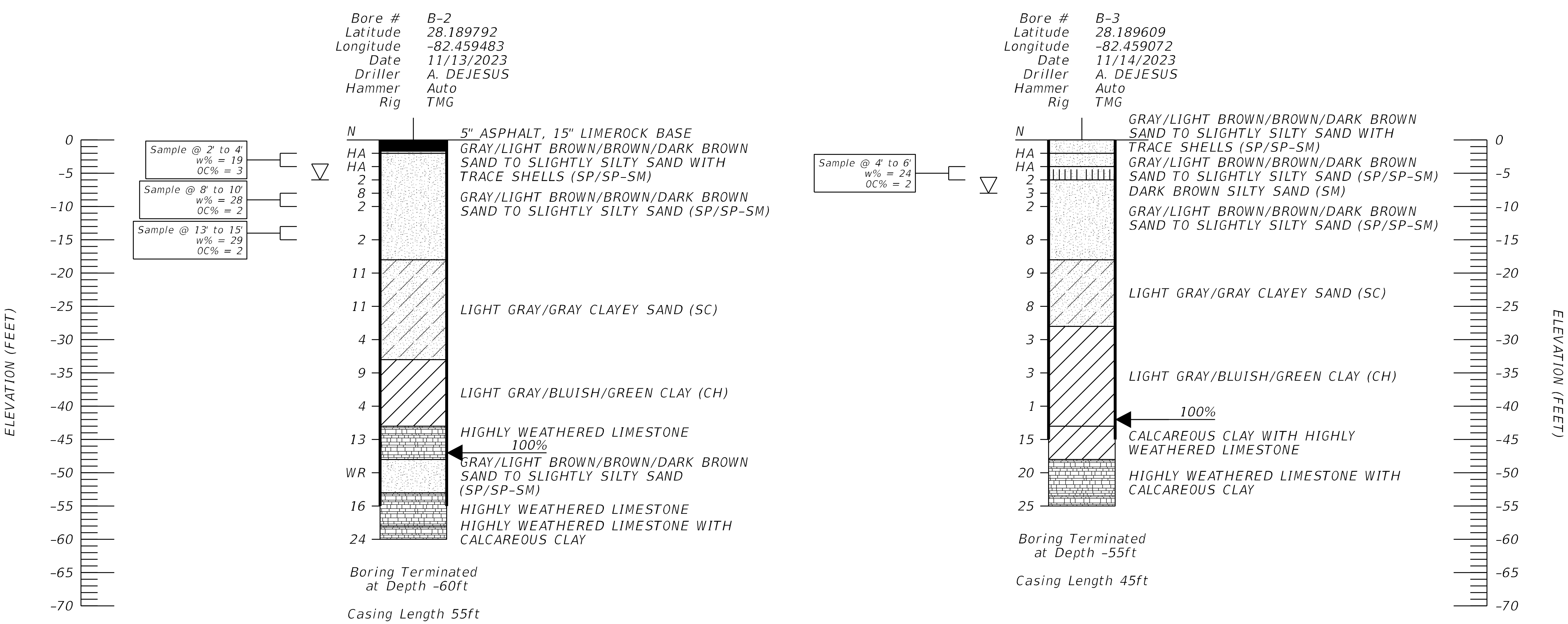
LEGEND

- ASPHALT
- SAND
- SILTY SAND
- CLAYEY SAND
- CLAY
- PEAT
- LIMESTONE

▽ GROUNDWATER TABLE
GNA GROUNDWATER TABLE NOT APPARENT
N NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12 INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).
HA HAND AUGER
WH FELL UNDER WEIGHT OF ROD AND HAMMER
WR FULL UNDER WEIGHT OF ROD
50/6" FIFTY BLOWS FOR SIX INCHES
◄— LOSS OF CIRCULATION (%)
| | CASING USED
w% NATURAL MOISTURE CONTENT (%)
OC ORGANIC CONTENT (%)
APPROXIMATE SPT BORING LOCATION

GRANULAR MATERIALS-RELATIVE DENSITY	SPT (BLOWS/FT.)
VERY LOOSE	LESS THAN 3
LOOSE	3-8
MEDIUM DENSE	8-24
DENSE	24-40
VERY DENSE	GREATER THAN 40
SILTS AND CLAYS CONSISTENCY	**SPT (BLOWS/FT.)**
VERY SOFT	LESS THAN 1
SOFT	1-3
FIRM	3-6
STIFF	6-12
VERY STIFF	12-24
HARD	GREATER THAN 24



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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

REPORT OF CORE BORINGS

SHEET NO.

APPENDIX B

GEOPHYSICAL SURVEYING RESULTS – GPR REPORT

FINAL REPORT
GEOPHYSICAL INVESTIGATION
STATE ROAD 54 ROADWAY DEPRESSION
EAST OF HIGHWAY 41
LUTZ, FLORIDA

Prepared for Intertek-PSI
Tampa, FL

Prepared by GeoView, Inc.
St. Petersburg, FL

September 28, 2023

Mr. Courtland Alvies, P.E.
Intertek-PSI
5801 Benjamin Center Drive, Suite 112
Tampa, FL 33634

Subject: Transmittal of Final Report for Geophysical Investigation
State Road 54 Roadway Depression (East of Highway 41)
Lutz, Florida
GeoView Project Number 39887

Mr. Alvies,

GeoView, Inc. is pleased to submit the final report that summarizes and presents the results of the geophysical investigation performed at the above referenced site. Ground penetrating radar was used to help characterize near surface geological conditions was used to investigate the eastbound lanes of the roadway. GeoView appreciates the opportunity to have assisted you on this project. If you have any questions or comments about the report, please contact us.

Sincerely,

GEOVIEW, INC.

Chris Taylor, P.G.
Vice President
Florida Professional Geologist Number 2256

5709 First Avenue South
St. Petersburg, FL 33707
Tel.: (727) 209-2334
Fax: (727) 328-2477

1.0 Introduction

A geophysical investigation was completed on September 7, 2023 along eastbound State Road 54 east of Highway 41 in Lutz, Florida. Prior to the geophysical investigation, cracking had been observed in the eastbound lanes of the roadway. The investigation was performed using ground penetrating radar (GPR). The location of the geophysical survey area is provided on Figure 1 (Appendix 1). The purpose of the geophysical investigation was to help characterize near-surface geological conditions and to identify subsurface features that may be associated with karst (sinkhole) activity.

2.0 Description of Geophysical Investigation

The survey area was 250 feet in in length and included the southern shoulder, three eastbound lanes and grass median. The GPR survey was completed across accessible areas of the site along a series of perpendicular transects spaced approximately 5 to 10 feet (ft) apart (Figure 1). The GPR data was collected with a GSSI radar system with a 350 MHz antenna and a time range of 140 nanoseconds. This equipment configuration provided an estimated exploration depth of 12 to 16 ft below land surface (bls). The GPR data was digitally recorded for both analysis and archiving purposes.

The positioning of the GPR transect lines was recorded using a Trimble Geo7x GPS system. A discussion of the limitations of the establishment of the survey grid is provided in Appendix A2.1. A description of the GPR technique and the methods employed for geological characterization studies is provided in Appendix A2.2.

3.0 Identification of Possible Sinkhole (Karst) Features Using GPR

The features observed on GPR data that are most commonly associated with karst features are:

- A downwarping of GPR reflector sets, that are associated with suspected lithological contacts, toward a common center. Such features typically have with a bowl or funnel shaped configuration and can be associated with a deflection of overlying sediment horizons caused by the migration of sediments into voids in the underlying limestone. If the GPR reflector sets are sharply downwarping and intersect, they can create “bow-tie” shaped GPR reflection feature, which often designates the apparent center of the GPR anomaly.

- A localized significant increase in the depth of the penetration and/or amplitude of the GPR signal response. The increase in GPR signal penetration depth or amplitude is often associated with either a localized increase in sand content at depth or decrease in soil density.

- An apparent discontinuity in GPR reflector sets, that are associated with suspected lithological contacts. The apparent discontinuities and/or disruption of the GPR reflector sets may be associated with the downward migration of sediments.

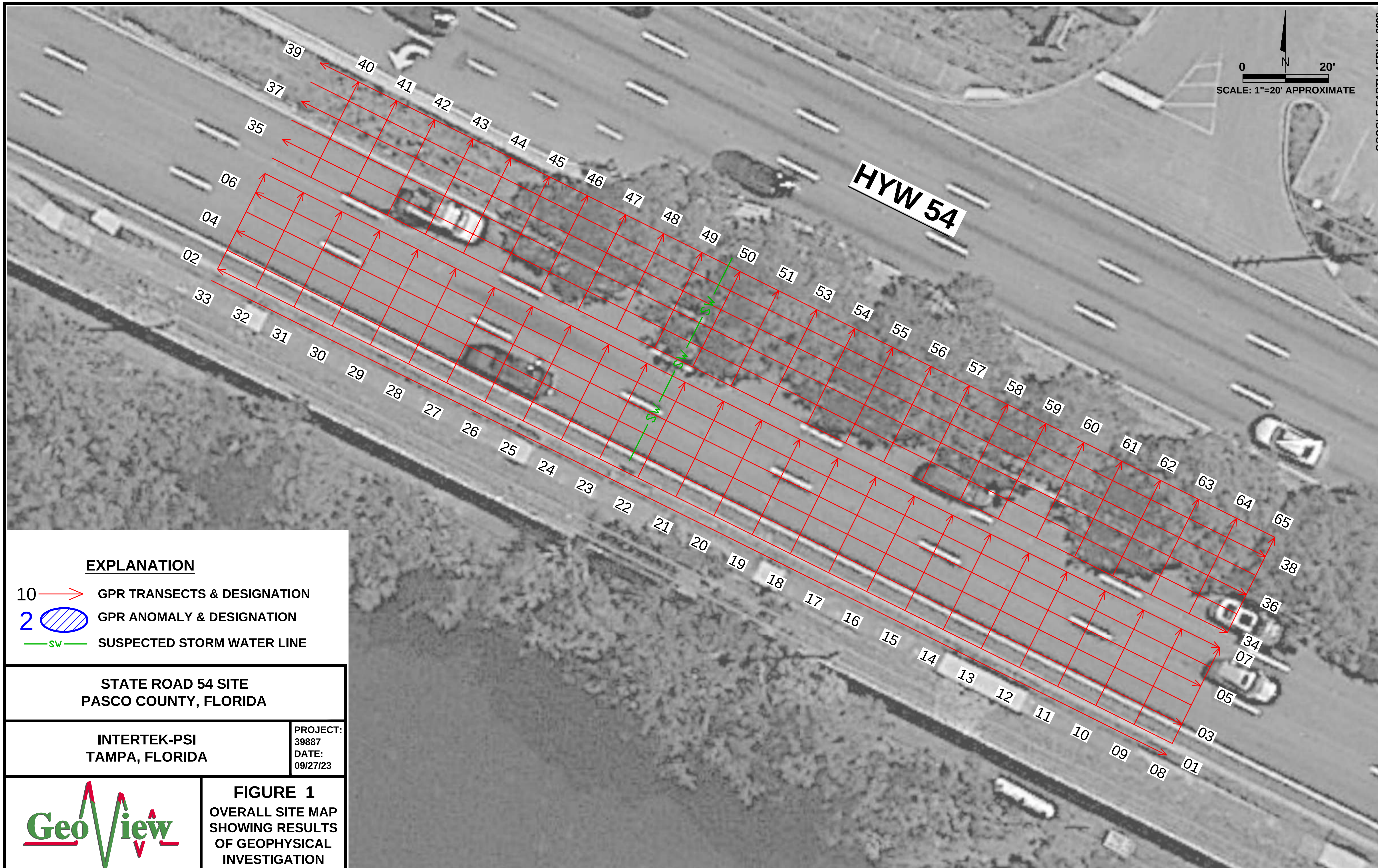
The greater the severity of these features or a combination of these features, the greater the likelihood that the identified feature is a sinkhole. It is not possible based on the GPR data alone to determine if an identified feature is an active karst-related geologic feature.

4.0 Survey Results

Results of the GPR survey indicate the presence of two well-defined, relatively continuous sets of GPR reflectors at an approximate depth range of 2 to 3 and 5 to 7 feet bls. These reflector sets are most likely associated with lithological transitions within those depth ranges.

The GPR reflector sets identified in the GPR investigation were continuous across the accessible areas of the project site. No observed areas of significant downwarping or other indicators of possible sinkhole activity were observed. Accordingly, based on the results of the GPR survey, the distress in the roadway is not associated with sinkhole activity. A suspected storm line was identified running north to south across the roadway in middle portion of the survey area. The location of the survey area is shown in green on Figure 1. An example of the GPR data collected at the project site are provided in Appendix 1. A discussion of the limitations of the GPR technique in geological characterization studies is provided in Appendix 2.

APPENDIX 1
FIGURE AND EXAMPLE OF GPR DATA COLLECTED ACROSS PROJECT SITE



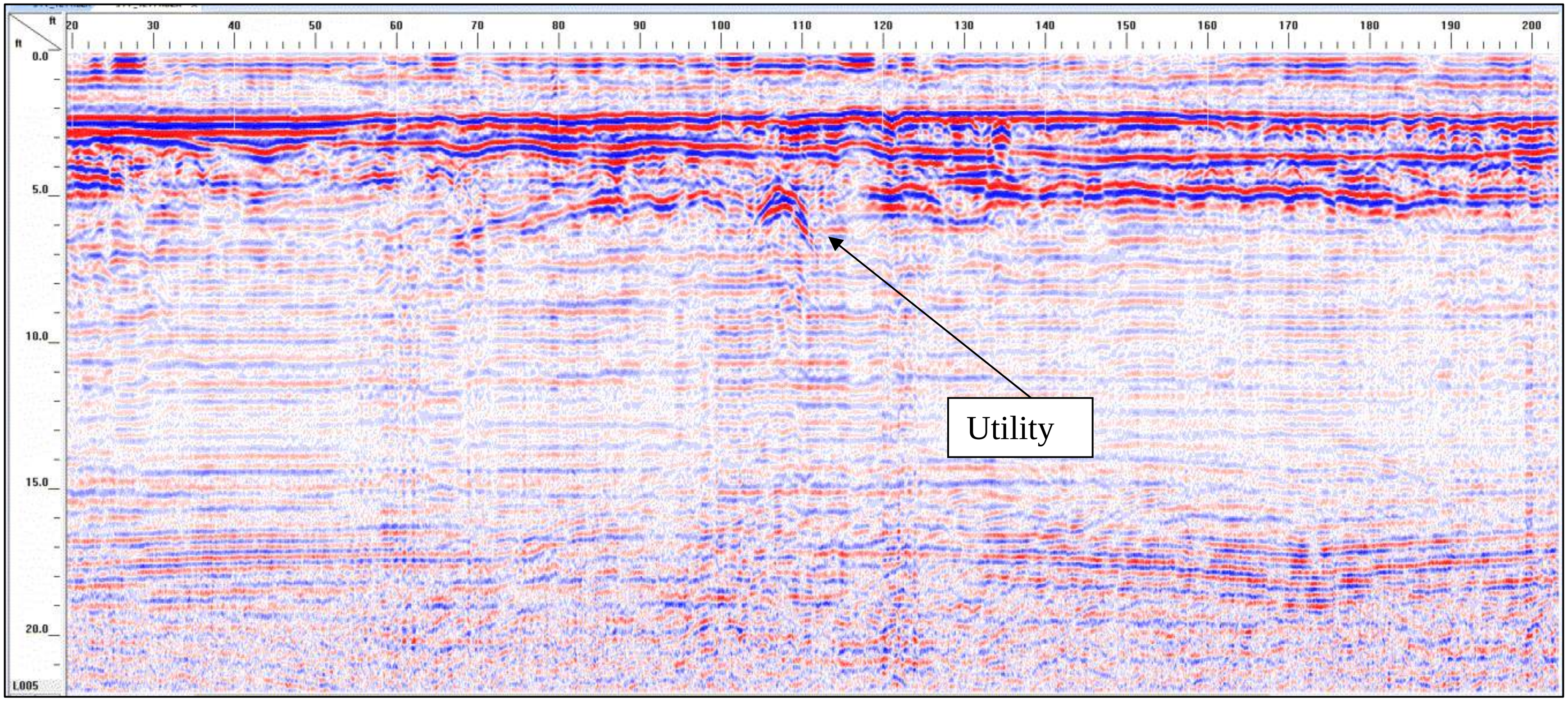
STATE ROAD 54 SITE
PASCO COUNTY, FLORIDA

INTERTEK-PSI
TAMPA, FLORIDA

PROJECT: 39887
DATE: 09/27/23

GeoView

FIGURE 1
OVERALL SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION



GPR TRANSECT 5 COLLECTED BETWEEN LANES 2 AND 3

APPENDIX 2
DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

A2.1 On Site Measurements

The measurements that were collected and used to create the site map were made using a fiberglass measuring tape. The degree of accuracy of such an approach is typically +/- 2.5% for lengths and +/- 2.5 degrees for angles. Corner points for the study area were established using a Trimble Geo7x Global Positioning System (GPS). These GPS systems typically have sub-foot accuracy.

A2.2 Ground Penetrating Radar

Ground Penetrating Radar (GPR) consists of a set of integrated electronic components which transmits high frequency (200 to 1500 megahertz [MHz]) electromagnetic waves into the ground and records the energy reflected back to the ground surface. The GPR system consists of an antenna, which serves as both a transmitter and receiver, and a profiling recorder that both processes the incoming signal and provides a graphic display of the data. The GPR data can be reviewed as both printed hard copy output or recorded on the profiling recorder's hard drive for later review. GeoView uses Mala and GSSI GPR systems. Geological studies are typically conducted using a 200 to 500 MHz antenna.

A GPR survey is conducted along survey lines (transects), which are measured paths along which the GPR antenna is moved. Electronic marks are placed in the data by the operator at designated points along the GPR transects. These marks allow for a correlation between the GPR data and the position of the GPR antenna on the ground.

A GPR survey provides a graphic cross-sectional view of subsurface conditions. This cross-sectional view is created from the reflections of repetitive short-duration electromagnetic (EM) waves that are generated as the antenna is pulled across the ground surface. The reflections occur at the subsurface contacts between materials with differing electrical properties. The electrical property contrast that causes the reflections is the dielectric permittivity that is directly related to conductivity of a material. The GPR method is commonly used to identify such targets as underground utilities, underground storage tanks or drums, buried debris, voids, rebar or geological features.

