Florida Department of TRANSPORTATION

Preliminary Soil Survey Report

Malabar Road (SR 514) PD&E Study
From East of Babcock Street (SR 507) to US 1
Brevard County, Florida

FPID: 430136-1-22-01

ETDM: 13026

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. §327 and a Memorandum of Understanding (MOU) dated December 14, 2016 and executed by the Federal Highway Administration and FDOT.

October 2013

PRELIMINARY SOIL SURVEY REPORT
STATE ROAD 514 PD&E STUDY
STATE ROAD 507 to US 1
BREVARD COUNTY, FLORIDA
FDOT Financial Project ID No. 430136-1-22-01

AEA PROJECT No. 201311

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ANTILLIAN
ENGINEERING ASSOCIATES, INC.

October 7, 2013

Atkins North America, Inc.
482 South Keller Road
Orlando, Florida 32810

Attention: Lance Decuir, P.E.

Reference: Preliminary Soil Survey Report
State Road 514 Malabar Road PD&E Study
State Road 507 to US 1
Brevard County, Florida
FDOT Financial Project No. 430136-1-22-01
AEA Project No. 201311

Mr. Decuir:

Antillian Engineering Associates, Inc. has completed a geotechnical engineering investigation for the Project Development and Environment (PD&E) Study for the proposed widening of State Road 514 (Malabar Road) from State Road 507 (Babcock Street) to US 1 in Brevard County, Florida. The investigation was conducted in general accordance with the scope of services negotiated with the Florida Department of Transportation on January 22, 2013. This report contains the results of the investigation, a preliminary assessment of encountered soils as they relate to roadway design and other concerns as appropriate.

It has been our pleasure to serve Atkins and the District Five office of the Florida Department of Transportation on this project. Please call if you have any questions or if you need additional information.

ANTILLIAN ENGINEERING ASSOCIATES, INC.
Certificate of Authorization No. EB 6685

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Geotechnical Engineer

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10.07.2013

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Attachments: Figures
Appendix A: Field and Laboratory Investigations
Appendix B: Important Information About Your Geotechnical Engineering Report
Appendix C: Constraints and Restrictions

PROJECT DESCRIPTION

The Florida Department of Transportation ("FDOT") is planning to widen State Road 514 ("SR 514") also known as Malabar Road in Brevard County. The project limits extend from about 1,000 feet east of SR 507 (Babcock Street) to US Route 1 for an overall length of about 3.7 miles. The approximate project alignment is shown on Figure 1.

It is our understanding that the roadway will be widened to the south within its current right-of-way.

The Orlando, Florida office of Atkins was selected by FDOT District Five to conduct the Project Development and Environment (PD&E) Study for this project. Antillian Engineering Associates, Inc. ("AEA") was retained by Atkins to provide geotechnical engineering services to support the study and conceptual-level design.

AVAILABLE INFORMATION

The United States Geological Survey (USGS) quadrangle topographic maps for the area and the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Soil Survey of Brevard County, Florida were reviewed to obtain general information about the project area. Preliminary project information furnished by Atkins was also examined for additional information.

The USGS maps (reproduced as Figure 1) showed the project alignment surrounded by a broad, low-lying partially wooded area interspersed with irregularly-shaped drainageways and swamps. Ground surface elevations were mapped mostly near the Elevation 20 feet NGVD (El. 20) contour, with slightly higher elevations near the western end of the alignment and on a few isolated knolls and ridges near the eastern end. Babcock Street (identified as SR 507), the current SR 514 alignment and US 1/SR 5 were depicted on the map. Single-family residential, light commercial developments and the Florida East Coast Railroad were shown west of US 1/SR 5.

The NRCS Soil Survey map (reproduced as Figure 2) showed near-surface soils along the western portion of the alignment that were typical of areas of broad, low ridges, wooded plains and low knolls. Broad areas of EauGallie sand and Oldsmar sand were mapped between Babcock Street and the central portion of the alignment. These soil units were described as being nearly level and poorly drained, with seasonal high groundwater levels reported near, and often above, the natural ground surface. An isolated area of Basinger sand, depressional was also shown. This soil unit was described as being a nearly level, poorly drained sandy soil that is submerged for most of the year. The map showed surficial soils near the central portion of the alignment that were typical of swamps, marshes and depressional areas. Predominant soil types were reported as Anclote sands, Basinger sand and Immokalee sand. These soil units were described as being nearly level and poorly drained, with seasonal high groundwater levels reported near the natural ground surface. Some areas of Anclote sand were reported to be frequently flooded. Near-surface soils in the vicinity of the eastern portion of the alignment were typical of broad flatwoods and urban land.

Predominant soil types were identified as Myakka sands, Paola sands, Pomello sand and St. Lucie sand. These soil units were described as being nearly level to gently sloping and poorly drained to excessively drained, with seasonal high groundwater levels reported to be within a few feet of the natural ground surface. Isolated areas of depressional soils (Anclote sand and Myakka sand) were shown on the map. Seasonal high groundwater levels for those soil units were reported to be near the natural ground surface.

The preliminary information furnished by Atkins appeared to be an electronic scroll plot of the alignment superimposed on an aerial photograph of the project area. Preliminary roadway stationing, right-of-way boundaries, major cross streets, developed subdivisions and some businesses were depicted, along with wetland and conservation areas, wooded areas and pastures.

[END OF SECTION]

FIELD INVESTIGATION

A field visit was conducted on July 19, 2013, to prepare for the drilling program and observe current field conditions. Boring locations were established in the field using preliminary roadway stationing and scaled dimensions from existing features shown on the aerial photograph furnished by Atkins and other readily-available aerial imagery. Those locations were staked to facilitate identification by the field crew, and for underground utility location and marking as required by Florida Statutes. Some of the planned locations had to be changed due to conflicts with underground utility services or overhead electrical power lines and/or inaccessibility to truck-mounted drilling equipment.

Borings were drilled at approximate 500-foot intervals along the southern side of SR 514 to examine subsurface conditions as they relate to the suitability for roadway construction. The borings were designated "AB-1" through "AB-40" and were drilled in general accordance with ASTM D 1452. The shallow boreholes were advanced using a hand-held bucket auger and were completed to a depth of five feet, while the deep boreholes were advanced using a four-inch-diameter continuous-flight auger powered by a rotary drill rig and were completed to a depth of 20 feet.

Soils and other noteworthy conditions encountered during drilling were logged by the field crew. Representative soil samples were sealed in clean, airtight containers for transportation to our Orlando office. The depth to groundwater in each borehole was measured when encountered and recorded on the field logs. Temporary piezometers were installed to a depth of about ten feet in boreholes AB-2, AB-6, AB-12, AB-20, AB-26, AB-32 and AB-36 to keep them open for periodic groundwater level measurements. The remaining boreholes were backfilled with soil cuttings.

LABORATORY TESTING

Recovered soil samples were examined in our office by a geotechnical engineer who confirmed the descriptions on the field logs, classified the soils visually in accordance with ASTM D 3282 and developed a representation of the soil stratigraphy at each boring location. Representative samples were selected for laboratory testing, which consisted of 15 soil gradation analyses, two Atterberg limits test series, nine natural moisture content tests and six organic content tests. Test results are shown on the Report of Tests sheet, the Summary of Laboratory Test Results sheet and corresponding charts and graphs in Appendix A.

