Geotechnical Engineering Report

Main Street Improvements

City of Crestview

Okaloosa County, Florida

July 6, 2022
Terracon Project No. HF225056

Prepared for:
Matrix Design Group, Inc.
707 17th Street, Suite 3150
Denver Colorado 80202

Prepared by:
Terracon Consultants, Inc.
3559 Timberlane School Road
Tallahassee, Florida 32312

July 6, 2022

Matrix Design Group, Inc.
707 17th Street, Suite 3150
Denver, Colorado 80202

Attn: Mr. Jason Rutt, P.E.
O: (303) 572 0200
E: Jason_Rutt@matrixdesigngroup.com

Re: Geotechnical Engineering Report
Main Street Improvements
City of Crestview
Okaloosa County, Florida
Terracon Project No. HF225056

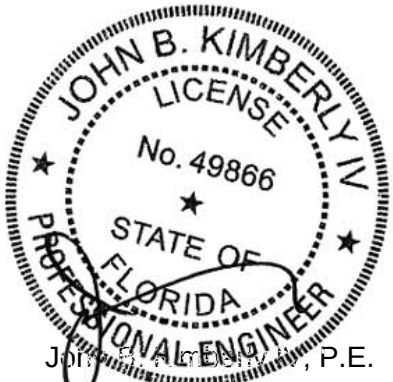
Dear Mr. Rutt:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with our Subconsultant Agreement dated May 13, 2022. This report presents the results of our subsurface exploration and recommendations conducted for the Main Street Improvements.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.



Dustin Travis Mills, P.E.
Project Manager
FL Registration No. 83656

John B. Kimberly IV, P.E.
Regional Manager
FL Registration No. 49866

SME Review by Keith D. Bennett, P.E. (Senior Engineer)

This item has been digitally signed and sealed by John B. Kimberly IV, 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.

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CITY OF CRESTVIEW
OKALOOSA COUNTY, FLORIDA

Terracon Project No. HF225056
July 6, 2022

1.0 INTRODUCTION

The purpose of this geotechnical engineering exploration was to obtain information about the existing soil and pavement conditions along the extents of the project and to provide geotechnical engineering recommendations for design and construction of the proposed shoulder addition and repaving. The scope of services for this exploration included the following:

- Reviewing the United States Geological Survey (USGS) Quadrangle Map (shown as **Exhibit A-1** in **Appendix A**) for the site proximity.
- Mobilizing a drill crew to the project site to perform 13 pavement cores with soil borings through existing roadways, distributed over each roadway to be reconstructed. The hand auger borings were performed to a depth of approximately 5 feet below the existing ground surface. Boring locations are presented in plan view on the Boring Location Map sheets as **Exhibit A-2A and A-2B**. The tabulated boring stationing are presented in **Exhibit A-3**. A description of Field Exploration Procedures is presented as **Exhibit A-7**.
- Visually classifying the recovered soil samples below the pavement section in the field by a Geotechnical Technician and in the laboratory by a Geotechnical Engineer in accordance with the AASHTO Classification system (**Exhibit B-4** in **Appendix B**).
- Laboratory classification and index property testing, including gradation tests and natural moisture tests, were assigned and performed in our laboratory to aid in classifying soils and assessing engineering characteristics. The test results are included on the Roadway Soil Survey Sheet, provided as **Exhibit A-5**. Laboratory test results have also been tabulated on the Summary of Laboratory Testing table, presented as **Exhibit B-2**.
- Development of this Geotechnical Engineering Report which documents our findings, evaluation, and recommendations.

2.0 PROJECT INFORMATION

The project is located in Downtown Crestview, Okaloosa County, Florida. The project begins at East James Lee Boulevard (SR 10 / US 90) and extends southeast along North Main Street to Industrial Drive. The project also includes the following cross-streets: Cedar Avenue, Pine

Avenue, Beech Avenue, Oakdale Avenue, and Woodruff Avenue. An overview of the project location has been provided as **Exhibit A-1**.

Based on the information provided by Matrix Design Group (Matrix), we understand the primary intent of this project is to remove and replace existing pavements and reconstruct the typical section to include improved parking and pedestrian traffic. Additionally, we understand the design speed is 25 miles per hour and the forecasted traffic for Main Street includes an AADT of 4,500 for the design year 2045 which we've used to estimate an Equivalent 18-kip Single-Axle Load (ESALs) of about 1.1 Million.

3.0 REVIEW OF AVAILABLE DATA

3.1 USGS Topographic Quadrangle Map

Based on the United States Geological Survey (USGS) "Crestview North, Florida" quadrangle map, the natural ground surface in the project area appears to range in elevation from about +230 feet to +240 feet, NGVD. The USGS topographic map overlaid with the project limits has been shown as **Exhibit A-1**.

3.2 Site Geology

The city of Crestview is located within the Citronelle Formation, which is widespread in the Gulf Coastal Plain. The type section for the Citronelle Formation, named by Matson (1916), is near Citronelle, Alabama. The Citronelle Formation grades laterally, through a broad facies transition, into the Miccosukee Formation of the eastern Florida panhandle. Coe (1979) investigated the Citronelle Formation in portions of the western Florida panhandle. The Citronelle Formation is a siliciclastic, deltaic deposit that is lithologically similar to, and time equivalent with, the Cypresshead Formation and, at least in part, the Long Key Formation (Cunningham et al., 1998) of the peninsula. In the western panhandle, some of the sediments mapped as Citronelle Formation may be reworked Citronelle. The lithologies are the same and there are few fossils present to document a possible younger age. The Citronelle Formation consists of gray to orange, often mottled, unconsolidated to poorly consolidated, very fine to very coarse, poorly sorted, clean to clayey sands. It contains significant amounts of clay, silt and gravel which may occur as beds and lenses and may vary considerably over short distances. Limonite nodules and limonite-cemented beds are common. Marine fossils are rare but fossil pollen, plant remains and occasional vertebrates are found. Much of the Citronelle Formation is highly permeable. It forms the Sand and Gravel Aquifer of the surficial aquifer system. This geological description is from publications provided by USGS.