The greater the electrical contrast between the surrounding materials (earth or concrete) and target of interest, the greater the amplitude of the reflected return signal. Unless the buried object is metal, only part of the signal energy will be reflected back to the antenna with the remaining portion of the signal continuing to propagate downward to be reflected by deeper features. If there is little or no electrical contrast between the target interest and surrounding earth materials it will be very difficult if not impossible to identify the object using GPR.

The depth of penetration of the GPR signal is reduced as the antenna frequency is increased. However, as antenna frequency is increased the resolution of the GPR data is improved. Therefore, when designing a GPR survey a tradeoff is made between the required depth of penetration and desired resolution of the data. As a rule, the highest frequency antenna that will still provide the desired maximum depth of penetration should be used.

Depth estimates are determined by dividing the time of travel of the GPR signal from the ground surface to the top of the feature by the velocity of the GPR signal. The velocity of the GPR signal is usually obtained from published tables of velocities for the type and condition (saturated vs. unsaturated) of soils underlying the site. The accuracy of GPR-derived depths typically ranges from 20 to 40 percent of the total depth.

A2.3 Limitations

The analysis and collection of GPR data is both a technical and interpretative skill. The technical aspects of the work are learned from both training and experience. Having the opportunity to compare GPR data collected in numerous settings to the results from geotechnical studies performed at the same locations develops interpretative skills for karst studies.

The ability of GPR to collect interpretable information at a project site is limited by the attenuation (absorption) of the GPR signal by underlying soils. Once the GPR signal has been attenuated at a particular depth, information regarding deeper geological conditions will not be obtained. GPR data can only resolve subsurface features that have a sufficient electrical contrast between the feature in question and surrounding earth materials. If an insufficient contrast is present, the subsurface feature will not be identified.

GeoView can make no warranties or representations of geological conditions that may be present beyond the depth of investigation or resolving capability of the GPR equipment or in areas that were not accessible to the geophysical investigation.

Geophysical Surveying Results – ERI Report

FINAL REPORT
GEOPHYSICAL INVESTIGATION
SR54 EASTBOUND
LUTZ, FLORIDA

Prepared for Intertek-PSI
Tampa, FL

Prepared by GeoView Associates, Inc.
St. Petersburg, FL

November 07, 2023

Mr. Courtland Alvies, P.E.
Intertek-PSI
5801 Benjamin Center Drive, Suite 112
Tampa, FL 33634

Subject: Transmittal of Final Report for Geophysical Investigation
SR54 Eastbound
Lutz, Florida
GeoView Project Number 39887.1

Mr. Alvies,

GeoView Associates, Inc. (GeoView) is pleased to submit the final report that summarizes and presents the results of the geophysical investigation performed at the above referenced site. Electrical resistivity imaging was used to help characterize near surface geological conditions at the project site. GeoView appreciates the opportunity to have assisted you on this project. If you have any questions or comments about the report, please contact us.

Sincerely,

GEOVIEW ASSOCIATES, INC.

Christopher Taylor, P.G.
Vice President
Florida Professional Geologist Number 2256

1.0 Introduction

A geophysical investigation was completed on October 27, 2023 in the median of State Road 54 east of Highway 41 in Lutz, Florida. Prior to the geophysical investigation, cracking had been observed in the eastbound lanes of the roadway. The location of the geophysical survey area is provided on Figure .

A prior GPR study was conducted in the roadway in September 2023 and a test boring was performed by Intertek. The boring showed very low strength material from a depth of 10 feet to at least 35 feet.

The purpose of this geophysical investigation was to help characterize near-surface geological conditions at depth. The investigation was performed using electrical resistivity imaging (ERI).

2.0 Description of Geophysical Investigation

The ERI survey was conducted using an Advanced Geosciences, Inc. Sting R8 automatic electrode resistivity system. One ERI transect was performed with an electrode spacing of 10 ft. The transect was 550 feet in length and provided an estimated maximum exploration depth of approximately 110 feet below land surface (bls).

A dipole-dipole combined with an inverse Schlumberger electrode configuration was used for the investigation. The ERI data was analyzed using EarthImager 2D, a computer inversion program, which provides two-dimensional vertical cross-sectional resistivity model (pseudo-section) of the subsurface. A discussion of the limitations of the establishment of the survey grid is provided in Appendix A2.1. A description of the ERI technique and the methods employed for geological characterization studies is provided in Appendix A2.2.

3.0 Identification of Possible Karst Related (Sinkhole) Features Using ERI

Sinkhole features are typically characterized by one of the following conditions on the ERI profile:

1. The occurrence of highly resistive material that extends to depth in a columnar fashion towards the top of the limestone. Such a feature may indicate the presence of a sand-filled depression or raveling zone.
2. The localized presence of low-resistivity material extending below the interpreted depth to the top of limestone. Such a feature may indicate the presence of a clay-filled void or fracture with the limestone or the presence of highly weathered limestone rock.

3. Any significant localized increase in the depth to limestone. Such a feature may indicate the presence of an in-filled depression (paleo-sink).

When comparing the results of the ERI method, the following considerations should be given. The ERI method, for example, describes the transition from clay to limestone as a transition, rather than a discrete depth. This transition is due to several factors including: a) The vertical density of the resistivity data decreasing with depth and b) The possibility that the upper portion of the limestone is weathered which would create a physical transition zone in terms of resistivity between the clay and competent (non-weathered) limestone and c) The limitations in the modeling process.

4.0 Survey Results

4.1 Discussion of ERI Survey Results

Results from the ERI transect are presented in Appendix 1. The ERI transect is of acceptable quality (a discussion of the criteria used to determine the quality of an ERI inversion model is provided in Appendix A2.3.1).

In general, analysis of the ERI transects indicate the presence of low to moderate resistivity near-surface soil materials to a depth range of approximately 10 to 50 feet bls (represented in yellow to red on the ERI transects). This high to moderate resistivity layer is likely associated with the sand to silty sand soils. The moderate resistivity layer is underlain by a low resistivity layer (represented green to blue). The low resistivity soils are most likely associated with clay. This low resistivity layer is underlain by a moderate resistivity layer (represented in yellow to orange) to the maximum depth of investigation of the ERI transects. The moderate resistivity soils may be associated with limestone.

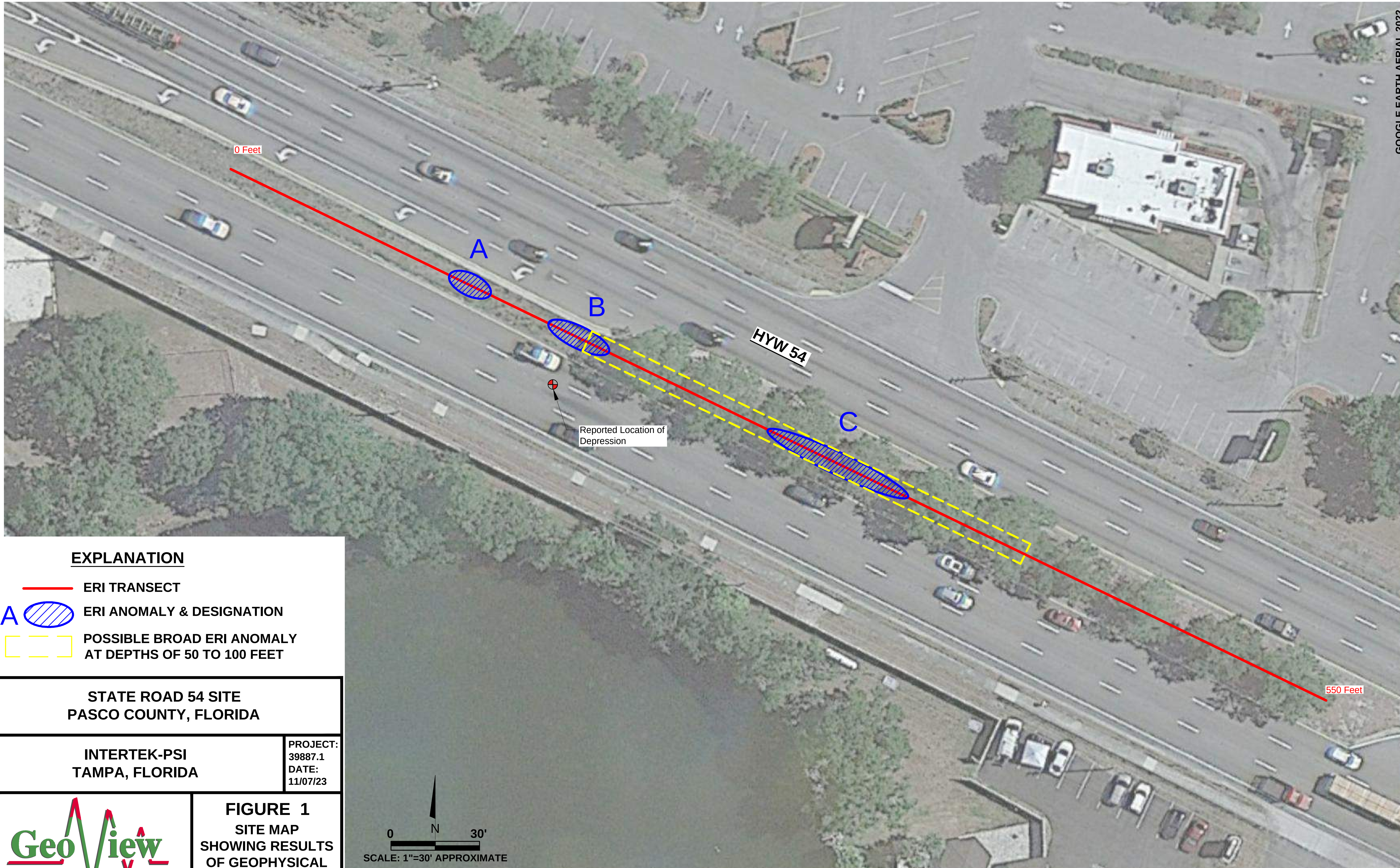
4.2 Description of ERI Anomalies

Three ERI anomalies were identified at the project site. The ERI anomalies were characterized by a lateral discontinuity in the low resistivity layer with associated infilling with the overlying moderate (sandy/silty) sediments. The anomaly areas are annotated as Anomalies A, B and C on to the ERI modeling results provided in Appendix 1 and are shown in blue on Figure 1. The reported depression was located adjacent to Anomaly B.

It is noted that the three anomalies may be associated with one larger, broad feature that is visible at depths of 50 to 100 feet. This broad areas is characterized by an increase in thickness of the suspected clay layer and possible increase in depth tot the underlying moderate resistivity layer (possible limestone). This feature is outlined in yellow on the figure.

A discussion of the limitations of the ERI technique in karst studies is provided in Appendix 2.

APPENDIX 1
FIGURE AND ERI TRANSECT



EXPLANATION

ERI TRANSECT

A ERI ANOMALY & DESIGNATION

POSSIBLE BROAD ERI ANOMALY AT DEPTHS OF 50 TO 100 FEET

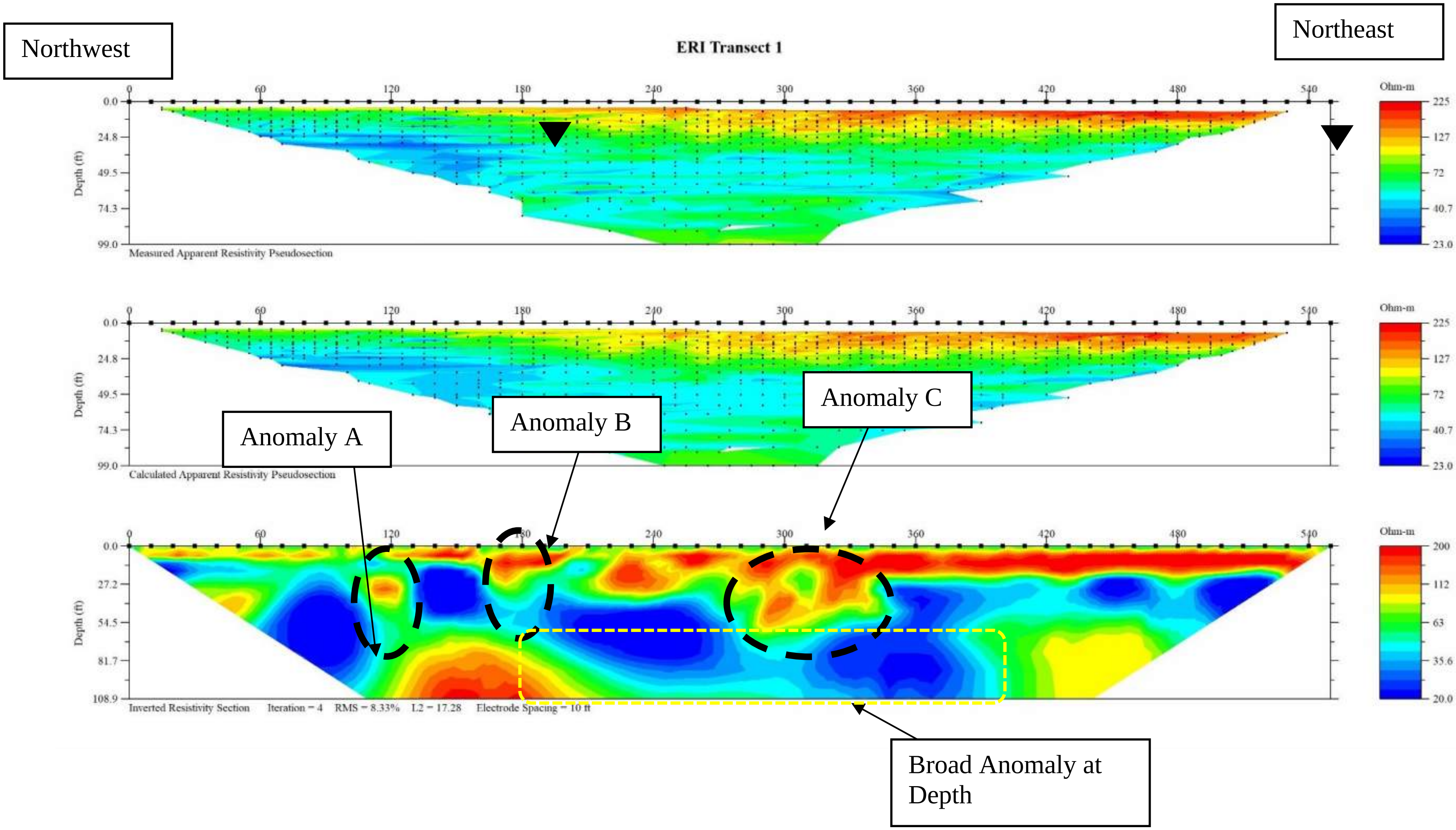
STATE ROAD 54 SITE
PASCO COUNTY, FLORIDA

INTERTEK-PSI
TAMPA, FLORIDA

PROJECT: 39887.1
DATE: 11/07/23

GeoView

FIGURE 1
SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION



ERI TRANSECT 1

APPENDIX 2
DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

A2.1 On Site Measurements

The measurements that were collected and used to create the site map were made using a fiberglass measuring tape. The degree of accuracy of such an approach is typically +/- 2.5% for lengths and +/- 2.5 degrees for angles.

A2.2 Electrical Resistivity Imaging

Electrical resistivity surveying is a geophysical method in which an electrical current is injected into the earth; the subsequent response (potential) is measured at the ground surface to determine the resistance of the underlying earth materials. The resistivity survey is conducted by applying electrical current into the earth from two implanted electrodes (current electrodes C_1 and C_2) and measuring the associated potential between a second set of implanted electrodes (potential electrodes P_1 and P_2). Field readings are in volts. Field readings are then converted to resistivity values using Ohm’s Law and a geometric correction factor for the spacing and configuration of the electrodes. The calculated resistivity values are known as “apparent” resistivity values. The values are referred to as “apparent” because the calculations for the values assume that the volume of earth material being measured is electrically homogeneous. Such field conditions are rarely present.

Resistivity of earth materials is controlled by several properties including composition, water content, pore fluid resistivity and effective permeability. For this study the properties that had the primary control on measured resistivity values are composition and effective permeability. The general geological setting of this project area is sand and clay underlain by limestone.

For this study a dipole-dipole combined with an inverse Schlumberger resistivity array configuration was used. The dipole-dipole array is different that most other resistivity arrays in that the electrode and current electrodes are kept together using a constant spacing value referred to as an “a spacing”. The current and potential electrode sets are moved away from each other using multiples of the “a spacing” value. The number of multiples is referred to as the “n value”. For example, an array with an “a spacing” of 5 feet and a “n value” of 6 would have the current and potential electrode sets spaced 30 ft apart with a separation between the two electrodes in the set of 5 ft. By sampling at varying “n values”, greater depth measurements can be achieved. Inverse Schlumberger data is collected with the current set of electrodes being kept with a fixed separation (L spacing) and the potential electrodes a minimum distance of 5L from the inner current electrodes.

Dipole-dipole resistivity data is usually presented in a two-dimensional pseudo-section format. Inverse Schlumberger data is usually presented as a vertical profile of resistivity distribution below the center point between the two current electrodes. The dipole-dipole and inverse Schlumberger data is combined and presented as either a contour of the individual data points (using the calculated apparent resistivity values) or as a geological model using least squares analysis. Such least squares analysis was used for this study using the computer software program (EarthImager 2D) developed for the equipment manufacturer. Apparent resistivity values are calculated using the following formula for a dipole-dipole configuration: $\gamma_a=\pi(b^3/a^2-b)\nabla V/I$:

Where:

- γ_a= apparent resistivity
- π= 3.14
- a= "a spacing"
- b= "a spacing" x "n value"
- ∇V= voltage between the two potential electrodes
- I= current (in amps)

For a Schlumberger configuration the apparent resistivity is calculated using: $\gamma_a=\pi([s^2-a^2]/4)\nabla V/aI$:

Where:

- γ_a= apparent resistivity
- π= 3.14
- a= spacing between the inner set of electrodes"
- s= distance between the outer electrode and nearest inner electrode
- ∇V= voltage between the two potential electrodes
- I= current (in amps)

A2.2.1 Inversion Modeling of ERI Data

The objective for inversion modeling of resistivity data is to create a description of the actual distribution of earth material resistivity based on the subsurface geology that closely matches the resistivity values that are measured by the instrumentation. This modeling is done through the use of EarthImager™, a proprietary computer program developed by the equipment manufacturer. When evaluating the validity of the inversion model several factors need to be considered. The RMS, or root mean square error, expresses the quality of fit between the actual and modeled resistivity values for the given set of points in the model. The lower the RMS error the higher the quality of fit between the actual and modeled data sets. In general, inversion models with an RMS error of less than 5 to 10 percent are acceptable. The size of the RMS error is dependent upon the number of bad data points within a data set and the magnitude of how bad the data points are. As part of the modeling process bad data points are typically removed, which decreases the RMS error and improves (with limitations) the quality of the model. The quality of fit between the actual and modeled resistivity values is also expressed as the L-2 norm. When the modeled and actual data sets have converged, the L-2 norm reduces to unity (1.0 or smaller).