SURFACE CONDITIONS

Most of SR 514 was a nearly level to level, two lane rural roadway raised above the surrounding natural ground surface on a low embankment. It had narrow paved shoulders and turn lanes at most cross streets. Shallow drainage ditches were observed along both sides of the road embankment. At the time of the field investigation, most of the ditches contained standing water of unknown depth except for those near the western and eastern ends of the alignment which were mostly dry. Overhead utility lines were also along both sides of the roadway. The natural ground surface was nearly level to level and mostly undeveloped and included broad pastures and wooded areas. Smaller parcels were developed as either commercial, light industrial or rural residential. The section of SR 514 near Babcock Street was a four-lane urban section with turn lanes, concrete sidewalks and overhead traffic signals, all of which appeared to be recent improvements.

SUBSURFACE CONDITIONS

The stratigraphy, soil types and groundwater levels described below are based on the results of the borings and laboratory testing. The stratigraphy is general. Detailed subsurface characteristics at each boring location are shown on the Report of Tests sheet, the Report of Roadway Auger Boring sheets, the Summary of Laboratory Test Results sheet and the corresponding charts and graphs in Appendix A.

In general, the uppermost materials encountered in most of the borings exhibited a wide range of colors but were mostly brown to very dark brown, gray to very dark gray, grayish brown to dark grayish brown, greenish gray to dark greenish gray, reddish brown and black fine sands that were visually classified as sand and sand with silt. Some of the materials encountered near the ground surface contained trace organic matter, while some of the materials typically encountered below a depth of about eight feet occasionally contained trace to few fine- to coarse-sand size shell fragments. Encountered thicknesses ranged from about five feet to 20 feet. Actual thicknesses could not be confirmed in many borings because they were terminated in this material without penetrating it completely. Gradation analysis of eight samples indicated fines contents (fraction by dry weight passing the U.S. Standard No. 200 sieve) that ranged from 3 percent to 10 percent. Additional testing of two samples that appeared to contain organic matter indicated an organic content of about 3 percent and natural moisture contents of 25 percent and 26 percent. The tests resulted in the American Association of State Highway and Transportation Officials (AASHTO) group designation “A-3” (which includes fine sands that contain trace to little silt). These soils, identified as Stratum 1 on the Report of Tests sheet, are considered select soils in accordance with FDOT Index 505.

Other materials encountered near the ground surface exhibited similar colors and shell content as Stratum 1 soils, but were visually classified as silty sand and clayey sand. Their encountered thicknesses ranged from about five feet to 20 feet. Actual thicknesses could not be confirmed in many borings because they were terminated in this material without penetrating it completely. Gradation analysis of five samples indicated fines contents that ranged from 11 percent to 19

percent. Additional laboratory testing of one sample that appeared to contain some silt indicated that the soil was non-plastic, while additional laboratory testing of another sample that appeared to contain some clay indicated a liquid limit of 25 and a plasticity index value of 8. The tests resulted in the AASHTO group designation "A-2-4" (which includes fine sands that contain some silt or some clay). These soils, identified as Stratum 2, are also considered select soils in accordance with FDOT Index 505.

Very dark brown, very dark gray and black fine sands that appeared to contain some silt and some partially decayed organic matter were also encountered in some borings. Encountered thicknesses ranged from less than a foot to about three feet. Single-sieve gradation analysis of two samples indicated fines contents of 18 percent and 24 percent. Additional testing indicated natural moisture contents that ranged from 37 percent to 68 percent, and organic contents of 15 percent and 27 percent. Because of the partially decayed organic matter, these soils were assigned the AASHTO group designation "A-8". These soils, identified as Stratum 3, are considered non-select soils in accordance with FDOT Index 505.

Groundwater was encountered in the boreholes on the dates drilled at depths that ranged from the existing ground surface to about 12 feet below it, but more typically between depths of two feet and four feet below the existing ground surface when encountered. Groundwater was not encountered in several of the shallow borings which were terminated at a depth of five feet.

PIEZOMETER GROUNDWATER LEVEL MEASUREMENTS

Groundwater depths were measured in the temporary piezometers on July 31, 2013 and August 20, 2013. Measured groundwater depths are tabulated below in Table 1.

TABLE 1
MEASURED GROUNDWATER DEPTHS

Boring	Approximate Station	Approximate Offset	Ground Surface Elevation (feet, NAVD)	Groundwater Depth (feet, BGS)	
				July 31, 2013	August 20, 2013
AB-2	105+00	TBD	TBD	5.7	5.3
AB-6	125+00	TBD	TBD	5.9	5.2
AB-12	155+00	TBD	TBD	4.0	3.3
AB-20	195+00	TBD	TBD	2.7	3.4
AB-26	225+00	TBD	TBD	2.1	2.2
AB-32	255+00	TBD	TBD	0.5	1.2
AB-36	275+00	TBD	TBD	3.9	3.4

Notes: TBD = To Be Determined

BGS = Below Ground Surface

GENERAL COMMENTS ON RECOMMENDATIONS

The following preliminary recommendations are based upon a review of the available information, the limited field and laboratory test results discussed in this report and our experience with similar projects and subsurface conditions. Because soils are natural materials, variations in composition and other physical characteristics are normal and should be expected. It is anticipated that further subsurface explorations will be conducted during future project design stages and it is likely that subsurface conditions encountered during those investigations will differ from those discussed in this report. As a result, the preliminary assessments discussed in the following sections will likely have to be revised as needed to reflect additional information that becomes available. Information compiled for this report should be considered when developing final geotechnical recommendations for roadway design and construction.

PRELIMINARY ASSESSMENT OF ENCOUNTERED SOILS

As discussed earlier in this report, Stratum 1 soils encountered during this investigation were fine sands containing trace to little silt, and occasionally trace organic material. Based on visual classification and laboratory test results, these soils were assigned the AASHTO group designation A-3. Stratum 2 soils were also fine sands but contained some silt or some clay, and based on visual classification and laboratory test results were assigned the AASHTO group designation A-2-4. Both Stratum 1 soils and Stratum 2 soils are considered select soils in accordance with FDOT Index 505. These soils should not adversely affect the design and construction of the roadway. As a result, they may be left in place or reused as select fill in accordance with FDOT Standard Index 505 Embankment Utilization, provided they are not mixed with other, less-desirable materials. Their fines contents suggested that these soils should compact and drain well.

Stratum 3 soils contained some partially decayed organic matter and were assigned the AASHTO group designation A-8. These soils are not considered suitable for use as foundation materials for the roadway, and should be removed and replaced with suitable fill soils in accordance with FDOT Index 500. Stratum 3 soils may be reused in accordance with FDOT Index 505.

It is likely that Stratum 3 soils are present at unexplored locations and may be encountered in greater thicknesses and to greater depths elsewhere on the project. Additional subsurface explorations are expected during future design phases. Those explorations are typically spaced no further than 100 feet apart on both sides of the roadway. More closely spaced explorations should be planned in those parts of the alignment where Stratum 3 soils are indicated in order to explore the presence or absence of those undesirable soils in more detail.

PRELIMINARY ESTIMATE OF SEASONAL HIGH GROUNDWATER LEVELS

During the rainy season in Florida, groundwater levels are generally higher than those observed at other times of the year. The extent of that variation depends on several factors, including the terrain, the intensity and duration of rainfall, hydrogeologic properties of the soils and the presence and proximity of artificial drainage facilities. Preliminary seasonal high groundwater level estimates at each boring location are presented adjacent to the boring profiles shown on the Report of Roadway Auger Borings sheets in Appendix A. As the project design progresses and more information becomes available, preliminary seasonal high groundwater level estimates should be reevaluated.