4.0 SUBSURFACE CONDITIONS

A map showing the individual boring and core locations overlain on aerial imagery has been presented as **Exhibits A-2A** and **A-2B** and boring locations have been tabulated by station in

Exhibit A-3 in **Appendix A**. The existing cross-section of Main street varies throughout the project limits, but primarily consists of one 12-foot-wide travel lane in each direction, with on-street parking and concrete sidewalks. Cross-street typical sections vary, but generally consist of one to three lanes, with on-street parking.

4.1 Pavement Conditions

To evaluate existing pavement conditions, 13 pavement cores were collected spread throughout the project. The pavement layers encountered, total length of each core, underlying base material, and pavement conditions at core location have been summarized in **Exhibit A-3**. In addition, the table includes estimates of the base thickness, rut depth, crack depth, and crack characteristics.

Based on the existing conditions, layer components, and thicknesses encountered, existing structural numbers have been estimated as summarized in **Exhibit A-4**. It should be noted that an Asphalt Rubber Membrane Interlayer (ARMI) was encountered in cores located along Main Street.

Full-depth cracking was observed at almost all core locations and was observed in a block pattern as well as longitudinal and transverse patterns. Based on visual assessment of pavement surfaces, crack depth and type, and rut depths, the pavements were primarily rated as being in fair condition, with West Pine Avenue (Core C-07) being the only location given a poor condition rating.

4.2 Roadway Base Conditions

The existing base material encountered on Main Street and Cedar Avenue consisted of Sand Asphalt Hot Mix (SAHM) varying in thickness from about 6.5 to 9.4 inches, while all other locations consisted of 3 to 12 inches of sand-clay base.

4.3 Existing Soils

In general, the soil stratification in borings performed, based on visual examination and laboratory test results consists of the following:

Stratum Number	Description	AASHTO Classification
1	Fine Sand	A-3
2	Silty Fine Sand (fines content < 15%)	A-2-4
3	Silty Fine Sand (fines content ≥ 15%)	A-2-4

A summary of stratum properties, testing, soil descriptions and stratifications has been presented in the Roadway Soil Survey provided in **Exhibit A-5** with a profile for the borings shown in **Exhibit A-6**. Strata boundaries shown on the profile represent approximate location of changes in soil types based on our observations; in-situ, the transition between materials may be gradual and may vary between boring locations.

4.4 Groundwater

Groundwater was not encountered within the borings while drilling. Therefore, the depth to estimated "normal" seasonal high groundwater is greater than 5 feet and not anticipated to influence the roadway design.

5.0 LABORATORY TESTING

5.1 General

A brief description of laboratory testing procedures is presented on **Exhibit B-1**. The results of laboratory testing, including moisture content and grain size distribution, are presented on the Summary of Laboratory Testing for included as **Exhibit B-2**.

5.2 Environmental Corrosion Testing

Corrosion series testing was performed on three samples of soil obtained from along Main Street. The testing included determination of soil resistivity, pH, sulfate content, and chloride content conducted in accordance with the FDOT recommended *Florida Method*. The testing results are presented on the Summary of Corrosion Series Testing table included as **Exhibit B-3**. The environmental classification was determined in accordance with Section 1.3 of the 2022 *FDOT Structures Design Guidelines*.

6.0 RECOMMENDATIONS

6.1 Existing Soils

The following include our recommendations for the different roadway soil strata encountered during the exploration:

- The material from strata 1 through 3 represent select (S) materials as defined by the FDOT Standard Plans Index and are considered satisfactory for reuse.
- Materials from stratum 3 are likely to retain excess moisture and be difficult to dry and compact.
- We recommend that if soil is excavated, it should be reused only in accordance with *FDOT Standard Plans index 120-001*.

6.2 Pavement Design Option

Given the majority of core locations contained full-depth cracks, the potential for reflective cracking can be reduced by a mill and overlay option but can only be eliminated by complete removal of the existing asphalt with reworking (improvement or replacement) of the existing base. From our understanding of the project, we understand that the grade will need to be lowered approximately 8-inches. Therefore, we believe a complete removal and replacement will be necessary.

6.3 Pavement Design

Based on our further discussions with Matrix, we understand that the pavement section should be designed to allow lowering the proposed grade line by about 6 to 8 inches below existing.

Required Structural Number (SN_R) – Pavement thickness were developed using the *FDOT Flexible Pavement Manual (2022)* with the following input parameters:

Parameter	Value
AADT [1]	4,500
Design Year [1]	2045
Design Traffic Speed	25 mph
Truck Factor	7%
Traffic Level	B
Reliability	90%
Resilient Modulus (M_R) [2]	12,000 psi
ESAL	1,100,000

1. Parameter provided by Matrix (100,000 ESALs was assumed for the shoulder design)
2. Resilient Modulus is estimated based on the 90% method, using DCP to LBR to Resilient Modulus (M_R) correlations.

Based on the above values and the recommendations in the *FDOT Flexible Pavement Design Manual, 2022*, we have calculated a Required Structural Number (SN_R) of **2.94** for travel lanes and **1.97** for shoulders.

Calculated Structural Number (SN_C) – The following presents our calculated structural number based on the associated layer coefficients recommended by the *FDOT Flexible Pavement Design Manual, 2022*:

Layer Description	Assumed Material Type	Structural Coefficient	Layer Thickness (Inches)	Layer Structural Number
TRAVEL LANES – TYPICAL				
Structural Course	SP-9.5	0.44	2.00	0.88
Base	Optional Base Group 6	0.18	8.0	1.44
Subgrade	Limerock Stabilized Silty Sand (A-2-4) Design LBR 40 [2]	0.06	12.0	0.72
Total SN_C				**3.04**
SHOULDERS – TYPICAL				
Structural Course	SP-9.5	0.44	1.50	0.66
Base	Optional Base Group 6	0.18	8.0	1.44
Subgrade	Limerock Stabilized Silty Sand (A-2-4) Design LBR 40 [2]	0.06	12.0	0.72
Total SN_C				**2.82**

1. Subgrade design LBR value is based on DCP correlations of subgrade material encountered.

Typical Section Descriptions – Based on the calculations above, we recommend the following Typical Section Descriptions:

TRAVEL LANES – TYPICAL
OPTIONAL BASE GROUP 6
AND TYPE SP STRUCTURAL COURSE (TRAFFIC B) (2.0")

SHOULDERS – SHOULDERS
OPTIONAL BASE GROUP 6
AND TYPE SP STRUCTURAL COURSE (TRAFFIC B) (1.5")

6.4 Design and Construction Considerations

We recommend the following construction and design considerations be reviewed and integrated into the project:

- A note should be added to the plans alerting the contractor to the presence of an ARMI layer on Main Street which is anticipated to cause difficult milling conditions.
- Pavement section is to be constructed in accordance with the latest *FDOT Standard Specifications for Road and Bridge Construction*.