However, as the number of data points is reduced, the validity of the inversion model is diminished. Accordingly, when interpreting a particular area of an inversion model the number of data points used to create that portion of the model must be taken into consideration. If very few points are within a particular area of the model, then the modeled solution in that area should be considered suspect and possibly rejected.

The entire ERI transect should be considered suspect if a model has a high RMS error and a large number of removed data points. It is likely that sources of interference have affected the field readings and rendered the modeled solution invalid. Such sources of interference can include buried metallic underground utilities, reinforced concrete slabs, septic leach fields or electrical grounding systems. Accordingly, all efforts need to be made in the field to locate, to the degree possible, the ERI transect lines away from such features. The locations of such features also need to be mapped in the field so their potential effects can be considered when interpreting the modeled results.

A2.3 Limitations

The analysis and collection of ERI data is both a technical and interpretative skill. The technical aspects of the work are learned from both training and experience. Having the opportunity to compare ERI data collected in numerous settings to the results from geotechnical studies performed at the same locations develops interpretative skills for karst studies.

GeoView can make no warranties or representations of geological conditions that may be present beyond the depth of investigation or resolving capability of the ERI equipment or in areas that were not accessible to the geophysical investigation.

APPENDIX C

PHOTOGRAPHS

PHOTOGRAPH 1 Subject Area of Distress Center Lane View

PHOTOGRAPH 2 Subject Area of Distress Looking North


PHOTOGRAPH 3 Subject Area of Distress Looking North Alternate View

PHOTOGRAPH 3 Subject Area of Distress Looking North Alternate View No. 2

APPENDIX D

RECOMMENDED GROUT INJECTION PLAN
&
GEOSYNTHETIC REINFORCEMENT
OPTION 1

LEGEND

- APPROXIMATE SPT BORING LOCATION
- APPROXIMATE GROUT POINT LOCATION

OPTION 1

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD

COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

GROUT POINT LOCATION PLAN

SHEET NO.

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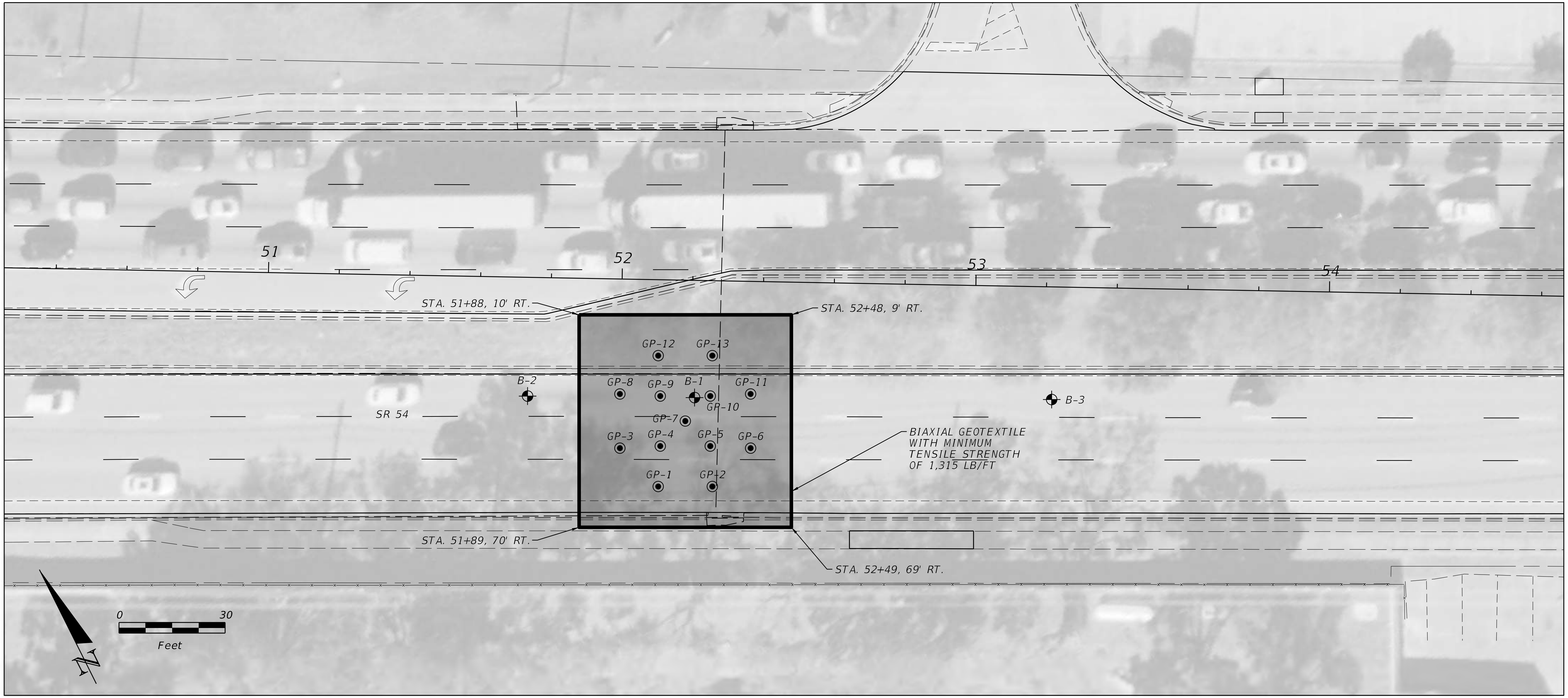
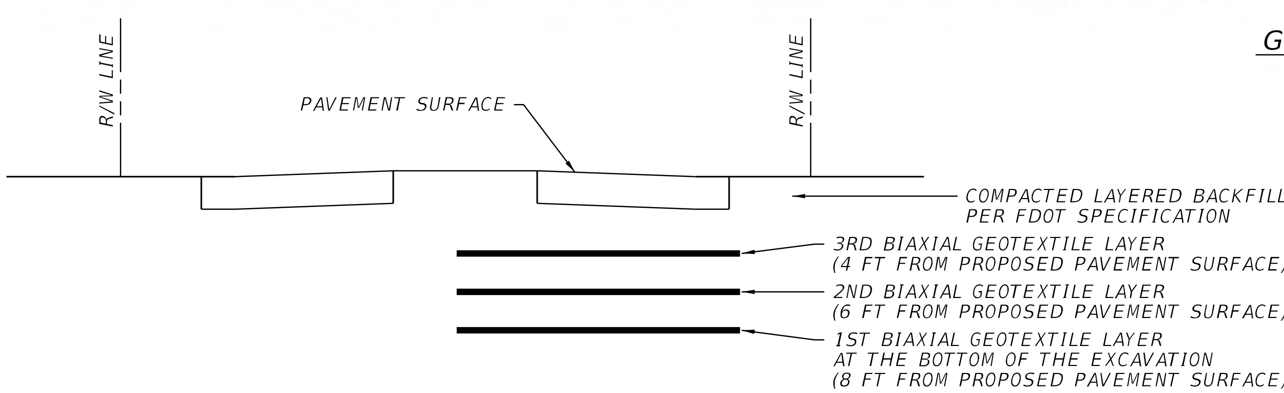


GEOTEXTILE LAYOUT



GEOSYNTHETIC REINFORCEMENT INSTALLATION

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=40'

NOTES:

1. THE INSTALLATION OF THE GEOSYNTHETIC REINFORCEMENT SHALL BE IN ACCORDANCE WITH FDOT STANDARD SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION, SECTION 145.
2. THE GEOSYNTHETIC REINFORCEMENT WILL BE BIAXIAL GEOTEXTILE WITH A MINIMUM TENSILE STRENGTH OF 1,315 LB/FT.
3. THE LOCATION AND THE DEPTH OF THE GEOTEXTILE CAN BE ADJUSTED IN THE FIELD DURING INSTALLATION TO AVOID POTENTIAL CONFLICTS WITH EXISTING UTILITIES.
4. THIS DRAWING PROVIDES THE GEOTEXTILE LAYOUT SHOWING THE LOCATION AND THE DEPTH. THE ACTUAL DETAIL ABOUT THE PRODUCT INSTALLATION WILL BE PROVIDED BY THE MANUFACTURER.

OPTION 1

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD
COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

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SR 54	PASCO	

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RECOMMENDED GROUT INJECTION PLAN

&

GEOSYNTHETIC REINFORCEMENT

OPTION 1A

LEGEND

APPROXIMATE SPT BORING LOCATION

APPROXIMATE GROUT POINT LOCATION

OPTION 1

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD

COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
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5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

GROUT POINT LOCATION PLAN

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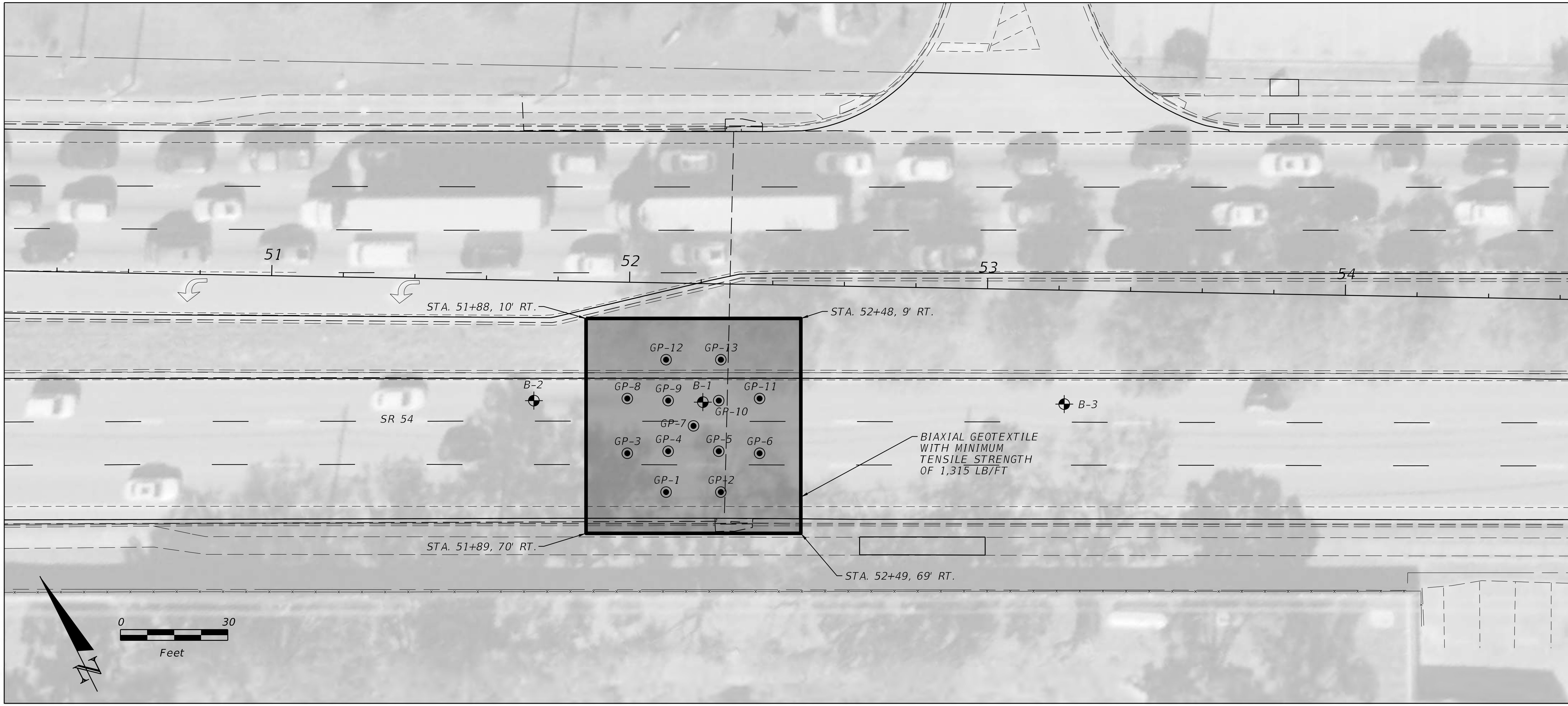
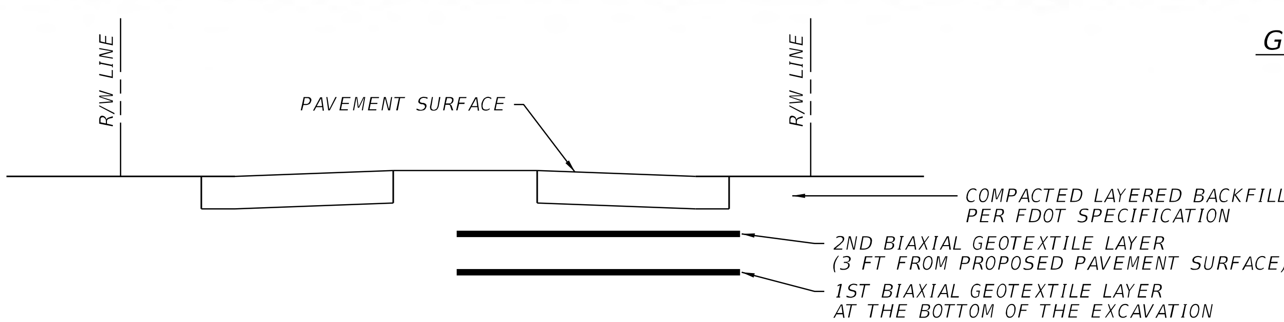


GEOTEXTILE LAYOUT



GEOSYNTHETIC REINFORCEMENT INSTALLATION

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=40'

NOTES:

1. THE INSTALLATION OF THE GEOSYNTHETIC REINFORCEMENT SHALL BE IN ACCORDANCE WITH FDOT STANDARD SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION, SECTION 145.
2. THE GEOSYNTHETIC REINFORCEMENT WILL BE BIAXIAL GEOTEXTILE WITH A MINIMUM TENSILE STRENGTH OF 1,315 LB/FT.
3. THE LOCATION AND THE DEPTH OF THE GEOTEXTILE CAN BE ADJUSTED IN THE FIELD DURING INSTALLATION TO AVOID POTENTIAL CONFLICTS WITH EXISTING UTILITIES.
4. THIS DRAWING PROVIDES THE GEOTEXTILE LAYOUT SHOWING THE LOCATION AND THE DEPTH. THE ACTUAL DETAIL ABOUT THE PRODUCT INSTALLATION WILL BE PROVIDED BY THE MANUFACTURER.

OPTION 1A

REVISIONS				ENGINEER OF RECORD	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION				SHEET NO.
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					SR 54	PASCO			

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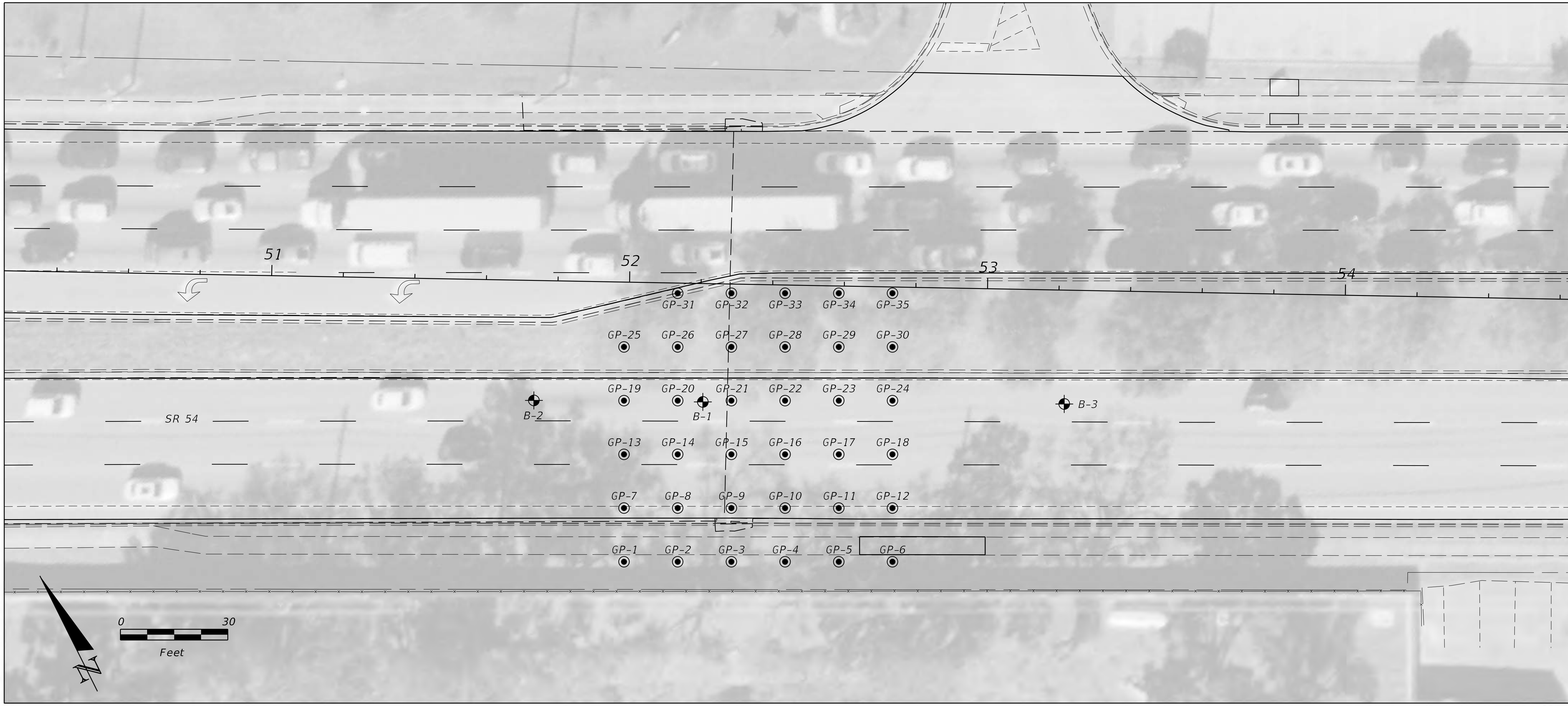
RECOMMENDED GROUT INJECTION PLAN

