Appendix 7

Soil Study

JACA & SIERRA
Testing Laboratories
Geotechnical Engineers

PRELIMINARY REPORT

ON THE GEOTECHNICAL EXPLORATION PERFORMED AT THE SITE OF THE PROPOSED IMPROVEMENTS TO INTERSECTION PR-2, 2R & SAN JUAN ST. (RUM ENTRANCE, LA VITA), MAYAGUEZ, PUERTO RICO

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PRELIMINARY REPORT

ON THE GEOTECHNICAL EXPLORATION PERFORMED AT THE SITE OF THE PROPOSED IMPROVEMENTS TO INTERSECTION PR-2, 2R & SAN JUAN ST. (RUM ENTRANCE, LA VITA), MAYAGUEZ, PUERTO RICO

1.0 INTRODUCTION:

The present soil report covers the results of the preliminary geotechnical exploration performed at the site of the proposed improvements to intersection PR-2, PR-2R and San Juan St. (main entrance of University of Puerto Rico, Mayaguez Campus) located at state road PR-2 Km. 153.9, Municipality of Mayaguez, Puerto Rico. Improvements extend to the north along PR-2 up to intersections with PR-3108 and PR-102.

Jaca & Sierra Engineering, PSC was contracted by *Jose A. Batlle & Associates, PSC* to conduct site investigations and prepare preliminary geotechnical recommendations for the project. The exploration program was directed to obtain subsurface soil information to be utilized in our engineering evaluation and in the formulation of pertinent recommendations for the intended improvement alternatives.

This preliminary geotechnical study was carried out in function of roadway and profile plans for four (4) different alternatives provided by Mr. Jose A. Batlle, PE. This soil report has been prepared for the exclusive use of the owner, their architects, engineers and/or others involved in the preparation of design plans and specifications for the project.

2.0 FIELD AND LABORATORY WORK:

The field exploration consisted of drilling a total of six (6) test borings distributed within the proposed improvements along state road PR-2. Borings were drilled to depths from 45 to 85 feet Beneath Existing Ground Surface (BEGS). Refer to boring location plan on Appendix A.

Subsurface drilling was executed by means of the power auger method as per ASTM D1452 using a CME-55 trailer-mounted drill rig to drive a 2.25-inch Internal Diameter (ID) helical hollow-stem auger into the ground. In-situ testing and soil sampling were achieved by means of the universally adopted Standard Penetration Test (SPT) and split-spoon sampler method according to ASTM D1586. Undisturbed soil samples were collected using Shelby tube samplers.

The soil samples were secured in jars and transported to our laboratory for visual-manual description (ASTM D2488) and moisture content determination (ASTM D2216). Unconfined compressive strength (ASTM D2166) and soil classification (ASTM D422 for particle size analysis and ASTM D4318 for Atterberg limits) tests were performed in selected samples. Undisturbed soil samples were subjected to consolidation tests (ASTM D2435). The soil classification and consolidation tests results are displayed on Appendix B.

The field and laboratory information was gathered to prepare boring logs, which reveal the stratigraphy and soil properties at the locations of the borings. This report was based on the information obtained in the boring logs and plans submitted to us.

3.0 SUBSOIL GENERALIZED CONDITIONS:

3.1 Site Geology:

According to the U.S. Geological Survey (USGS) geologic map of the Mayaguez and Rosario Quadrangles, the explored area falls within geologic zones that correspond to *Alluvium (Qal)* and *Yauco Formation (Ky)*. *Two-Pyroxene Basalt (TKpb)* and *Swamp Deposits (Qs)* are in the vicinity of the area. Figure 1 below shows a portion of the geologic map and the approximate site location. The USGS describes the mentioned geologies as follows:

- ***Alluvium (Qal)*** *– Poorly to moderately sorted and moderately to well-bedded sand, silt, and cobble or boulder gravel, chiefly along streams; includes unsorted rock-fall and landslide debris at foot of steep slopes.*
- ***Yauco Formation (Ky)*** *– Dark-bluish-gray to dark-gray, to dark-greenish-gray, interbedded, calcareous, volcaniclastic sandstone, siltstone, mudstone, claystone, limestone, and subordinate breccia and conglomerate, characteristically thin- to medium-bedded and fine- to medium-grained. The Yauco characteristically weathers to a light-orange-brown saprolite that preserves the texture and structure of the original rock.*
- ***Two-Pyroxene Basalt (TKpb)*** *– Light-greenish-gray to light- to dark-gray, porphyritic augite-hypersthene-plagioclase basalt. Weathers to a light-brownish-gray or light-brown grus soil. Preserved rounded masses of fresh rock are common in saprolite.*
- ***Swamp Deposits (Qs)*** *– Clay, silt, and organic matter; commonly covered by thick vegetation.*

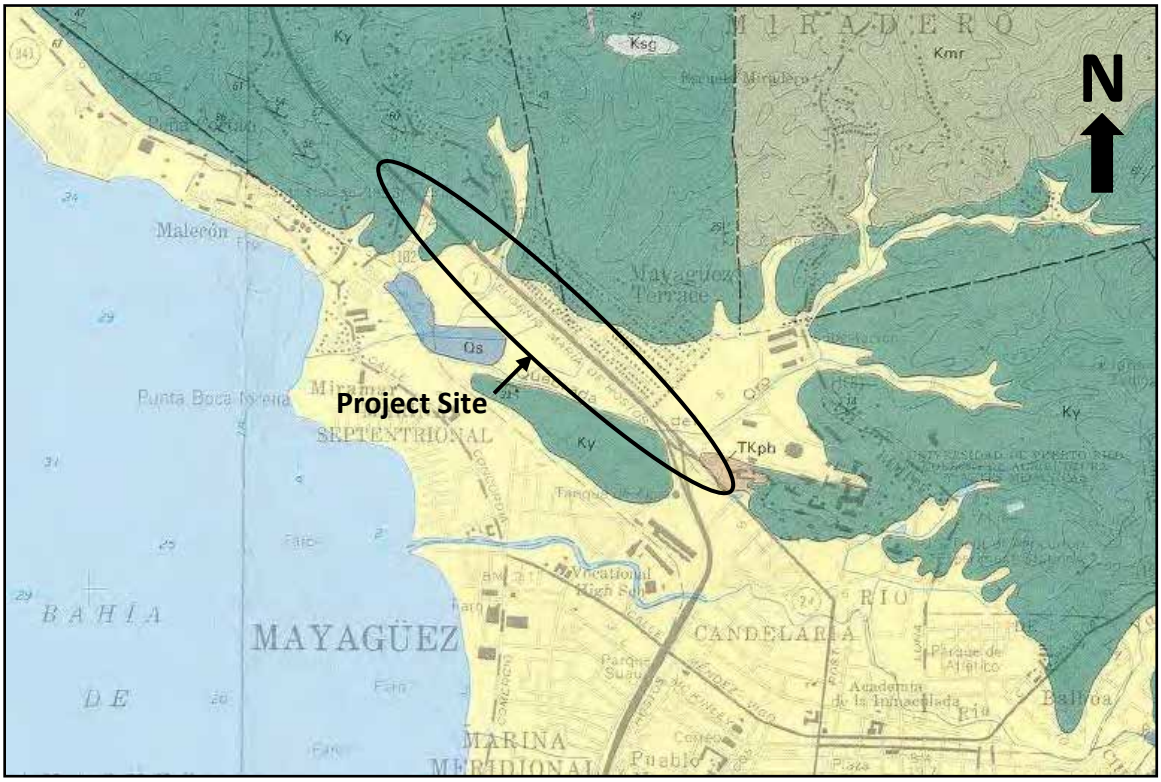

Figure 1: Project site location in USGS geologic map[1].

3.2 Soil Stratigraphy:

Two (2) main soil profiles were identified along the project site. One stratigraphy (borings no. 1, no. 4 and no. 5) is characterized by upper man-made fill material, followed by alluvium deposits, underlain by saprolitic and weathered horizons of the Yauco formation. Old swamp deposits are within the alluvium stratum. The other stratigraphy (borings no. 2, no. 3 and no. 6) consists of upper man-made fill material directly over saprolitic and weathered

[1] A.F. Curet (1986), "Geologic Map of the Mayaguez and Rosario Quadrangles, Puerto Rico", Map I-1657, Miscellaneous Investigations Series, U.S. Geological Survey, Department of the Interior, Washington, D.C.

horizons of the Yauco formation, with little or no alluvium layer in the middle. Each stratum is described as follows:

Stratum no. 1 – Man-Made Fill

The upper man-made fill material is composed mostly of silty sand with variable amounts of gravel. The layer thickness varies from 2 to 14 feet. SPT-N values recorded are varying from 16 to 70 blows per foot (bpf) of penetration. Higher N values are chiefly related to the presence of gravel. The moisture contents measured are from 2 to 20 %.

Stratum no. 2 – Alluvium Deposits

The above described fill stratum overlays alluvium deposits in borings no. 1, no. 4 and no. 5. The layer occurs from 9 to 14 feet depth BEGS and extends from 59 to 69 feet depth BEGS. Alluvium deposits are mainly comprised of very soft to medium stiff clayey silt with traces of sand and loose to medium dense clayey sand with gravel. Very soft clayey silt with variable amounts of peat and organic matter from old swamp deposits is present at different depths between 15 and 55 feet depth BEGS. A relatively thin 5 feet layer (from 14 to 19 feet depth BEGS) of alluvium consisting of gravel with sand and clay was observed in boring no. 3. The SPT-N values within the clayey silt horizon are from 0 (i.e. the sampler was pushed through the layer with the weight of the hammer and no blows, e.g. Weight of Hammer depicted as WH in boring no. 1) to 9 bpf, while within the clayey sand horizon are from 5 to 19 bpf. Moisture contents obtained within non swamp soils are from 18 to 60 %, while with peat and organic matter content are from 40 to 95 %.

