PRELIMINARY SOIL SURVEY REPORT
SR 40 PD&E STUDY
BREAKAWAY TRAIL to WILLIAMSON BLVD.
VOLUSIA COUNTY, FLORIDA
FDOT Financial Project ID No. 428947-1-22-01
ROADWAY SECTION No. 791 100 000
AEA PROJECT No. 201106

Antillian Engineering Associates, Inc.
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ANTILLIAN
ENGINEERING ASSOCIATES, INC.

February 22, 2013

Kittelson and Associates, Inc.
225 East Robinson Street, Suite 450
Orlando, Florida 32801

Attention: John R. Freeman, Jr., P.E.

Reference: Preliminary Soil Survey Report
SR 40 PD&E Study
Breakaway Trail to Williamson Boulevard
Volusia County, Florida
FDOT Financial Project No. 428947-1-22-01
AEA Project No. 201106

Dear Mr. Freeman:

Antillian Engineering Associates, Inc. has completed a preliminary soils survey for Preliminary Engineering (Conceptual Design) and Environmental Studies for the proposed widening of SR 40 from Breakaway Trail to Williamson Boulevard in Volusia County, Florida. The investigation was conducted in accordance with the scope of services negotiated with the Florida Department of Transportation for this project on April 12, 2011. This report contains the results of our investigation, a preliminary assessment of the soils at the designated pond sites as they relate to drainage design and other concerns as appropriate.

It has been our pleasure to serve Kittelson and Associates 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.

Very truly yours,
ANTILLIAN ENGINEERING ASSOCIATES, INC.
Certificate of Authorization No. EB6685

PETER GREGORY SUAH LICENSE NO. 46910 STATE OF FLORIDA PROFESSIONAL ENGINEER
02.28.2013

Peter G. Suah, P.E.
Florida Registration No. 46910
Principal Engineer

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 40 west of Interstate Highway 95 (I-95) in Volusia County, from Breakaway Trail to Williamson Boulevard. Its approximate location is shown on Figure 1. The Orlando, Florida office of Kittelson and Associates, Inc. (Kittelson) was selected by the FDOT District Five office to conduct the Preliminary Engineering (Conceptual Design) and Environmental (PD&E) Study for this project. Four new ponds and reconfiguration of two existing ponds are anticipated as part of the proposed widening. This firm was selected by Kittelson to conduct a preliminary soil survey of the pond sites.

AVAILABLE INFORMATION

The United States Geological Survey (USGS) quadrangle topographic map for the area, the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey of Volusia County, Florida and The Potentiometric Surface Map of the Upper Floridan Aquifer for February 2012 published online by the St. Johns River Water Management District (SJRWMD) were reviewed to obtain general information about the project area. Kittelson provided preliminary right-of-way plans superimposed on digital aerial images which were reviewed for more local and project-specific information.

The USGS map showed the project area as a broad, nearly level to level area interspersed with a few low, irregularly shaped knolls and a number of shallow, natural drainageways to the Tomoka River. The area north of SR 40 generally showed more variation in relief than the broad, nearly level to level area to the south. Land use was mapped as mostly rural- agricultural, although some residential development was also apparent. I-95, SR 40, Breakaway Trail and Williamson Boulevard were shown, along with most of the local streets and roads. The ground surface in the area was mapped between the Elevation 15 feet NGVD (El. 15) and El. 20 contours. A low knoll near the middle of the alignment, and knolls on opposite banks of the Tomoka River were mapped above the El. 20 contour, while the Tomoka River floodplain was mapped below the El. 5 contour. Wetlands or swamps were mapped in parts of the broad, nearly level area south of SR 40.

The NRCS Soil Survey reported Farmton fine sand as the predominant soil unit on the broad, nearly level to level plain areas on the USGS map. Electra fine sand and Cassia fine sand were mapped at slightly higher elevations on the plains and Tavares fine sand was mapped on the knolls near the Tomoka River. Farmton fine sand was reported to be a level, poorly drained soil with seasonal high groundwater level within a foot of the natural ground surface. Small areas of other soils with similar characteristics such as Eau Gallie, Immokalee, Myakka and Basinger fine sand are often included in this map unit. Electra fine sand and Cassia fine sand were reported as somewhat poorly drained soils with seasonal high groundwater between two feet and four feet below the natural ground surface. Tavares fine sand was reported to be a gently sloping, moderately well drained soil with seasonal high groundwater level between three feet and more than six feet below the natural ground surface. Permeability in the near-surface zones of this soil was reported to exceed 40 feet per day (ft/day). The NRCS Soil Survey sheet is shown in Figure 2.

The SJRWMD Potentiometric Surface Map for February 2012 showed the potentiometric surface of the Upper Floridan Aquifer between the Elevation 0 and Elevation 30 contours in the general area of the project. That is the approximate level to which the water surface of the Upper Floridan aquifer would rise if it were not confined by the low-permeability materials above it. Based on the proximity to the coastline and the mapped distance to the Elevation 30 contour, the elevation of the potentiometric surface in the project area was estimated to be below the Elevation 10 contour.

The preliminary right-of-way sheets showed seven parcels of land designated as possible pond sites. The sites were designated from west to east as Ponds 1-2, 2A, 2B-1, 2B-2, 2B-3, 3 and Pond 4. It is our understanding that an eighth pond site (near the I-95/SR 40 interchange) is also included in the project but it was not designated on the plans, reportedly because it was originally designed in anticipation of the proposed widening and further enhancements would not be needed. Copies of the Kittelson preliminary right-of-way plan sheets are reproduced as Figures 3 through 6.

FIELD INVESTIGATION

Boring locations were selected in collaboration with the design team based on defined project needs. A field visit was conducted on May 10, 2012 to examine the existing site conditions and prepare for the drilling program. Boring locations were established in the field using dimensions and existing features on the preliminary right-of-way plans provided by Kittelson. The locations were staked and marked for underground utility location as required by Florida Statutes.

Eight test borings were drilled to examine the subsurface conditions as they relate to the suitability for ponds. Each boring was designated by its pond site and relative position east to west on that site, i.e., in the direction of increasing roadway stationing. For example "1-2-PB1" was the western boring (lower stationing) on the Pond 1-2 site. Two additional borings, designated "AB-1"and "AB-2" were drilled to check the groundwater conditions on the inside of the superelevated curve near the middle of the alignment. Approximate boring locations are summarized in Table 1 on the following page.

TABLE 1
SUMMARY OF FIELD INVESTIGATION PROGRAM

POND	BORING	APPROX. STATION (SR 40)	APPROX. OFFSET (feet)	APPROX. ELEVATION (feet)	DEPTH (feet)
Pond 1-2	1-2-PB1	1311+50	530	24	20
	1-2-PB2	1315+00	730	23	20
Pond 2A	2A-PB-1	1317+70	1110	24	20
Pond 2B-1	2B1-PB1	1320+00	825	22	20
Pond 2B-2	2B2-PB1	1335+20	-180	17	20
Pond 2B-3	2B3-PB1	1335+40	-530	18	20
Pond 3	3-PB1	1360+30	100	19	20
Pond 4	4-PB1	1370+60	120	19	20
Roadway	AB-1	1331+00	-110	20	20
Roadway	AB-2	1336+00	-100	18	20

The soils encountered during drilling were logged by the field crew. Representative samples were sealed in clean, airtight containers for transportation to our Orlando office. The depth to groundwater encountered at each boring location was measured and recorded on the field logs. Groundwater levels were measured a minimum of 24 hours after drilling. Field permeability tests were conducted in borings 3-PB1 and 3-PB2. At the completion of the field program, the borings were backfilled with soil. The boring locations were not surveyed but the approximate location information shown for each boring should be sufficient for the intent of this investigation.

LABORATORY TESTING

The recovered soil samples were examined in our office by a geotechnical engineer who confirmed the descriptions on the field logs, classified the soils visually and developed a representation of the soil stratigraphy at each boring location. Representative samples were selected for laboratory testing, which consisted of 20 soil gradation analyses, one Atterberg limits test series and one natural moisture content test. Test results are presented on the Report of Tests sheet, on the Summary of Laboratory Test Results sheets and on the graphs in Appendix A.

SURFACE CONDITIONS

As expected from the review of the available information, the natural ground surface over most of the project area was nearly level to level. Slightly higher terrain was observed in the locations corresponding to the low knolls on the USGS map, i.e., the knolls near the middle of the alignment (near the intersection with Old Tomoka Road) and on the opposite banks of the Tomoka River. Sites 1-2, 2A and 2B-1 were on cleared, nearly level, apparently agricultural land on the southern side of State Road 40 west of Old Tomoka Road. Pond sites 2B-2 and 2B-3 were in a wooded, slightly elevated area on the north side of SR 40 just east of Old Tomoka Road. Pond 3 was an existing dry pond on the south side of SR 40 on the upper edge of the western bank of the river; Pond 4 was a dry pond in a similar position on the eastern bank of the river. The Pond 3B site was a wooded area near the top of the slope leading down to the floodplain on the western bank of the river.

PRELIMINARY SUBSURFACE CONDITIONS

Because of the apparently common characteristics observed in the test borings drilled for this study, the encountered subsurface conditions were separated into two sections using Tymber Creek Road as the separating line. The reader is cautioned that Tymber Creek Road was selected **simply and arbitrarily for ease of reference for this preliminary investigation only**. The actual subsurface profile at any location in either section may not necessarily correspond to the general descriptions for that section (see roadway borings AB-1 and AB-2 as an example).