&

GEOSYNTHETIC REINFORCEMENT

OPTION 1B



LEGEND

- APPROXIMATE SPT BORING LOCATION
- APPROXIMATE GROUT POINT LOCATION

OPTION 1B

REVISIONS				ENGINEER OF RECORD	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION				SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	COURTLAND L. ALVIES, P.E. LICENSE NUMBER: 93388 PROFESSIONAL SERVICE INDUSTRIES, INC. 5801 BENJAMIN CENTER DR., SUITE 112 TAMPA, FL 33634	ROAD NO.	COUNTY	FINANCIAL PROJECT ID	GROUT POINT LOCATION PLAN	
					SR 54	PASCO			

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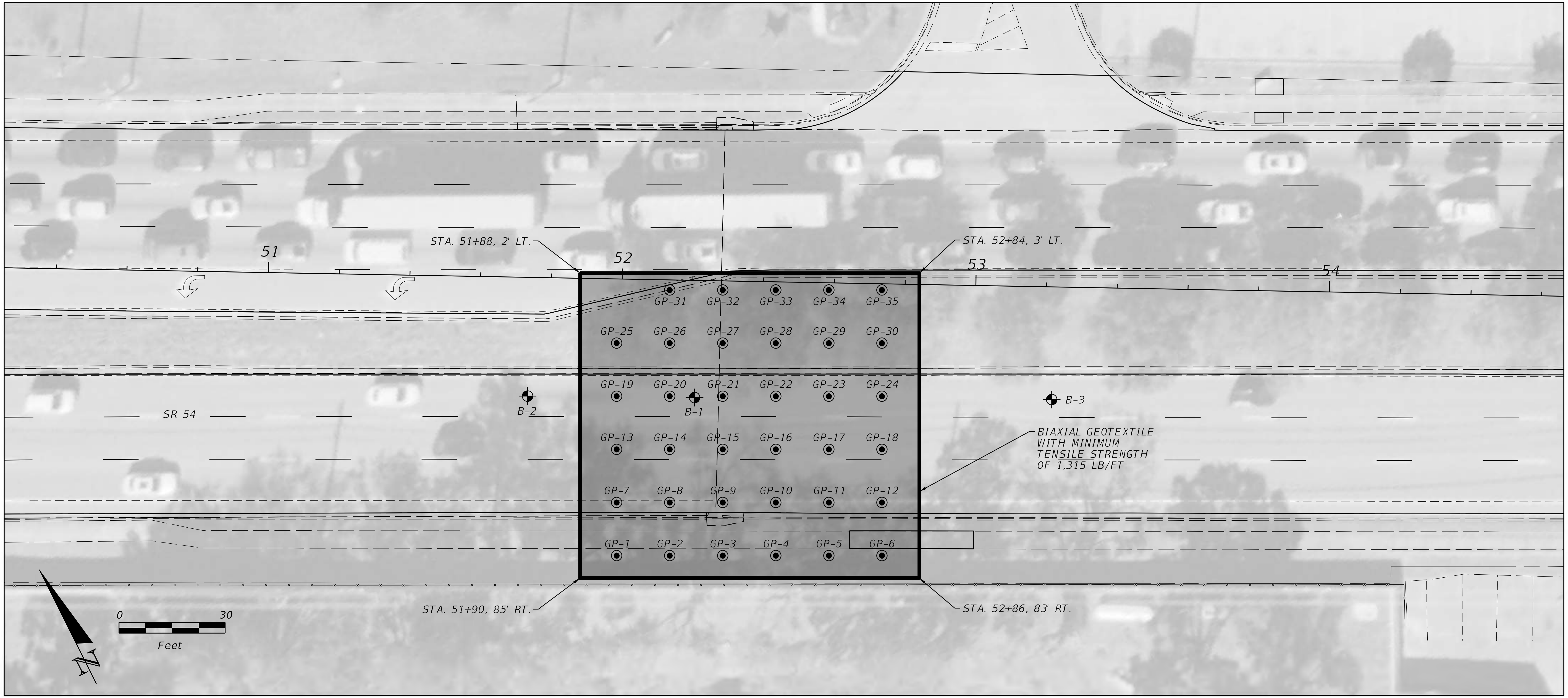
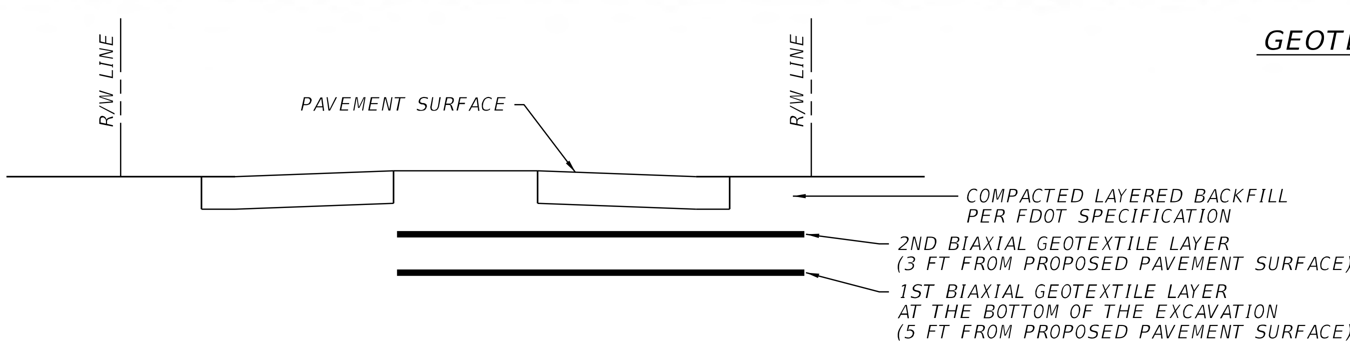


GEOTEXTILE LAYOUT



GEOSYNTHETIC REINFORCEMENT INSTALLATION

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=40'

NOTES:

1. THE INSTALLATION OF THE GEOSYNTHETIC REINFORCEMENT SHALL BE IN ACCORDANCE WITH FDOT STANDARD SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION, SECTION 145.
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OPTION 1B

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD
COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

DRAFT GEOSYNTHETIC REINFORCEMENT DETAIL

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RECOMMENDED GROUT INJECTION PLAN
&
GEOSYNTHETIC REINFORCEMENT
OPTION 2

LEGEND

- APPROXIMATE SPT BORING LOCATION
- APPROXIMATE GROUT POINT LOCATION

OPTION 2

REVISIONS				ENGINEER OF RECORD	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION				SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	COURTLAND L. ALVIES, P.E. LICENSE NUMBER: 93388 PROFESSIONAL SERVICE INDUSTRIES, INC. 5801 BENJAMIN CENTER DR., SUITE 112 TAMPA, FL 33634	ROAD NO.	COUNTY	FINANCIAL PROJECT ID	GROUT POINT LOCATION PLAN	
					SR 54	PASCO			

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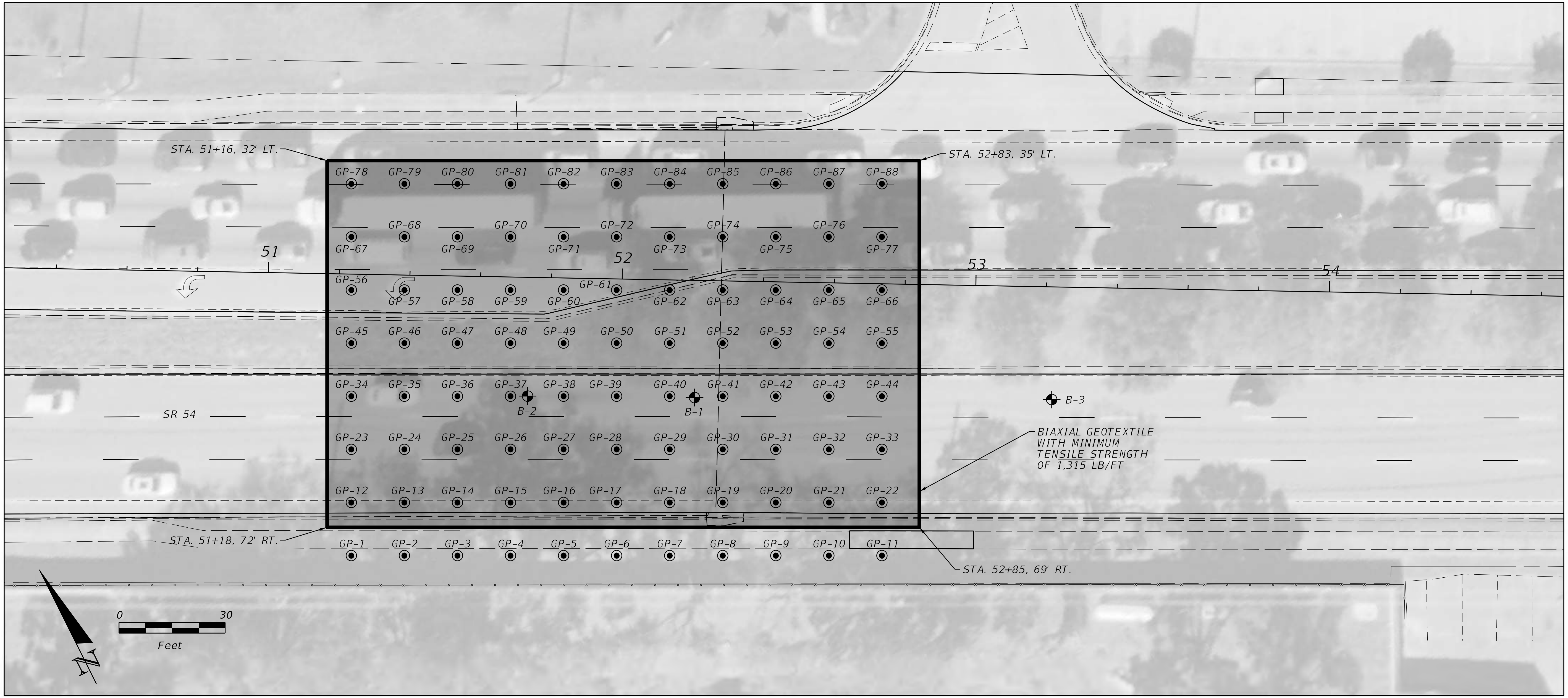

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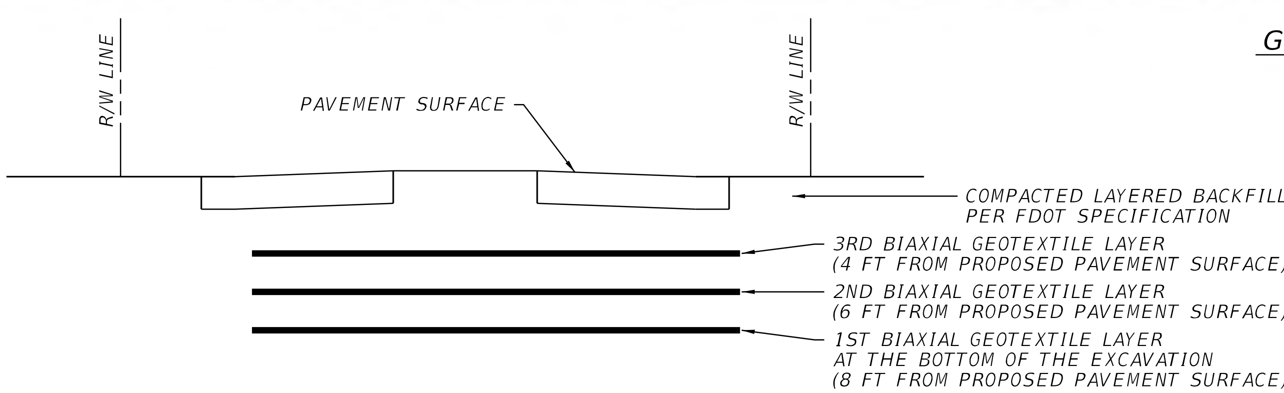

GEOSYNTHETIC REINFORCEMENT INSTALLATION

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=40'

NOTES:

1. THE INSTALLATION OF THE GEOSYNTHETIC REINFORCEMENT SHALL BE IN ACCORDANCE WITH FDOT STANDARD SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION, SECTION 145.
2. THE GEOSYNTHETIC REINFORCEMENT WILL BE BIAXIAL GEOTEXTILE WITH A MINIMUM TENSILE STRENGTH OF 1,315 LB/FT.
3. THE LOCATION AND THE DEPTH OF THE GEOTEXTILE CAN BE ADJUSTED IN THE FIELD DURING INSTALLATION TO AVOID POTENTIAL CONFLICTS WITH EXISTING UTILITIES.
4. THIS DRAWING PROVIDES THE GEOTEXTILE LAYOUT SHOWING THE LOCATION AND THE DEPTH. THE ACTUAL DETAIL ABOUT THE PRODUCT INSTALLATION WILL BE PROVIDED BY THE MANUFACTURER.

OPTION 2

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD

COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

DRAFT GEOSYNTHETIC REINFORCEMENT DETAIL

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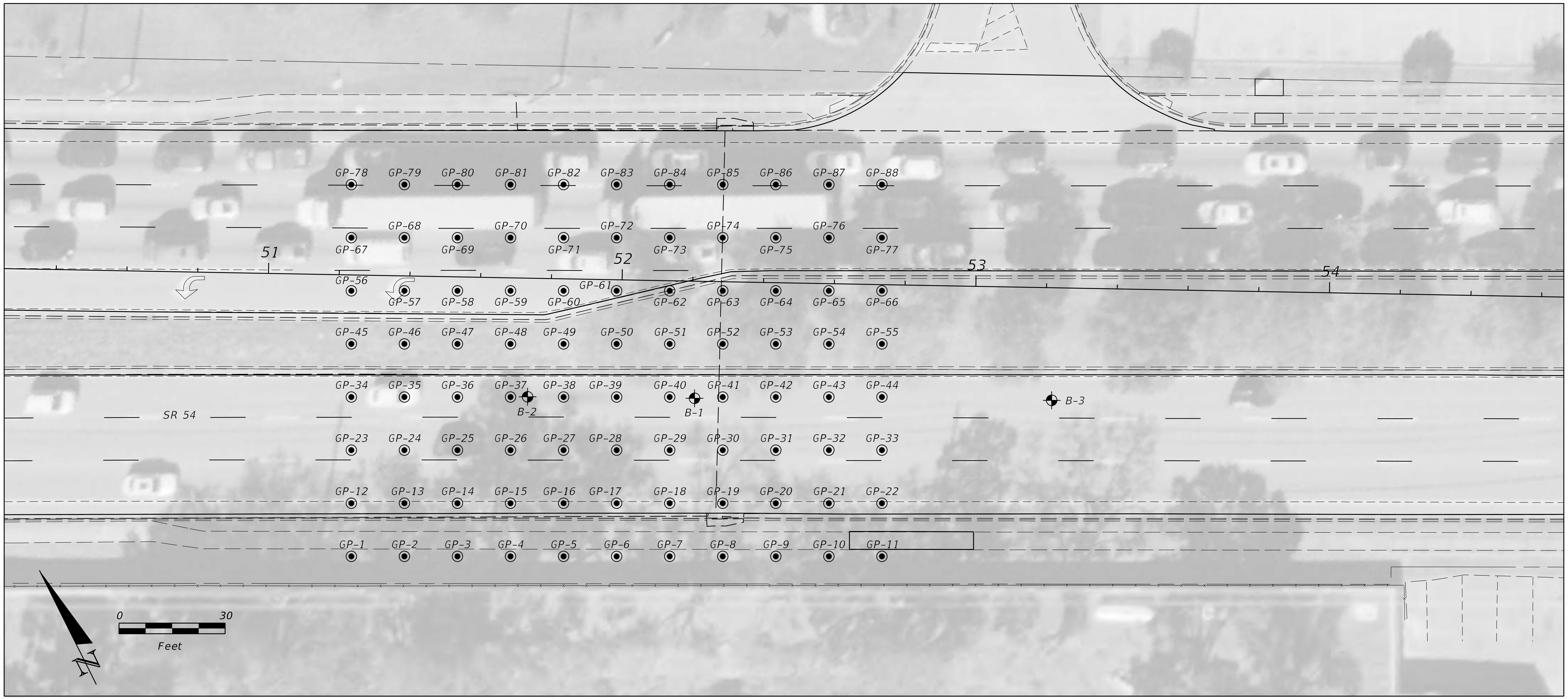
RECOMMENDED GROUT INJECTION PLAN

&

GEOSYNTHETIC REINFORCEMENT

OPTION 2A



LEGEND

APPROXIMATE SPT BORING LOCATION

APPROXIMATE GROUT POINT LOCATION

OPTION 2

REVISIONS				ENGINEER OF RECORD	STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION				SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	COURTLAND L. ALVIES, P.E. LICENSE NUMBER: 93388 PROFESSIONAL SERVICE INDUSTRIES, INC. 5801 BENJAMIN CENTER DR., SUITE 112 TAMPA, FL 33634	ROAD NO.	COUNTY	FINANCIAL PROJECT ID	GROUT POINT LOCATION PLAN	
					SR 54	PASCO			