7.0 REPORT LIMITATIONS AND GENERAL CONSIDERATIONS

This report has been performed for the exclusive use of our client for specific information applicable to the subject project. Our conclusions and recommendations have been prepared using generally accepted standards of geotechnical engineering practice in the area. No other warranty is expressed or implied. Terracon is not responsible for the conclusions, opinions, or recommendations of others based on the data provided.

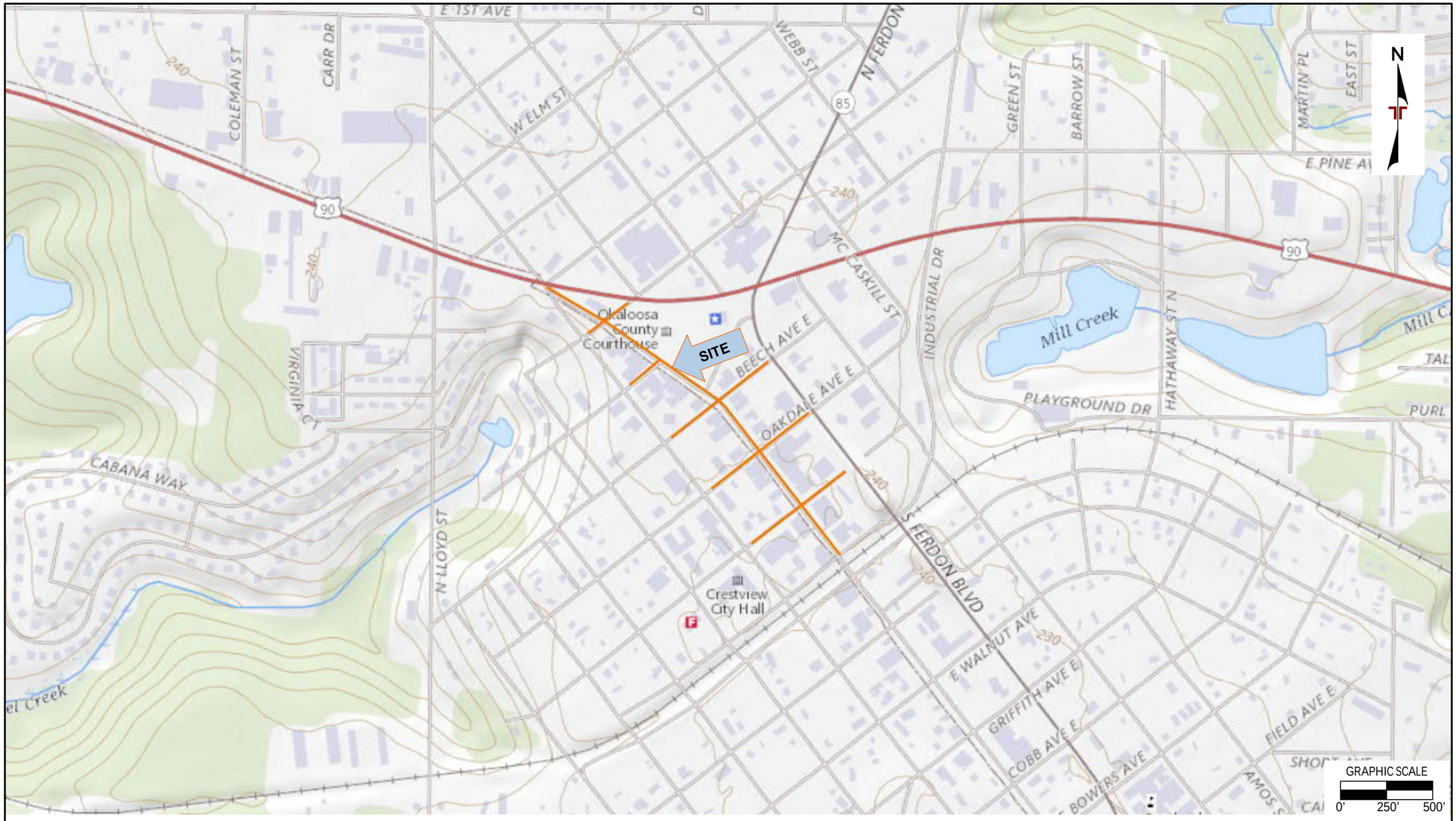
The scope of our services did not include, either specifically or implied, any environmental or biological assessments or investigations for the possible presence of pollutants, hazardous or toxic materials in the soil, groundwater or surface water within or in the general vicinity of the site studied. Any statements made in this report or shown on the Boring Logs regarding unusual subsurface conditions and / or subsurface materials are strictly for the information of our client and may not be indicative of an environmental problem.

The analysis and recommendations presented in this report are based on the design information furnished to us; data obtained from this subsurface exploration as described herein, and our previous experience. They do not reflect variations in the subsurface conditions which may occur across the site. that are likely to exist away from our borings and in unexplored areas of the site. These variations result from the inherent variability of the subsurface conditions in this geologic region or due to the modifying effects of construction or weather. If such variations become apparent during construction, it will be necessary for us to reevaluate our conclusions and recommendations based on an on-site observation of the conditions.