Stratum no. 3 – Saprolitic Yauco Formation

Below both fill and alluvium strata, a saprolitic horizon of the Yauco formation was found. The layer thickness varies from 5 to 55 feet. Saprolitic Yauco formation is decomposed as silty sand, clayey sand and clayey silt with variable amounts of rock fragments. SPT-N values registered are ranging from 13 to 100+ (i.e. refusal blow counts, e.g. 50 blows per 4 inches of penetration depicted as 50/4" in boring no. 3) bpf. The moisture contents fluctuated from 7 to 59 %.

Stratum no. 4 – Weathered Yauco Formation

The lower stratum encountered consists of a weathered horizon of the Yauco formation extending to the end of boreholes (45 to 85 feet depth BEGS). Weathered rock is sampled as rock fragments, sandy gravel, gravelly sand and silty sand. Most of the retrieved samples from the Yauco formation consist of weathered volcanic sandstone and siltstone. Weathered limestone is present in boring no. 5. The SPT tests resulted in N values between 29 and 100+ bpf. Moisture contents are from 7 to 41 %.

3.3 Groundwater Conditions:

The observations made at the time of our subsoil exploration revealed groundwater level in the order of 13 to 15 feet depth BEGS. Table 1 below presents groundwater level at each boring location. However, groundwater level may rise during and after prolonged rain events.

The above information corresponds to a general interpretation of the subsoil conditions of the explored area. For more detailed description regarding the soil profile, refer to the enclosed boring logs on Appendix A.

Table 1: Groundwater level at boring locations.

Boring no.	Groundwater Level (ft)
1	15
2	14
3	14
4	15
5	13
6	13

4.0 PRELIMINARY RESULTS AND RECOMMENDATIONS:

The proposed project consists of improvements intended to optimize traffic along PR-2 from its intersection with PR-2R and San Juan St. to its intersections with PR-3108 and PR-102. Improvements include one (1) or two (2) bridges along PR-2 crossing over San Juan St. and PR-3108. At the moment, there are four (4) preliminary alternatives considered for design: "Viaducto", "Camello", "Diamante" and "Loops".

The geotechnical investigation uncovered very soft compressible soils at the locations of borings no. 1, no. 4 and no. 5. These compressible soils are prone to consolidation settlements greater than tolerable limits under load increments. Hence, we recommend the design of a deep foundation system such as drilled shafts to transfer loads into the weathered horizon of the Yauco formation. On the other hand, borings no. 2 and no. 6 revealed shallow dense to very

dense/very stiff to hard saprolitic horizon of the Yauco formation. Considering this shallow competent saprolite, a shallow foundation system is favorable at these locations. In case of boring no. 3, although it does not have compressible soils, it does have a considerable fill layer (14 feet thick) and the saprolitic horizon is at greater depth (below 20 feet depth BEGS). Consequently, it is our opinion that a deep foundation system will also be required at this location.

The following subsections provide preliminary geotechnical recommendations for shallow and deep foundations design as well as for bridge abutments and approach.

4.1 Shallow Foundations:

The relatively shallow saprolitic horizon at the locations of borings no. 2 and no. 6 is suitable to support structures over shallow foundation system. The base of the foundations shall be lowered to a minimum depth of 10 feet BEGS at these locations. This determination to use shallow foundations at certain supports is preliminary and shall be confirmed by additional test borings at the selected locations of the foundations. The conditions within the area of borings no. 2 and no. 3 are highly variable. Some of the proposed alternatives have alignments to the east of boring no. 2. The conditions at certain distance of boring no. 2 may not be viable for shallow foundations.

Where feasible, shallow foundations shall be designed considering the nominal bearing resistance (q_n) provided in this report and the bearing resistance factor (φ_b) as per American

Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications 2012 (Table 10.5.5.2.2-1). The AASHTO LRFD Bridge 2012 specifies a bearing resistance factor (φ_b) of 0.45 for footings resting over rock, which in our opinion is also applicable to the existing saprolite. Based on the present subsoil conditions, we preliminarily recommend a nominal bearing resistance (q_n) of 13,333 psf (ultimate) on areas having hard saprolitic soils or weathered rock at foundation level. Therefore, the resultant **factored bearing resistance (q_R) is 6,000 psf**.

Similarly, the nominal sliding resistance against failure by sliding (R_n) shall also be factorized. The formula to calculate the factored resistance against failure by sliding (R_R) is as follows:

$$R_R = \varphi R_n = \varphi_\tau R_\tau + \varphi_{ep} R_{ep}$$

where φ_τ is the resistance factor for shear resistance between soil and foundation, R_τ is the nominal sliding resistance between soil and foundation, φ_{ep} is the resistance factor for passive resistance and R_{ep} is the nominal passive resistance of soil available throughout the design life of the structure. The AASHTO LRFD Bridge 2012 (Table 10.5.5.2.2-1) specifies sliding resistance factors for shear resistance (φ_τ) and passive resistance (φ_{ep}) of 0.80 and 0.50, respectively.

The nominal sliding resistance between soil and foundation (R_τ), considering cohesionless soil beneath the footing and concrete cast against soil, is calculated as follows:

$$R\tau = V \tan(\varphi_f)$$

where V is the total vertical force at the footing and φ_f is the angle of internal friction of soil beneath the footing. We recommend an angle of internal friction (φ_f) of 32° for nominal sliding resistance (R_τ) calculation. The nominal passive resistance (R_{ep}) shall be included only if soil will be permanent in front of the foundation. However, consideration shall also be given to the possibility of future removal of the soil that provides the passive pressure.

4.2 <u>Drilled Shafts:</u>

Due to the presence of deep soft soils, deep foundation system will be necessary at the locations of borings no. 1, no. 3, no. 4 and no. 5. Each boring log was modeled using the geotechnical software SHAFT v5.0 to estimate compressive axial load capacities in function of depth. Different diameters were considered for drilled shaft design, from 48-inch to 96-inch, 6-inch interval.

Graphs exhibiting allowable compressive axial loads (in tons) for all diameters analyzed in function of depth (up to 80 feet depth BEGS) are illustrated on Appendix C. Note that the axial loads provided in graphs are allowable, not ultimate, so the factor of safety is already included. Please also notice that the depths refer to the existing ground surface elevation at the boring locations, thus actual depths need to be adjusted with respect to the final cutoff elevations.

For lateral load analysis, the soil parameters that can be used in the geotechnical software LPILE 2013 are tabularized on Appendix D. We could provide lateral load analysis results upon request and receipt of design loads (axial, lateral and moment).

The following general recommendations are made with regards to installation of the drilled shafts, testing requirements and quality assurance methods:

1. It envisioned and recommended that a permanent casing will be required for the zones having soft to very soft soils. Table 2 below shows the estimated casing length per boring location. Either temporary or permanent casing evaluation shall be covered in further depth in the final geotechnical report. Bentonite drilling will be required for stabilization during drilled shaft construction. Final design shall include performance or prescriptive specifications for different drilling and installation methods.

Table 2: Estimated casing depth at boring locations.

Boring no.	Permanent Casing Depth (ft)
1	65
3	25
4	45
5	60

2. Load tests shall be made by means of Osterberg Cell Method. The quantity and locations of test piles shall be coordinated with the consultant geotechnical engineer and shall be further discussed on the final geotechnical report.

3. As part of the quality assurance of the proposed drilled shafts, we recommended performance of Crosshole Sonic Logging (CSL) per ASTM D6760 – 16 Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing. Similarly, the quantity and locations of these tests shall be further elaborated in the final geotechnical report by the geotechnical engineer of record of the project.
4. The installation of the drilled shafts shall be continuously monitored by third party geotechnical laboratory to provide drilling logs, casing installation, bentonite quality assurance/control testing, shaft base cleaning, reinforcement installation and tremie concrete pouring logs, among other details.

4.3 Bridge Abutments and Approach:

Based on the profile plans submitted to us, it is understood that bridge abutments may have maximum heights in the order of 15 feet. As mentioned above, there are very soft compressible soils at different depths between 15 and 55 feet depth BEGS at the locations of borings no. 1, no. 4 and no. 5, which are locations planned to support abutments and approach ramps. The new fill intended for the abutment structures will induce load increments within the compressible soil strata thus triggering consolidation settlements.

Consolidation settlements were estimated as a function of the height of the proposed abutments and soil properties gathered from laboratory consolidation tests. Considering

permanent fill heights of 6, 12 and 15 feet, we conducted preliminary calculations of primary consolidation settlements of 11, 19 and 24 inches, respectively. Similarly, additional secondary consolidation settlements will be 9, 11 and 12 inches, respectively. Therefore, total consolidation settlements for fill heights of 6, 12 and 15 feet are 20, 30 and 36 inches, respectively.

Consolidation is time dependent and settlements take place as a result of pore water dissipation from the void spaces of the saturated cohesive soils. The time required to achieve 90 % of primary consolidation was computed in approximately 4 years. In order to shorten the time of consolidation settlements, the use of prefabricated vertical drains (i.e. wick drains) is typical; by shorten the water path distance for dissipation. Considering the use of vertical drains installed to depths up to reach the bottom of compressible soils (40 to 55 feet depth BEGS) and spaced to 5 and 6 feet interval, we estimated that the time for consolidation settlements will be reduced to 7 and 12 months, respectively.

Another concern will be slope stability and fill progress. Depending on the fill height and location, slope stability may need to be monitored by inclinometers. A plan for temporary slopes and stabilization measures shall be established for the final concept development. Settlement progress shall be monitored with settlement plates. It is preliminarily estimated that fill shall not be raised in level by more than 3 ft per week. Monitoring of embankment shall include: settlement plates, piezometers and inclinometers.

Based on the relatively high magnitude of settlements expected and long period of time for stabilization, it is our opinion that bridge abutments consisting of above-ground fill material and earth retaining structures is not the most cost-effective option for this project. As a feasible mitigation alternative for this condition, we recommend the use of low height abutment and approach to raise the road from existing elevations to the proposed bridge elevations. The abutments shall be supported over the herein recommended drilled shafts and the bridge design to provide as minimum height approach as possible. Similar design has been used for Viaduct over Baldorioty Avenue and Kennedy Avenue in San Juan, Puerto Rico.