West of Tymber Creek Road

The uppermost material encountered in borings 1-2-PB1, 1-2-PB2, 2A-PB1, 2B1-PB1, 2B2-PB1 and 2B3-PB1was light brownish gray, grayish brown, pale yellow and occasionally very dark brown fine sand that appeared to contain very small amounts of silt or clay. Encountered thicknesses ranged from three feet to about 11 feet. Gradation analysis of three samples indicated fines contents (fraction passing the U.S. Standard No. 200 sieve) that ranged from 1 percent to 7 percent. They were classified as "A-3" material using the American Association of State Highway and Transportation Officials (AASHTO) Designation M-145 and were designated "Stratum 1".

Beneath the Stratum 1 soils was mostly grayish brown (and occasionally dark gray, brown and yellowish brown fine sands containing significant amounts of clay. These soils typically had a non-plastic texture. Encountered thicknesses ranged from nine feet to about 13 feet. Actual thicknesses could not be confirmed as the borings were terminated in this soil without penetrating it completely. Gradation analysis of eight samples indicated fines contents that ranged from 12 percent to 18 percent. The samples were classified as "A-2-4" soils using AASHTO Designation M-145 and were designated "Stratum 2".

A thin layer (less than four feet thick) of gray sand containing more clay was encountered at a depth of about 14 feet within the clayey Stratum 2 soils in boring 2B-3-PB1. Analysis of a sample indicated a fines content of 53 percent, Plastic Limit of 14, Liquid Limit of 31 and natural moisture

content of 28 percent. Based on those results, the sample was classified as sandy clay ("A-6") material using AASHTO Designation M-145. It was designated "Stratum 3".

Groundwater was encountered in the borings at depths between six feet and nine feet below the existing ground surface. Details of the subsurface characteristics encountered at each boring location are shown on the Report of Pond Boring sheets and on the Summary of Laboratory Tests sheets and charts in Appendix A.

East of Tymber Creek Road

The uppermost soils in borings 3-PB1 and 4-PB1 exhibited similar composition to the Stratum 1 soils encountered in roadway borings AB-1, AB-2 and the other pond sites, but their coloration varied more with depth at each location. As noted earlier in this report, both pond banks were also partially impounded by fill. As a result, the uppermost soils in both pond borings were designated "possible fill" in which case soil color should not be used as an aid to estimating seasonal high groundwater levels. Gradation analysis of three samples indicated fines contents that ranged from 4 percent to 5 percent, resulting in classification as "A-3" material using AASHTO Designation M-145. Constant-head field permeability tests in borings 3-PB1 and 4-PB1 yielded permeability in the horizontal direction (k_h) exceeding 40 ft/day. The soils were designated "Stratum 4".

Beneath the Stratum 4 soils in borings 3-PB1 and 4-PB1 and the Stratum 1 soils in borings AB-1 and AB-2 was light olive brown and grayish brown to brown and strong brown fine sand that appeared to contain more clay than the Stratum 2 soils encountered elsewhere on the project. The encountered thickness of these soils ranged from about two feet to about seven feet. Actual thicknesses could not be confirmed in AB-1 and AB-2 both of which were terminated in this soil without penetrating it completely. Gradation analysis of four samples indicated fines contents that ranged from 19 percent to 28 percent. The samples were classified as "A-2-4" soils using AASHTO Designation M-145 and were designated "Stratum 5".

Beneath the Stratum 5 soils in 3-PB1 and 4-PB1 was grayish brown sand that appeared to contain less clay. Encountered thicknesses were between three feet and seven feet. Actual thicknesses could not be confirmed as both borings were terminated in this soil without penetrating it completely. Gradation analysis of two samples indicated fines contents of 13 percent and 15 percent, so the samples were classified as "A-2-4" soils using AASHTO Designation M-145. The gradation results were consistent with the "Stratum 2" soils encountered west of Tymber Creek Road.

Groundwater was encountered in the borings at depths between eight feet and 18 feet below the existing ground surface. Details of the subsurface characteristics encountered at each boring location are shown on the boring logs and on the Summary of Laboratory Tests sheets in Appendix A.

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 the design stage of this project and it is likely that the conditions encountered during those investigations may differ from those discussed in this report. As a result, the preliminary assessments discussed in the following sections may have to be changed as needed to reflect the additional information that becomes available. The information compiled for this report should be considered when developing final geotechnical recommendations for pond design and construction.

GENERAL PRELIMINARY ASSESSMENT OF ENCOUNTERED SOILS

In general, the soils encountered during this investigation should not adversely affect the design and construction of the ponds. As discussed earlier in this report, the uppermost soils were mostly fine sands containing small amounts of silt that were classified as "A-3"soil. If these soils are excavated to create new ponds or expand existing ponds, they may be reused as select fill in accordance with FDOT Standard Index 505 Embankment Utilization, provided they are not mixed with other, less-desirable materials. The comparatively low fines contents suggested that these soils should drain well, provided they are not excessively compacted during construction

Clayey sands designated "A-2-4" and clay "A-6" soils were encountered beneath the surficial sands. If excavated during construction, they should only be reused as allowed by FDOT Standard Index 505 Embankment Utilization. They should not be reused in load-bearing situations, in the shoulders of any water-impounding embankment or in any impoundment through which seepage will be used to dispose of stormwater runoff. However, they may be used for non-load-bearing purposes such as low permeability liner or as a seepage barrier ("clay core") within a water-impounding embankment. If used for that purpose, these soils should be compacted at a moisture content several points wet of the optimum to ensure that they do not dry out and crack produce an unintended seepage path. These soils should be expected to have limited drainage characteristics and should be considered as the confining layer defining the "aquifer bottom" for stormwater recovery analyses.

ESTIMATED SEASONAL HIGH GROUNDWATER LEVEL

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, the hydrogeologic properties of the soils and the presence and proximity of artificial drainage facilities. Because of the time of year of this investigation, we expect higher groundwater levels under the normal, cyclic influence of seasonal rainfall. However, the groundwater was encountered at significant depths below the ground surface in sloping to strongly

sloping terrain. In addition, only a limited number of borings was drilled and ground surface elevations at the boring locations were not surveyed. As a result, only preliminary estimates of seasonal high groundwater level could be developed at this stage. Those estimates are shown on the Report of Borings sheets.

The seasonal high groundwater level was set conservatively at two feet above the top of the clayey "Stratum 5" soils encountered in roadway borings AB-1 and AB-2. Those depths were at least three feet below the bottom of pavement base shown on the cross-sections. The cross-sections showed open swales with bottoms at least two feet below the bottom of the pavement base. Underdrains were shown beneath the eastbound lanes of SR 40, but their age and current condition are unknown. Underdrains can also become ineffective if not properly maintained. As a result, we do not recommend using the depicted underdrains as a reference for setting pavement base elevation.

Until more information becomes available, we recommend a preliminary estimate of the seasonal high groundwater level at two to three feet above the encountered groundwater level, zero to one foot above the top of the clayey sand horizons (to model perched conditions) or two feet above the bottom of the pond boring, whichever is highest. Estimated seasonal high groundwater levels may be set at other depths as needed to model specific conditions for preliminary design purposes. As the project design progresses and more information becomes available and the estimates of seasonal high groundwater level can be refined.

POTENTIAL FOR ARTESIAN CONDITIONS

As discussed earlier in this report, the ground surface in the project area was mapped between the Elevation 15 feet NGVD (El. 15) and El. 20 contours, while the potentiometric surface of the Upper Floridan aquifer was mapped between the Elevation 0 and Elevation 10 contours. Those conditions suggest that artesian flow conditions should not be expected in the conventional sense. However, excavations could encounter near-surface seepage from groundwater at higher elevations in adjacent soils following periods of rainfall. The clayey sand horizons which can limit natural percolation and give rise to short-term, perched groundwater conditions. If unexpected seepage is encountered during any excavation activity, that activity should be halted immediately and the excavation should be backfilled as quickly as possible to suppress further seepage and bank erosion. Dewatering should be initiated immediately to control the seepage flow and depress the groundwater to a level that will permit a resumption of work. Even small volumes of uncontrolled seepage can cause loss of material and adversely affect the stability of existing slopes and cuts.

PRELIMINARY POND RECOVERY ANALYSES

It is our understanding that preliminary pond recovery analyses are likely to be conducted at this stage to assess the general suitability of each site for the proposed pond reconfiguration. Preliminary soil and groundwater properties are presented below in Table 2.

TABLE 2
PRELIMINARY SOIL PROPERTIES
FOR STORMWATER POND RECOVERY ANALYSES

POND	APPROXIMATE DEPTH (feet)		PERMEABILITY (feet/day)		FILLABLE POROSITY (%)
	ESHGWL	AQUIFER	k_h	k_v	
Pond 3	6½	7	40	26 to 40	25
Pond 4	9½	10	40	26 to 40	25

The reader is cautioned that those values are for presented for preliminary estimating purposes only and should not be used for final design. Permeability values for final design should be obtained from tests conducted for that purpose during the final design phase of the project.