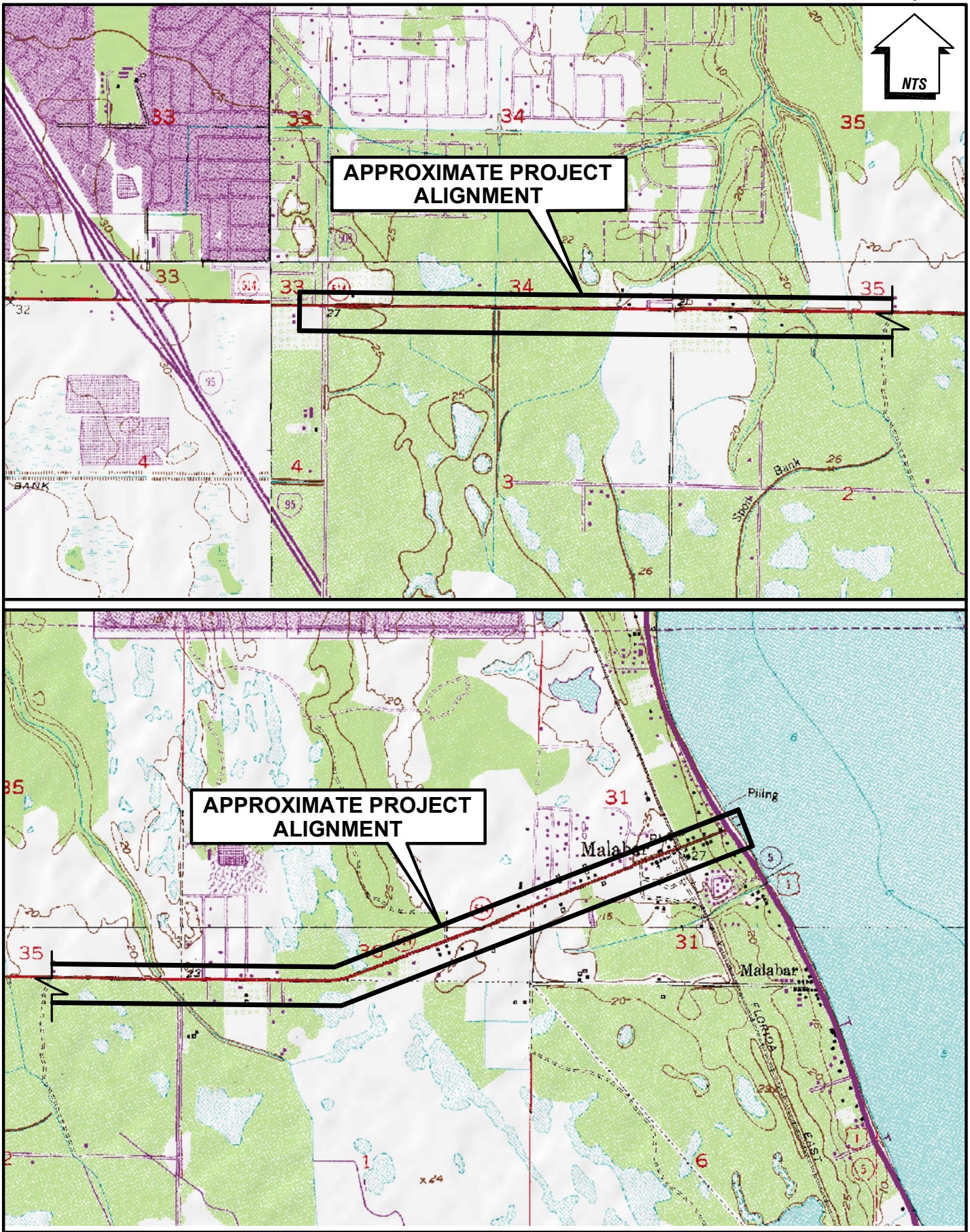
LIMITATIONS

This report presents a preliminary evaluation of the subsurface conditions at the indicated locations on the basis of accepted geotechnical procedures for site characterization. The recovered soil samples were not examined or tested in any way for chemical composition or environmental hazards.

The investigation was confined to the zone of soil that was most likely to be affected by the proposed construction. It did not address the potential of surface expression of deep geologic activity such as sinkholes, which requires more extensive services than those performed for this study.

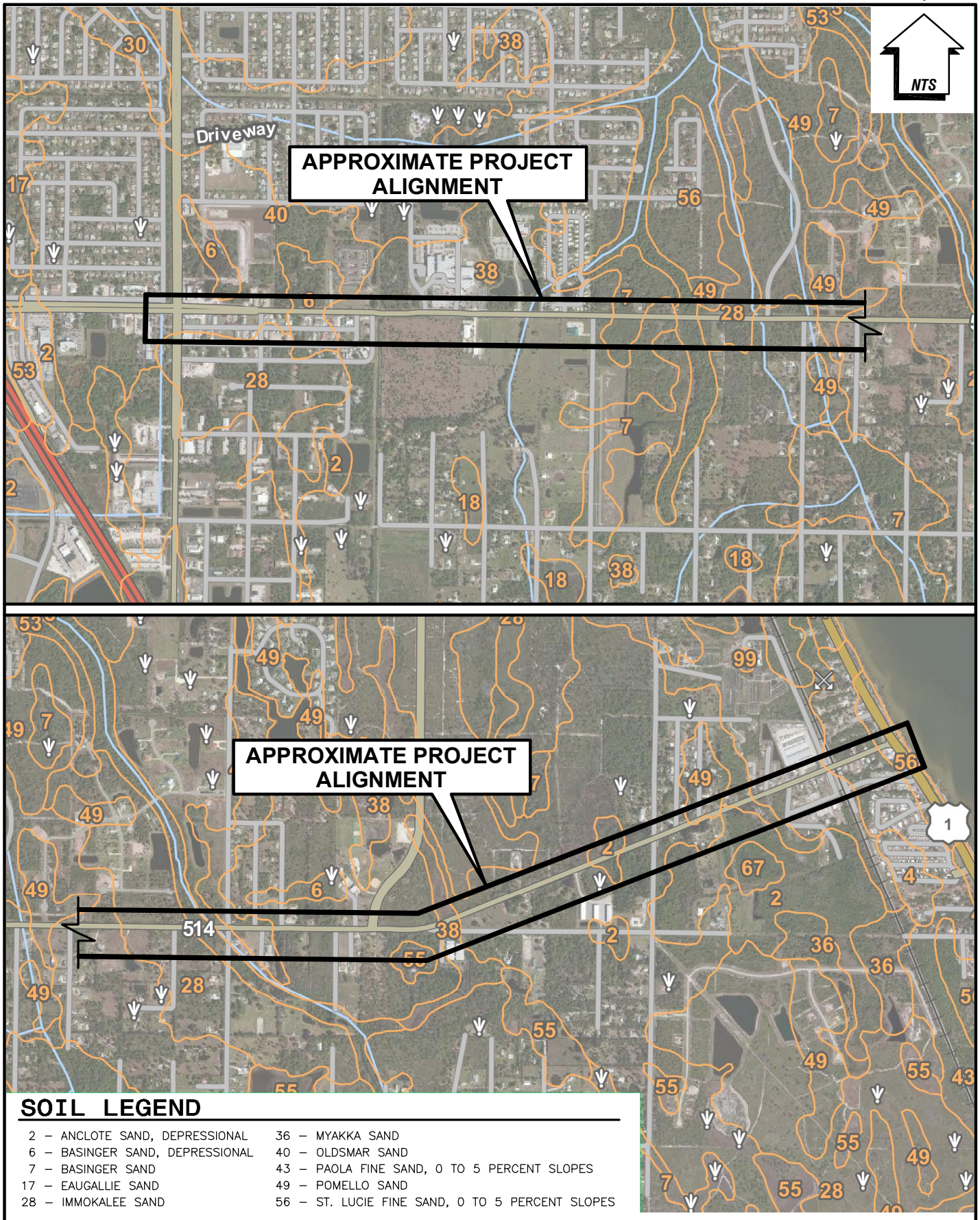
Because of the natural limitations inherent in working below the ground surface, a geotechnical engineer cannot predict and address all possible problems and on most construction projects, ground-related issues not addressed in this report may arise. “Important Information About Your Geotechnical Engineering Report,” a bulletin published by the Association of Engineering Firms Practicing in the Geosciences (ASFE) is provided in Appendix B to help explain the nature of geotechnical engineering issues. Additional narrative is presented in Appendix C to bring to your attention the potential concerns and the basic limitations of a typical geotechnical engineering report.