We could analyze other options upon request and submission of details of the intended solution.

4.4 Seismic Site Classification:

Based on our evaluation of the test borings completed and our knowledge of the site geological conditions, it is our opinion that the seismic site classification at the project site as per International Building Code (IBC) 2009 and American Society of Civil Engineers (ASCE) Standard 7-05 is variable including Site Class C, D and E. Table 3 below presents the design spectral acceleration parameters at each boring location, where S_{DS} and S_{D1} are the design spectral acceleration parameters at short period and at 1 second period, respectively.

Table 3: Design spectral acceleration parameters at boring locations.

Boring no.	Site Class	S_{DS}	S_{D1}
1	E	0.684	0.620
2	C	0.760	0.352
3	D	0.793	0.408
4	E	0.684	0.621
5	E	0.685	0.621
6	C	0.761	0.352

5.0 ADDITIONAL COMMENTS:

It is recommended that this submitted preliminary geotechnical report be carefully studied and evaluated to coordinate those pertinent office meetings during the project design stage to discuss the various considered project design concepts and to clarify or include any other pertinent geotechnical design recommendations not covered in our soil report, which would need to be covered in the final geotechnical report.

Please note that these preliminary recommendations have been provided based on limited site information. Once the project alternative and layout has been established, it is recommended that a final geotechnical exploration be performed to formulate more accurate recommendations.

We wish to thank you for the opportunity of submitting this preliminary geotechnical engineering report and remain,

Cordially yours,

JACA & SIERRA ENGINEERING, PSC

Carlos R. Sierra Del Llano, MSCE, PE

Rommel Cintrón Aponte, MSCE, PE

Enclosures

Appendix A: Boring Logs & Locations

Appendix B: Laboratory Tests Results

Appendix C: SHAFT v5.0 Software Graphs

Appendix D: LPILE 2013 Software Tables

Appendix E: Generalized Soil Profile

Appendix A:
Boring Logs & Locations

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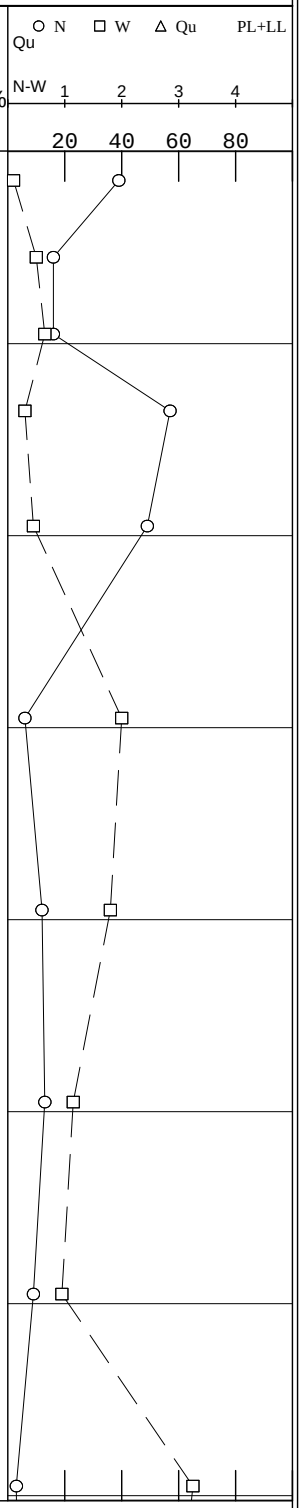
SUBSURFACE EXPLORATION LOG

BORING N0.: 1

PROJECT	Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	**JOB** 7716	**SHEET** 1 **OF** 3
LOCATION	Mayaguez, PR	**DRILLER/DRILL RIG:**	Luis Santos / CME-55
COORDINATES	241743 N 124706 E	**DATE HOLE STARTED**	12-13-16 **COMPLETED** 12-13-16
DESCRIPTION BY	Manuel Candelario	**ELEVATION TOP OF HOLE (mts):**	6.18
GROUNDWATER (FT)	**Initial:** 20 **Final:** 15	**ENGINEER**	Rommel Cintron
DRILLING METHOD:	Hollow-Stem Auger 2.25" ID	**TOTAL DEPTH OF HOLE (ft):**	85.5

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00										
6.18	0	0 FILL: silty sand some gravel, medium dense to very dense, yellowish brown, reddish yellow, gray		S-1		10 29 10	39	2			
				S-2		6 11 5	16	10			
	5			S-3		5 7 9	16	13			
				S-4		24 39 18	57	6			
	10			S-5		45 25 24	49	9			
2.83		11									
		CLAYEY SAND with gravel, loose to medium dense, grayish brown, yellowish brown		S-6		4 3 3	6	40			
	15 ▼										
				S-7		4 5 7	12	36			
	20 ▽										
				S-8		4 6 7	13	23			
	25										
				S-9		4 4 5	9	19			
	30										
-4.19		34									
		CLAYEY SILT trace peat and organic matter, very		S-10		WH 1	3	65			
	35										



"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight.
"Qu" - Unconfined Compressive Strength in tons per square foot.
▽ Initial G.W. Depth
▼ Final G.W. Depth
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
"WH" - Sample was recovered by advancing the sampler with the weight of the hammer.
"P" - A "P" in the Unconfined Compressive Strength test indicates the use of the pocket Penetrometer.

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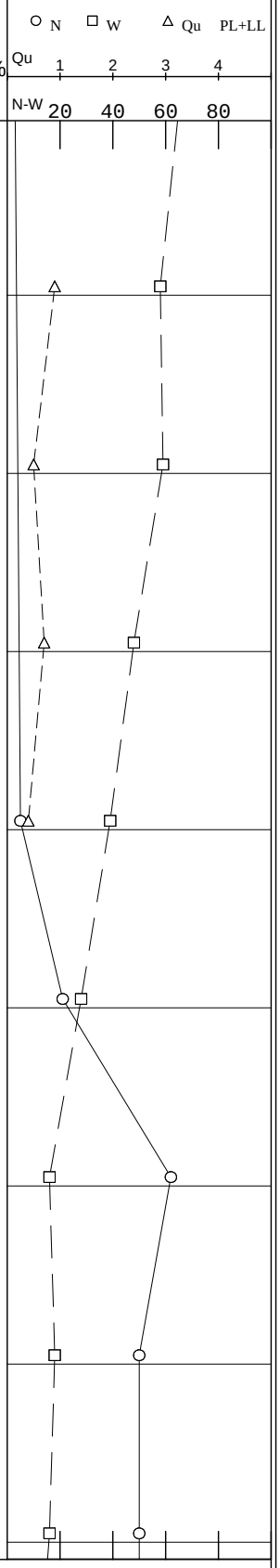
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 1

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET	OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	2	3

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00	soft to soft, light gray, bluish gray, black				2					
	40			S-11		WH WH WH	WH	58	0.9		
	45			S-12		WH WH WH	WH	59	0.5		
	50			S-13		WH WH WH	WH	48	0.7		
	55			S-14		WH 2 3	5	39	0.4		
-11.81		59									
	60	SILTY SAND some clay and rock fragments, medium dense to very dense, greenish gray, yellowish brown (Saprolite)		S-15		7 10 11	21	28			
	65			S-16		18 26 36	62	16			
-14.86		69									
	70	HIGHLY WEATHERED ROCK sampled as gravelly sand with clayey silt, brown, reddish yellow, gray		S-17		36 50/4"	50/4"	18			
	75			S-18		50/4"	50/4"	16			



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"W" - Natural Moisture Content in percentage of dry weight.
"Qu" - Unconfined Compressive Strength in tons per square foot.
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
"WH" - Sample was recovered by advancing the sampler with the weight of the hammer.
"P" - A "P" in the Unconfined Compressive Strength test indicates the use of the pocket Penetrometer.

Initial G.W. Depth
Final G.W. Depth

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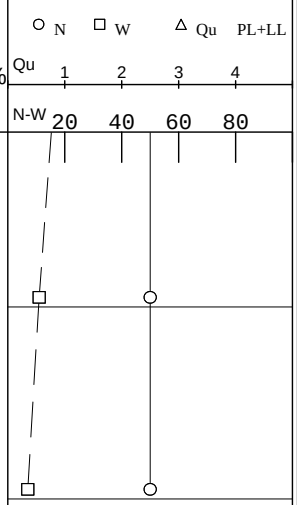
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 1

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET / OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	3 / 3

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00										
	80			S-19		50/2"	50/2"	11			
	85			S-20		50/1"	50/1"	7			
	90										
	95										
	100										
	105										
	110										
	115										



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"W" - Natural Moisture Content in percentage of dry weight.
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"P" - A "P" in the Unconfined Compressive Strength test indicates the use of the pocket Penetrometer.