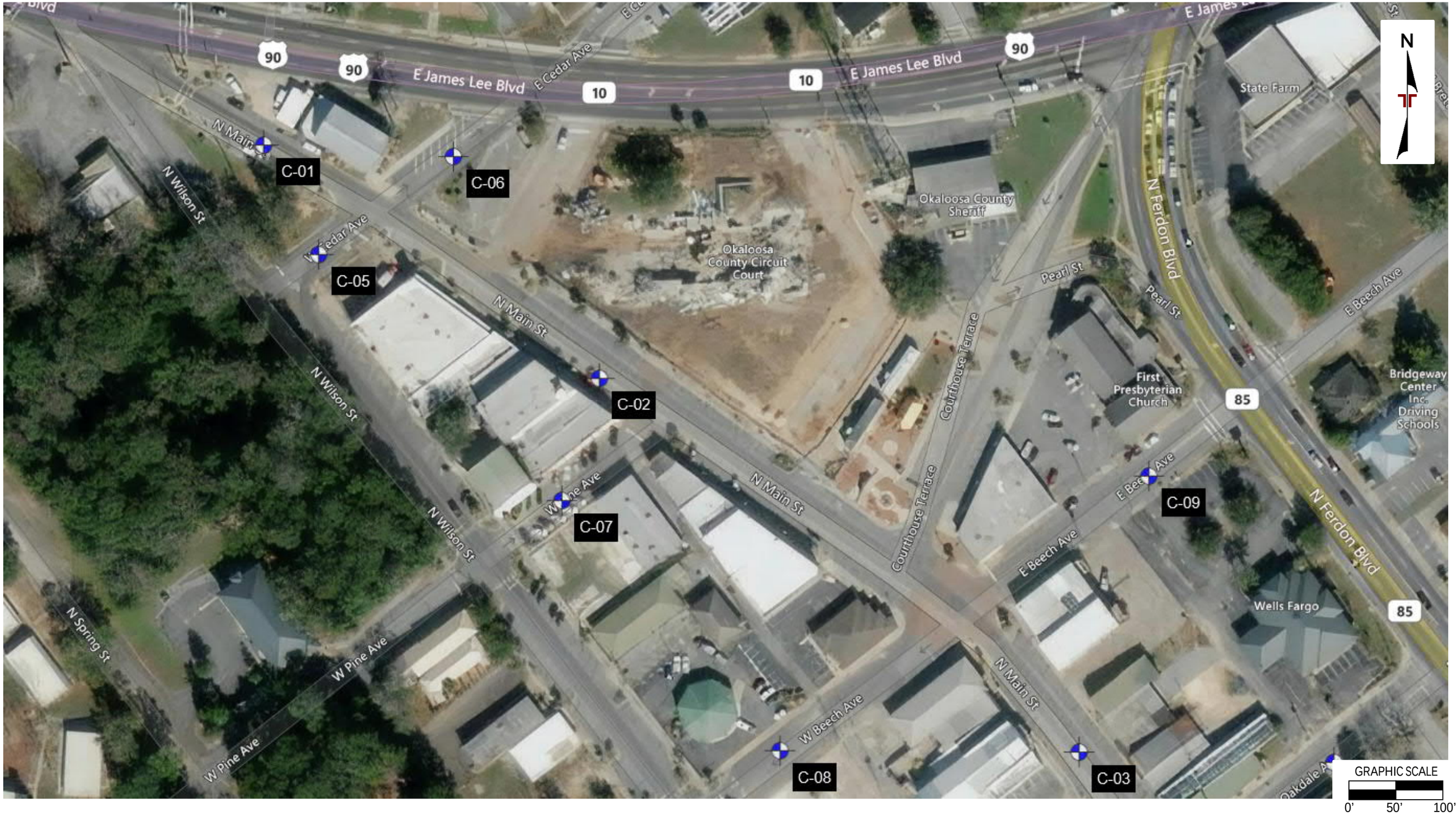
If the overall design or if the proposed site layout is changed, the recommendations contained in this report must not be considered valid unless our firm reviews the changes and our recommendations are modified or verified in writing. When the design is finalized, we should be retained to review the plans and applicable portions of the project specifications. This review would allow us to check whether these documents are consistent with the intent of our recommendations.

APPENDIX A

Field Exploration Results



Project Manager: DTM	Project No. HF225056	Terracon Consulting Engineers & Scientists 3559 TIMBERLANE SCHOOL ROAD TALLAHASSEE, FLORIDA 32312 PH. (850) 692-7185 FAX. (850) 692-7186	PROJECT LOCATION MAP MAIN STREET IMPROVEMENTS CITY OF CRESTVIEW OKALOOSA COUNTY, FLORIDA	EXHIBIT A-1
Drawn by: DTM	Scale: AS SHOWN			
Checked by: JBK	File Name: Main St Loc Map			
Approved by: JBK	Date: 6/28/22			



LEGEND

CORE / BORING LOCATION

Project Manager: DTM	Project No. HF225056	Terracon Consulting Engineers & Scientists	FIELD EXPLORATION PLAN
Drawn by: DTM	Scale: AS SHOWN	3559 TIMBERLANE SCHOOL ROAD TALLAHASSEE, FLORIDA 32312	MAIN STREET IMPROVEMENTS
Checked by: JBK	File Name: Main St Loc Map	PH. (850) 692-7185 FAX. (850) 692-7186	CITY OF CRESTVIEW
Approved by: JBK	Date: 6/28/22		OKALOOSA COUNTY, FLORIDA

EXHIBIT A-2A

LEGEND

CORE / BORING LOCATION

Project Manager:	DTM
Drawn by:	DTM
Checked by:	JBK
Approved by:	JBK
Project No.	HF225056
Scale:	AS SHOWN
File Name:	Main St Loc Map
Date:	6/28/22

Terracon
Consulting Engineers & Scientists
3559 TIMBERLANE SCHOOL ROAD
TALLAHASSEE, FLORIDA 32312
PH. (850) 692-7185 FAX. (850) 692-7186

FIELD EXPLORATION PLAN

MAIN STREET IMPROVEMENTS
CITY OF CRESTVIEW
OKALOOSA COUNTY, FLORIDA

EXHIBIT
A-2B

EXHIBIT A-3
PAVEMENT CORE AND CONDITION SUMMARY
MAIN STREET IMPROVEMENTS
CITY OF CRESTVIEW
OKALOOSA COUNTY, FLORIDA
TERRACON PROJECT NO. HF225056