FIGURES



PROJECT LOCATION MAP

201311	SR 514 PD&E	FIG. 1



SOIL LEGEND

2 – ANCLOTE SAND, DEPRESSIONAL	36 – MYAKKA SAND
6 – BASINGER SAND, DEPRESSIONAL	40 – OLDSMAR SAND
7 – BASINGER SAND	43 – PAOLA FINE SAND, 0 TO 5 PERCENT SLOPES
17 – EAUGALLIE SAND	49 – POMELLO SAND
28 – IMMOKALEE SAND	56 – ST. LUCIE FINE SAND, 0 TO 5 PERCENT SLOPES

Figure developed from UDSA NRCS Soil Survey of Brevard County, Florida, Version 10, June 7, 2012

USDA NRCS SOIL SURVEY MAP

201311	SR 514 PD&E	FIG. 2

APPENDIX A

ROADWAY SOILS SURVEY
REPORT OF TESTS

PROJECT NO.: AEA PROJ. NO. 201311
ROAD NO.: SR 514 MALABAR ROAD FROM SR 507 (BABCOCK STREET) TO US 1
SUBMITTED BY: ANTILLIAN ENGINEERING ASSOCIATES, INC.

DATE OF SURVEY: JULY 2013
SURVEYED BY: ANTILLIAN ENGINEERING ASSOCIATES, INC.
SURVEY BEGINS STA. NO.: 100+00
SURVEY ENDS STA. NO.: 293+00
DATE REPORTED: OCTOBER 2013

		ORGANIC CONTENT			SIEVE ANALYSIS RESULTS (% PASSING)						ATTERBERG LIMITS (%)					CORROSION TEST RESULTS				ENVIRONMENTAL CLASSIFICATION (SUBSTRUCTURE)	
STRATUM NO.	LBR VALUE	NO. OF TESTS	% ORGANIC	MOISTURE CONTENT %	NO. OF TESTS	#10 MESH	#40 MESH	#60 MESH	#100 MESH	#200 MESH	NO. OF TESTS	LIQUID LIMIT	PLASTICITY INDEX	AASHTO GROUP	DESCRIPTION	RESISTIVITY ohm-cm	CHLORIDES ppm	SULFATES ppm	pH	CONCRETE	STEEL
1	--	2	3	25-26	8	94-100	71-98	49-88	26-54	3-10	--	--	--	A-3	BROWN TO VERY DARK BROWN, GRAY TO VERY DARK GRAY, GRAYISH BROWN TO DARK GRAYISH BROWN, WHITE TO LIGHT GRAY, GRAY TO DARK GRAY, LIGHT GREENISH GRAY TO DARK GREENISH GRAY, DARK REDDISH BROWN AND BLACK FINE SAND, TRACE TO LITTLE SILT, OCCASIONAL TRACE ORGANIC MATERIAL AND OCCASIONAL TRACE TO FEW SHELL FRAGMENTS (FINE TO COARSE SAND SIZE)	--	--	--	--	--	--
2	--	--	--	--	5	95-100	81-97	43-83	24-47	11-19	2	NP-25	NP-8	A-2-4	BROWN TO VERY DARK BROWN, GRAY TO VERY DARK GRAY, GRAYISH BROWN TO DARK GRAYISH BROWN, LIGHT GREENISH GRAY TO DARK GREENISH GRAY, DARK REDDISH BROWN, YELLOWISH BROWN AND BLACK FINE SAND, SOME SILT OR SOME CLAY, OCCASIONAL TRACE TO FEW SHELL FRAGMENTS (FINE TO COARSE SAND SIZE)	--	--	--	--	--	--
3	--	4	15-27	37-68	2	100	85-98	51-88	33-58	18-24	--	--	--	A-8	VERY DARK BROWN, VERY DARK GRAY AND BLACK MUCKY FINE SAND AND PEAT	--	--	--	--	--	--

NOTES

1. THE SYMBOL "--", IF PRESENT, REPRESENTS UNMEASURED SOIL PARAMETERS.
2. THE SYMBOL "NP" REPRESENTS NON-PLASTIC.
3. STRATA BOUNDARIES ARE APPROXIMATE AND REPRESENT SOIL STRATA AT EACH BORING LOCATION ONLY. ANY STRATUM CONNECTING LINES SHOWN ARE FOR ESTIMATING EARTHWORK ONLY AND DO NOT INDICATE ACTUAL STRATUM LIMITS. SUBSURFACE VARIATION BETWEEN BORINGS SHOULD BE ANTICIPATED AS INDICATED IN SECTION 2-4 OF THE FDOT STANDARD SPECIFICATIONS.
4. ▼ – ENCOUNTERED GROUNDWATER LEVEL; ▽ – ESTIMATED SEASONAL HIGH GROUNDWATER LEVEL; GNE – GROUNDWATER NOT ENCOUNTERED
5. STRATA NOS. 1 AND 2 SHALL BE TREATED AS SELECT (S) MATERIAL IN ACCORDANCE WITH FDOT INDEX 505.
6. STRATUM NO. 3 SHOULD BE TREATED AS MUCK (M) IN ACCORDANCE WITH FDOT INDEX 500 AND 505.
7. STRATUM NO. 2 WILL RETAIN EXCESS MOISTURE AND MAY BE DIFFICULT TO DRY AND COMPACT.
8. REMOVAL OF MUCK MATERIAL OCCURRING WITHIN THE ROADWAY SHALL BE ACCOMPLISHED IN ACCORDANCE WITH INDEX 500 OF THE FDOT DESIGN STANDARDS UNLESS OTHERWISE SHOWN ON THE PLANS. THE MATERIAL USED IN EMBANKMENT CONSTRUCTION SHALL BE IN ACCORDANCE WITH INDEX 505 OF THE FDOT DESIGN STANDARDS.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