▽ Initial G.W. Depth
▼ Final G.W. Depth

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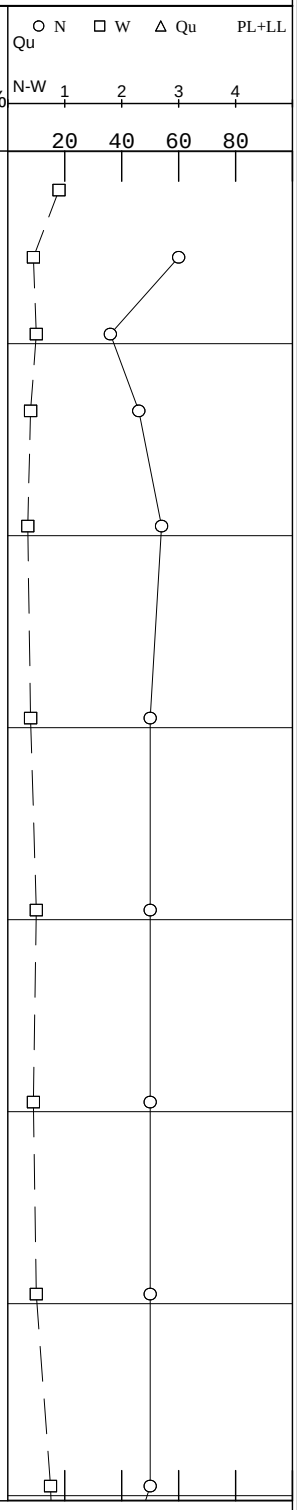
SUBSURFACE EXPLORATION LOG

BORING N0.: 2

PROJECT Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)		**JOB** 7716	SHEET 1 OF 2
LOCATION Mayaguez, PR		**DRILLER/DRILL RIG:** Luis Santos / CME-55	
COORDINATES 241947 N	124639 E	**DATE HOLE STARTED** 12-14-16	**COMPLETED** 12-14-16
DESCRIPTION BY Manuel Candelario		**ELEVATION TOP OF HOLE (mts):** 8.27	
GROUNDWATER (FT) **Initial:** 16	**Final:** 14	**ENGINEER** Rommel Cintron	
DRILLING METHOD: Hollow-Stem Auger 2.25" ID		**TOTAL DEPTH OF HOLE (ft):** 65.5	

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
8.27	0.00										
	0	FILL: sandy silt trace roots, yellowish brown (topsoil)	0	S-1				18			
7.66			2								
		SILTY SAND, dense to very dense, yellowish brown, light gray, yellow (Saprolite)		S-2		15 28 32	60	9			
	5			S-3		13 17 19	36	10			
				S-4		23 24 22	46	8			
	10			S-5		14 27 27	54	7			
4.00			14								
	15	HIGHLY WEATHERED ROCK sampled as silty sand, yellowish brown, light gray, yellow		S-6		22 29 50/5"	50/5"	8			
	20			S-7		28 50/4"	50/4"	10			
	25			S-8		50/4"	50/4"	9			
	30			S-9		50/5"	50/5"	10			
	35			S-10		39 50/5"	50/5"	15			



"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight.
"Qu" - Unconfined Compressive Strength in tons per square foot.
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
"WH" - Sample was recovered by advancing the sampler with the weight of the hammer.
"P" - A "P" in the Unconfined Compressive Strength test indicates the use of the pocket Penetrometer.

Initial G.W. Depth
Final G.W. Depth

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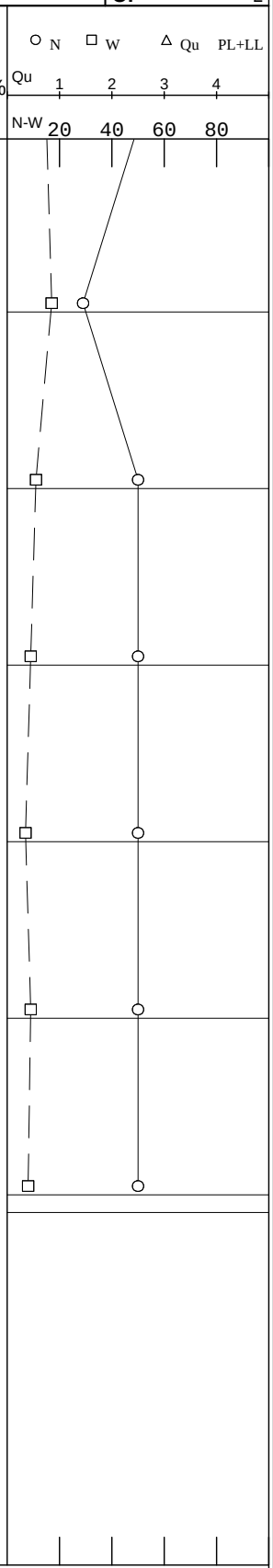
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 2

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET / OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	2 / 2

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00										
	40			S-11		14 15 14	29	17			
	45			S-12		50/3"	50/3"	11			
	50			S-13		50/4"	50/4"	9			
	55			S-14		50/2"	50/2"	7			
	60			S-15		50/2"	50/2"	9			
	65			S-16		50/1"	50/1"	8			
	70										
	75										



"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight.
"Qu" - Unconfined Compressive Strength in tons per square foot.
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▽ Initial G.W. Depth
▼ Final G.W. Depth

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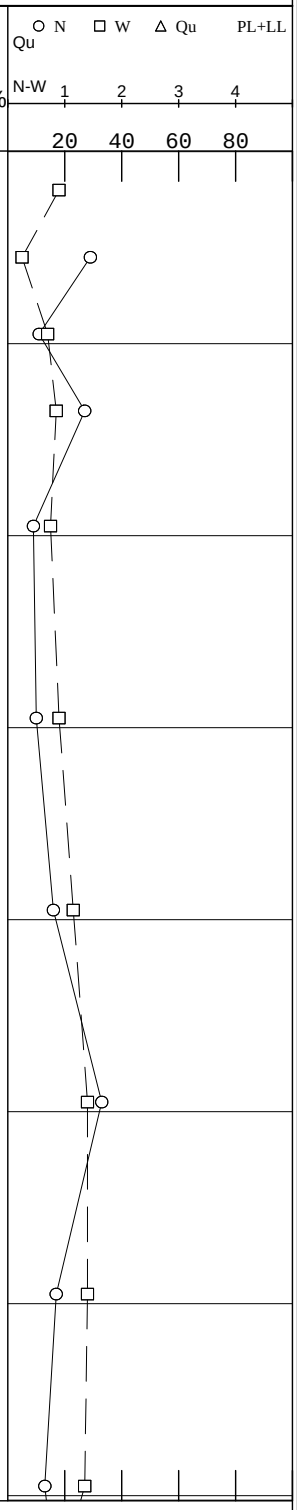
SUBSURFACE EXPLORATION LOG

BORING N0.: 3

PROJECT Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)		**JOB** 7716	SHEET 1 OF 3
LOCATION Mayaguez, PR		**DRILLER/DRILL RIG:** Luis Santos / CME-55	
COORDINATES 242041 N	124618 E	**DATE HOLE STARTED** 12-6-16	**COMPLETED** 12-6-16
DESCRIPTION BY Manuel Candelario		**ELEVATION TOP OF HOLE (mts):** 7.05	
GROUNDWATER (FT) **Initial:** 15	**Final:** 14	**ENGINEER** Rommel Cintron	
DRILLING METHOD: Hollow-Stem Auger 2.25" ID		**TOTAL DEPTH OF HOLE (ft):** 85.5	

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00										
7.05	0			S-1				18			
		FILL: silty sand with gravel, medium dense, yellowish brown, gray		S-2		54 19 10	29	5			
5.83		4									
	5	FILL: sand some silt and gravel, loose to medium dense, yellowish brown, gray		S-3		6 5 6	11	14			
				S-4		7 9 18	27	17			
	10			S-5		5 3 6	9	15			
2.78		14									
	15	GRAVEL with sandy clay, loose, gray, brown		S-6		3 4 6	10	18			
1.26		19									
	20	CLAYEY SAND with rock fragments, medium dense to dense, reddish yellow, brown, gray, yellow (Saprolite)		S-7		3 6 10	16	23			
	25			S-8		8 20 13	33	28			
	30			S-9		6 7 10	17	28			
	35			S-10		5 5	13	27			



"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight.
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Initial G.W. Depth
Final G.W. Depth

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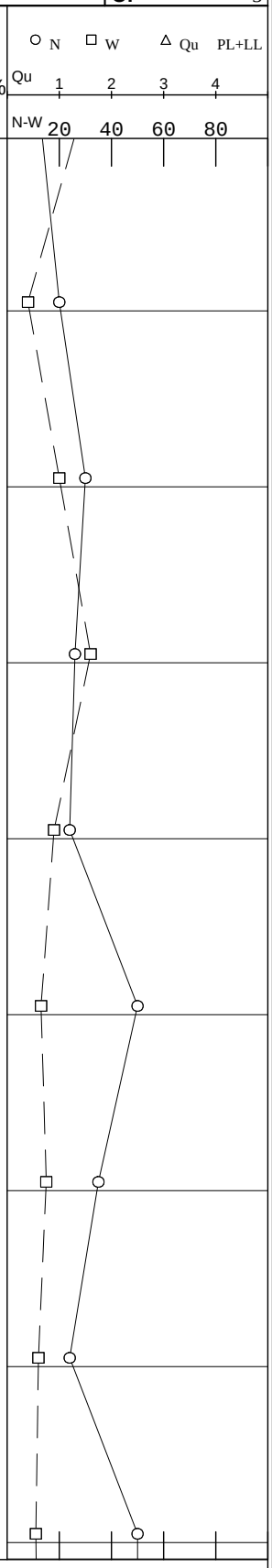
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 3

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET	OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	2	3

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00										
						8					
				S-11		10 9 11	20	8			
	40										
				S-12		8 14 16	30	20			
	45										
				S-13		15 14 12	26	32			
	50										
				S-14		8 10 14	24	18			
	55										
				S-15		17 24 50/4"	50/4"	13			
	60										
				S-16		18 19 16	35	15			
	65										
				S-17		13 12 12	24	12			
	70										
-15.51		74									
		HIGHLY WEATHERED ROCK sampled as rock fragments with clayey sand, dark gray, yellowish		S-18		50/3"	50/3"	11			
	75										



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"W" - Natural Moisture Content in percentage of dry weight.
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"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
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▽ Initial G.W. Depth
▼ Final G.W. Depth

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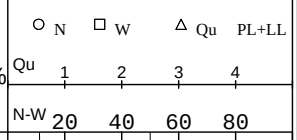
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 3

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET / OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	3 / 3

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00	brown									
	80			S-19		50/0"	50/0"				
	85			S-20		45 50/2"	50/2"	13			
	90										
	95										
	100										
	105										
	110										
	115										