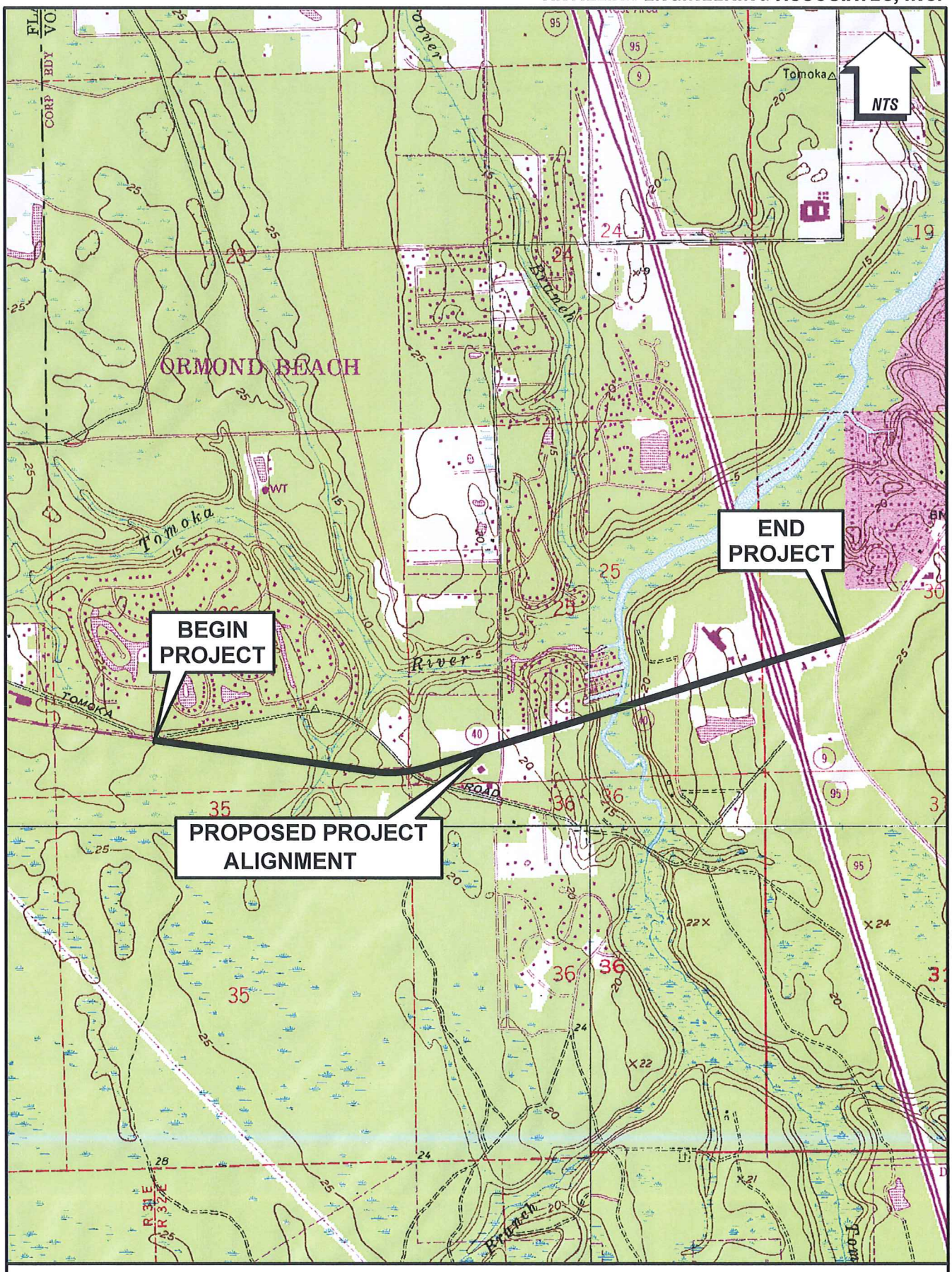
LIMITATIONS

This report presents an 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.

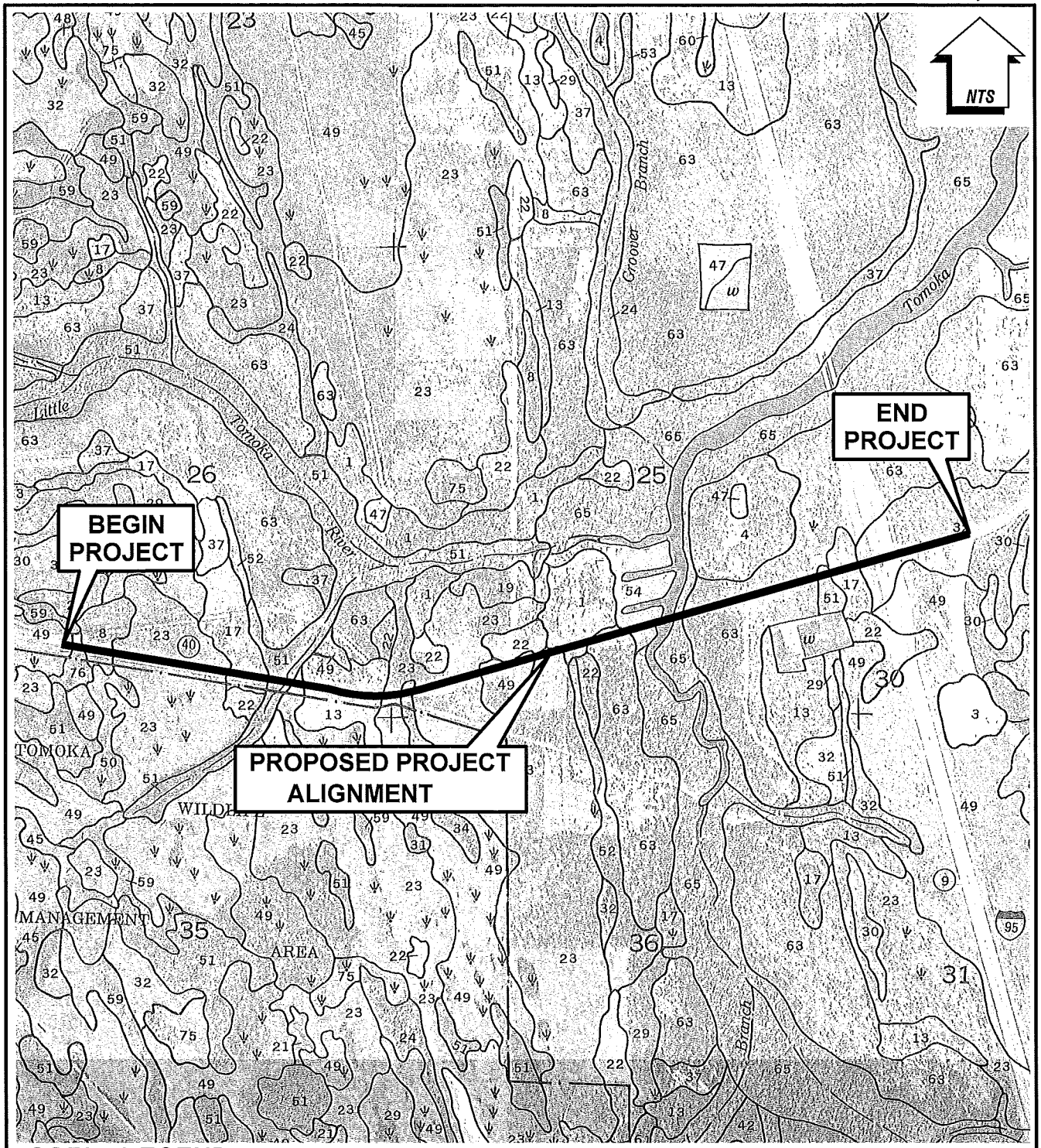
Because of the natural limitations inherent in working below the ground surface, a geotechnical engineer cannot predict and address all possible problems and on most construction projects, ground-related issues not addressed in this report may arise. "Important Information About Your Geotechnical Engineering 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