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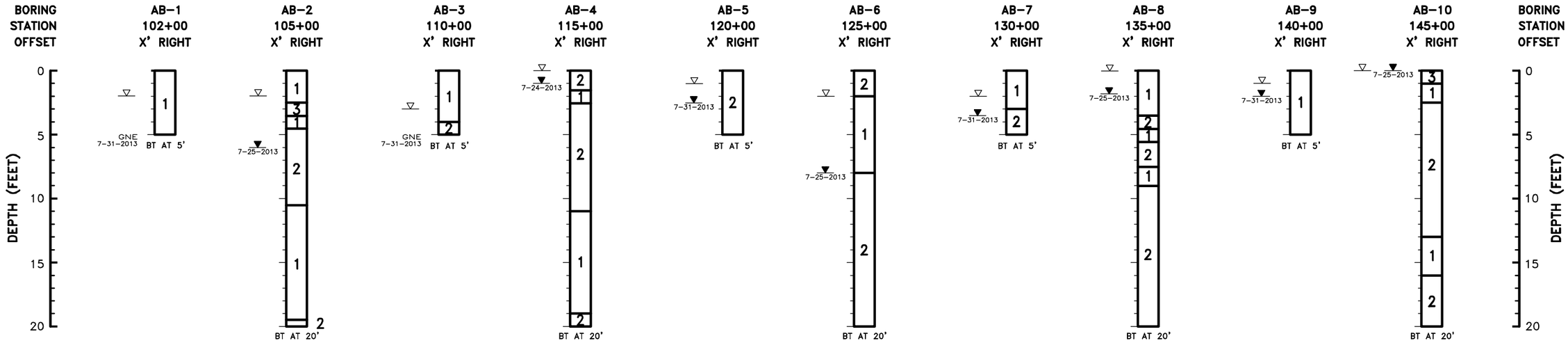
CERTIFICATE OF AUTHORIZATION EB6685

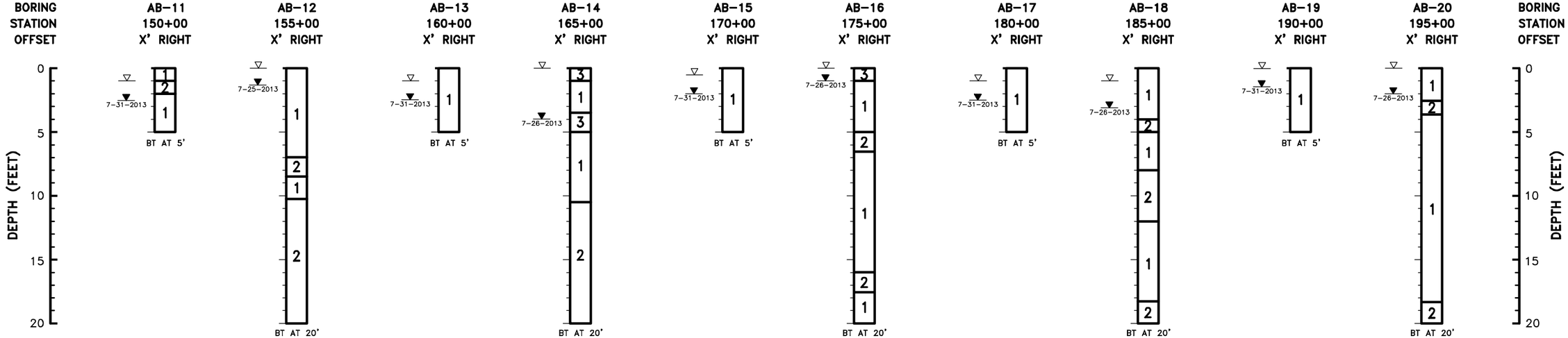
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
514	BREVARD	430136-1-22-01

REPORT OF TESTS

SHEET NO. XX





STRATUM NO.	AASHTO SOIL CLASSIFICATION SYMBOL	DESCRIPTION
1	A-3	BROWN TO VERY DARK BROWN, GRAY TO VERY DARK GRAY, GRAYISH BROWN TO DARK GRAYISH BROWN, WHITE TO LIGHT GRAY, GRAY TO DARK GRAY, LIGHT GREENISH GRAY TO DARK GREENISH GRAY, DARK REDDISH BROWN AND BLACK FINE SAND, TRACE TO LITTLE SILT, OCCASIONAL TRACE ORGANIC MATERIAL AND OCCASIONAL TRACE TO FEW SHELL FRAGMENTS (FINE TO COARSE SAND SIZE)
2	A-2-4	BROWN TO VERY DARK BROWN, GRAY TO VERY DARK GRAY, GRAYISH BROWN TO DARK GRAYISH BROWN, LIGHT GREENISH GRAY TO DARK GREENISH GRAY, DARK REDDISH BROWN, YELLOWISH BROWN AND BLACK FINE SAND, SOME SILT OR SOME CLAY, OCCASIONAL TRACE TO FEW SHELL FRAGMENTS (FINE TO COARSE SAND SIZE)
3	A-8	VERY DARK BROWN, VERY DARK GRAY AND BLACK MUCKY FINE SAND AND PEAT

REVISIONS					
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ROAD NO.	COUNTY	FINANCIAL PROJECT ID
514	BREVARD	430136-1-22-01

REPORT OF ROADWAY AUGER BORINGS

SHEET NO.
XX

NOTICE: THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE SIGNED AND SEALED UNDER RULE 61G15-23.003, F.A.C.

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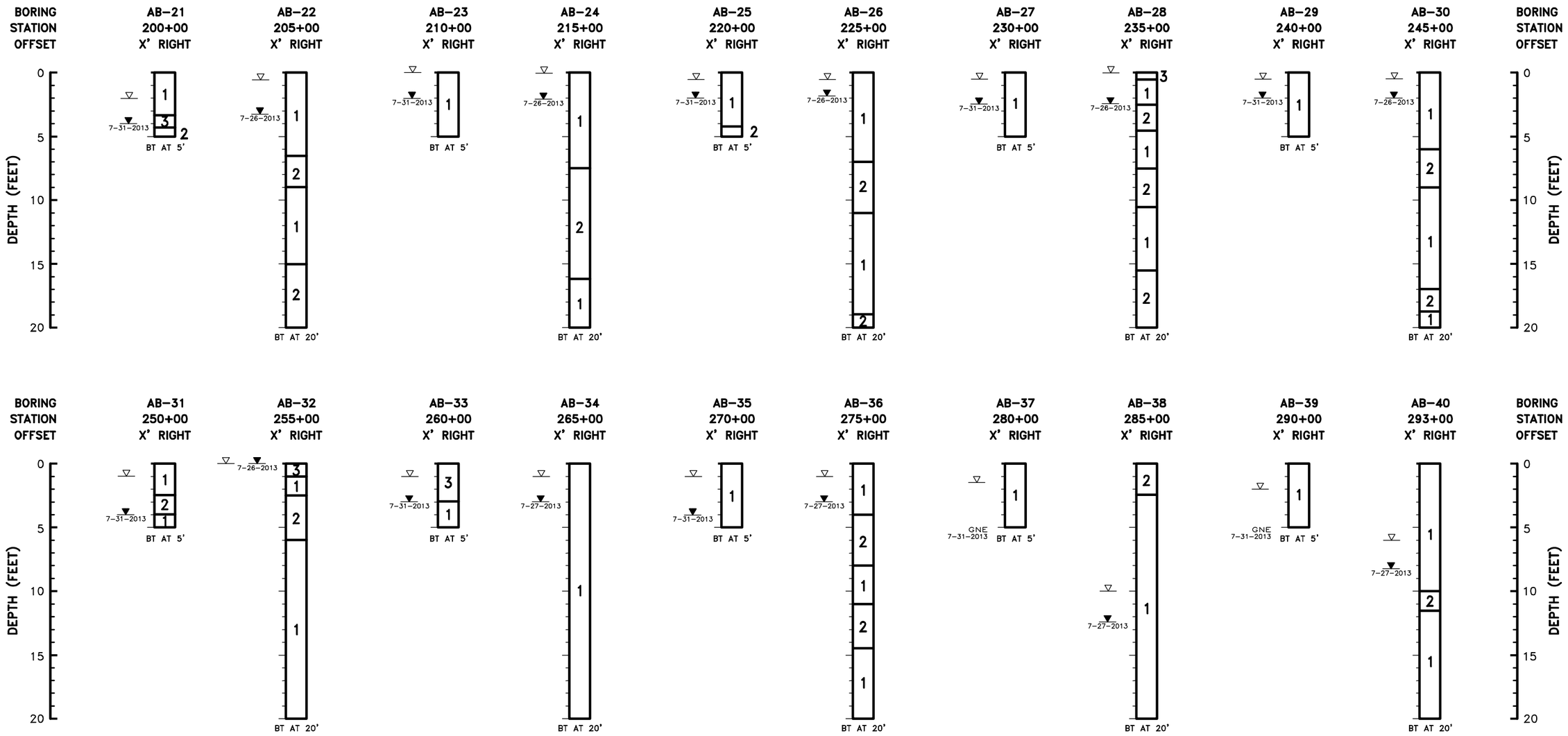