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"W" - Natural Moisture Content in percentage of dry weight.
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▽ Initial G.W. Depth
▼ Final G.W. Depth

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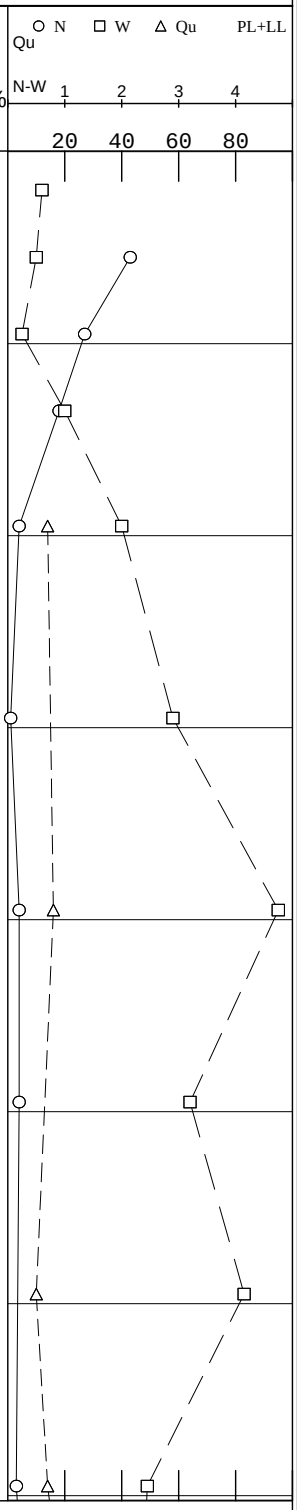
SUBSURFACE EXPLORATION LOG

BORING N0.: 4

PROJECT Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)		**JOB** 7716	SHEET 1 OF 3
LOCATION Mayaguez, PR		**DRILLER/DRILL RIG:** Luis Santos / CME-55	
COORDINATES 242152 N	124489 E	**DATE HOLE STARTED** 12-8-16	**COMPLETED** 12-8-16
DESCRIPTION BY Manuel Candelario		**ELEVATION TOP OF HOLE (mts):** 5.11	
GROUNDWATER (FT) **Initial:** 25	**Final:** 15	**ENGINEER** Rommel Cintron	
DRILLING METHOD: Hollow-Stem Auger 2.25" ID		**TOTAL DEPTH OF HOLE (ft):** 85.5	

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00										
5.11	0	FILL: silty sand with gravel, medium dense to dense, yellowish brown, gray	0	S-1				12			
				S-2		6 23 20	43	10			
	5			S-3		14 15 12	27	5			
				S-4		8 9 9	18	20			
2.37			9								
	10	CLAYEY SILT trace sand, very soft to soft, dark gray, brown		S-5		2 2 2	4	40	0.7		
	15			S-6		WH WH 1	1	58			
	20	Do... with peat and organic matter, bluish gray		S-7		WH 2 2	4	95	0.8		
	25			S-8		WH 2 2	4	64			
	30			S-9		WH WH WH	WH	83	0.5		
	35	Do... reddish yellow, gray, white		S-10		WH WH	3	49	0.7		



"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight.
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Initial G.W. Depth
Final G.W. Depth

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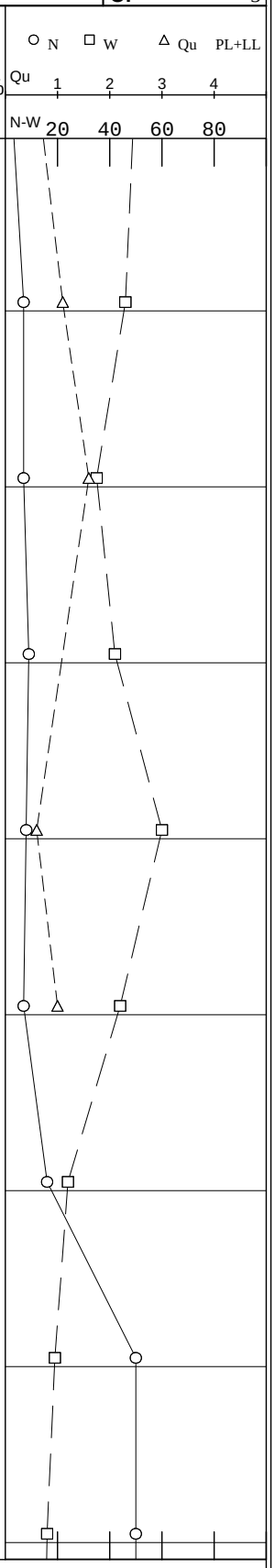
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 4

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET	OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	2	3

Elev. (mts)	DEPTH (feet)	DESCRIPTION	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00				3					
-6.78	39									
		CLAYEY SILT trace sand, medium stiff to stiff, yellowish red, brownish yellow, dark gray	S-11		2 3 4	7	46	1.1		
	40									
			S-12		1 3 4	7	35	1.6		
	45									
			S-13		1 4 5	9	42			
	50									
			S-14		2 3 5	8	60	0.6		
	55									
			S-15		2 3 4	7	44	1.0		
	60									
		Do... with sand some gravel, very stiff, yellowish brown, yellow	S-16		4 8 8	16	24			
	65									
-15.93	69									
		HIGHLY WEATHERED ROCK sampled as gravelly sand with clayey silt, brown, reddish yellow, gray	S-17		50/5"	50/5"	19			
	70									
			S-18		19 25	50/4"	16			
	75									



"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight.
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Initial G.W. Depth
Final G.W. Depth

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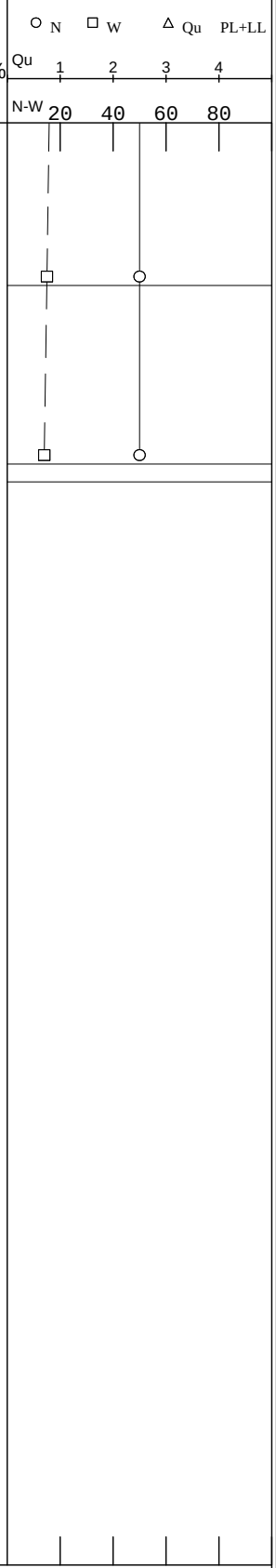
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 4

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET / OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	3 / 3

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00					50/4"					
	80			S-19		50/5"	50/5"	15			
-20.50		84									
	85	WEATHERED ROCK sampled as sandy gravel some clayey silt, HCl reaction, dark gray, brown, reddish yellow		S-20		50/1"	50/1"	14			
	90										
	95										
	100										
	105										
	110										
	115										



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▽ Initial G.W. Depth
▼ Final G.W. Depth

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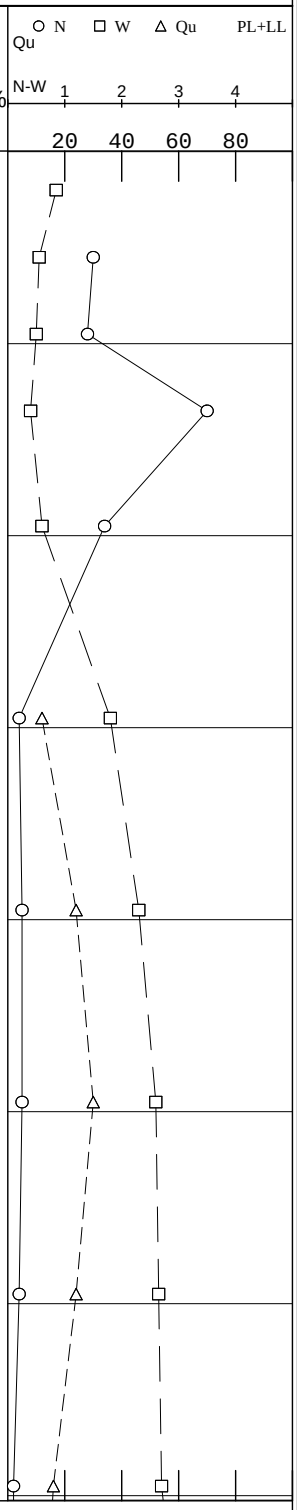
SUBSURFACE EXPLORATION LOG

BORING N0.: 5

PROJECT	Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	**JOB** 7716	SHEET 1 OF 3
LOCATION	Mayaguez, PR	**DRILLER/DRILL RIG:**	Luis Santos / CME-55
COORDINATES	242586 N 124025 E	**DATE HOLE STARTED**	12-7-16 **COMPLETED** 12-7-16
DESCRIPTION BY	Manuel Candelario	**ELEVATION TOP OF HOLE (mts):**	5.26
GROUNDWATER (FT)	**Initial:** 14 **Final:** 13	**ENGINEER**	Rommel Cintron
DRILLING METHOD:	Hollow-Stem Auger 2.25" ID	**TOTAL DEPTH OF HOLE (ft):**	85.5