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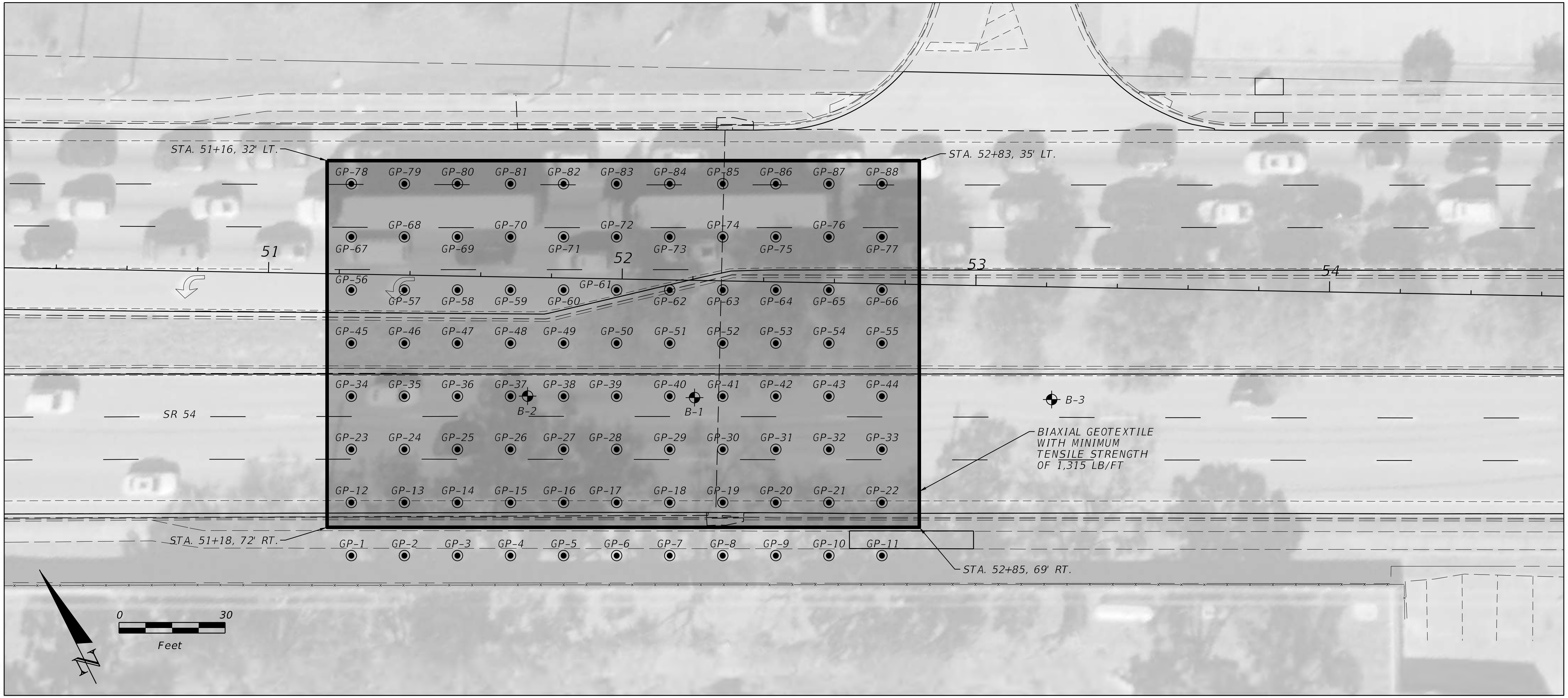
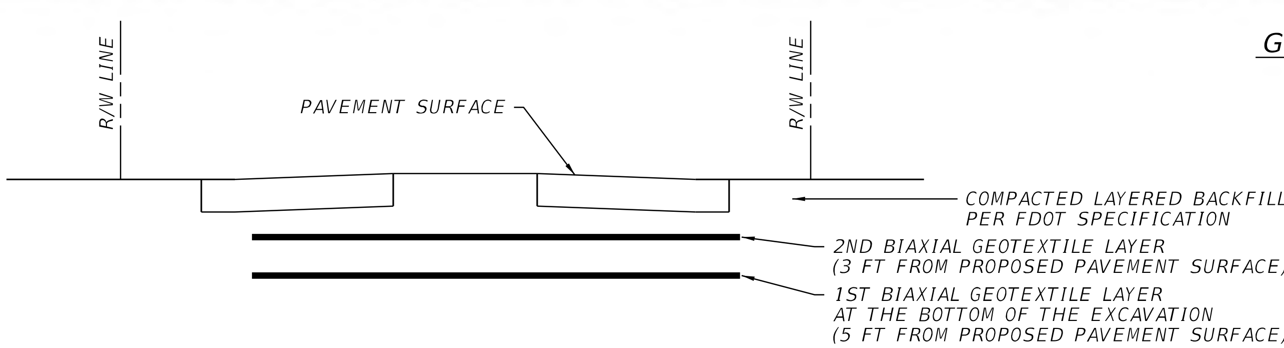


GEOTEXTILE LAYOUT



GEOSYNTHETIC REINFORCEMENT INSTALLATION

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=40'

NOTES:

1. THE INSTALLATION OF THE GEOSYNTHETIC REINFORCEMENT SHALL BE IN ACCORDANCE WITH FDOT STANDARD SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION, SECTION 145.
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OPTION 2A

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD
COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

DRAFT GEOSYNTHETIC REINFORCEMENT DETAIL

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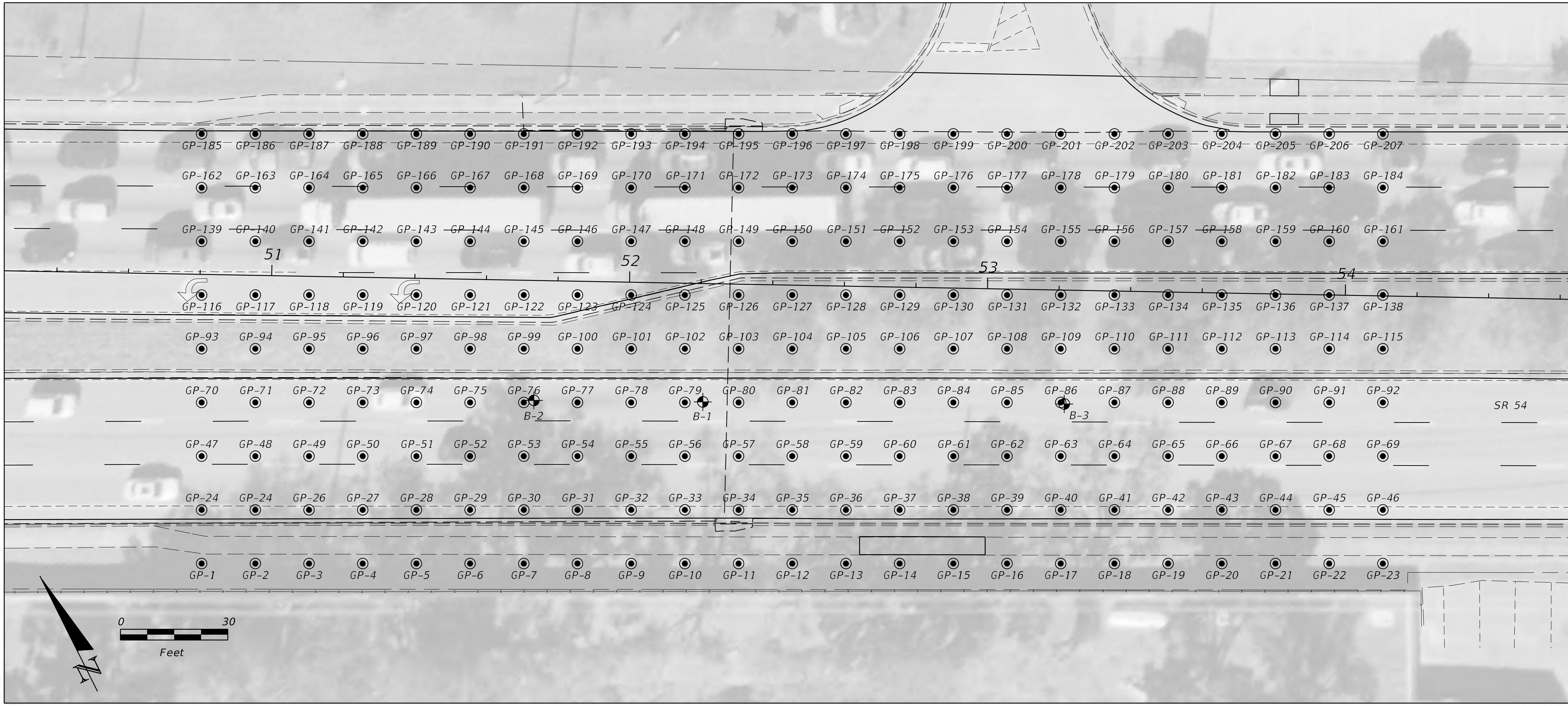
Recommended Grout Injection Plan
&
Geosynthetic Reinforcement
Option 3



LEGEND

- APPROXIMATE SPT BORING LOCATION
- APPROXIMATE GROUT POINT LOCATION

OPTION 3

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD

COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

Grout Point Location Plan

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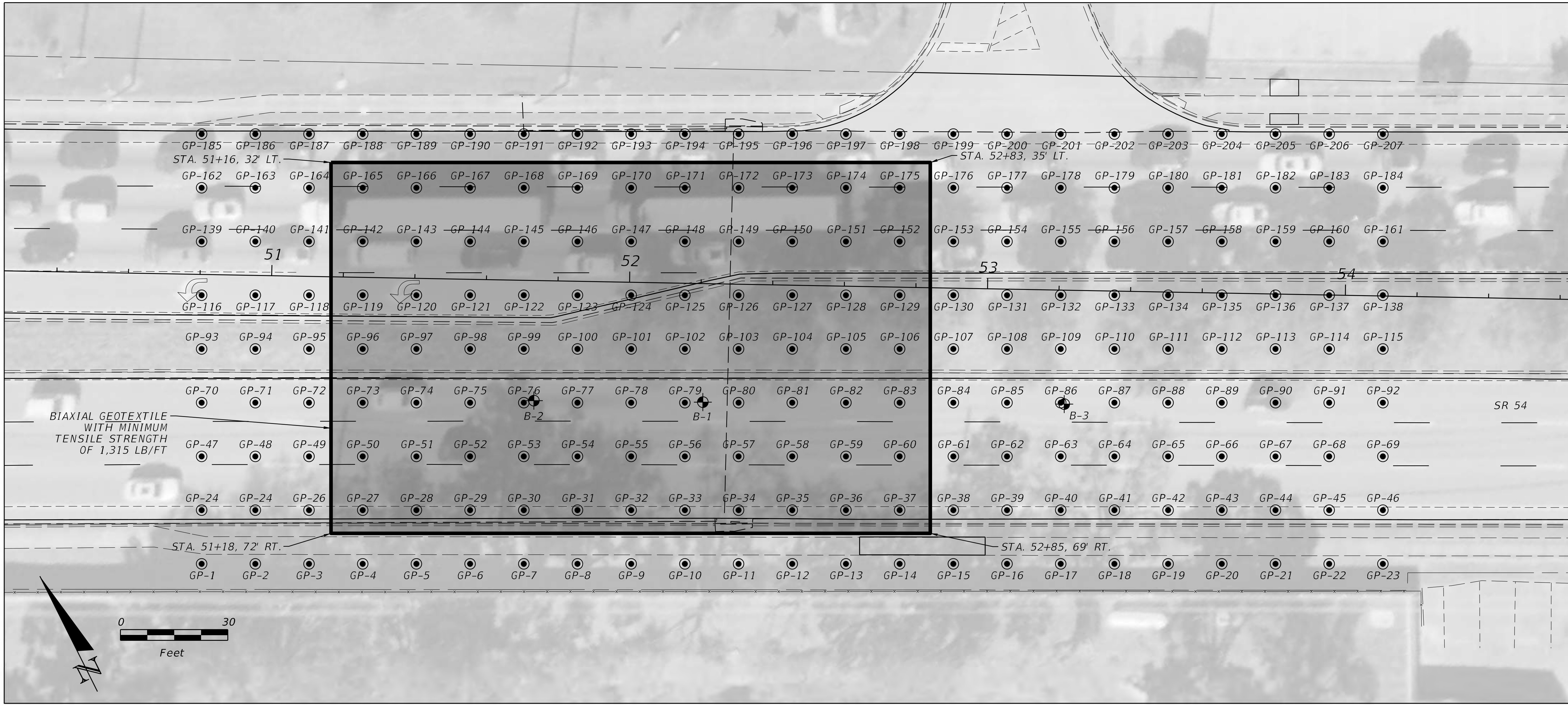
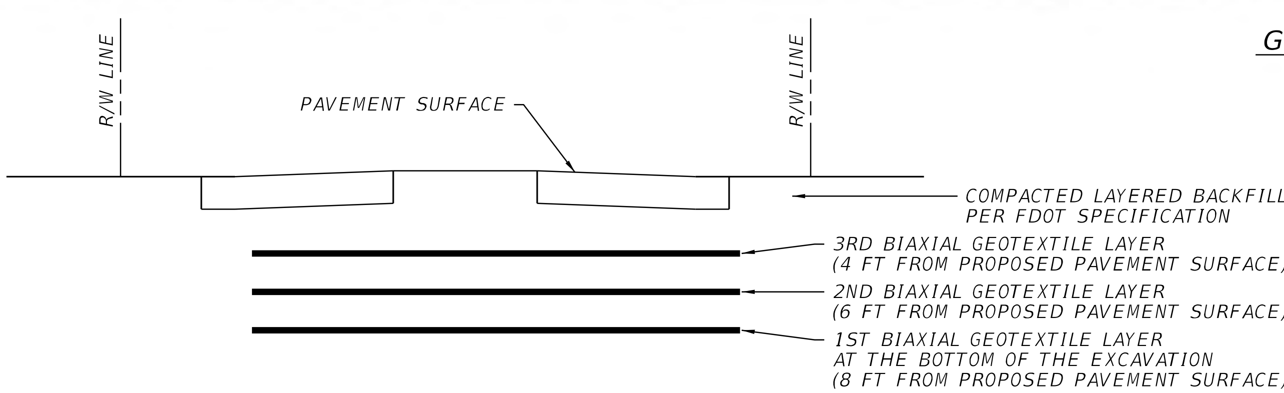


GEOTEXTILE LAYOUT



GEOSYNTHETIC REINFORCEMENT INSTALLATION

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=40'

NOTES:

1. THE INSTALLATION OF THE GEOSYNTHETIC REINFORCEMENT SHALL BE IN ACCORDANCE WITH FDOT STANDARD SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION, SECTION 145.
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OPTION 3

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ENGINEER OF RECORD
COURTLAND L. ALVIES, P.E.
LICENSE NUMBER: 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 54	PASCO	

DRAFT GEOSYNTHETIC REINFORCEMENT DETAIL

SHEET NO.

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APPENDIX E

TECHNICAL SPECIFICATIONS FOR COMPACTION GROUTING

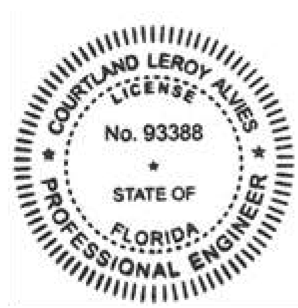
TECHNICAL SPECIAL PROVISION

FOR

COMPACTION GROUTING

This item has been digitally signed and sealed by Courtland LeRoy Alvies, P.E. on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date:	December 15, 2023
Fla. License No.:	93388
Firm Name:	Professional Service Industries Inc.
Firm Address:	5801 Bejamin Center Drive, Suite 112,
City, State, Zipcode:	Tampa, Florida 33634
Pages:	1 - 5



SECTION T173
COMPACTION GROUTING

T173–1 DESCRIPTION

The work specified in this SPECIFICATION is to treat and stabilize the anomalous features and depressions located along SR 54 in Pasco County, Florida, approximately 2,000 feet east of the intersection with US 41 in Pasco County, Florida. The recommended compaction grout remediation program should plug and seal potential avenues for future migration of the overlying soils, which may contribute to settlement distress across the treatment area.

T173-2 SCOPE OF WORK

The Contractor shall be responsible for project control, supervision, labor, materials, and the equipment necessary to accomplish the following scope of work:

1. Install the grout injection points to limestone or competent soils at the location as shown in the Grout Pipe Location Plan or as directed by the Engineer. This shall be assumed to be the depth where refusal of the grout pipe to be advanced further occurs. Anticipated depths are within the range of 50 to 100 feet below existing ground surface. Actual depth of installation may be adjusted by the Engineer at their discretion dependent upon field conditions.
2. Provide necessary equipment to install, clean and extract 3 to 4 inch inside diameter flush joint grout pipe.
3. Provide equipment and material necessary to inject 4 to 6 inch slump Portland cement grout into the desired zones. The maximum quantity of grout to be placed (per injection point) is indicated in T173-6 Grouting Procedures. The actual grout quantities may be adjusted at the Engineer's discretion.
4. Provide detailed documentation of the borehole drilling and grouting procedures including, but not limited to; quantity of pipe installed and quantity of grout pumped.
5. Provide equipment, materials, and manpower to monitor the relative elevations of ground surface and nearby structures (if any) during grouting.

T173-3 CONTRACTOR SUBMITTALS

The Florida Licensed Contractor shall have: adequate and proven experience in the compaction grouting process; which shall include a minimum of three (3) satisfactorily completed projects of similar scope and purpose. The proposed Contractor must submit to the Engineer a minimum of the following items:

1. Project experience list.
2. A list of key personnel to be used on the project with a brief experience resume for each.
3. The proposed grouting procedure and schedule.
4. Grout mix data.
5. A list of equipment to be used on the project (i.e., type of drilling apparatus, grout pump data, pipe extraction equipment, etc.).

T173-4 MATERIALS: COMPACTION GROUT

The grout mix shall consist of sand, fly ash, cement and water. Proportion the grout mix to provide a slump between 4 to 6 inches and a minimum 7-day compressive strength of 250 psi. Grout with excessive slump shall be rejected. The temperature of the grout mix shall not exceed 100˚F, and the grout mix shall not be more than three (3) hours old at the time of pumping.

The proposed grout mix shall be submitted by the contractor to the Engineer for review prior to commencing the grouting program. Detailed documentation shall be presented by the Contractor to the Engineer which shows that slump and strength requirements have been met on past projects using the proposed mix design.