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3	A-8	VERY DARK BROWN, VERY DARK GRAY AND BLACK MUCKY FINE SAND AND PEAT

REVISIONS					
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ROAD NO.	COUNTY	FINANCIAL PROJECT ID
514	BREVARD	430136-1-22-01

REPORT OF ROADWAY AUGER BORINGS

SHEET NO. XX

Project: **SR 514 (Malabar Road) PD&E** Job Number: **201311** Sheet **1** of **1**

Manager: _____ Client: _____ Project Description: _____

Location: _____

Boring / Depth	Sample Description	#4	#10	#40	#60	#100	Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)		AASHTO	USCS
AB- 2	Black mucky sand														
2.7		100.0	100.0	84.8	51.2	32.9	23.5	37			15.4			A-8	
AB- 4	Grayish brown silty sand														
4.0			100.0	81.1	42.8	24.1	14.8	17	NP	NP				A-2-4	
AB- 6	Dark brown sand with silt														
0.0		97.5	96.0	82.0	53.2	29.4	10.7	17						A-2-4	
AB- 9	Light brown and dark brown sand with silt														
2.0		99.2	98.2	89.3	65.8	37.6	6.0							A-3	
AB-10	Grayish brown clayey sand														
2.5		100.0	99.9	94.7	80.0	46.3	18.8	19	25.4	7.9				A-2-4	
AB-10	Dark gray sand with silt and shell fragments														
13.0		99.4	93.5	71.3	49.2	26.3	9.8							A-3	
AB-15	Gray sand														
1.5			100.0	97.6	86.9	39.0	3.4							A-3	
AB-16	Brown sand with silt														
6.5			100.0	98.0	87.5	54.8	8.5							A-3	
AB-20	Black sand with silt														
3.5		100.0	100.0	97.0	85.8	37.7	8.4	25			2.9			A-3	
AB-21	Black mucky sand														
3.0			100.0	97.6	88.1	58.0	18.1	39			14.5			A-8	
AB-22	Light gray sand														
1.0			100.0	97.5	86.5	42.1	2.8							A-3	
AB-26	Black sand														
3.8		100.0	100.0	96.6	80.4	42.2	4.9	26			2.7			A-3	
AB-28	Grayish brown silty sand														
7.7			100.0	96.9	82.5	47.2	13.4							A-2-4	
AB-30	Brown sand with silt														
1.4			100.0	96.3	79.7	35.2	5.3							A-3	
AB-32	Black peat														
0.0								68			27.1			A-8	
AB-33	Black peat														
0.0								47			22.6			A-8	
AB-38	Grayish brown silty sand														
0.0		97.5	94.5	83.1	59.2	34.0	12.3							A-2-4	

Summary Of Laboratory Test Results

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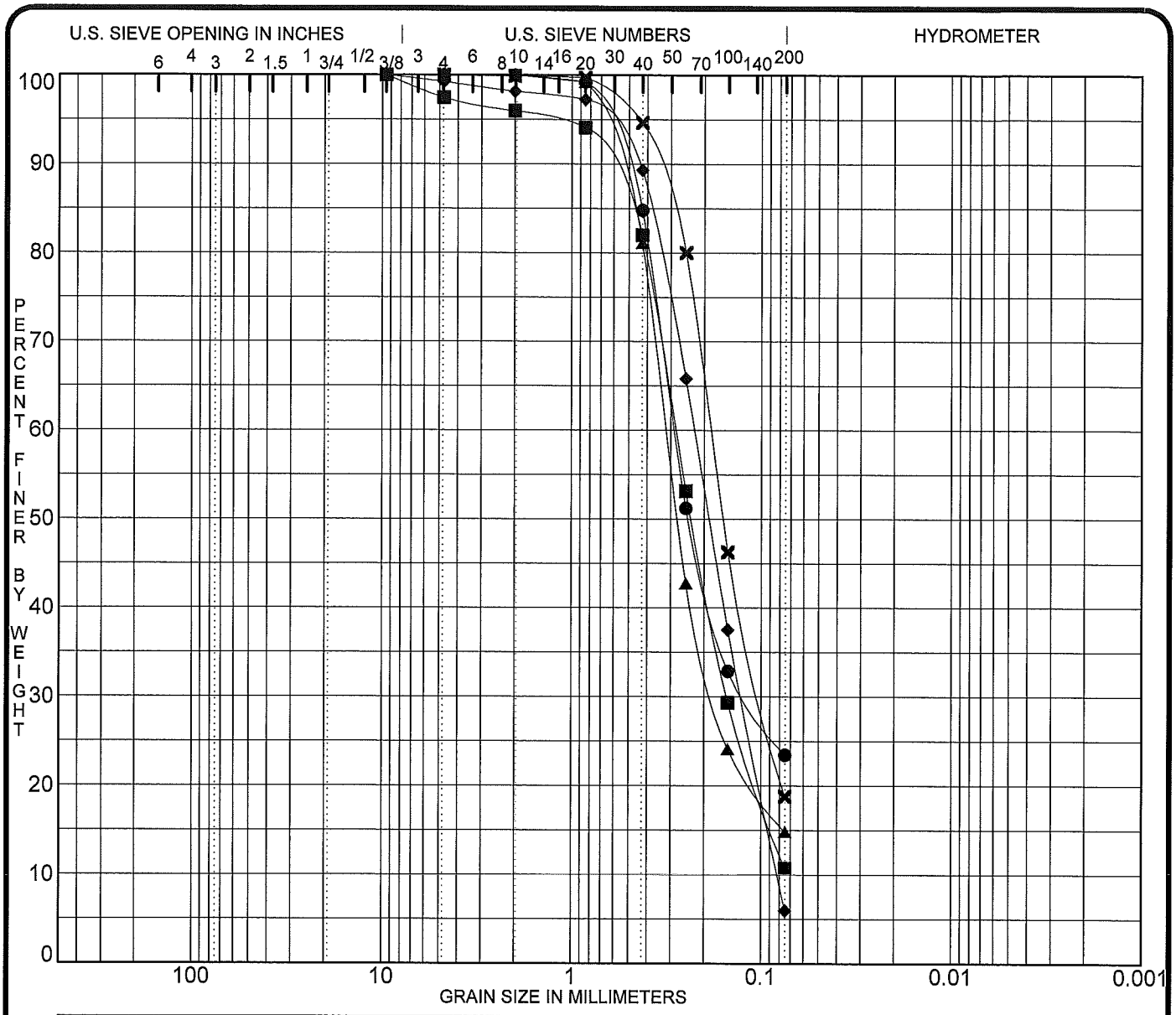