Elev. (mts)	DEPTH (feet)	DESCRIPTION	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
5.26	0.00									
	0	0 FILL: silty sand with gravel, medium dense to very dense, yellowish brown, gray, reddish yellow	S-1				17			
			S-2		4 15 15	30	11			
	5		S-3		8 10 18	28	10			
			S-4		29 39 31	70	8			
2.52		9								
	10	SAND some silt, dense, yellowish gray	S-5		13 17 17	34	12			
0.99		14								
	15	CLAYEY SILT some sand trace gravel, soft to medium stiff, gray, brownish yellow	S-6		2 2 2	4	36	0.6		
	20		S-7		1 2 3	5	46	1.2		
	25		S-8		1 2 3	5	52	1.5		
	30		S-9		1 2 2	4	53	1.2		
-5.11		34								
	35	CLAYEY SILT, very soft, bluish gray	S-10		WH WH	2	54	0.8		



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"W" - Natural Moisture Content in percentage of dry weight.
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Initial G.W. Depth
Final G.W. Depth
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
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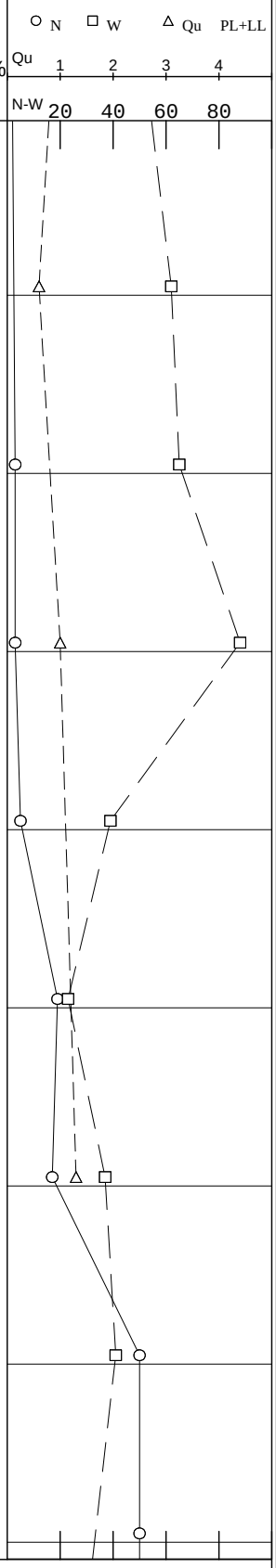
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 5

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET	OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	2	3

Elev. (mts)	DEPTH (feet)	DESCRIPTION	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00				2					
	40	Do... with peat and organic matter, dark bluish gray, black, brown	S-11		WH WH WH	WH	62	0.6		
	45		S-12		WH 1 2	3	65			
	50		S-13		2 1 2	3	88	1.0		
-11.20		54								
	55	CLAYEY SAND with gravel, very loose to medium dense, bluish gray, yellowish brown	S-14		1 2 3	5	39			
	60		S-15		3 9 10	19	23			
-14.25		64								
	65	CLAYEY SILT trace sand, very stiff, greenish gray, reddish yellow	S-16		7 8 9	17	37	1.3		
-15.78		69								
	70	WEATHERED LIMESTONE sampled as rock fragments, HCl reaction, pale yellow, gray	S-17		40 50/5"	50/5"	41			
	75		S-18		50/1"	50/1"				



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"W" - Natural Moisture Content in percentage of dry weight.
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"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
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Initial G.W. Depth
Final G.W. Depth

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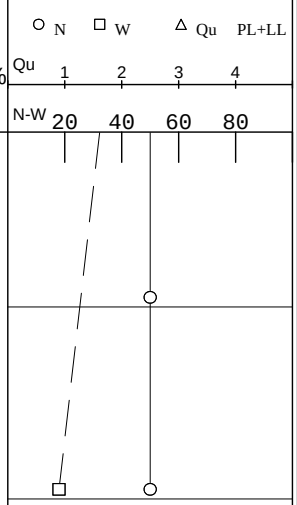
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 5

BORING LOG (CONT. SHEET)

PROJECT	JOB	SHEET / OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	3 / 3

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00										
	80			S-19		50/2"	50/2"				
	85	Do... sampled as clayey silt with sand, pale yellow		S-20		50/1"	50/1"	18			
	90										
	95										
	100										
	105										
	110										
	115										



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Initial G.W. Depth
Final G.W. Depth

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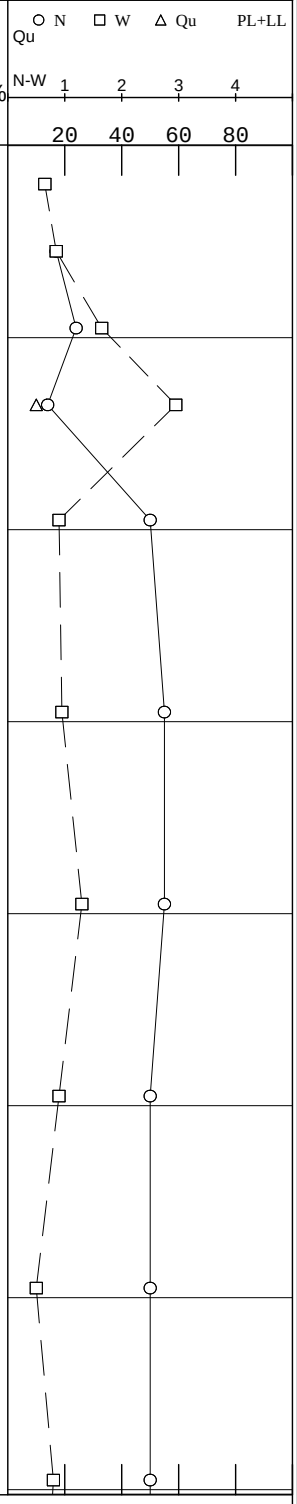
SUBSURFACE EXPLORATION LOG

BORING N0.: 6

PROJECT Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)		**JOB** 7716	SHEET 1 OF 2
LOCATION Mayaguez, PR		**DRILLER/DRILL RIG:** Luis Santos / CME-55	
COORDINATES 242677 N	123933 E	**DATE HOLE STARTED** 12-9-16	**COMPLETED** 12-9-16
DESCRIPTION BY Manuel Candelario		**ELEVATION TOP OF HOLE (mts):** 7.44	
GROUNDWATER (FT) **Initial:** 15	**Final:** 13	**ENGINEER** Rommel Cintron	
DRILLING METHOD: Hollow-Stem Auger 2.25" ID		**TOTAL DEPTH OF HOLE (ft):** 45.5	

Elev. (mts)	DEPTH (feet)	DESCRIPTION	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00									
7.44	0	0 FILL: silty sand some gravel, medium dense, brown, gray 2.5	S-1				13			
6.68		CLAYEY SILT some sand, relic joints, very stiff to hard, brownish yellow, reddish yellow, dark gray (Saprolite)	S-2		4 7 10	17	17			
	5		S-3		5 10 14	24	33			
			S-4		8 8 6	14	59	0.5		
	10		S-5		27 50/4"	50/4"	18			
	15		S-6		11 19 36	55	19			
1.65		19 SILTY SAND, very dense, reddish yellow (Saprolite)	S-7		26 27 28	55	26			
	20									
	25	Do... with rock fragments	S-8		50/5"	50/5"	18			
-1.40		29 WEATHERED ROCK sampled as gravel with silty sand, brownish yellow, dark gray	S-9		50/4"	50/4"	10			
	30									
			S-10		50/3"	50/3"	16			
	35									



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"W" - Natural Moisture Content in percentage of dry weight.
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Initial G.W. Depth
Final G.W. Depth

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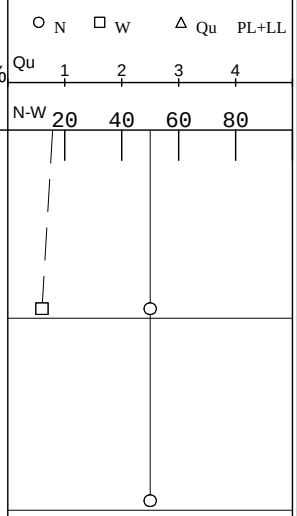
SUBSURFACE EXPLORATION LOG

BORING NUMBER: 6

BORING LOG (CONT. SHEET)