Location			Pavement Layer Thickness (in)						Pavement Condition					
Core #	Centerline Station	Lane (EB/WB)	SP	ARMI	S-3	Binder	SAHM	T-III	Core Length (in)	Base Type [1]	Base Thickness (in)	Crack Depth (in)	Rut Depth (in)	Pvmnt Cond.[2]
1	12+20	NB	2.50			1.50	9.00		13.00	SAHM	0.0	13.00	0.125	F
2	16+55	SB	1.30	0.20	0.75	1.00	8.50		11.75	SAHM	0.0	11.75	0.000	F
3	23+10	NB	1.50	0.25	0.75		8.25		10.75	SAHM	0.0	10.75	0.000	F
4	31+10	SB	1.40	0.20		0.90	9.40		11.90	SAHM	0.0	0.00	0.000	F
5	19+20	EB	2.40		0.35	1.25	7.75		11.75	SAHM	0.0	11.75	0.000	F
6	21+00	EB	1.30		1.20	1.50	6.50		10.50	SAHM	0.0	10.50	0.000	F
7	18+50	EB	0.90						0.90	SC	3.0	0.00	0.125	P
8	27+50	EB	1.10						1.10	SC	5.5	1.10	0.000	F
9	32+40	WB	1.00					1.00	1.00	SC	12.0	0.00	0.000	F
10	37+60	WB	2.15		0.35				2.50	SC	11.0	2.50	0.000	F
11	42+05	WB	1.75					0.50	1.75	SC	4.0	0.00	0.000	F
12	47+50	WB	1.30		1.10				2.40	SC	6.1	0.00	0.000	F
13	52+10	WB	3.00						3.00	SC	9.0	3.00	0.000	F

Notes: 1. In locations where SAHM was included as part of the pavement core, no base thickness has been included.
2. Pavement condition is based on visual assessment of pavement condition, crack class and extent, and rut depth.

EXHIBIT A-4
EXISTING STRUCTURAL NUMBER CALCULATION
MAIN STREET IMPROVEMENTS
CITY OF CRESTVIEW
OKALOOSA COUNTY, FLORIDA
TERRACON PROJECT NO. HF225056

Core #	SP		ARMI		S-3		Binder		SAHM		T-III		Core Length (in)	Pvmnt Cond.	Base			Subgrade		Total Structural Number
	T1 (in)	Coeff 1	T2 (in)	Coeff 2	T3 (in)	Coeff 3	T4 (in)	Coeff 4	T5 (in)	Coeff 5	T6 (in)	Coeff 6			Type	TB (in)	Coeff. B	TS (in)	Coeff. S	
Main Street																				
1	2.50	0.25					1.50	0.20	9.00	0.11			13.00	Fair	-	0.00	0.00	12.00	0.08	2.88
2	1.30	0.25	0.20	0.00	0.75	0.25	1.00	0.20	8.50	0.11			11.75	Fair	-	0.00	0.00	12.00	0.08	2.61
3	1.50	0.25	0.25	0.00	0.75	0.25			8.25	0.11			10.75	Fair	-	0.00	0.00	12.00	0.08	2.43
4	1.40	0.25	0.20	0.00			0.90	0.20	9.40	0.11			11.90	Fair	-	0.00	0.00	12.00	0.08	2.52
																			Average	2.61
Cedar Avenue																				
5	2.40	0.25			0.35	0.25	1.25	0.20	7.75	0.11			11.75	Fair	-	0.00	0.00	12.00	0.08	2.75
6	1.30	0.25			1.20	0.25	1.50	0.20	6.50	0.11			10.50	Fair	-	0.00	0.00	12.00	0.08	2.60
																			Average	2.68
West Pine Avenue																				
7	0.90	0.25											0.90	Poor	SC	3.00	0.12	12.00	0.08	1.55
Beech Avenue																				
8	1.10	0.25											1.10	Fair	SC	5.50	0.12	12.00	0.08	1.90
9	1.00	0.25									1.00	0.20	2.00	Fair	SC	12.00	0.12	12.00	0.08	2.85
																			Average	2.37
Oakdale Avenue																				
10	2.15	0.25			0.35	0.25							2.50	Fair	SC	11.00	0.12	12.00	0.08	2.91
11	1.75	0.25									0.50	0.20	2.25	Fair	SC	4.00	0.12	12.00	0.08	1.98
																			Average	2.44
Woodruff Avenue																				
12	1.30	0.25			1.10	0.25							2.40	Fair	SC	6.10	0.12	12.00	0.08	2.29
13	3.00	0.25											3.00	Fair	SC	9.00	0.12	12.00	0.08	2.79
																			Average	2.54

Note: 1. Structural coefficients are based on visual pavement classification and condition in accordance with *FDOT Flexible Pavement Design Manual 2022* .

REPORT OF TESTS

DATE OF SURVEY: MAY 2022

SURVEY MADE BY: TERRACON CONSULTANTS, INC.

SUBMITTED BY: JOHN B. KIMBERLY IV, P.E.

PROJECT NAME: MAIN STREET IMPROVEMENTS

CROSS SECTION SOIL SURVEY FOR THE DESIGN OF ROADS

SURVEY BEGINS STA.: 10+00 SURVEY ENDS STA.: 31+58

REFERENCE: CENTERLINE CONSTRUCTION

ROAD NO.: MAIN STREET

COUNTY: OKALOOSA

	ORGANIC CONTENT		MOISTURE CONTENT		SIEVE ANALYSIS RESULTS % PASS						ATTERBERG LIMITS (%)					CORROSION TEST RESULTS				
STRATUM NO.	NO. OF TESTS	% ORGANIC	NO. OF TESTS	MOISTURE CONTENT	NO. OF TESTS	10 MESH	40 MESH	60 MESH	100 MESH	200 MESH	NO. OF TESTS	LIQUID LIMIT	PLASTIC INDEX	AASHTO GROUP	MATERIAL DESCRIPTION	NO. OF TESTS	RESISTIVITY ohm-cm	CHLORIDES ppm	SULFATES ppm	pH
1	-	-	2	4-5	2	100	58-65	27-29	13-14	8-10	-	-	NP	A-3	TAN FINE SAND	2	16,520-68,145	50-63	BD	7.5
2	-	-	2	4-5	2	85-100	58-65	32	17-19	11-13	-	-	NP	A-2-4	TAN AND BROWN SILTY FINE SAND	1	7434.000	50.000	BD	7.5
3	-	-	3	7-9	3	97	55-69	36-48	25-34	21-28	-	-	NP	A-2-4	BROWN AND ORANGE SILTY FINE SAND	-	-	-	-	-

EMBANKMENT AND SUBGRADE MATERIAL

STRATA BOUNDARIES ARE APPROXIMATE MAKE FINAL CHECK AFTER GRADING

▼ = WATER TABLE ENCOUNTERED

GNE = GROUNDWATER NOT ENCOUNTERED

NOTES:

1) SOIL BOUNDARIES ARE APPROXIMATE AND REPRESENT SOIL STRATA AT EACH BORING LOCATION ONLY.