SITE LOCATION PLAN

201106	SR 40 PD&E STUDY	FIG. 1



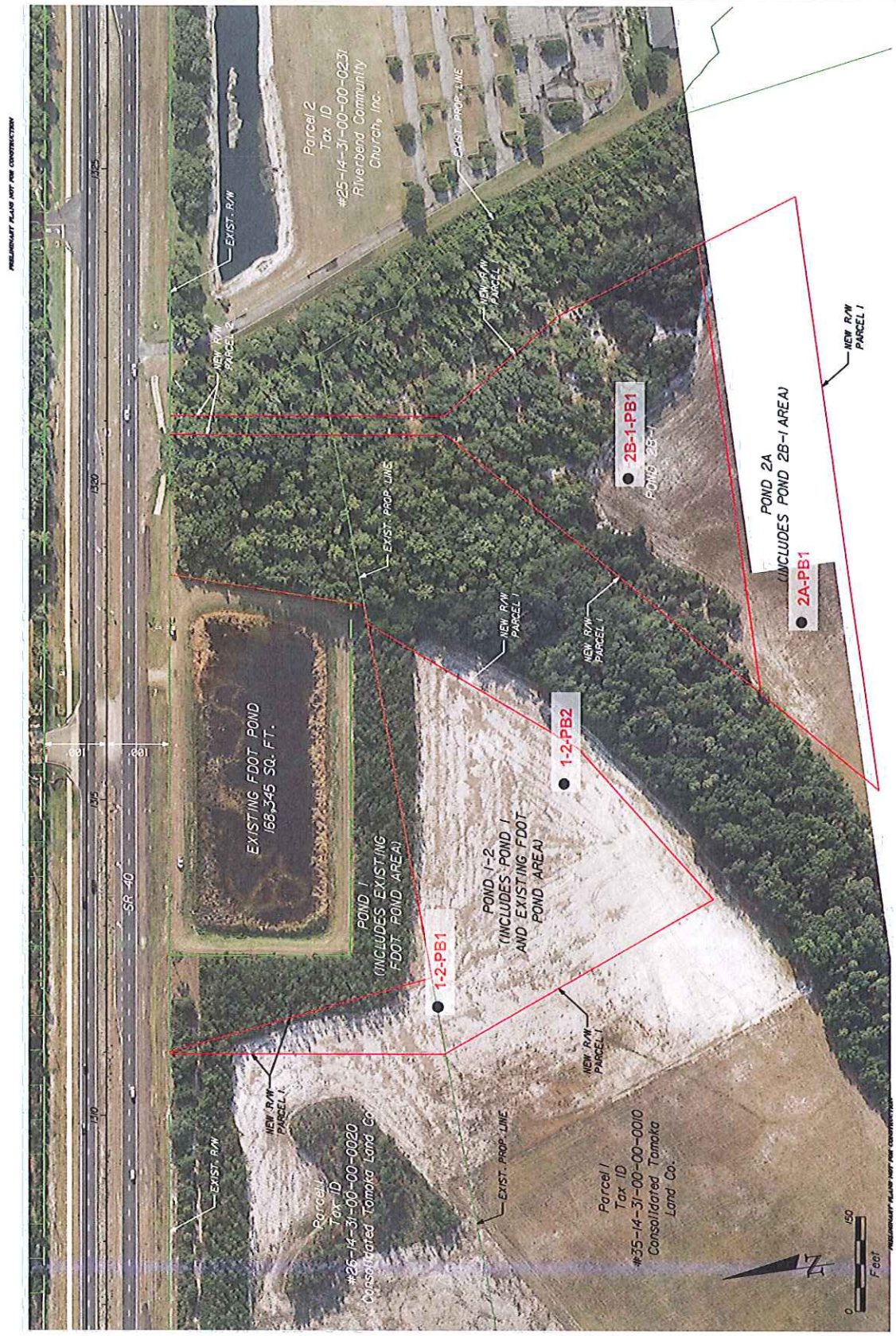
SOIL LEGEND

1 – APOPKA FINE SAND, 0 TO 5 PERCENT SLOPES
8 – BASINGER FINE SAND, DEPRESSIONAL
13 – CASSIA FINE SAND
17 – DAYTONA SAND, 0 TO 5 PERCENT SLOPES
22 – ELECTRA FINE SAND, 0 TO 5 PERCENT SLOPES
23 – FARMTON FINE SAND
32 – MYAKKA FINE SAND
49 – POMONA FINE SAND
51 – POMONA–ST. JOHNS COMPLEX
54 – QUARTZIPSAMMENTS, GENTLY SLOPING
63 – TAVARES FINE SAND, 0 TO 5 PERCENT SLOPES
65 – TERRA CEIA MUCK
76 – WACHULA FINE SAND, DEPRESSIONAL

Figure developed from USDA SCS Soil Survey of Volusia County, Florida, issued 1980

USDA SCS SOIL SURVEY MAP

201106	SR 40 PD&E STUDY	FIG. 2



LEGEND

● APPROXIMATE LOCATION OF BORING

Figure developed from image furnished by Client

BORING LOCATION PLAN

201106	SR 40 PD&E STUDY	FIG. 3

LEGEND

● APPROXIMATE LOCATION OF BORING

Figure developed from image furnished by Client

BORING LOCATION PLAN

201106	SR 40 PD&E STUDY	FIG. 4

Figure developed from image furnished by Client

LEGEND

● APPROXIMATE LOCATION OF BORING

BORING LOCATION PLAN

201106	SR 40 PD&E STUDY	FIG. 5

Figure developed from image furnished by Client

LEGEND

● APPROXIMATE LOCATION OF BORING

BORING LOCATION PLAN

201106	SR 40 PD&E STUDY	FIG. 6

APPENDIX A

ANTILLIAN ENGINEERING ASSOCIATES, INC.
3331 Bartlett Boulevard Orlando, Florida 32811
Tel (407) 422-1441 Fax (407) 422-2226

KEY TO BORING LOGS

SYMBOLS

10	SPT N-Value (number of blows a 140-lb weight falling 30 inches required to drive a Standard Split-Spoon sampler one foot into otherwise undisturbed soil)
WR	Penetration of sampler under weight of drill rods
WH	Penetration of sampler under weight of drill rods and hammer
SS	Split Spoon sample
ST	Undisturbed thin-walled Shelby Tube sample
	Observed change in soil type
	Unobserved change in soil type
▽	Estimated seasonal high groundwater level
▼	Encountered groundwater level

SOIL CONSISTENCY

(Based on empirical correlation with SPT N-Value)

GRANULAR SOILS

Very Loose - Less Than 4 blows/ft.
Loose - 4 to 10 blows/ft.
Medium Dense - 10 to 30 blows/ft.
Dense - 30 to 50 blows/ft.
Very Dense - More Than 50 blows/ft.

FINE-GRAINED SOILS

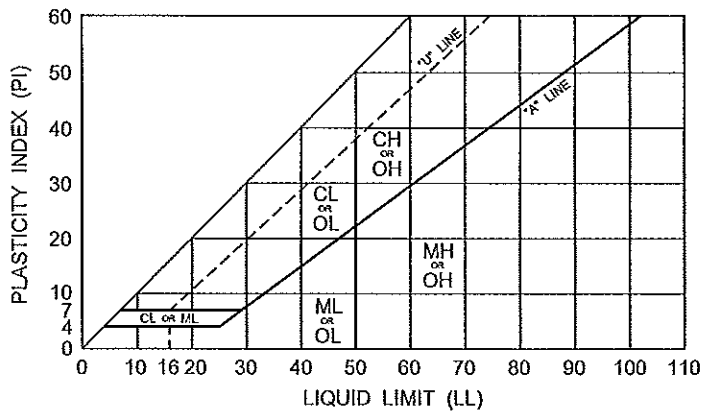
Very Soft - Less Than 2 blows/ft.
Soft - 2 to 4 blows/ft.
Firm - 4 to 8 blows/ft.
Stiff - 8 to 15 blows/ft.
Very Stiff - 15 to 30 blows/ft.
Hard - More Than 30 blows/ft.

UNIFIED SOILS CLASSIFICATION SYSTEM ASTM D 2487

(Based on material passing the 3-inch (75-mm) sieve)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS More than 50% passing No. 200 sieve	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS			Pt	Peat, muck and other highly organic soils

PLASTICITY CHART



ROADWAY SOILS SURVEY
REPORT OF TESTS

TOWNSHIP: 14 SOUTH
RANGE: 31 EAST
SECTION: 25, 26

PROJECT NO.: 428947-1-22-01
ROAD NO.: SR 40 PD&E STUDY BREAKAWAY TRAIL TO WILLIAMSON BLVD.
SUBMITTED BY: ANTILLIAN ENGINEERING ASSOCIATES, INC.

DATE OF SURVEY: 05/24/12 TO 06/05/12
SURVEYED BY: ANTILLIAN ENGINEERING ASSOCIATES, INC.
SURVEY BEGINS STA. NO.: MP 24.5
SURVEY ENDS STA. NO.: MP 26.5
DATE REPORTED: 06/15/2012

		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	--	--	--	--	3	100	92-95	73-76	21-27	1-7	--	--	--	A-3	LIGHT BROWNISH GRAY, GRAYISH BROWN AND OCCASIONALLY VERY DARK BROWN FINE SAND	--	--	--		--	--
2	--	--	--	--	11	98-100	88-97	49-82	19-38	12-18	--	--	--	A-2-4	GRAYISH BROWN, OCCASIONALLY DARK GRAY, BROWN AND YELLOWISH BROWN CLAYEY OR SILTY FINE SAND	--	--	--		--	--
3	--	--	--	--	1	100	98	93	73	53	1	33	19	A-6	GRAY SANDY CLAY	--	--	--		--	--
4	--	--	--	--	2	100	95-97	82-87	28-33	4-5	--	--	--	A-3	LIGHT BROWNISH GRAY AND PALE YELLOW FINE SAND (POSSIBLE FILL)	--	--	--		--	--
5	--	--	--	--	4	100	93-98	74-86	32-49	19-28	--	--	--	A-2-4	LIGHT OLIVE BROWN AND GRAYISH BROWN TO BROWN AND STRONG BROWN CLAYEY FINE SAND	--	--	--		--	--
6	--	--	--	--	3	100	94-98	70-86	31-42	4-9	--	--	--	A-3	LIGHT GRAY AND BROWN TO DARK GRAYISH BROWN AND DARK GRAY FINE SAND	--	--	--		--	--
7	--	--	--	--	1	100	66	20	8	6	--	--	--	A-3	BROWN FINE TO MEDIUM SAND	--	--	--		--	--

NOTES

1. THE SYMBOL "--", IF PRESENT, REPRESENTS UNMEASURED SOIL PARAMETERS.
2. STRATA BOUNDARIES ARE APPROXIMATE AND REPRESENT SOIL STRATA AT EACH BORING LOCATION ONLY. ANY STRATA CONNECTION LINES SHOWN ARE FOR ESTIMATING EARTH WORK ONLY AND DO NOT INDICATE ACTUAL STRATUM LIMITS. SURFACE VARIATION BETWEEN BORINGS SHOULD BE ANTICIPATED.
3. ▼ – ENCOUNTERED GROUNDWATER LEVEL
4. ▽ – PRELIMINARY ESTIMATED SEASONAL HIGH GROUNDWATER LEVEL (LEVELS SHOWN MAY CHANGE AS MORE INFORMATION BECOMES AVAILABLE)

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ANTILLIAN
ENGINEERING ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS
CERTIFICATE OF AUTHORIZATION EB6685
3331 BARTLETT BOULEVARD ORLANDO, FLORIDA 32811
PHONE: 407-422-1441 FAX: 407-422-2226
ENGINEER OF RECORD: PETER O. SUAH, P.E. LICENSE NO. 49910

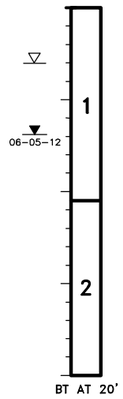
STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION		
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 40	VOLUSIA	428947-1-22-01

REPORT OF TESTS

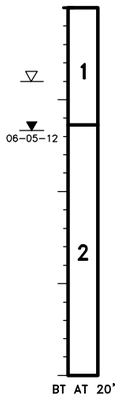
SHEET NO.

POND 1–2

BORING: 1–2–PB1
STATION: 1311+50
OFFSET: 530' RT.
ELEVATION: 24 APPROX.