T173-5 EQUIPMENT

The contractor shall provide all equipment and tools necessary to drill grout holes into hard limestone, place grout pipes, clean grout pipes, inject grout and extract the pipe. Equipment required for this project shall include, but is not limited to:

1. Suitable drilling equipment capable of installing 4 inch diameter casing to and into limestone, subject to the approval of the Engineer.
2. Drilling equipment free of leaking oil, fuel and all other hazardous materials.
3. A crane, hydraulic ram or other suitable lifting apparatus capable of extracting the grout pipe.
4. A grout pump capable of pumping 4 to 6 inch slump cement grout. The pump shall be fitted with a stroke counter or other acceptable device for use in grout volume calibration. The pump shall also have a pressure gauge at the point of discharge.
5. A sufficient supply of durable 3 to 4 inch inside diameter grout casing, 4 inch grout hose, fittings/couplings, and at least 1 functioning in-line pressure gauge.
6. An accurate, self-leveling survey level, level rod, and other equipment necessary to permit accurate elevation surveys during grout pumping.
7. All other incidental equipment and tools necessary to complete the project.

T173-6 GROUTING PROCEDURES

The injection points shall be installed at the locations shown on the plans. Secondary and tertiary injection points may be installed depending upon the grout takes of the primary injection points and at the discretion of the Engineer. The contractor shall provide at least 72 hours notice to the Engineer prior to commencement of drilling or grouting operations. Grout injection shall commence within 24 hours of grout injection point installation, preferably sooner.

The Contractor shall keep drilling records for each injection point. The record shall include the grout point number, the drill being used, start date/time, and the date/time of completion. This data shall be reviewed and approved by the Engineer prior to the Contractor's commencement of grouting. The contractor shall also record the grout volume injected with respect to injection depth intervals.

Compaction grout with 4 to 6 inch slump shall be injected into each grout point through a 3 to 4 inch I.D. pipe. The slump of grout may be adjusted between 4 to 6 inches as directed by the Engineer according to the field operation conditions. Unless otherwise directed by the Engineer, continue pumping at each injection point depth until one of the following criteria has been satisfied:

1. Minimum grout pressure of 100 psi increase over the pressure necessary to initiate grout intake.
2. Maximum grout pressures at the ground surface of 400 psi or as directed by the Engineer.
3. Maximum grout quantity of 5 cubic yards per 5-foot interval of injection depth or at the direction of the Engineer.
4. Surface indications such as ground heave, pipe lift, grout to the surface, or at the direction of the Engineer.
5. A maximum quantity of approximately 50 cubic yards of grout is placed throughout any given grout pipe or at the direction of the Engineer.

The grout pipe shall be lifted in one to two-foot increments such that grout injection is nearly continuous until the bottom of the grout pipe reaches approximately 10 feet below existing grade or at the direction of the Engineer.

It shall be the responsibility of the grouting contractor to perform the grouting operations without detrimentally impacting existing underground utilities in the area when present.

The contractor shall provide a detailed grouting record for each grout point. The record shall include the grout point number, date, the maximum grouting depth, the volume of grout placed versus depth, the total quantity of grout placed, and the injection pressure versus depth. This data shall be submitted to the Engineer for review and approval during the monitoring operation. Copies of the delivery tickets will be provided to the Engineer.

T173-7 TESTING AND QUALITY CONTROL

A minimum of one (1) set of two (2) 4 inch diameter by 8 inch grout cylinders shall be made from every day of grout injection and for every 50 cubic yards of grout pumped. Unconfined compression tests shall be performed on the samples at 7 and if necessary 21 days. Slump tests shall be performed on each load of grout brought to the site or at the direction of the Engineer. The above testing shall be performed by the Engineer's testing laboratory.

The Contractor shall supply the daily drilling and grouting documents outlined above to the Engineer within 24 hours after completion of each day work. Work is to be performed through coordination with the Engineer. Alterations to grouting procedures shall be implemented as necessary. Actual procedures and quantities of work items performed shall be verified.

T173–8 MEASUREMENT AND PAYMENT

The quantity to be paid for will be mobilization of equipment, length of pipe installed and the volume of grout, in cubic yards, pressure injected into the ground.

Pay Item Number	Pay Item
173 - 71	DRILLING HOLES FOR PRESSURE GROUTING - EACH
173 - 76	GROUT PIPE INSTALLATION – PER LINEAR FOOT
173 - 77 - 1	SUBSURFACE PRESSURE GROUTING SAND CEMENT - PER CUBIC YARD

Intertek-PSI
5801 Benjamin Center Drive
Suite 112
Tampa, Florida 33634

Tel +1 813 886 1075
Fax +1 813 249 4916
intertek.com/building

July 29, 2022

Florida Department of Transportation
District VII
MS7-800
11201 N. McKinley Drive
Tampa, Florida 33612

Attention: Mr. Kisan Patel, P.E.

RE: Roadway Depression
Pavement Distress –along SR 54
300 Feet NE of Osprey Lane
District VII Office
Pasco County, Florida
FDOT FPIN 198296-1-32-12
FDOT FPID 441658-1
FDOT Contract No. CAD65
Task Work Order No. 2.010
PSI Project No. 07753347

Dear Mr. Patel:

In accordance with your authorization, **Professional Service Industries, Inc. (PSI), an Intertek Company**, has provided geotechnical engineering services at the referenced site. The following presents the results of our field activities and recommendations.

BACKGROUND

PSI was contacted by the Florida Department of Transportation (FDOT) on May 31, 2022 via email and requested geotechnical services under TWO 2.010, including providing geotechnical exploration services related to a reported area of pavement distress located along SR 54 in Pasco County, Florida. Specifically, Our scope of services has consisted of providing geotechnical engineering services in general accordance with the Geotechnical Services Contract CAD65. The services included performing a site visit/site reconnaissance, coordinating the performance of ground penetrating radar (GPR) geophysical surveying as well as performing Standard Penetration Test (SPT) boring, if deemed necessary, to evaluate the subsurface and geologic conditions in the vicinity of the reported pavement distress. A brief site visit was conducted shortly after notification and was intended to confirm the subject area of distress was not actively expanding. Once no active expansion activity was observed, the fieldwork was coordinated and performed through the standard FDOT channels for receiving permission to impact public roadways via limited Maintenance of Traffic (MOT).

PSI coordinated a lane closure effort (MOT) to perform a site reconnaissance and GPR test on on June 27, 2022, to perform a site reconnaissance of the reported pavement distressed area. While on-site, the reported distressed area was observed along the outer eastbound lane of SR 54, approximately 300 Feet

NE of the intersection with Osprey Lane. The settlement/distress on the roadway surface was observed to be a depression, circular in shape, measuring approximately 6 feet in diameter and 3 inches in depth at the center of the apparent distress

Photographs of the distressed area of SR 54 taken during our site visit are presented in **Appendix C**. The approximate site location is presented on **Sheet 1** in **Appendix A**.

FIELD EXPLORATION

A program of subsurface exploration was performed to evaluate the geological conditions in the distressed areas. The program included a Ground Penetrating Radar (GPR) geophysical survey and subsequent Standard Penetration Test (SPT) boring within the general suspect area at accessible location. The GPR survey was performed on June 27, 2022; GPR operations were limited to accessible locations along the outer eastbound lane of SR 54, the roadway shoulder, and the south right of the way.

The GPR survey was performed along a grid with a series of perpendicular GPR transects spaced at 2 ½ to 5-foot intervals. The transect grids were performed with an approximate total area of approximately 500 feet by 25 feet. The results of the GPR survey is presented in **Appendix B**.

The GPR survey identified a total of two GPR anomaly features within the surveyed areas. The first anomaly feature (Anomaly A) was observed on the western side of the subjected area of pavement distress. The second anomaly (Anomaly B) is west of the area of distressed pavement. Therefore, a Standard Penetration Test (SPT) boring was recommended and performed only within Anomaly A for the purposes of obtaining additional subsurface information in the project area. The SPT soil boring was performed approximately at the location designated as B-1 in the **Report of Core Boring Sheet** in **Appendix A**, and generally located at the approximate center of the corresponding GPR anomaly feature.

One additional shallow GPR anomaly was identified near the area of distressed pavement. This anomaly was located at a depth of 2 to 4 feet and was characterized by a horizontal GPR reflector and a change in amplitude of the GPR signal. The anomaly was approximately 5 by 50 feet in size. It is suspected this anomaly may be associated with a former patch or area of repair. This anomaly is not suspected to be indicative of sinkhole activity.

The performed SPT boring generally encountered very loose sand to slightly silty sand (SP/SP-SM) and sandy fill to the depth of 6 feet below the existing ground surface. Below the sandy material, the boring encountered a layer of organic soil herein described as peat (PT) to an approximate depth of 13 feet below the existing ground surface. Immediately below the observed organic peat material, the boring revealed relatively clean to slightly silty sands with roots extending to a depth of approximately 17 feet below existing grade. The SPT N-values in the organic soil and relatively clean sand with roots varied between WH (weight-of-hammer) to 3 blows per foot. Thus, these materials were observed to be very loose in terms of relative density. Below these materials, very loose to medium dense clayey sand was observed to an approximate depth of 77 feet below the existing ground surface. Within this clayey sand layer, 100% loss of the circulation of the drilling fluid was observed at 65 feet. The highly weathered limestone material was observed from the approximate depth of 77 feet to the termination depth at 90 feet below the existing ground surface.

The boring locations and respective soil profiles are presented on **Sheet 1** in **Appendix A.**

CONCLUSIONS

The results of the GPR survey indicated the anomaly features may be indicative of ongoing sinkhole activity within the subject area. Based on the results of the GPR survey, site reconnaissance, and results of the SPT boring program, pavement distress is likely linked to a combined effect of karst geology and observed organic soils.

REMEDIAL RECOMMENDATIONS

We recommend a program of compaction grouting remediation be undertaken to address the of the subject depression and GPR-identified anomalous areas. Following the grouting process, we recommend the uppermost 4-feet of the roadway embankment and subgrade within the treatment areas be over-excavated and reconstructed with controlled lifts of layered backfill for the upper 4 feet from surface in accordance with FDOT Specifications. In order to minimize the risk of differential settlement due to shallower saturated unsuitable soil, a layer of biaxial geotextile (with a minimum tensile strength of 1,315 ponds/foot) should be placed across the base of the excavation prior to backfilling and establishing the grade for pavement section. We also recommend the subject area be monitored for a period of one (1) month following the completion of remediation procedures.

Compaction grouting is a method of ground improvement where a low slump grout is injected under pressure to fill possible voids within the underlying limestone and permeate into the surrounding soils, thereby densifying them.

For compaction grouting, the following program should be implemented. A low slump, sand-cement grout should be pumped, under pressure, into the ground at grout injection pipe locations established in advance. It is our opinion that the soils within and around the subject depression be treated with subsurface grouting to fill any voids or loose/soft soil conditions. We recommend a total of 12 primary grout injection points should be installed. Depending on grout takes at the initial points, secondary or tertiary points may be recommended. Anticipated depths for injection points are estimated to range from 75 to 80 feet below the current ground surface. For preliminary planning and budgeting purposes, we anticipate grout takes will be on the order of 25 to 35 cubic yards of grout per pin based on experience in the project area and the geologic conditions observed in our study. It should be noted actual grout takes will be entirely dependent upon the progress of the grouting program and historically have been exceedling difficult to estimate due to the highly variable nature of the subsurface conditions being addressed. The embedment depths of grout injection points located near the center of the observed depressions and anomaly features may extend deeper than anticipated. Recommended primary grout injection pin locations are presented in **Appendix D**.

GPR results also indicate a number of busy underground utility networks presence of the proposed remediation treatment areas. It shall be the responsibility of the grouting contractor to perform the grouting operations without detrimentally impacting existing underground utilities in the area while taking proper safety mesaures.

Technical Specifications for Compaction Grouting are presented in **Appendix E.**

<u>CLOSING</u>

We trust you will find this information suitable for your immediate needs. Please contact us if you have any questions regarding this report. Thank you for the opportunity to be of service to you.

Sincerely,
Professional Service Industries, Inc.

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY:

ON THE DATE ADJACENT TO THE SEAL

PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED. THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES

PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DRIVE, SUITE 112, TAMPA, FL 33634
CERTIFICATE OF AUTHORIZATION 3684
NAYAN SAHA, P.E. NO. 81635

Muthanna AL Saadi, E.I.
Staff Engineer Intern

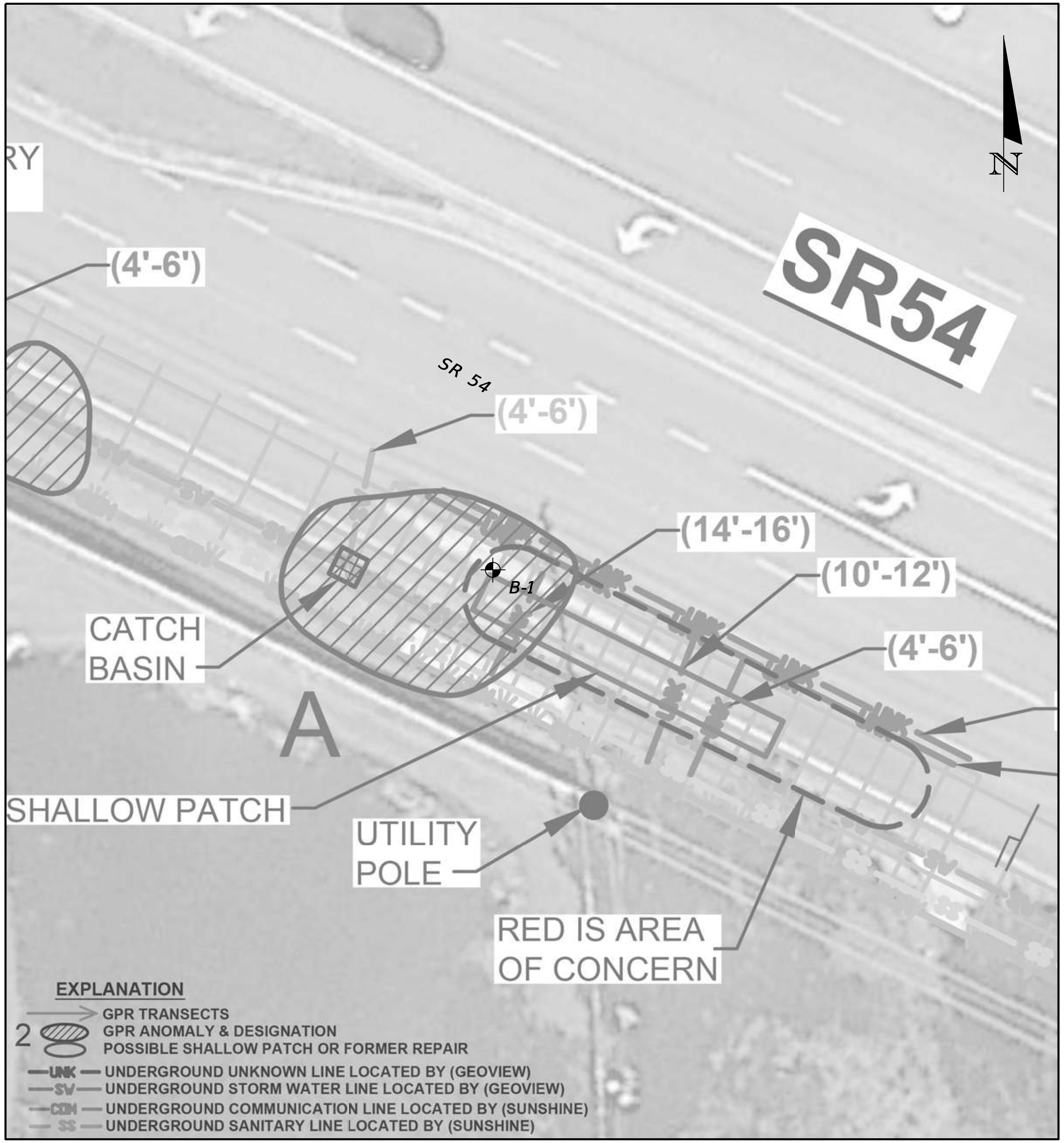
Nayan Saha, P.E.
Senior Geotechnical Engineer
Florida License No. 81635

Courtland Alvies, P.E.
Geotechnical Services Department Manager
Florida License No. 93388

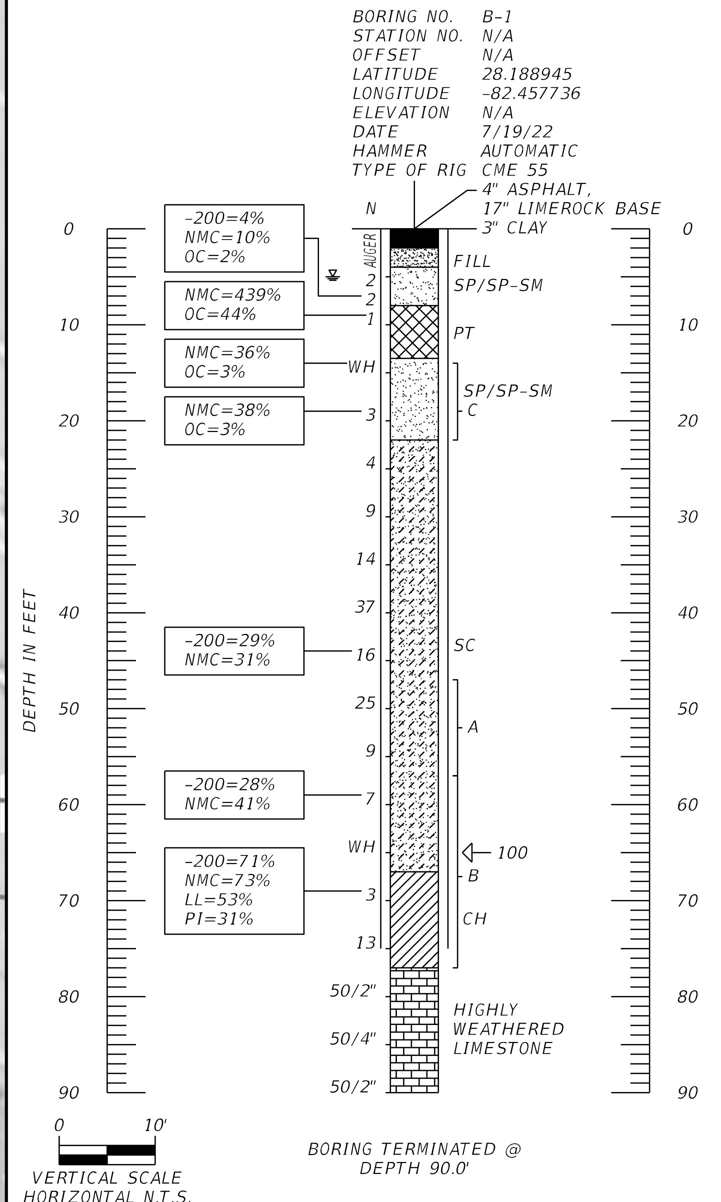
Attachments: Appendix A – Report of Core Borings
Appendix B - GPR Report by GeoView
Appendix C - Site Photographs
Appendix D - Recommended Primary Grout Injection Plan
Appendix E - Technical Specifications for Compaction Grouting

APPENDIX A

SHEETS



BORING LOCATION PLAN



LEGEND

- FILL, BROWN/GRAY SAND, CLAYEY SAND WITH TRACE LIMEROCK FRAGMENTS
- (SP/SP-SM), BROWN/GRAY FINE SAND TO SLIGHTLY SILTY SAND
- DARK GRAY/BLACK MUCK (PT)
- (SC), BROWN/GRAY CLAYEY SAND
- (CH), GRAY/BLUE CLAY
- GRAY HIGHLY WEATHERED LIMESTONE

A WITH DARK GRAY ROCK FRAGMENTS

B WITH HIGHLY WEATHERED LIMESTONE FRAGMENTS

C WITH ROOTS

NOTES:

- WATER TABLE
- N NUMBERS TO THE LEFT OF BORINGS INDICATE SPT VALUE FOR 12" PENETRATION. (UNLESS OTHERWISE NOTED.)
- WH FELL UNDER WEIGHT OF ROD AND HAMMER
- 50/6" FIFTY BLOWS FOR SIX INCHES
- LOSS OF CIRCULATION (%)
- CASING USED
- -200 FINES PASSING NO. 200 SIEVE (%)
- NMC NATURAL MOISTURE CONTENT (%)
- OC ORGANIC CONTENT (%)
- LL LIQUID LIMIT (%)
- PI PLASTICITY INDEX (%)
- APPROXIMATE SPT BORING LOCATION

ENVIRONMENTAL CLASSIFICATION

SUBSTRUCTURE: EXTREMELY AGGRESSIVE (ASSUMED)

GRANULAR MATERIALS- RELATIVE DENSITY	SPT (BLOWS/FT.)
VERY LOOSE	LESS THAN 4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	GREATER THAN 50

SILTS AND CLAYS CONSISTENCY	SPT (BLOWS/FT.)
VERY SOFT	LESS THAN 2
SOFT	2-4
FIRM	4-8
STIFF	8-15
VERY STIFF	15-30
HARD	GREATER THAN 30

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

COURTLAND L. ALVIES, P.E.
P.E. LICENSE NO. 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
	PASCO	

REPORT OF CORE BORINGS

SHEET NO.