2) THE SYMBOL "-" REPRESENTS AN UNMEASURED PARAMETER.

3) THE MATERIAL FROM STRATA 1 THROUGH 3 REPRESENT SELECT (S) MATERIALS AS DEFINED BY THE FDOT STANDARD PLANS INDEX.

4) STRATUM 2 IS LIKELY TO RETAIN EXCESS MOISTURE AND BE DIFFICULT TO DRY AND COMPACT.

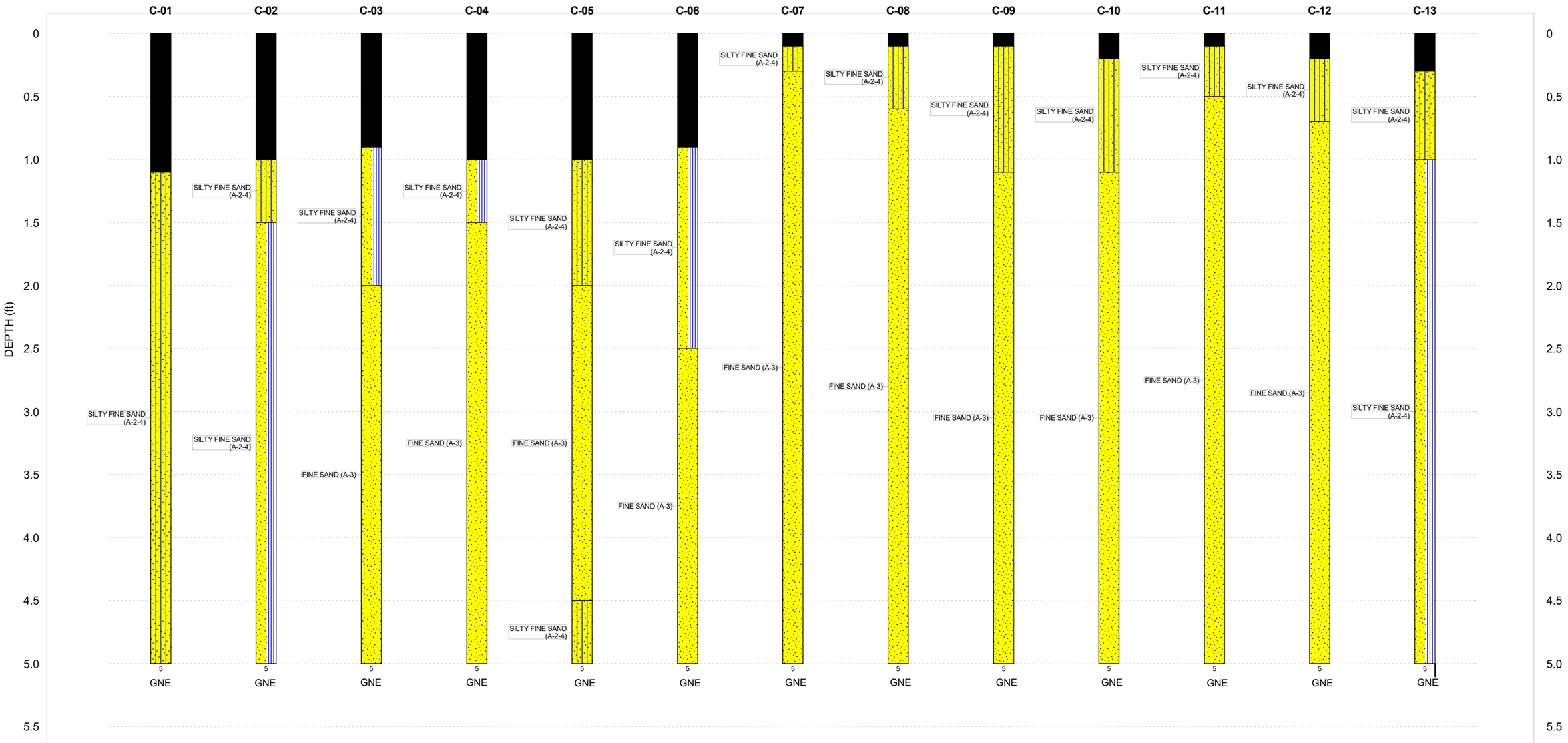
5) SOIL UTILIZED IN EMBANKMENT CONSTRUCTION SHALL BE IN ACCORDANCE WITH FDOT STANDARD PLAN INDEX 120-001.

Exhibit A-5

REVISIONS					
DATE	DESCRIPTION	DATE	DESCRIPTION		
				JOHN B. KIMBERLY IV, P.E. P.E. LICENSE NUMBER 49866 TERRACON 3559 TIMBERLANE SCHOOL ROAD TALLAHASSEE, FLORIDA 32312	OKALOOSA COUNTY PROJECT MAIN STREET IMPROVEMENTS

ROADWAY SOIL SURVEY

SHEET NO.



SPT Soil Classification Legend

- Asphalt
- Silty Sand
- Poorly-graded Sand with Silt
- Poorly-graded Sand

NOTES:

See Exhibit A-2 for boring plan.
See General Notes in Appendix C for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ.
GNE - Groundwater Not Encountered

Project Manager:	Project No.: HF225056
Drawn by: DTM	Scale: N.T.S.
Approved by: JBK	File Name: Main St Prof
Date: 7/5/2022	

Terracon
3559 Timberlane School Rd
Tallahassee, FL
PH. 850-692-7185 FAX. 850-692-7186

SUBSURFACE PROFILE

GENERALIZED BORING PROFILE
MAIN STREET IMPROVEMENTS
MAIN STREET
CRESTVIEW, FLORIDA

EXHIBIT

A-6

Field Exploration Procedures

The field exploration program for this report consisted of drilling 13 pavement cores in conjunction with soil borings through the existing roadway. Each boring was performed to a depth of approximately 5 feet below the existing ground surface. The boring and pavement core locations were selected and laid out on the site by a Terracon representative based on the project information provided by Matrix. Each sampling location was recorded by hand-held GPS.