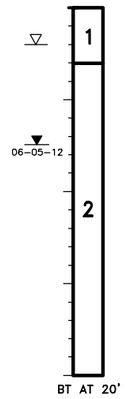


BORING: 1–2–PB2
STATION: 1315+00
OFFSET: 730' RT.
ELEVATION: 23 APPROX.



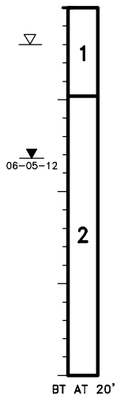
POND 2A

BORING: 2A–PB1
STATION: 1317+70
OFFSET: 1110' RT.
ELEVATION: 24 APPROX.



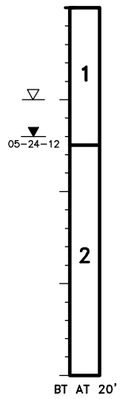
POND 2B–1

BORING: 2B–1–PB1
STATION: 1320+00
OFFSET: 825' RT.
ELEVATION: 22 APPROX.



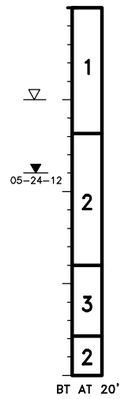
POND 2B–2

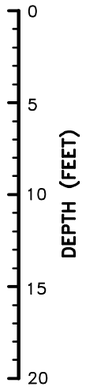
BORING: 2B–2–PB1
STATION: 1335+20
OFFSET: 180' LT.
ELEVATION: 17 APPROX.



POND 2B–3

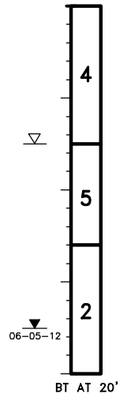
BORING: 2B–3–PB1
STATION: 1335+40
OFFSET: 530' LT.
ELEVATION: 18 APPROX.





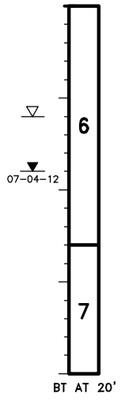
POND 3

BORING: 3–PB1
STATION: 1360+30
OFFSET: 100' RT.
ELEVATION: 19 APPROX.

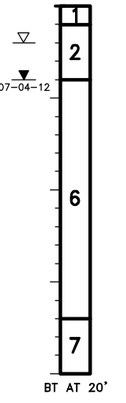


POND 3B

BORING: 3B–PB1
STATION: 1359+50
OFFSET: 220' LT.
ELEVATION: 14 APPROX.

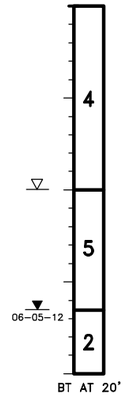


BORING: 3B–PB2
STATION: 1362+00
OFFSET: 130' LT.
ELEVATION: 4 APPROX.



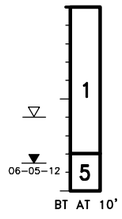
POND 4

BORING: 4–PB1
STATION: 1370+60
OFFSET: 120' RT.
ELEVATION: 19 APPROX.

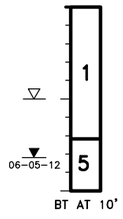


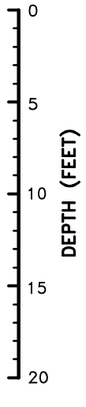
SR 40 ROADWAY

BORING: AB–1
STATION: 1331+00
OFFSET: 110' LT.
ELEVATION: 20 APPROX.



BORING: AB–2
STATION: 1336+00
OFFSET: 100' LT.
ELEVATION: 18 APPROX.





STRATUM NO.	AASHTO SOIL CLASSIFICATION SYMBOL	DESCRIPTION
1	A–3	LIGHT BROWNISH GRAY, GRAYISH BROWN AND OCCASIONALLY VERY DARK BROWN FINE SAND
2	A–2–4	GRAYISH BROWN, OCCASIONALLY DARK GRAY, BROWN AND YELLOWISH BROWN CLAYEY FINE SAND
3	A–6	GRAY SANDY CLAY
4	A–3	LIGHT BROWNISH GRAY AND PALE YELLOW FINE SAND (POSSIBLE FILL)
5	A–2–4	LIGHT OLIVE BROWN AND GRAYISH BROWN TO BROWN AND STRONG BROWN CLAYEY FINE SAND
6	A–3	LIGHT GRAY AND BROWN TO DARK GRAYISH BROWN AND DARK GRAY FINE SAND
7	A–3	BROWN FINE TO MEDIUM SAND

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ANTILLIAN
ENGINEERING ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS
CERTIFICATE OF AUTHORIZATION EB6685
3331 BARTLETT BOULEVARD ORLANDO, FLORIDA 32811
PHONE: 407-422-1441 FAX: 407-422-2226
ENGINEER OF RECORD: PETER G. SUAH, P.E. LICENSE NO. 46910

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 40	VOLUSIA	428947–1–22–01

REPORT OF POND BORINGS

SHEET NO.

Project: SR 40 PD&E Study Job Number: 201106 Sheet 1 of 2

Manager: _____ Client: Kittelson 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
1-2-PB1	Grayish brown fine sand														
1.5			100.0	92.6	73.1	24.0	3.9							A-3	
1-2-PB2	Brown clayey fine sand														
6.5			100.0	92.5	74.6	33.5	17.6							A-2-4	
1-2-PB2	Grayish brown clayey fine sand														
10.5			100.0	88.7	67.3	19.9	12.4							A-2-4	
2A-PB1	Dark yellowish brown clayey fine sand														
4.0			100.0	93.4	77.5	34.7	17.5							A-2-4	
2A-PB1	Grayish brown clayey fine sand														
7.0			100.0	90.0	69.8	24.1	12.8							A-2-4	
2A-PB1	Dark gray clayey fine sand														
13.0			99.9	92.7	75.3	37.5	17.5							A-2-4	
2B-1-PB1	Very dark brown fine sand with silt														
3.0			100.0	93.3	75.3	26.9	6.9							A-3	
2B-1-PB1	Very dark gray clayey fine sand														
17.0			100.0	89.5	69.6	24.2	17.6							A-2-4	
2B-2-PB1	Light brownish gray fine sand														
1.0			100.0	94.4	75.7	21.0	1.4							A-3	
2B-2-PB1	Grayish brown clayey fine sand														
7.5			100.0	95.1	78.5	35.0	14.9	19.7						A-2-4	
2B-2-PB1	Grayish brown clayey fine sand														
10.0			100.0	93.0	75.5	29.4	15.3	22.4						A-2-4	
2B-3-PB1	Gray sandy clay														
14.0			100.0	98.2	92.9	72.5	53.4	28.1	33.1	18.9				A-6	
3B-PB1	Light gray and brown mixed fine sand														
4.0			100.0	94.9	75.5	35.0	4.2							A-3	
3B-PB1	Brown fine to medium sand with silt														
13.5			100.0	66.0	19.6	8.1	6.3							A.3	
3B-PB2	Very dark gray silty fine sand with roots														
2.0		100.0	98.9	91.1	70.4	31.6	14.1							A-2-4	
3B-PB2	Dark grayish brown fine sand with silt														
4.0			100.0	96.9	84.4	42.2	7.7							A-3	
3B-PB2	Dark gray fine sand with silt														
8.5		100.0	99.3	97.2	85.9	34.9	8.8							A-3	
3-PB-1	Light brownish gray fine sand														
2.0			100.0	95.6	82.0	27.9	4.6							A-3	
3-PB-1	Light olive bn. and strong bn. clayey fine sand														
8.0		100.0	100.0	95.3	83.7	42.9	27.4							A-2-4	