$USER$ $DATE$ $TIME$ $FILE$

APPENDIX B

GPR RESULTS

FINAL REPORT
GEOPHYSICAL INVESTIGATION
STATE ROAD 54 EASTBOUND
LUTZ, PASCO COUNTY, FLORIDA

Prepared for Intertek-PSI
Tampa, FL

Prepared by GeoView, Inc.
St. Petersburg, FL

July 6, 2022

Mr. Courtland Alvies, P.E.
Intertek-PSI
5801 Benjamin Center Drive, Suite 112
Tampa, FL 33634

Subject: Transmittal of Final Report for Geophysical Investigation
State Road 54
Lutz, Pasco County, Florida
GeoView Project Number 36995

Dear Mr. Alvies,

GeoView, Inc. (GeoView) is pleased to submit the final report that summarizes and presents the results of the geophysical investigation conducted on State Road 54 in Lutz, Pasco County, Florida. Ground penetrating radar was used to investigate a cracking in the outer eastbound lane of the roadway. GeoView appreciates the opportunity to have assisted you on this project. If you have any questions or comments about the report, please contact us.

GEOVIEW, INC.

Christopher Taylor

Chris Taylor, P.G.
Vice President
Florida Professional Geologist Number 2256

A Geophysical Services Company

4610 Central Avenue
St. Petersburg, FL 33711
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Fax: (727) 328-2477

1.0 Introduction

A geophysical investigation was conducted on State Road 54 east of Land O'Lakes Boulevard in Pasco County, Florida. Prior to the geophysical investigation, cracking had been observed in the outer eastbound lane of the roadway. The depression had been filled prior to the GPR survey. The GPR investigation was conducted on June 27, 2022. A discussion of the field methods used to generate the report figure is provided in Appendix A2.1

2.0 Description of Geophysical Investigation

<u>Ground Penetrating Radar Survey</u>

The survey area was approximately 500 feet by 25 feet. The survey was conducted along a series of east/west transects spaced 5 feet apart and north/south transects spaced 10 to 20 feet apart. The GPR data was collected with a GSSI radar system with a 350 MHz antenna. The GPR settings used for the survey are presented in Table 1.

Table 1
GPR Equipment Settings Used for the Survey

Antenna Frequency	Time Range (nano-seconds)	Estimated Depth of GPR Signal Penetration
350 MHz [1/]	82 to 138	12 to 20 ft bls

1/ MHz means mega-Hertz and is the mid-range operating frequency of the GPR antenna.

2/bls means below land surface.

The corner points of the grid were recorded using a Trimble Geo7x GPS. A description of the GPR technique and the methods employed for geological characterization studies is provided in Appendix A2.2.

3.0 Identification of Possible Sinkhole or Void Features Using GPR

The features observed on GPR data that are most commonly associated with sinkhole or void activity are:

- A downwarping of GPR reflector sets, that are associated with suspected lithological contacts, toward a common center. Such features typically have with a bowl or funnel shaped configuration and can be associated with a deflection of overlying sediment horizons caused by the migration of sediments into voids in the underlying limestone. If the GPR reflector sets are sharply downwarping and intersect, they can create “bow-tie” shaped GPR reflection feature, which often designates the apparent center of the GPR anomaly.

- A localized significant increase in the depth of the penetration and/or amplitude of the GPR signal response. The increase in GPR signal penetration depth or amplitude is often associated with either a localized increase in sand content at depth or decrease in soil density.
- An apparent discontinuity in GPR reflector sets, that are associated with suspected lithological contacts. The apparent discontinuities and/or disruption of the GPR reflector sets may be associated with the downward migration of sediments.

The greater the severity of these features or a combination of these features, the greater the likelihood that the identified feature is a sinkhole or soil void. It is not possible based on the GPR data alone to determine if an identified feature is a void and/or a sinkhole or, more importantly, whether that feature is an active geologic feature.

4.0 Survey Results

Results of the GPR survey indicate the presence of two well-defined, relatively continuous sets of GPR reflectors at an approximate depth range of 4 to 6 and 10 to 18 feet bls. This reflector sets are most likely associated with lithological transitions within those depth ranges.

Two GPR anomalies were identified within the boundaries of the project site. The locations of the Anomalies are shown as Anomalies A and B on Figure 1. GPR Anomaly A was located on the western side of the area of distressed pavement. GPR Anomaly B was located west of the area of distressed pavement. The GPR anomalies were characterized by a downwarping of 4 to 7 feet of the lower GPR reflector set and a localized increase in depth of penetration of the GPR signal. The anomalies were evident at depths of 10 to 20 feet. It is suspected these anomalies are indicative of karst activity.

One additional shallow GPR anomalies was identified near the area of distressed pavement. This anomaly was located at a depth of 2 to 4 feet and was characterized by a horizontal GPR reflector and a change in amplitude of the GPR signal. The anomaly was approximately 5 by 50 feet in size. It is suspected this anomaly may be associated with a former patch or area of repair. This anomaly is not suspected to be indicative of sinkhole activity.

The locations of the GPR anomalies are shown on Figure 1. Coordinates of the anomalies are provided in Table 2. Examples of the GPR data collected at the project site are provided in Appendix 1. A discussion of the limitations of the GPR technique in geological characterization studies is provided in Appendix A2.3.

Table 2

Anomaly Coordinates

Anomaly	Easting	Northing
A	508705	1401675
B	508646	1401698

US State Plane, FL West (2011), Feet

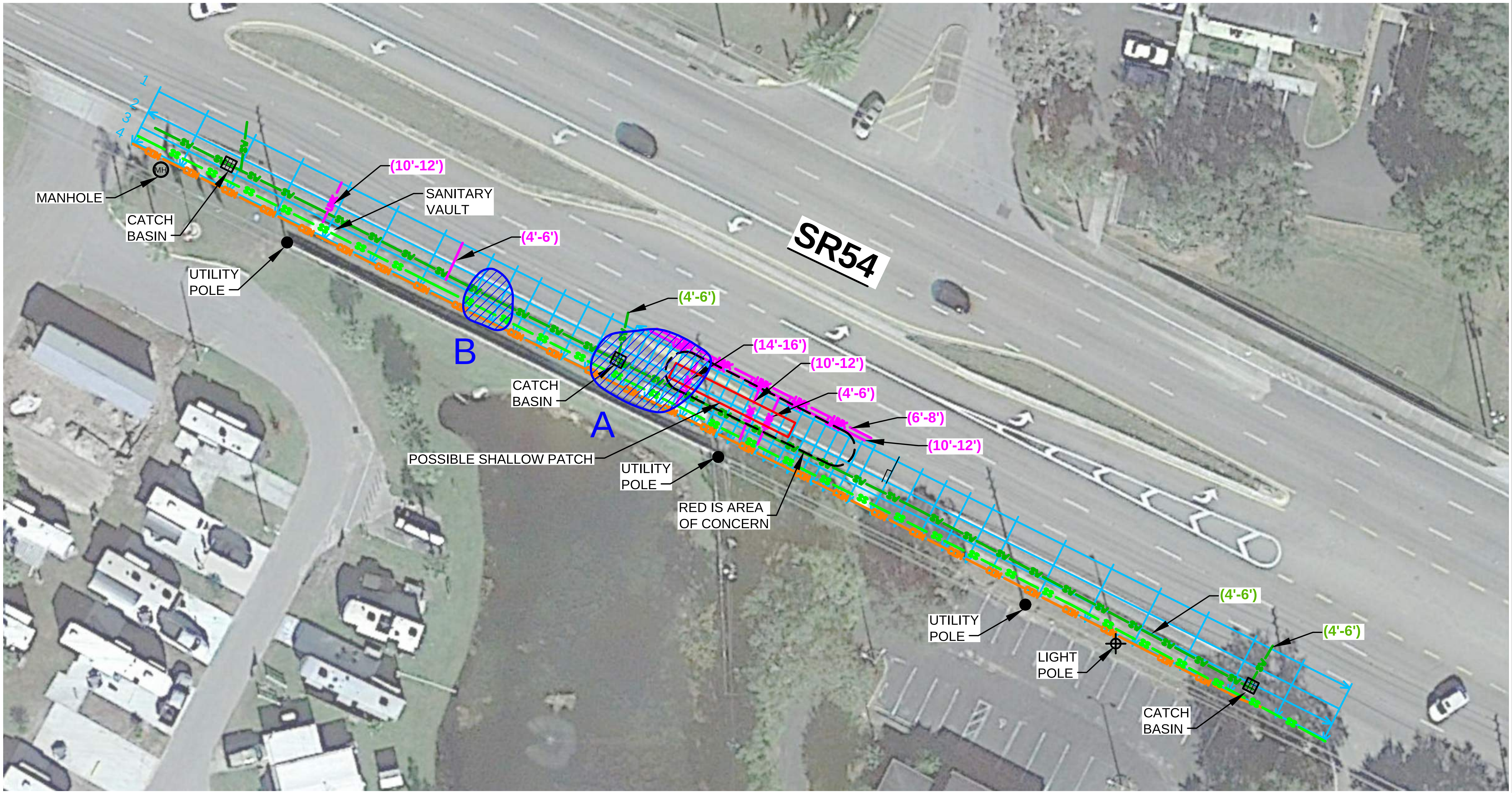
.

APPENDIX 1

FIGURE, SITE PHOTOGRAPH

AND EXAMPLES OF THE GPR DATA

SITE PHOTOGRAPH 1 – SURVEY AREA



GOOGLE EARTH AERIAL 2022

EXPLANATION

- GPR TRANSECTS
- 2 GPR ANOMALY & DESIGNATION
- POSSIBLE SHALLOW PATCH OR FORMER REPAIR
- UNK UNDERGROUND UNKNOWN LINE LOCATED BY (GEOVIEW)
- SV UNDERGROUND STORM WATER LINE LOCATED BY (GEOVIEW)
- COM UNDERGROUND COMMUNICATION LINE LOCATED BY (SUNSHINE)
- SS UNDERGROUND SANITARY LINE LOCATED BY (SUNSHINE)

N

0 35'

SCALE: 1"=35' APPROXIMATE

GeoView

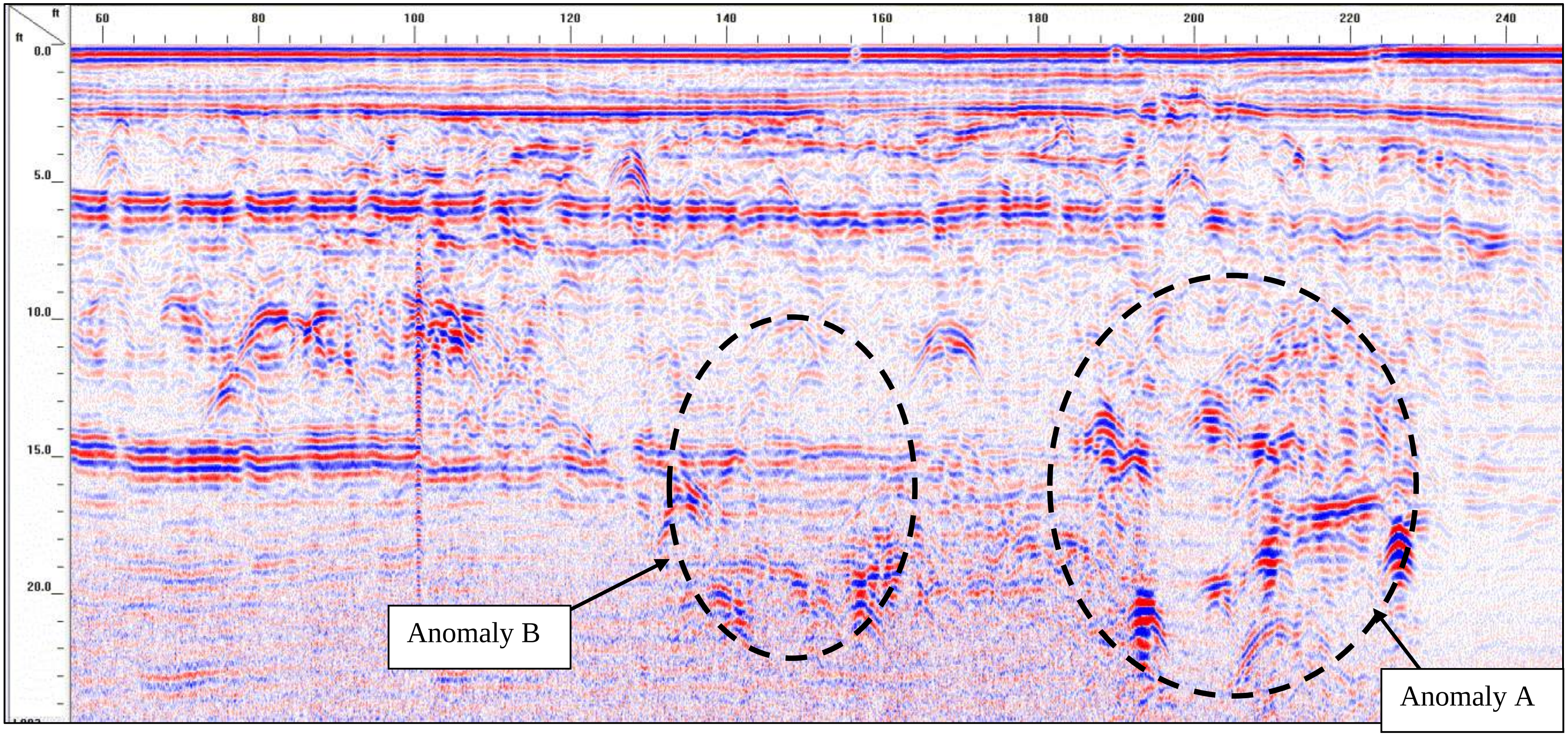
FIGURE 1

SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION

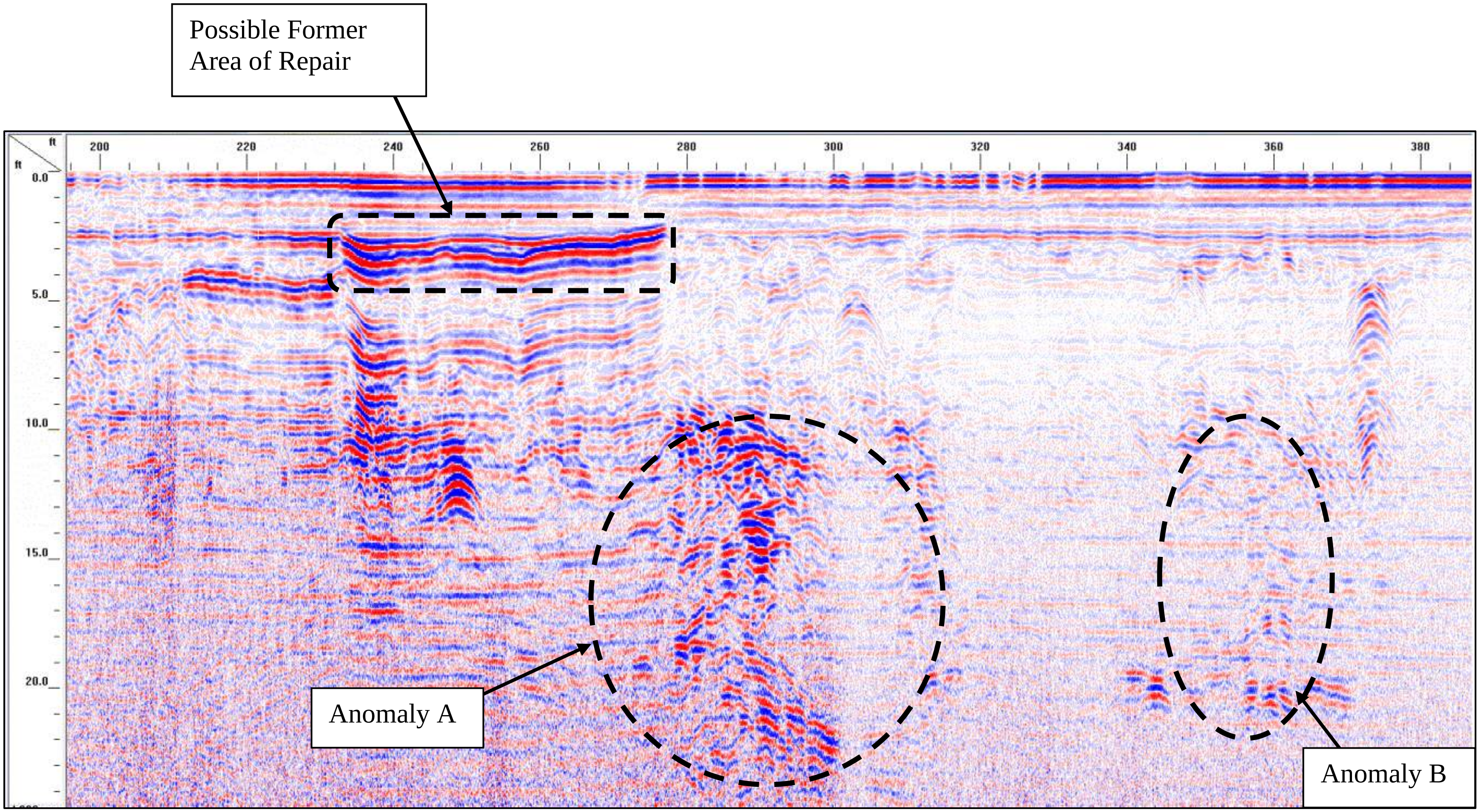
SR54 EB OUTSIDE LANE
PASCO COUNTY, FLORIDA

INTERTEK-PSI
TAMPA, FLORIDA

PROJECT: 36955
DATE: 07/06/22



GPR Transect 3 Across Anomalies A and B



GPR Transect 2 Across Anomalies A and B and Possible Patch/Area of Repair

APPENDIX 2
DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

A2.1 On Site Measurements

The measurements that were collected and used to produce the report figures were made using a fiberglass measuring tape and a Trimble Geo7x GPS. The degree of accuracy of such an approach is typically +/- 5% for lengths.