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	MC%	LL	PL	PI	Cc	Cu
●	AB- 2	2.7	Black mucky sand	19					
▲	AB- 4	4.0	Grayish brown silty sand	19	NP	NP	NP		
■	AB- 6	0.0	Dark brown sand with silt	19				1.12	3.9
◆	AB- 9	2.0	Light brown and dark brown sand with silt	19				0.88	2.7
✕	AB-10	2.5	Grayish brown clayey sand	19	25	17	8		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	AB- 2	2.7	4.75	0.29	0.121		0.0	76.5	23.5	
▲	AB- 4	4.0	2.00	0.32	0.176		0.0	85.2	14.8	
■	AB- 6	0.0	9.50	0.28	0.152		2.5	86.8	10.7	
◆	AB- 9	2.0	9.50	0.23	0.127	0.0819	0.8	93.3	6.0	
✕	AB-10	2.5	4.75	0.18	0.100		0.0	81.2	18.8	

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GRADATION CURVES

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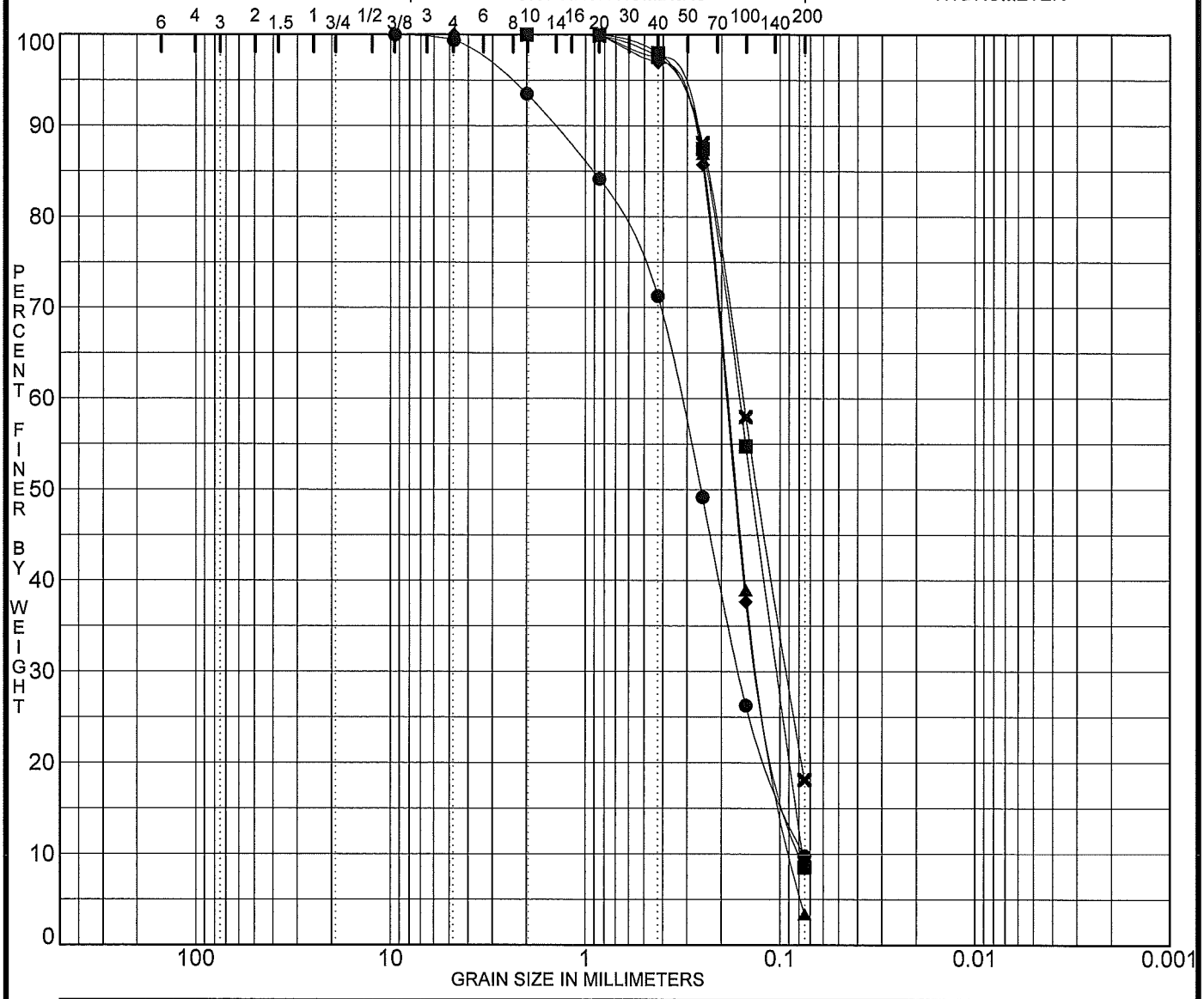

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	AB-10	13.0	Dark gray sand with silt and shell fragments	39				1.08	4.3
▲	AB-15	1.5	Gray sand	39				0.99	2.2
■	AB-16	6.5	Brown sand with silt	39				0.86	2.1
◆	AB-20	3.5	Black sand with silt	39				1.06	2.4
✕	AB-21	3.0	Black mucky sand	39					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	AB-10	13.0	9.50	0.32	0.163	0.0757	0.6	89.6	9.8	
▲	AB-15	1.5	2.00	0.19	0.126	0.0853	0.0	96.6	3.4	
■	AB-16	6.5	2.00	0.16	0.103	0.0767	0.0	91.5	8.5	
◆	AB-20	3.5	4.75	0.19	0.125	0.0779	0.0	91.6	8.4	
✕	AB-21	3.0	2.00	0.16	0.092		0.0	81.9	18.1	