Summary Of Laboratory Test Results

ANTILLIAN ENGINEERING ASSOCIATES, INC

Project: SR 40 PD&E Study Job Number: 201106 Sheet 2 of 2

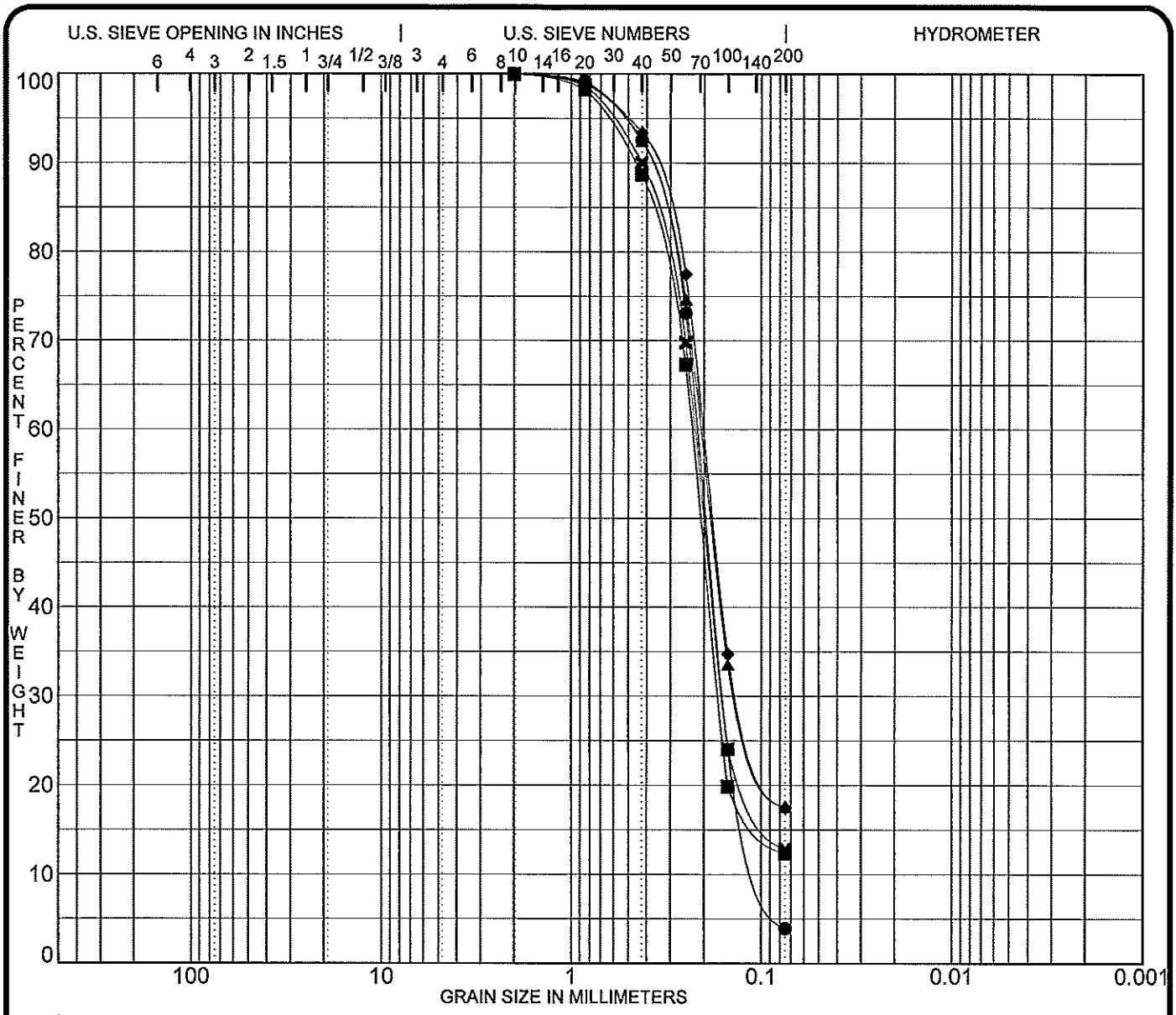
Manager: _____ Client: Kittelson Project Description: _____

Location: _____

Boring / Depth	Sample Description	#4	#10	#40	#60	#100	Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)		AASHTO	USCS
3-PB-1	Brownish yellow clayey fine sand														
17.0		100.0	100.0	88.1	49.1	23.8	15.0							A-2-4	
4-PB-1	Pale yellow fine sand														
7.0			100.0	97.0	86.7	32.3	4.4							A-3	
4-PB-1	Strong brown clayey fine sand														
13.0			100.0	97.8	86.0	48.7	24.7							A-2-4	
4-PB-1	Yellowish brown clayey fine sand														
17.0			100.0	97.0	81.7	25.2	12.9							A-2-4	
AB-1	Brown clayey fine sand														
8.0			100.0	93.5	74.0	32.8	19.0							A-2-4	
AB-2	Grayish brown clayey fine sand														
8.0		100.0	100.0	94.8	77.2	37.5	21.9							A-2-4	

Summary Of Laboratory Test Results

ANTILLIAN ENGINEERING ASSOCIATES, INC



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	1-2-PB1	1.5	Grayish brown fine sand					1.26	2.4
▲	1-2-PB2	6.5	Brown clayey fine sand						
■	1-2-PB2	10.5	Grayish brown clayey fine sand					2.01	3.8
◆	2A-PB1	4.0	Dark yellowish brown clayey fine sand						
✕	2A-PB1	7.0	Grayish brown clayey fine sand						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1-2-PB1	1.5	2.00	0.22	0.160	0.0925	0.0	96.1	3.9	
▲	1-2-PB2	6.5	2.00	0.21	0.129		0.0	82.4	17.6	
■	1-2-PB2	10.5	2.00	0.23	0.167		0.0	87.6	12.4	
◆	2A-PB1	4.0	2.00	0.20	0.124		0.0	82.5	17.5	
✕	2A-PB1	7.0	2.00	0.22	0.160		0.0	87.2	12.8	

PROJECT SR 40 PD&E Study

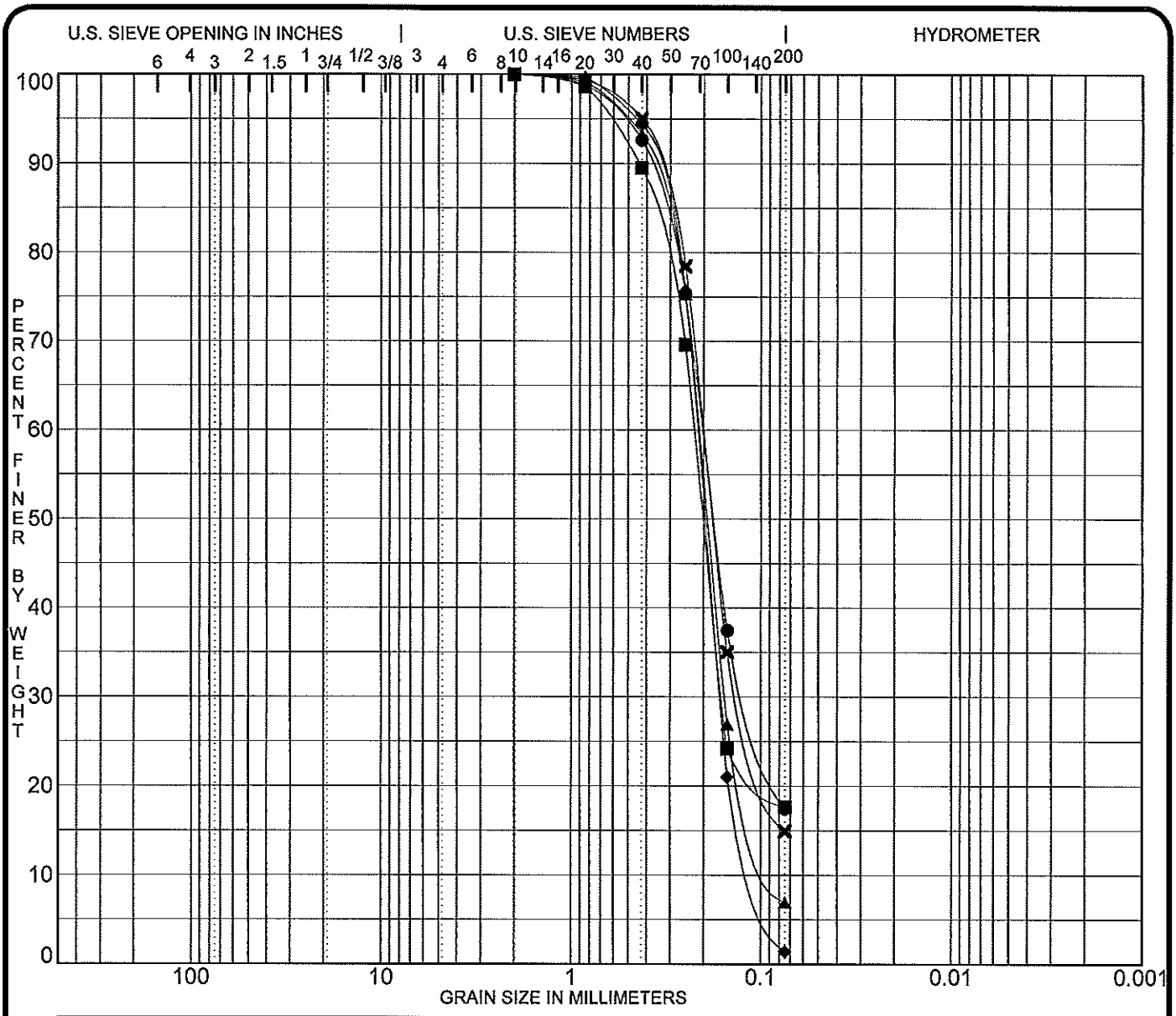
JOB NO. 201106

DATE 07/12/12

GRADATION CURVES

ANTILLIAN ENGINEERING ASSOCIATES, INC.

Orlando, Florida, USA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	2A-PB1	13.0	Dark gray clayey fine sand	19.7					
▲	2B-1-PB1	3.0	Very dark brown fine sand with silt	19.7				1.35	2.6
■	2B-1-PB1	17.0	Very dark gray clayey fine sand	19.7					
◆	2B-2-PB1	1.0	Light brownish gray fine sand	19.7				1.21	2.1
✕	2B-2-PB1	7.5	Grayish brown clayey fine sand	19.7					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2A-PB1	13.0	2.00	0.20	0.116		0.0	82.5	17.5	
▲	2B-1-PB1	3.0	2.00	0.21	0.155	0.0834	0.0	93.1	6.9	
■	2B-1-PB1	17.0	2.00	0.22	0.160		0.0	82.3	17.6	
◆	2B-2-PB1	1.0	2.00	0.22	0.163	0.1016	0.0	98.6	1.4	
✕	2B-2-PB1	7.5	2.00	0.20	0.126		0.0	85.1	14.9	