A2.2 Ground Penetrating Radar

Ground Penetrating Radar (GPR) consists of a set of integrated electronic components that transmits high frequency (270 to 500 megahertz [MHz]) electromagnetic waves into the ground and records the energy reflected back to the ground surface. The GPR system consists of an antenna, which serves as both a transmitter and receiver, and a profiling recorder that both processes the incoming signal and provides a graphic display of the data. The GPR data can be reviewed as both printed hard copy output and recorded on the profiling recorder's hard drive for later review. GeoView uses GSSI and Mala GPR systems.

A GPR survey provides a graphic cross-sectional view of subsurface conditions. This cross-sectional view is created from the reflections of repetitive short-duration electromagnetic (EM) waves that are generated as the antenna is pulled across the ground surface. The reflections occur at the subsurface contacts between materials with differing electrical properties. The electrical property contrast that causes the reflections is the dielectric permittivity that is directly related to conductivity of a material. The GPR method is commonly used to identify such targets as underground utilities, underground storage tanks or drums, buried debris, voids or geological features.

The greater the electrical contrast between the surrounding earth materials and target of interest, the greater the amplitude of the reflected return signal. Unless the buried object is metal, only part of the signal energy will be reflected back to the antenna with the remaining portion of the signal continuing to propagate downward to be reflected by deeper features. If there is little or no electrical contrast between the target interest and surrounding earth materials it will be very difficult if not impossible to identify the object using GPR.

The depth of penetration of the GPR signal is very site specific and is controlled by two primary factors: subsurface soil conditions and selected antenna frequency. The GPR signal is attenuated (absorbed) as is passes through earth materials. As the energy of the GPR signal is diminished due to attenuation, the energy of the reflected waves is reduced, eventually to the level that the reflections can no longer be detected. As the conductivity of the earth materials increases, the attenuation of the GPR signal increases thereby reducing the signal penetration depth. In Florida, the typical soil conditions that severely limit GPR signal penetration are near-surface clays and/or organic materials.

The depth of penetration of the GPR signal is also reduced as the antenna frequency is increased. However, as antenna frequency is increased the resolution of the GPR data is improved. Therefore, when designing a GPR survey a tradeoff is made between the required depth of penetration and desired resolution of the data. As a rule, the highest frequency antenna that will still provide the desired maximum depth of penetration should be used.

A GPR survey is conducted along survey lines (transects) that are measured paths along which the GPR antenna is moved. Electronic marks are placed in the data by the operator at designated points along the GPR transects. These marks allow for a correlation between the GPR data and the position of the GPR antenna on the ground.

Depth estimates to the top of lithological contacts or voids are determined by dividing the time of travel of the GPR signal from the ground surface to the top of the feature by the velocity of the GPR signal. The velocity of the GPR signal is usually obtained from published tables of velocities for the type and condition (saturated vs. unsaturated) of soils underlying the site. The accuracy of GPR-derived depths typically ranges from 20 to 40 percent of the total depth.

A2.3 Interpretation and Limitations of GPR data

The analysis and collection of GPR data is both a technical and interpretative skill. The technical aspects of the work are learned from both training and experience. Having the opportunity to compare GPR data collected in numerous settings to the results from geotechnical studies performed at the same locations develops interpretative skills for geological characterization studies.

The ability of GPR to collect interpretable information at a project site is limited by the attenuation (absorption) of the GPR signal by underlying soils. Once the GPR signal has been attenuated at a particular depth, information regarding deeper geological conditions will not be obtained. GPR data can only resolve subsurface features that have a sufficient electrical contrast between the feature in question and surrounding earth materials. If an insufficient contrast is present, the subsurface feature will not be identified.

GeoView can make no warranties or representations of geological conditions that may be present beyond the depth of investigation or resolving capability of the GPR equipment or in areas that were not accessible to the geophysical investigation.

APPENDIX C

PHOTOGRAPHS

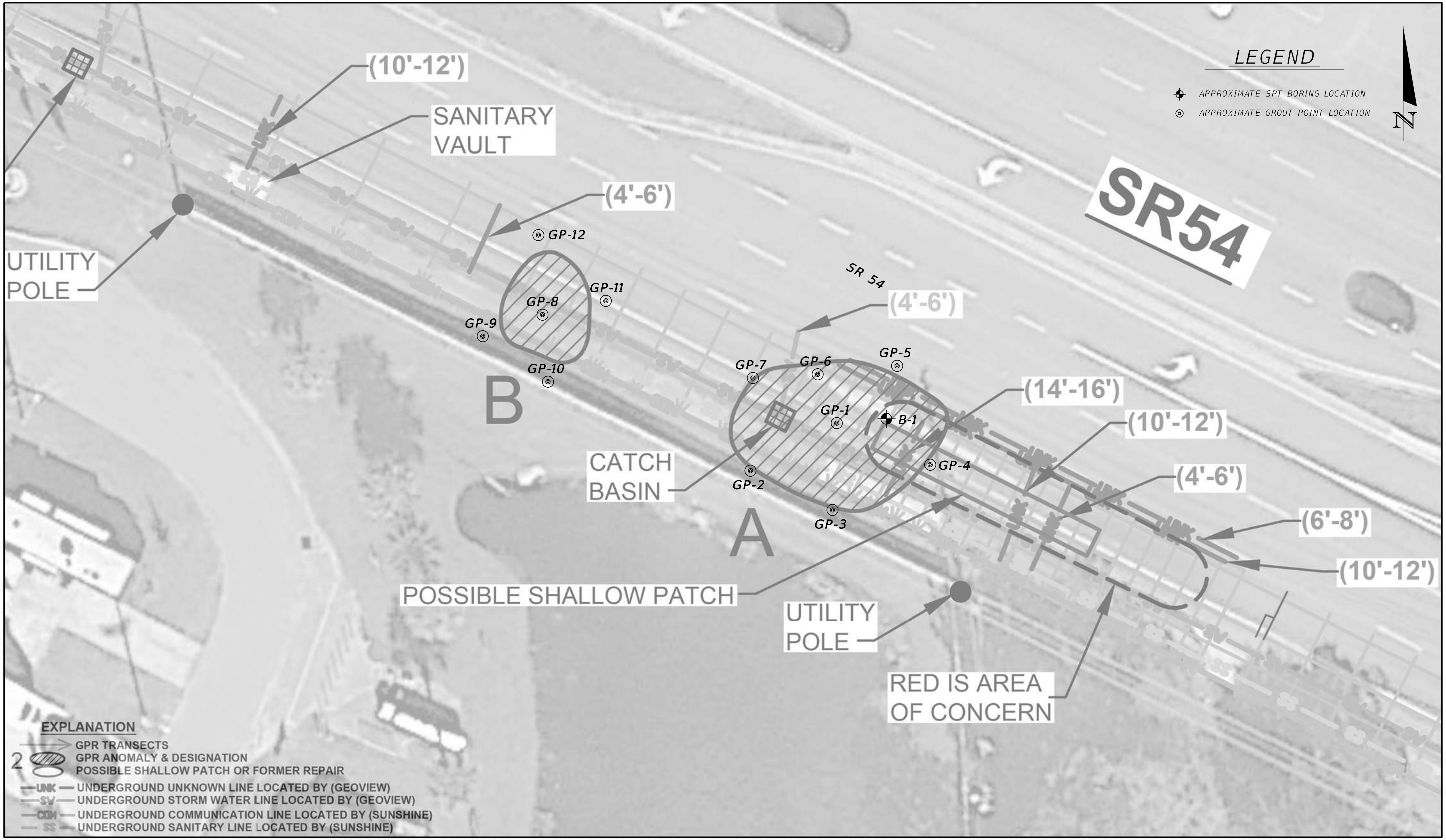
PHOTOGRAPH 1 Depression Looking North

PHOTOGRAPH 2 Depression Looking East

PHOTOGRAPH 3 DEPRESSION LOOKING WEST

APPENDIX D

RECOMMENDED PRIMARY GROUT INJECTION PLAN



0 5 20
Feet

GROUT POINT LOCATION PLAN

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

COURTLAND L. ALVIES, P.E.
P.E. LICENSE NO. 93388
PROFESSIONAL SERVICE INDUSTRIES, INC.
5801 BENJAMIN CENTER DR., SUITE 112
TAMPA, FL 33634

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
	PASCO	

GROUT POINT LOCATION PLAN

SHEET NO.

$USERS $DATES $TIMES $FILES

APPENDIX E

TECHNICAL SPECIFICATIONS FOR COMPACTION GROUTING

TECHNICAL SPECIFICATIONS

FOR

COMPACTION GROUTING

AT

PAVEMENT DISTRESS
SR 54 300 FEET NE OF OSPREY LANE
PASCO COUNTY, FLORIDA

FPN 441658-1

Prepared by:
PSI, Inc., an Intertek Company

Courtland Alvies, P.E.
Geotechnical Services Department Manager
Florida License No. 93388

Nayan Saha, P.E.
Senior Geotechnical Engineer
Florida License No. 81635

COMPACTION GROUTING SPECIFICATION

1.0 DESCRIPTION

The work specified in this SPECIFICATION is to treat and stabilize the anomalous features and depressions located along SR 54 in Pasco County, Florida, approximately 300 Feet NE of the intersection with Osprey Lane, Pasco County, Florida. The recommended compaction grout remediation program should plug and seal potential avenues for future migration of the overlying soils, which may contribute to settlement distress.

2.0 SCOPE OF WORK

A qualified contractor specializing in compaction grouting shall be responsible for project control, supervision, labor, materials, and the equipment necessary to accomplish the following scope of work:

1. Install the grout injection points to limestone or competent soils at the location as shown in the Grout Pipe Location Plan or as directed by the Engineer. This shall be assumed to be the depth where refusal of the grout pipe to be advanced further occurs. Anticipated depths are within the range of 75 to 80 feet below existing ground surface. Actual depth of installation may be adjusted by the Engineer at their discretion dependent upon field conditions.
2. Provide necessary equipment to install, clean and extract 3 to 4 inch inside diameter flush joint grout pipe.
3. Provide equipment and material necessary to inject 4 to 6 inch slump Portland cement grout into the desired zones. The maximum quantity of grout to be placed (per injection point) is indicated in Section 6.0 Grouting Procedures. The actual grout quantities may be adjusted at the Engineer's discretion.
4. Provide detailed documentation of the borehole drilling and grouting procedures including, but not limited to; quantity of pipe installed and quantity of grout pumped.
5. Provide equipment, materials, and manpower to monitor the relative elevations of ground surface and nearby structures (if any) during grouting.

3.0 CONTRACTOR QUALIFICATIONS

The Florida Licensed Contractor should have: 1) a minimum of 5 years experience in the compaction grouting process; and 2) should have satisfactorily completed at least three (3) projects of similar scope and purpose. As part of the qualification process, the proposed contractor must submit to the Engineer:

1. Project experience list.
2. A list of key personnel to be used on the project with a brief experience resume for each.
3. The proposed grouting procedure and schedule.
4. Grout mix data.
5. A list of equipment to be used on the project (i.e., type of drilling apparatus, grout pump data, pipe extraction equipment, etc.).

4.0 MATERIALS: COMPACTION GROUT

The grout mix may consist of sand, fly ash, cement and water. The grout mix should be proportioned to provide a minimum 7-day compressive strength of 250 psi. The maximum slump shall be 4 to 6 inches. Grout with excessive slump shall be rejected. The temperature of the grout mix should not exceed 100˚F and the grout mix should not be more than three (3) hours old at the time of pumping.

The proposed grout mix shall be submitted by the contractor to the Engineer for review prior to commencing the grouting program. Detailed documentation shall be presented by the Contractor to the Engineer which shows that slump and strength requirements have been met on past projects using the proposed mix design.

5.0 EQUIPMENT

The contractor shall provide all equipment and tools necessary to drill grout holes into hard limestone, place grout pipes, clean grout pipes, inject grout and extract the pipe. Equipment required for this project may include, but is not limited to:

1. Suitable drilling equipment capable of installing 4 inch diameter casing to and into limestone, subject to the approval of the Geotechnical Engineer.
2. Drilling equipment should be free of any leaks of oil, fuel or any other hazardous materials. The drilling equipment should be steam cleaned and inspected by the Geotechnical Engineer prior to commencing the drilling operation.
3. A crane, hydraulic ram or other suitable lifting apparatus capable of extracting the grout pipe.
4. A grout pump capable of pumping 4 to 6 inch slump cement grout. The pump should be fitted with a stroke counter or other acceptable device for use in grout volume calibration. The pump shall also have a pressure gauge at the point of discharge.
5. A sufficient supply of durable 3 to 4 inch inside diameter grout casing, 4 inch grout hose, and fittings/couplings.

6. An accurate, self-leveling survey level, level rod, and other equipment necessary to permit accurate elevation surveys during grout pumping.
7. All other incidental equipment and tools necessary to complete the project.

6.0 GROUTING PROCEDURES

The injection points shall be installed at the locations shown on the plans. Secondary and tertiary injection points may be installed depending upon the grout takes of the primary injection points and at the discretion of the Engineer. The contractor shall provide at least 72 hours notice to the Engineer prior to commencement of drilling or grouting operations. Grout injection should commence within 24 hours of grout injection point installation, preferably sooner.

The contractor shall keep a drilling record for each borehole. The record should include the grout point number, the time rate of advancement (sec/ft.) for each foot of penetration, the drill being used, start date/time, and the date/time of completion. This data shall be reviewed by the Engineer prior to commencement of grouting.

Compaction grout with 4 to 6 inch slump shall be injected into each grout point through a 4 inch I.D. pipe. Unless otherwise directed by the Engineer, the grout shall be continued until one of the following criteria has been satisfied. The slump of grout may be adjusted between 4 to 6 inches as directed by the Engineer according to the field operation conditions.

1. Minimum grout pressure of 100 psi increase over the pressure necessary to initiate grout intake.
2. Maximum grout pressures at the ground surface of 400 psi or as directed by the Engineer.
3. Maximum grout quantity of 5 cubic yards per 5-foot interval of grout pipe or at the direction of the Engineer.
4. Surface indications such as ground heave, pipe lift, grout to the surface, or at the direction of the Engineer
5. A maximum quantity of approximately 50 cubic yards of grout is placed throughout any given grout pipe or at the direction of the Engineer.

The grout pipe shall then be lifted in one to two-foot increments. The grouting procedure shall repeat until the bottom of the grout pipe reaches approximately 10 feet below existing grade.

It shall be the responsibility of the grouting contractor to perform the grouting operations without detrimentally impacting existing underground utilities in the area, when present.

The contractor shall also follow proper safety measures in accordance with OSHA guidelines during grouting operations.

The contractor shall provide a detailed grouting record for each grout point. The record shall include the grout point number, date, the maximum grouting depth, the volume of grout placed versus depth, the total quantity of grout placed, and the injection pressure versus depth. This data shall be submitted to the Engineer for review and approval during the monitoring operation. Copies of the delivery tickets will be provided to the Engineer.

7.0 TESTING AND QUALITY CONTROL

For off-site batching and mixing of the grout, a minimum of one (1) set of two (2) 4 inch diameter by 8 inch grout cylinders shall be made from every other load of grout pumped. Unconfined compression tests shall be performed on the samples at 7 and if necessary 21 days. Slump tests shall be performed on each load of grout brought to the site or at the direction of the Engineer. The above testing shall be performed by the Engineer's testing laboratory.

The Contractor shall supply the daily drilling and grouting documents outlined above to the Engineer within 24 hours after completion of each day work. The Engineer shall review reports and provide on-site personnel to verify the procedures performed, the quantities used, and alter grouting procedures as necessary.

8.0 MEASUREMENT AND PAYMENT

The quantity to be paid for will be mobilization of equipment, length of pipe installed and the volume of grout, in cubic yards, pressure injected into the ground.

Pay Item Number	Pay Item
173 - 71	DRILLING HOLES FOR PRESSURE GROUTING
173 - 76	GROUT PIPE INSTALLATION
173 - 77 - 3	SUBSURFACE PRESSURE GROUTING, CEMENT SLURRY