Pavement Cores – The general location of each pavement core was determined by Terracon personnel and included one core in alternating lanes approximately every 1,500 feet. Our pavement survey was performed on May 31st, 2022. Core samples and pavement evaluation were conducted in general accordance with the *FDOT Flexible Pavement Condition Survey Handbook (2022)* and Section 3.2 of the *FDOT Materials Manual (2022)*.

Pavement cores were cut from the existing roadway using a nominal 4-inch diameter core barrel advanced by a trailer-mounted rotary coring machine. The approximate thickness of the asphalt and base materials were recorded on site. To estimate the existing structural number, a Dynamic Cone Penetrometer (DCP) test sounding (ASTM D6951) was performed to a depth of approximately 24-inches below top of pavement in the underlying subgrade soils. The results of the DCP tests were used to correlate a base and subgrade Limerock Bearing Ratio (LBR). Samples of base and subgrade soils were collected to a depth of 5-feet using a hand-auger and taken to Terracon's laboratory for index property testing. Additional pavement observations were recorded at each pavement core location including rut depth, crack depth, and crack type. Pavement cores were then backfilled with bentonite-grout and pavement was patched with cold-mix asphalt patch.

Soil Borings – The standard hand auger boring procedure consists of manually turning a 3-inch diameter, 6-inch long bucket type auger sampler into the soil until full. The sampler is then retrieved and the soils in the sampler visually examined and classified. This procedure is repeated until the desired termination depth is achieved.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Portions of the samples from each of the borings were placed in glass jars to reduce moisture loss and taken to our laboratory for further observation and classification. Upon completion, the boreholes were backfilled with soil cuttings.

APPENDIX B

Laboratory Testing

Laboratory Testing Procedures

General - During the field exploration, a portion of each recovered soil sample was placed in glass jars and transported to our laboratory for further visual observation and laboratory testing. Representative samples were tested for moisture content and grain size distribution. The visual-manual classifications for soil samples were modified as appropriate based upon the laboratory testing results.

The results of the laboratory testing are presented on the following in the **Appendix**:

- Exhibit B-2 Summary of Laboratory Testing for Roadway
- Exhibit B-3 Summary of Corrosion Series Testing

The soil samples were classified in general accordance with the AASHTO soil classification system based on the material's texture and plasticity. A brief description of the soil classification system is included as **Exhibit B-4**. The following are brief descriptions of the laboratory testing procedures performed during this study.

Moisture Content - To determine the moisture content of the selected soil sample, the test specimen was dried in an oven to constant mass in general accordance with AASHTO T 265. The water content was then calculated using the mass of the water and the mass of the dry specimen. The water content is used to express the phase relationship of air, water, and solid in a given volume of material.

Grain Size Distribution - To conduct this test, a sample is dried and then shaken over various standard sieve sizes. The weight of soil retained on each sieve is measured and cumulative percentage by weight passing each sieve is calculated. In the case of the fines content testing, the dried sample was washed over a No. 200 mesh sieve and the dry weight of the sample remaining on the sieve was used to determine the percentage passing the No. 200 mesh sieve, which is the silt and/or clay content of the sample. This testing was conducted in general accordance with AASHTO T 088.

pH - The pH is an expression of the concentration of the dissociated hydrogen ions present in aqueous solution. The pH values range from 1 to 14 with values below 7 indicating acidic conditions and values above 7 indicating alkaline conditions. This test is performed using a calibrated electronic pH meter with a sensing probe. The meter is calibrated by immersing the probe in a solution with a known pH. The soil pH is determined by mixing equal weights of soil and distilled water and testing the supernatant solution with the pH probe. The testing was conducted in general accordance with FM 5-550.

Electrical Resistivity - Resistivity is a measure of the resistance to flow of electrical current through the soil. Resistivity, the inverse of conductivity, is measured in units of ohm-centimeters. This measurement was performed with a soil box and a soil resistance meter. The testing was conducted in general accordance with FM 5-551.

Chloride Content - The chloride content of the sample was determined by titration with mercuric nitrate. The soil was rinsed with an amount of distilled water equal in weight to the dry soil. The soil was then removed from the water (which consisted of distilled water and natural soil moisture) and the silver nitrate titration was performed on the water. The testing was conducted in general accordance with FM 5-552.

Sulfate Content - The sulfate content of the sample was determined turbidimetrically. The soil was rinsed with an amount of distilled water equal in weight to the dry soil. The soil was then removed from the water (which consisted of distilled water and natural soil moisture) and the turbidity of the water was determined using a photometer. The turbidity gives an indirect indication of the sulfate content. The testing was conducted in general accordance with FM 5-553.

EXHIBIT B-2
SUMMARY OF LABORATORY TESTING FOR ROADWAY
MAIN STREET IMPROVEMENTS
CITY OF CRESTVIEW
OKALOOSA COUNTY, FLORIDA
TERRACON PROJECT NO. HF225056

Boring Number	Sample Depth (Feet)	Percent Passing (%) US Standard Sieve					Moisture Content (%)	Atterberg Limits			AASHTO Soil Classification	Stratum Number
		10	40	60	100	200		LL	PL	PI		
C-01	1.1 - 1.6	97	69	48	34	28	9	-	NP	-	A-2-4	3
C-02	1.5 - 2.0	100	65	32	17	11	4	-	NP	-	A-2-4	2
C-03	0.9 - 1.4	85	58	32	19	13	5	-	NP	-	A-2-4	2
C-06	4.0 - 4.5	100	58	27	13	8	5	-	NP	-	A-3	1
C-08	0.2 - 0.7	97	66	43	27	23	7	-	NP	-	A-2-4	3
C-10	1.2 - 1.7	100	65	29	14	10	4	-	NP	-	A-3	1
C-12	0.3 - 0.8	97	55	36	25	21	7	-	NP	-	A-2-4	3