PROJECT **SR 40 PD&E Study**

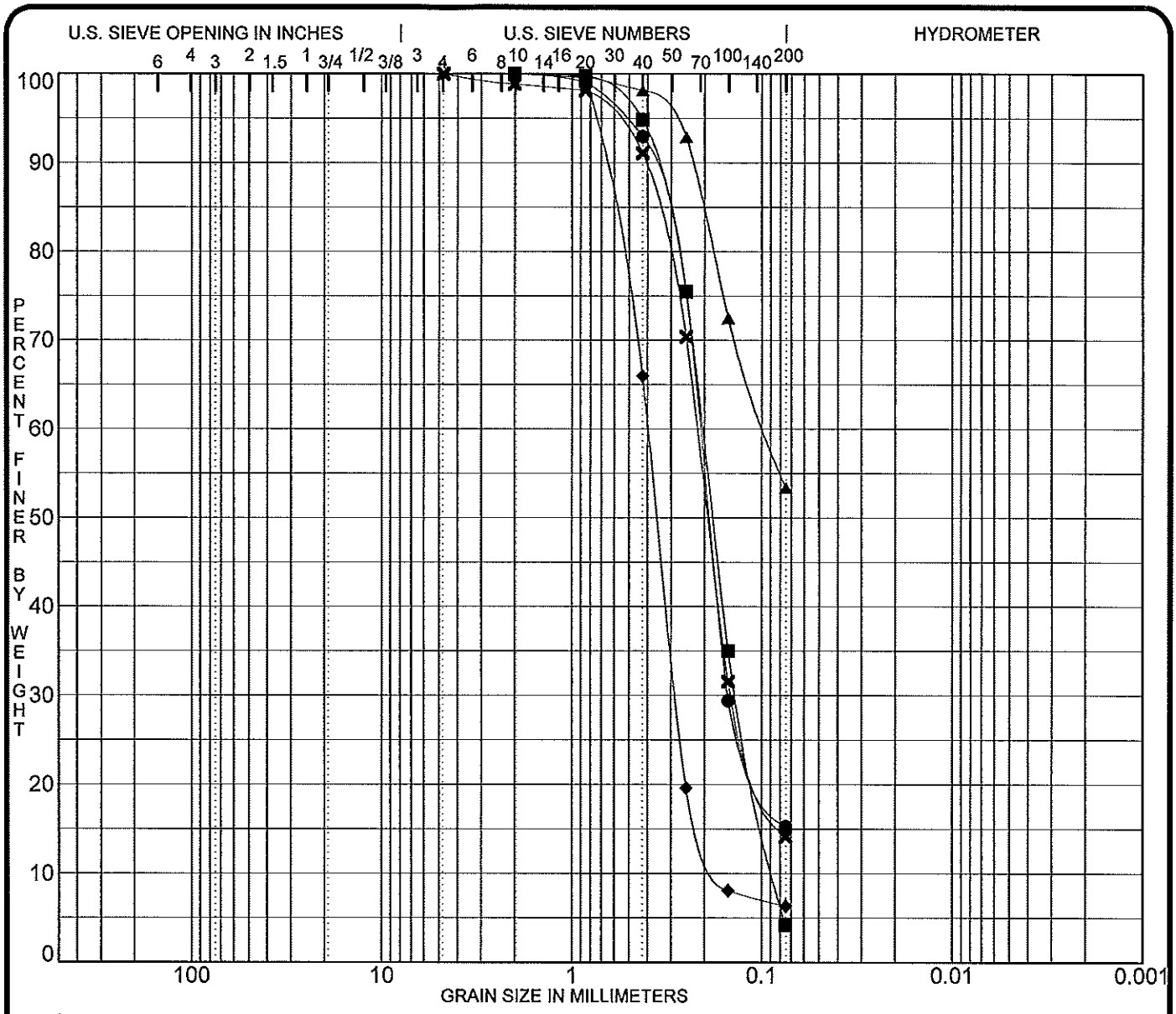
JOB NO. **201106**

DATE **07/12/12**

GRADATION CURVES

ANTILLIAN ENGINEERING ASSOCIATES, INC.

Orlando, Florida, USA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	2B-2-PB1	10.0	Grayish brown clayey fine sand						
▲	2B-3-PB1	14.0	Gray sandy clay		33	14	19		
■	3B-PB1	4.0	Light gray and brown mixed fine sand					1.02	2.4
◆	3B-PB1	13.5	Brown fine to medium sand with silt					1.22	2.4
✕	3B-PB2	2.0	Very dark gray silty fine sand with roots						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2B-2-PB1	10.0	2.00	0.21	0.151		0.0	84.7	15.3	
▲	2B-3-PB1	14.0	2.00	0.10			0.0	46.6	53.4	
■	3B-PB1	4.0	2.00	0.21	0.134	0.0854	0.0	95.8	4.2	
◆	3B-PB1	13.5	2.00	0.40	0.282	0.1633	0.0	93.7	6.3	
✕	3B-PB2	2.0	4.75	0.22	0.141		0.0	85.9	14.1	

PROJECT SR 40 PD&E Study

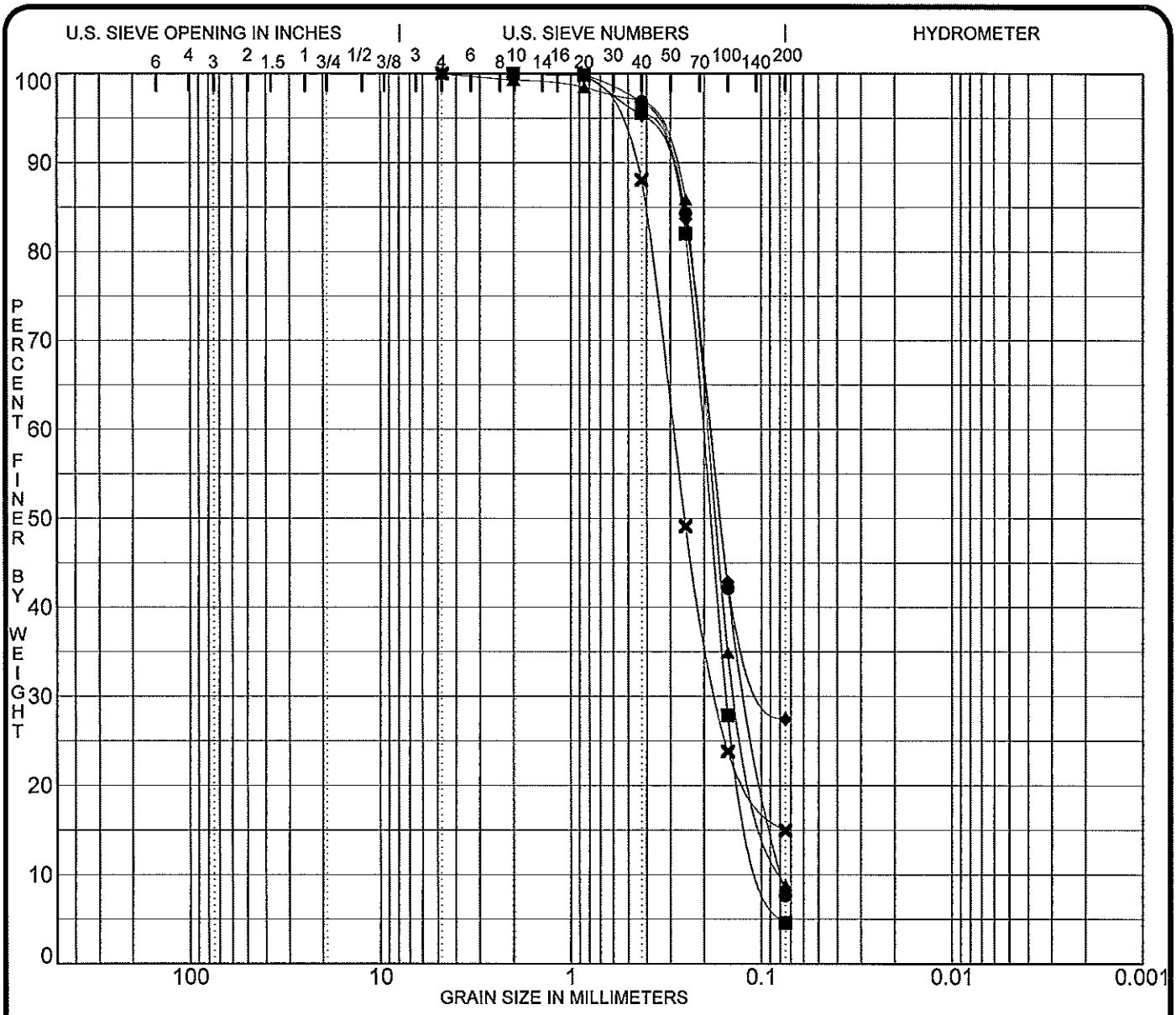
JOB NO. 201106

DATE 07/12/12

GRADATION CURVES

ANTILLIAN ENGINEERING ASSOCIATES, INC.