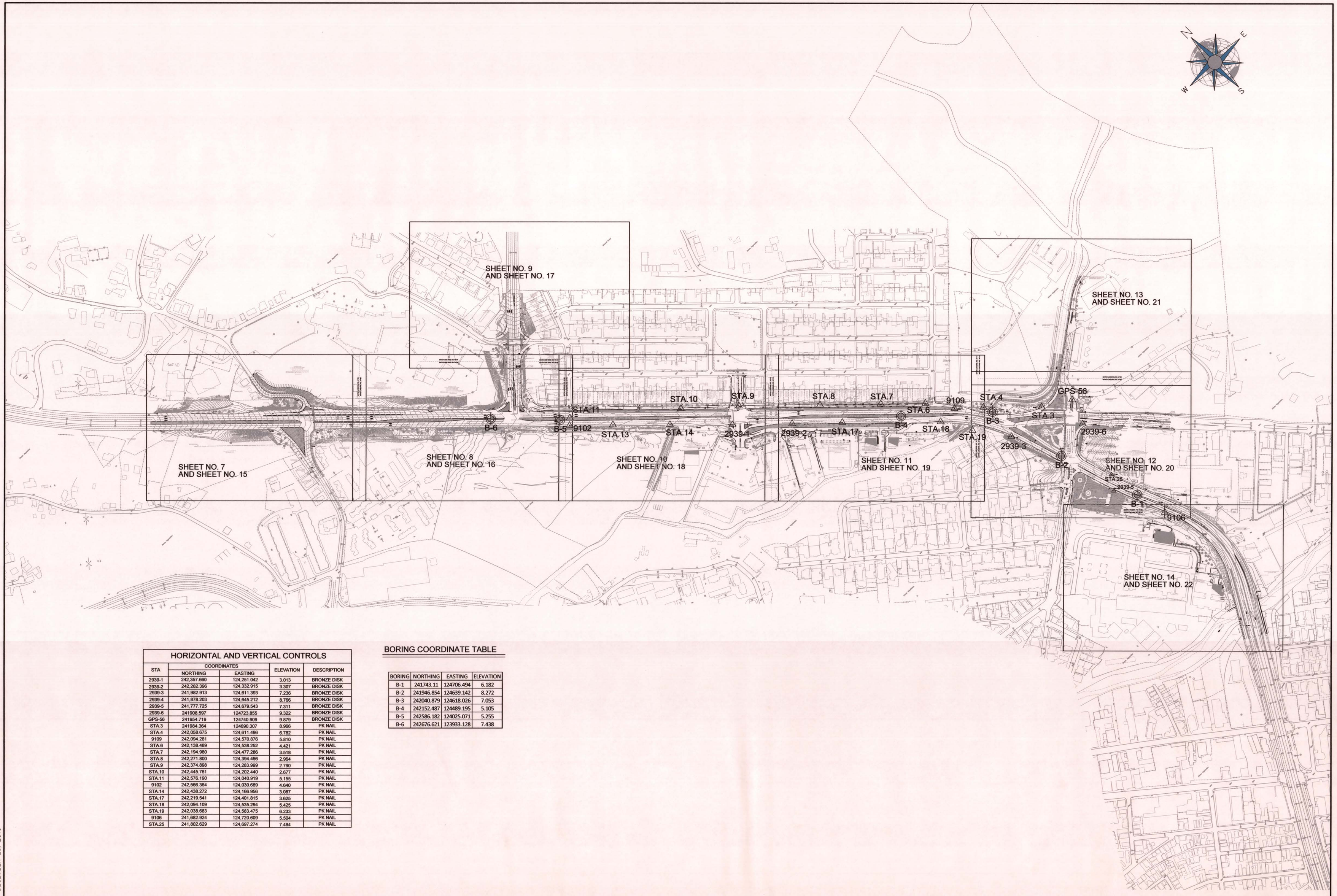
PROJECT	JOB	SHEET / OF
Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)	7716	2 / 2

Elev. (mts)	DEPTH (feet)	DESCRIPTION	LEGEND	Sample No.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
	0.00										
	40			S-11		50/2"	50/2"	12			
	45	Do... sampled as gravel		S-12		50/1"	50/1"				
	50										
	55										
	60										
	65										
	70										
	75										



"N" - Number of blows required to drive the sampling spoon a distance of 12 in. with a 140 lbs hammer falling 30 in.
"W" - Natural Moisture Content in percentage of dry weight.
"Qu" - Unconfined Compressive Strength in tons per square foot.
"Rc" - Core recovery in percent for each successive run. "Rqd" - Rock quality designation.
"WH" - Sample was recovered by advancing the sampler with the weight of the hammer.
"P" - A "P" in the Unconfined Compressive Strength test indicates the use of the pocket Penetrometer.

▽ Initial G.W. Depth
▼ Final G.W. Depth



HORIZONTAL AND VERTICAL CONTROLS

STA	COORDINATES		ELEVATION	DESCRIPTION
	NORTHING	EASTING		
2939-1	242,357.660	124,251.042	3.013	BRONZE DISK
2939-2	242,282.396	124,332.915	3.307	BRONZE DISK
2939-3	241,982.913	124,611.393	7.236	BRONZE DISK
2939-4	241,878.203	124,645.212	8.766	BRONZE DISK
2939-5	241,777.725	124,679.543	7.311	BRONZE DISK
2939-6	241908.597	124723.855	9.322	BRONZE DISK
GPS-56	241954.719	124740.909	9.879	BRONZE DISK
STA.3	241984.364	124690.307	8.986	PK NAIL
STA.4	242,058.675	124,611.496	6.782	PK NAIL
9109	242,094.281	124,570.876	5.810	PK NAIL
STA.6	242,138.489	124,538.252	4.421	PK NAIL
STA.7	242,194.980	124,477.286	3.518	PK NAIL
STA.8	242,271.800	124,394.466	2.964	PK NAIL
STA.9	242,374.898	124,283.999	2.790	PK NAIL
STA.10	242,445.761	124,202.440	2.677	PK NAIL
STA.11	242,576.190	124,040.919	5.155	PK NAIL
9102	242,566.364	124,030.689	4.640	PK NAIL
STA.14	242,438.272	124,166.956	3.087	PK NAIL
STA.17	242,219.541	124,401.815	3.625	PK NAIL
STA.18	242,094.109	124,535.294	5.425	PK NAIL
STA.19	242,038.683	124,583.475	6.233	PK NAIL
9106	241,682.924	124,720.609	5.504	PK NAIL
STA.25	241,802.629	124,697.274	7.484	PK NAIL

BORING COORDINATE TABLE

BORING	NORTHING	EASTING	ELEVATION
B-1	241743.11	124706.494	6.182
B-2	241946.854	124639.142	8.272
B-3	242040.879	124618.026	7.053
B-4	242152.487	124489.195	5.105
B-5	242586.182	124025.071	5.255
B-6	242676.621	123933.128	7.438

GENERAL SITE PLAN

SCALE 1:3,000

FOR LEGEND AND IMPORTANT NOTES, PLEASE SEE DRAWING NO. VF-1

GRAPHIC SCALE
60 30 0 60 120 180
SCALE 1 : 3,000

PLOT DATE : DECEMBER 23, 2016

SYM.	DESCRIPTIONS	BY:	DATE:

REVISIONS

JAVIER E. BIDOT ASSOCIATES, PSC
Land Surveyors & Consultants
16 Cordova St. | Trenilinda | Caguas, PR 00727
Phone: (787)746-5486 Fax: (787)704-0215
www.jebpr.com

EXISTING CONDITIONS, TOPOGRAPHIC AND SUBSURFACE UTILITY SURVEY
FOR IMPROVEMENTS TO INTERSECTION PR-2, 2R AND SAN JUAN STREET (LA VITA)
LOCATED AT STATE ROAD PR-2, KM 153.90, INT. WITH STATE ROAD PR-2R
MUNICIPALITY OF MAYAGUEZ, PUERTO RICO

CERTIFY CORRECT

JAVIER E. BIDOT CRUZ
AGRIMENSOR
LICENCIADO
LIC. 12972
PUERTO RICO
JAVIER E. BIDOT CRUZ
LAND SURVEYOR LIC.NO. 12972

PLOT SCALE :1:1

EXISTING CONDITIONS TOPOGRAPHIC & SUBSURFACE UTILITY SURVEY

SCALE: 1 : 3,000

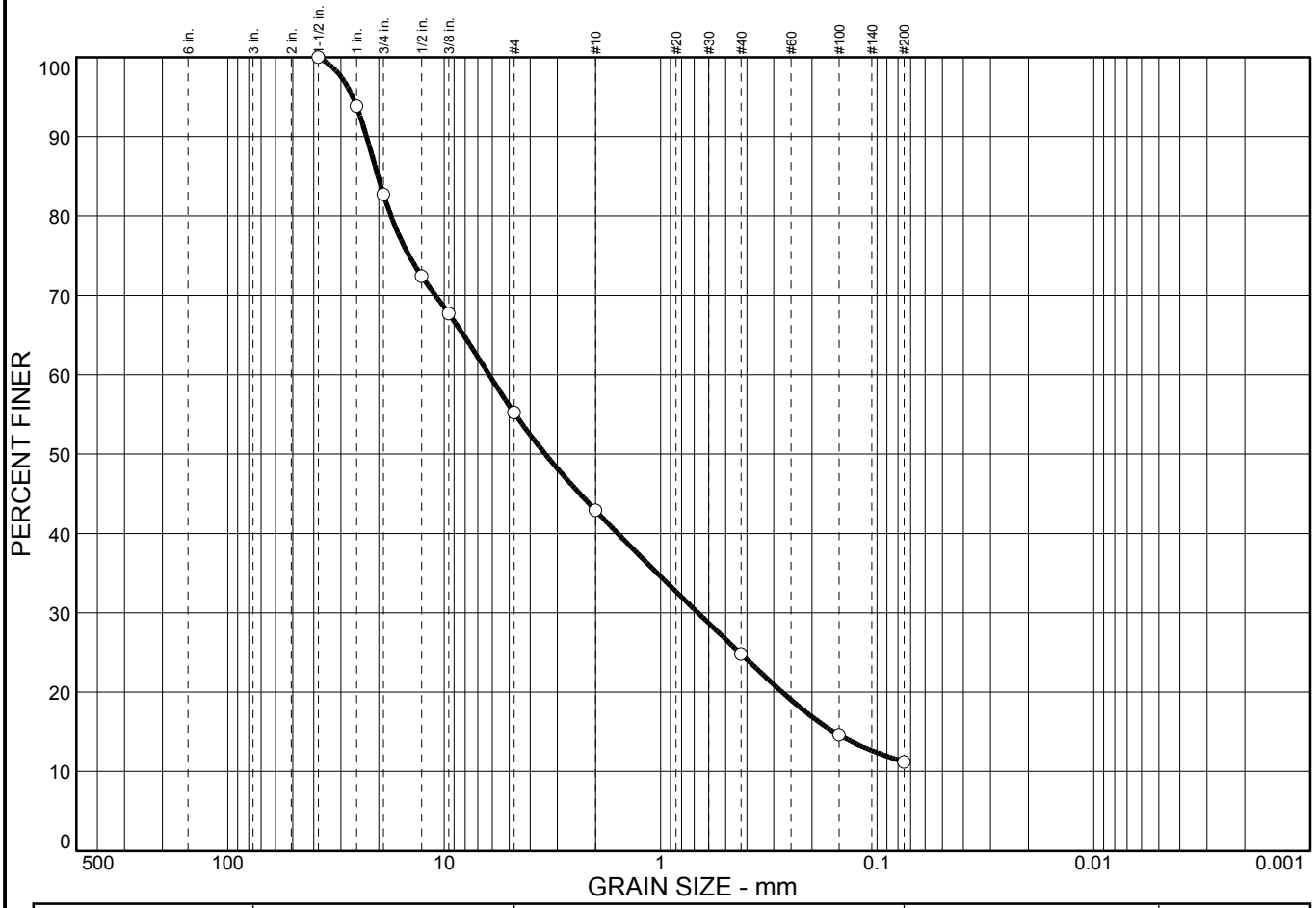
PROJECT: JEB-2939	DWG. NO. VF-2
CHECKED BY J.BIDOT	SHEET No. 2 / 23
DRAWING BY: V.D. / J.C.	
DATE: DEC. 21, 2016	