Note: 1. NP indicates that the material is non-plastic

EXHIBIT B-3
SUMMARY OF CORROSION SERIES TESTING
MAIN STREET IMPROVEMENTS
CITY OF CRESTVIEW
OKALOOSA COUNTY, FLORIDA
TERRACON PROJECT NO. HF225056

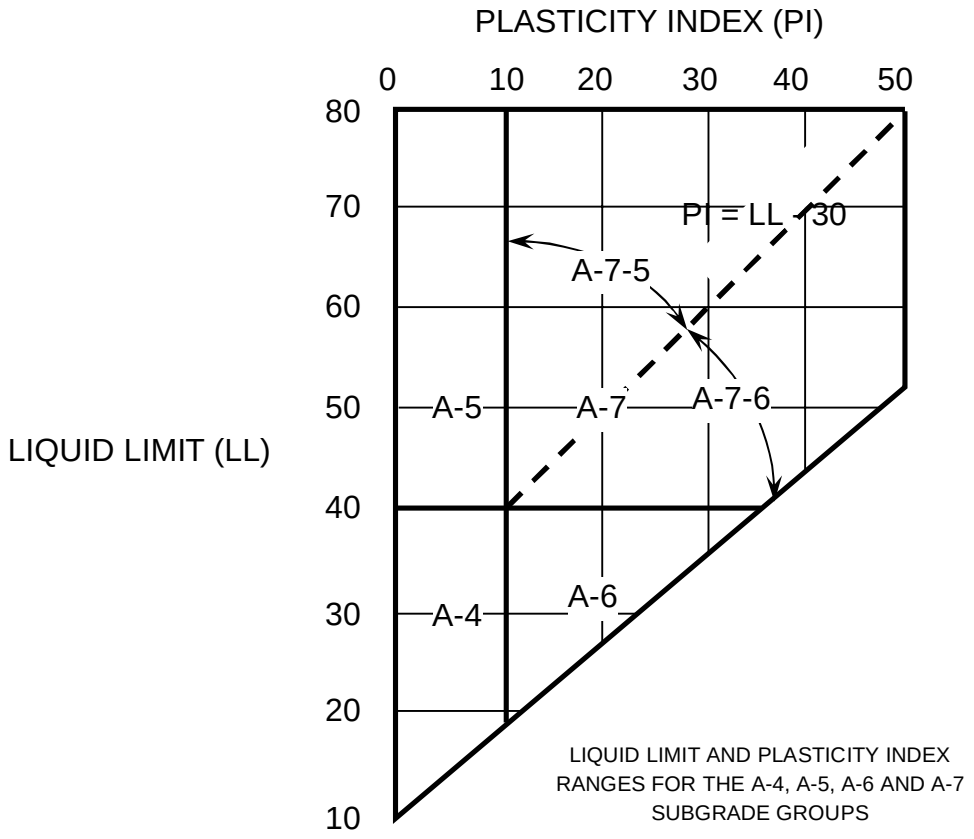
Station (Boring)	Depth Range (ft)	Material Tested (AASHTO)	pH	Chloride Content (ppm)	Sulfate Content (ppm)	Electrical Resistivity (ohm-cm)	Substructure Environmental Classification [1]	
							Steel	Concrete
Sta. 12+20 (C-01)	1.6-2.1	A-3	7.5	50	BD [2]	68,145	Slightly Aggressive	Slightly Aggressive
Sta. 23+10 (C-03)	2.0-2.5	A-3	7.5	63	BD [2]	16,520	Slightly Aggressive	Slightly Aggressive
Sta. 31+10 (C-04)	1.0-1.5	A-2-4	7.5	50	BD [2]	7,434	Slightly Aggressive	Slightly Aggressive

Note: 1. Environmental classification was determined in accordance with Section 1.3 of the 2022 FDOT Structures Design Guidelines.
2. BD indicates that testing result was below detection.

AASHTO SOIL CLASSIFICATION SYSTEM

Group	Subgroup	Percent Passing U.S. Sieve No.			Character of Fraction Passing No. 40 Sieve		Group Index No.[3]
		10	40	200	Liquid Limit (LL)	Plasticity Index (PI)	
A-1			50 Max.	25 Max.	-	6 Max.	0
	A-1-a	50 Max.	30 Max.	15 Max.	-	6 Max.	0
	A-1-b		50 Max.	25 Max.	-	6 Max.	0
A-2[1]				35 Max.			0 to 4
	A-2-4			35 Max.	40 Max.	10 Max.	0
	A-2-5			35 Max.	41 Min.	10 Max.	0
	A-2-6			35 Max.	40 Max.	11 Min.	4 Max.
	A-2-7			35 Max.	41 Min.	11 Min.	4 Max.
A-3	-		51 Min.	10 Max.	-	Non-Plastic	0
A-4	-	-	-	36 Min.	40 Max.	10 Max.	8 Max.
A-5	-	-	-	36 Min.	41 Min.	10 Max.	12 Max.
A-6	-	-	-	36 Min.	40 Max.	11 Min.	16 Max.
A-7[2]				36 Min.	41 Min.	11 Min.	20 Max.
	A-7-5			36 Min.	41 Min.	11 Min.	20 Max.
	A-7-6			36 Min.	41 Min.	11 Min.	20 Max.
A-8	HIGHLY ORGANIC SOIL (Qualifying Minimum Organic Content Varies by Region – Typically > 5% by Weight)						

1. Group A-2 includes all soils having 35% or less passing the #200 sieve that cannot be classified as A-1 or A-3
2. PI of A-7-5 subgroup is equal to or less than LL – 30. PI of A-7-6 subgroup is greater than LL - 30
3. Group Index GI = (F – 35)[0.2 + 0.005(LL – 40)] + 0.01 (F – 15)(PI – 10) where F = % passing #200 sieve.



LIQUID LIMIT AND PLASTICITY INDEX RANGES FOR THE A-4, A-5, A-6 AND A-7 SUBGRADE GROUPS

Exhibit B-4