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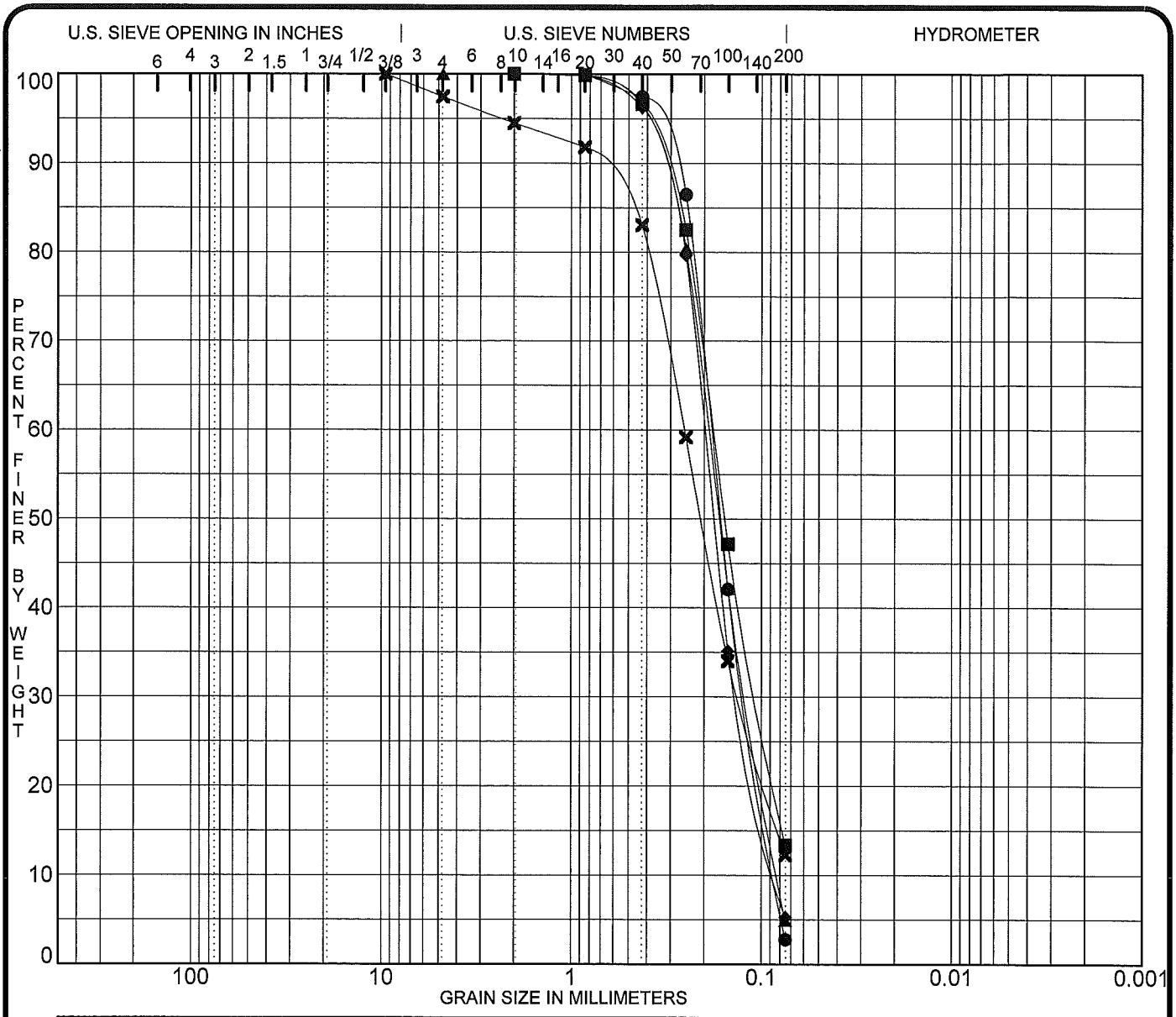

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	AB-22	1.0	Light gray sand					0.94	2.2
▲	AB-26	3.8	Black sand					0.91	2.3
■	AB-28	7.7	Grayish brown silty sand						
◆	AB-30	1.4	Brown sand with silt					1.06	2.4
✕	AB-38	0.0	Grayish brown silty sand					0.98	3.6

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	AB-22	1.0	2.00	0.18	0.121	0.0852	0.0	97.2	2.8	
▲	AB-26	3.8	4.75	0.19	0.120	0.0824	0.0	95.1	4.9	
■	AB-28	7.7	2.00	0.18	0.105		0.0	86.6	13.4	
◆	AB-30	1.4	2.00	0.20	0.133	0.0837	0.0	94.7	5.3	
✕	AB-38	0.0	9.50	0.25	0.132		2.5	85.2	12.3	

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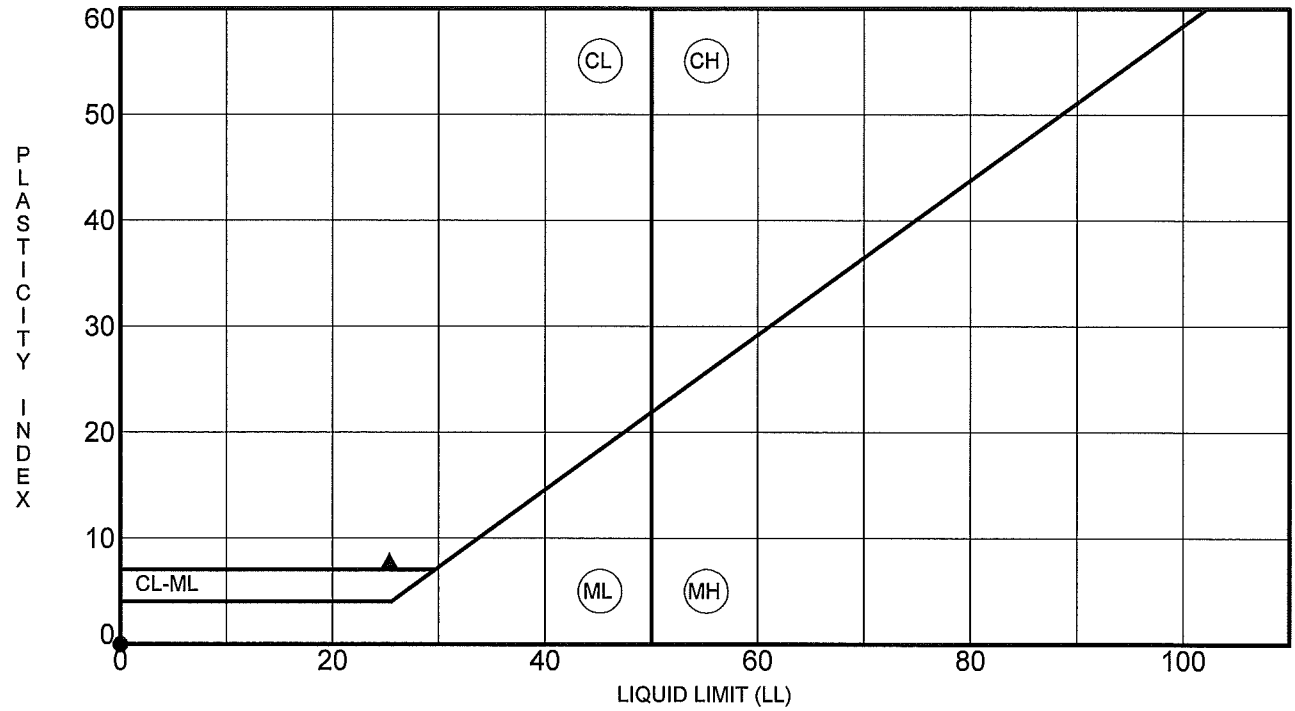

Specimen Identification			LL	PL	PI	Fines	Classification
●	**AB- 4**	**4.0**	**NP**	**NP**	**NP**	**14.8**	
▲	**AB-10**	**2.5**	**25**	**17**	**8**	**18.8**	

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ATTERBERG LIMITS

ANTILLIAN ENGINEERING ASSOCIATES, INC.
Orlando, Florida, USA

APPENDIX B

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*.

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage,* to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

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ASFE THE ASSOCIATION OF ENGINEERING FIRMS PRACTICING IN THE GEOSCIENCES

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APPENDIX C

ANTILLIAN ENGINEERING ASSOCIATES, INC.
CONSTRAINTS AND RESTRICTIONS

WARRANTY

Antillian Engineering Associates, Inc. has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur between these borings.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Antillian Engineering Associates, Inc., as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Antillian Engineering Associates, Inc. of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Antillian Engineering Associates, Inc. to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Antillian Engineering Associates, Inc. is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Antillian Engineering Associates, Inc..

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Antillian Engineering Associates, Inc..

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations to determine those conditions that may affect construction operations. Antillian Engineering Associates, Inc. cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative ease or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicate normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions of variations.

LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Antillian Engineering Associates, Inc. to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Antillian Engineering Associates, Inc. to locate any such buried objects. Antillian Engineering Associates, Inc. cannot be responsible for any buried man-made objects which are subsequently encountered during construction that are not discussed within the text of this report.

TIME

This report reflects the soil conditions at the time of investigation. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.