Orlando, Florida, USA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	MC%	LL	PL	PI	Cc	Cu
●	3B-PB2	4.0	Dark grayish brown fine sand with silt					0.94	2.4
▲	3B-PB2	8.5	Dark gray fine sand with silt					1.16	2.5
■	3-PB-1	2.0	Light brownish gray fine sand					1.31	2.3
◆	3-PB-1	8.0	Light olive bn. and strong bn. clayey fine sand						
✕	3-PB-1	17.0	Brownish yellow clayey fine sand						

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	3B-PB2	4.0	2.00	0.19	0.117	0.0786	0.0	92.3	7.7	
▲	3B-PB2	8.5	4.75	0.19	0.132	0.0773	0.0	91.2	8.8	
■	3-PB-1	2.0	2.00	0.20	0.153	0.0881	0.0	95.4	4.6	
◆	3-PB-1	8.0	4.75	0.19	0.084		0.0	72.6	27.4	
✕	3-PB-1	17.0	4.75	0.29	0.170		0.0	85.0	15.0	

PROJECT SR 40 PD&E Study

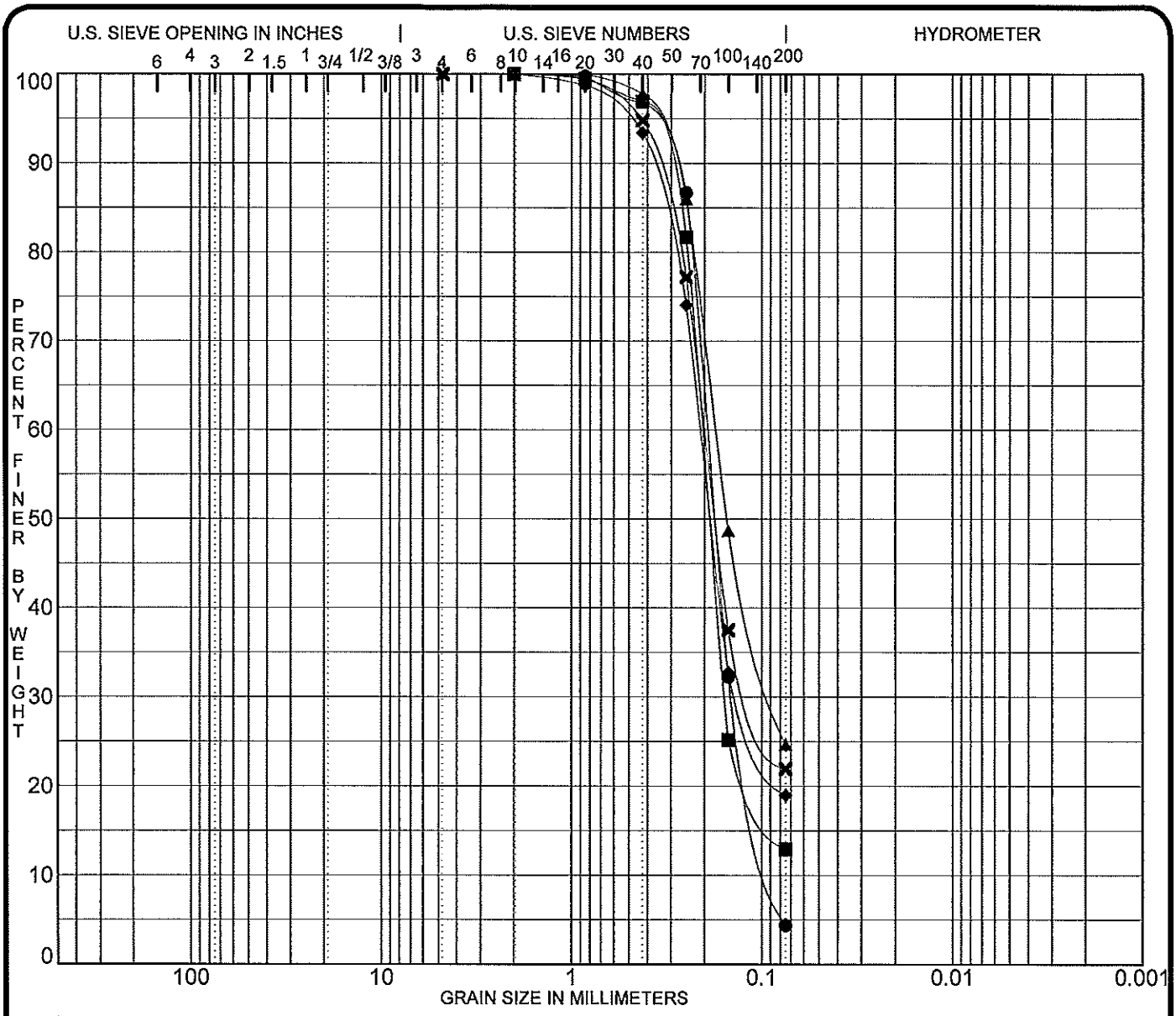
JOB NO. 201106

DATE 07/12/12

GRADATION CURVES

ANTILLIAN ENGINEERING ASSOCIATES, INC.

Orlando, Florida, USA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	4-PB-1	7.0	Pale yellow fine sand					1.20	2.3
▲	4-PB-1	13.0	Strong brown clayey fine sand						
■	4-PB-1	17.0	Yellowish brown clayey fine sand						
◆	AB-1	8.0	Brown clayey fine sand						
✕	AB-2	8.0	Grayish brown clayey fine sand						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	4-PB-1	7.0	2.00	0.19	0.142	0.0862	0.0	95.6	4.4	
▲	4-PB-1	13.0	2.00	0.18	0.088		0.0	75.3	24.7	
■	4-PB-1	17.0	2.00	0.21	0.157		0.0	87.1	12.9	
◆	AB-1	8.0	2.00	0.21	0.131		0.0	81.0	19.0	
✕	AB-2	8.0	4.75	0.20	0.107		0.0	78.1	21.9	

PROJECT **SR 40 PD&E Study**

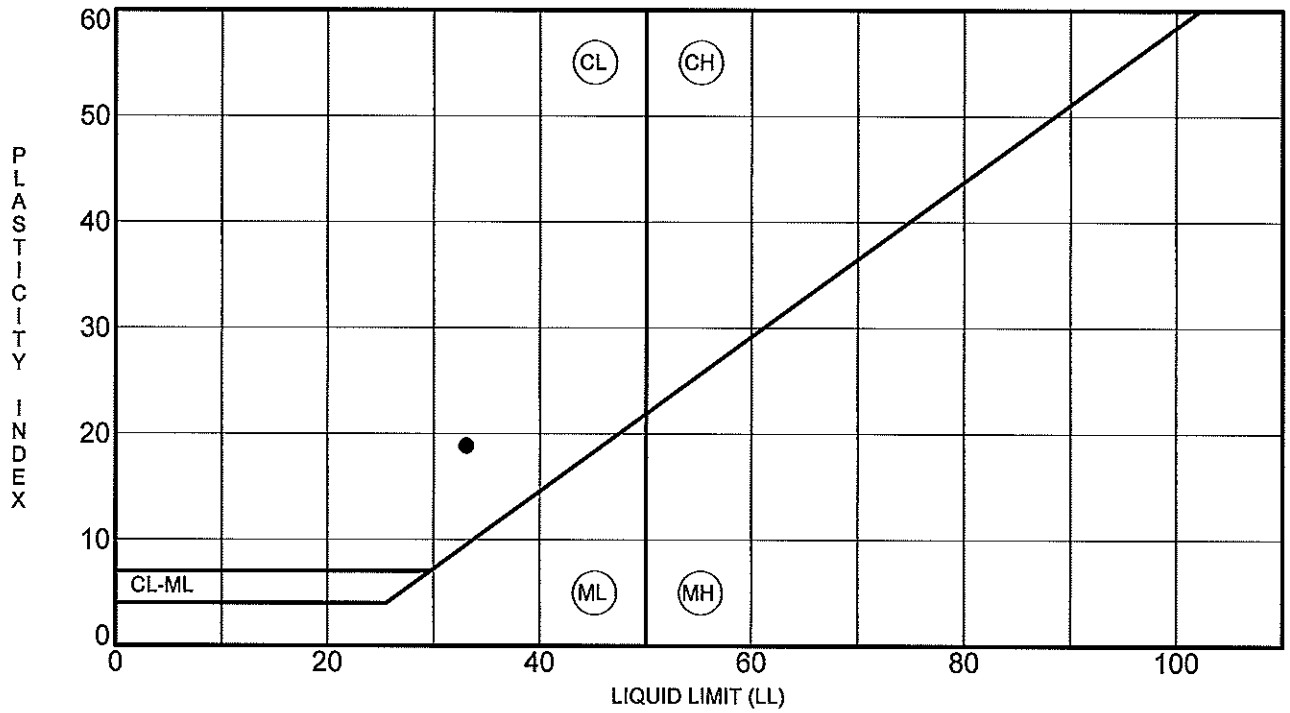
JOB NO. **201106**

DATE **07/12/12**

GRADATION CURVES

ANTILLIAN ENGINEERING ASSOCIATES, INC.

Orlando, Florida, USA



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**2B-3-PB1**	**14.0**	**33**	**14**	**19**	**53.4**	

CDM NO. _____

PROJECT **SR 40 PD&E Study**

JOB NO. **201106**

DATE **07/12/12**

ATTERBERG LIMITS

ANTILLIAN ENGINEERING ASSOCIATES, INC.

Orlando, Florida, USA

SR 40 PD STUDY
BREAKAWAY TRAIL TO WILLIAMSON BOULEVARD
PRELIMINARY FIELD PERMEABILITY TEST RESULTS

LOCATION	**DEPTH** (ft)	**Volume** (gal)	**T** (min)	**V_{60}** (oz/min)	**k_H** (ft/day)	**k_V** (ft/day)
3-PB1	4 - 6	12	3.05	30,216	40	>26
4-PB1	8 - 10	12	2.75	33,513	>40	>26

LOCATION	3-PB1	4-PB1
B - Casing Diameter (in)	3	3
D - Depth Below Grade (ft)	6	10
G - Depth To Groundwater (ft)	17	16
H - Riser Height (ft)	1	2
L - Total Casing Length (ft)	5	10
T - Test Interval (ft)	2	2
Water Level Below Top of Casing (ft):	0	0
k_H:k_V Ratio	1.5	1.5
m	1.22	1.22
Water volume (gal)	12	12
Elapsed time (min)	3.05	2.75
Flow rate (oz/hr)	30,216	33,513
L (cm)	61.0	61.0
D (cm)	7.6	7.6
h_c (cm)	548.6	548.6
q (cm^3/sec)	992.9	1101.2
q (cm^3/sec)	992.9	1101.2
k_H (cm/s)	0.0141	0.0156
k_H (feet/day)	39.9	44.2
k_V (feet/day)	26.6	29.5

Constant Head $k_h = \dfrac{q\, ln\left[\frac{mL}{D} + \sqrt{1 + \left(\frac{mL}{D}\right)^2}\right]}{2\pi L h_c}$

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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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.