PAPER SIZE: 24x36

FILE NAME : 2937-VTA-SUS-EC

Appendix B:
Laboratory Tests Results

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	44.8	44.0	11.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	93.8		
.75 in.	82.7		
.5 in.	72.4		
.375 in.	67.7		
#4	55.2		
#10	42.9		
#40	24.8		
#100	14.6		
#200	11.2		

* (no specification provided)

Material Description

Poorly graded gravel with silt and sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 20.2 D_{60}= 6.20 D_{50}= 3.41
D_{30}= 0.673 D_{15}= 0.159 D_{10}=
C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-a

Remarks

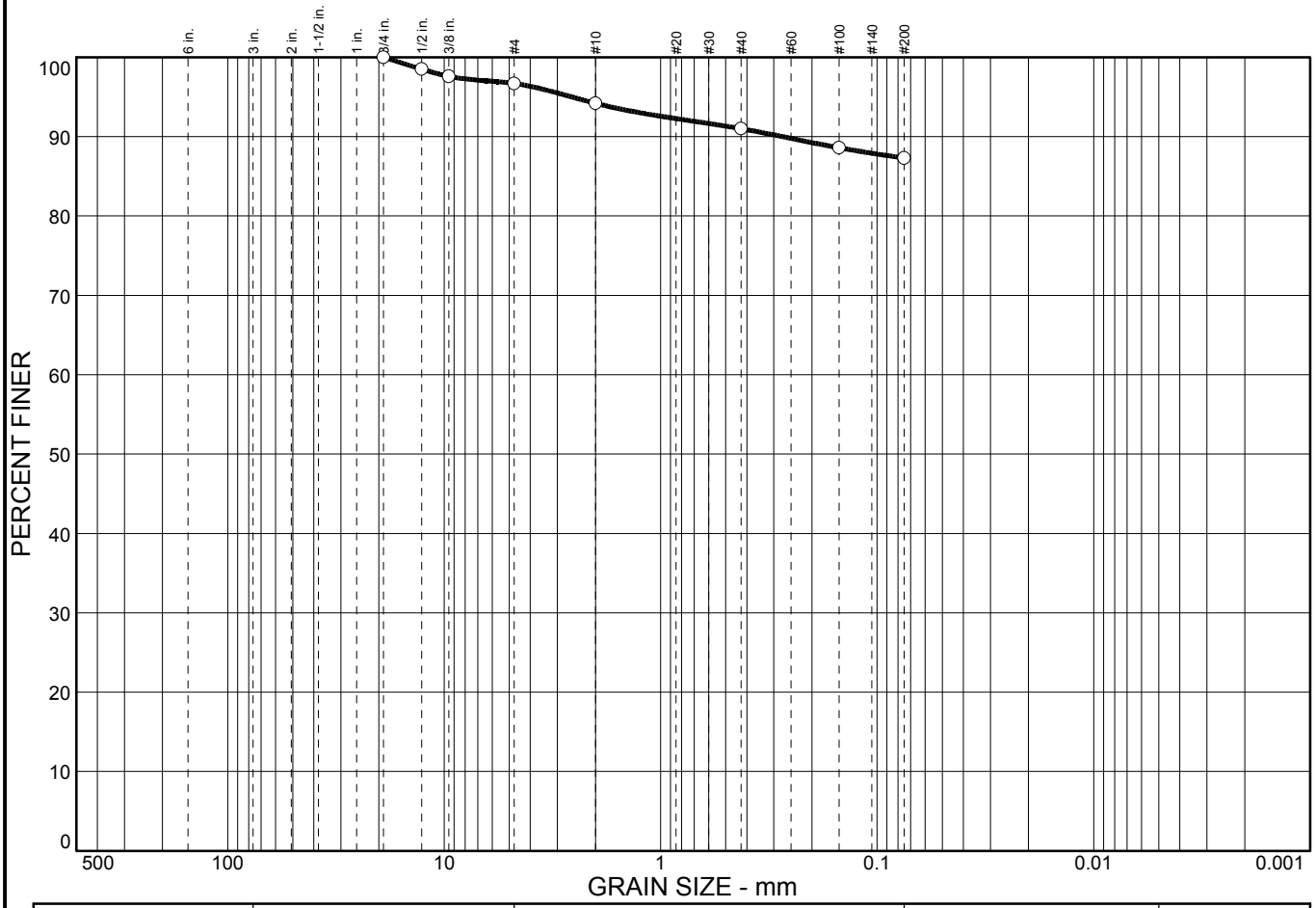
Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=1.80

Sample No.: Bo. 1 **Source of Sample:** Project Site **Date:** 2/2/17
Location: Mayaguez, PR **Elev./Depth:** 19-25.5'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	3.3	9.4	87.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	98.5		
.375 in.	97.6		
#4	96.7		
#10	94.2		
#40	91.0		
#100	88.6		
#200	87.3		

* (no specification provided)

Material Description

Fat clay

Atterberg Limits

PL= 29 LL= 64 PI= 35

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(35)

Remarks

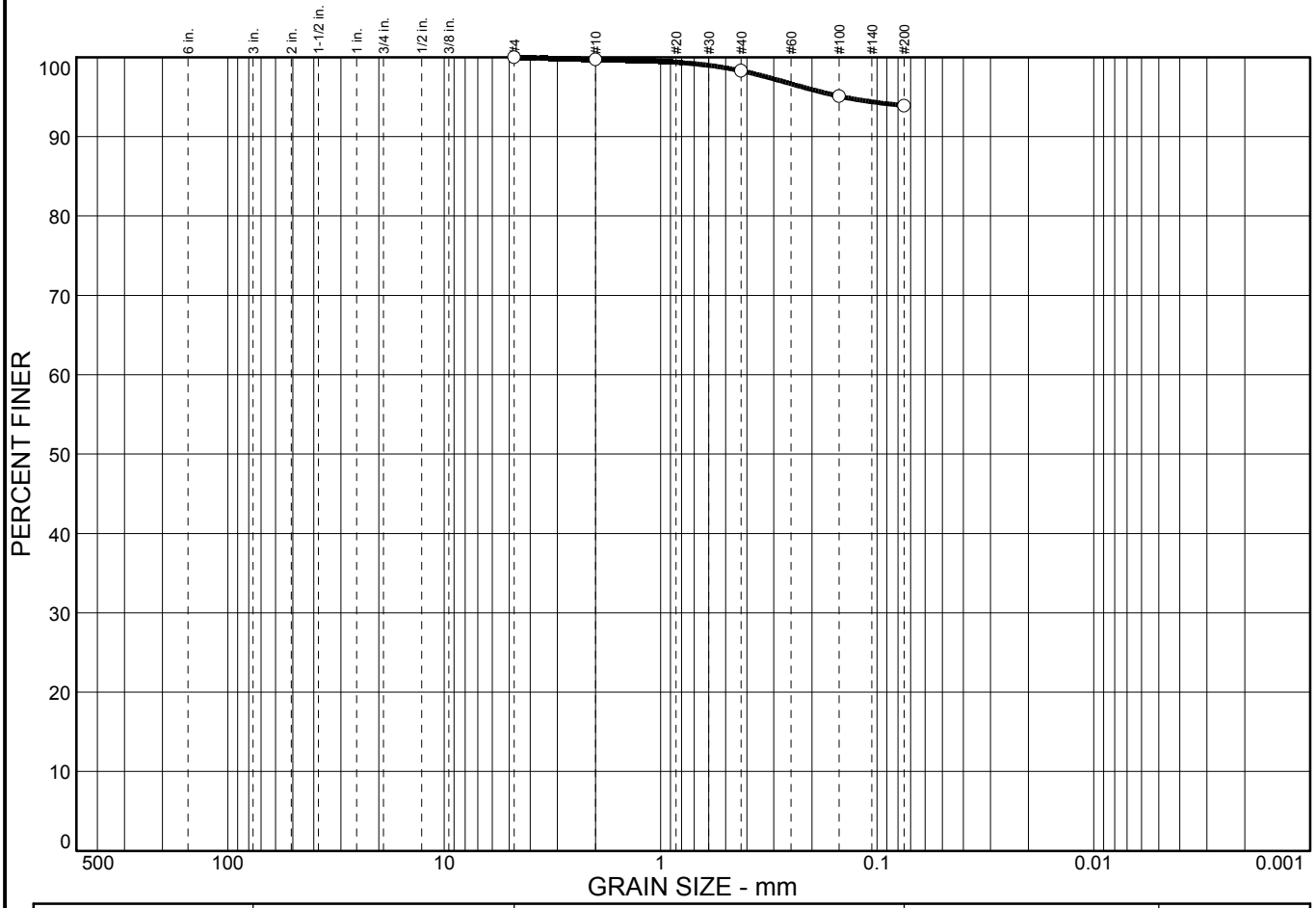
Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=0.17

Sample No.: Bo. 1 (Shelby) **Source of Sample:** Project Site **Date:** 2/2/17
Location: Mayaguez, PR **Elev./Depth:** 34-36'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	6.1	93.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.7		
#40	98.3		
#100	95.1		
#200	93.9		

* (no specification provided)

Material Description

Elastic silt

Atterberg Limits

PL= 36 LL= 64 PI= 28

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(33)

Remarks

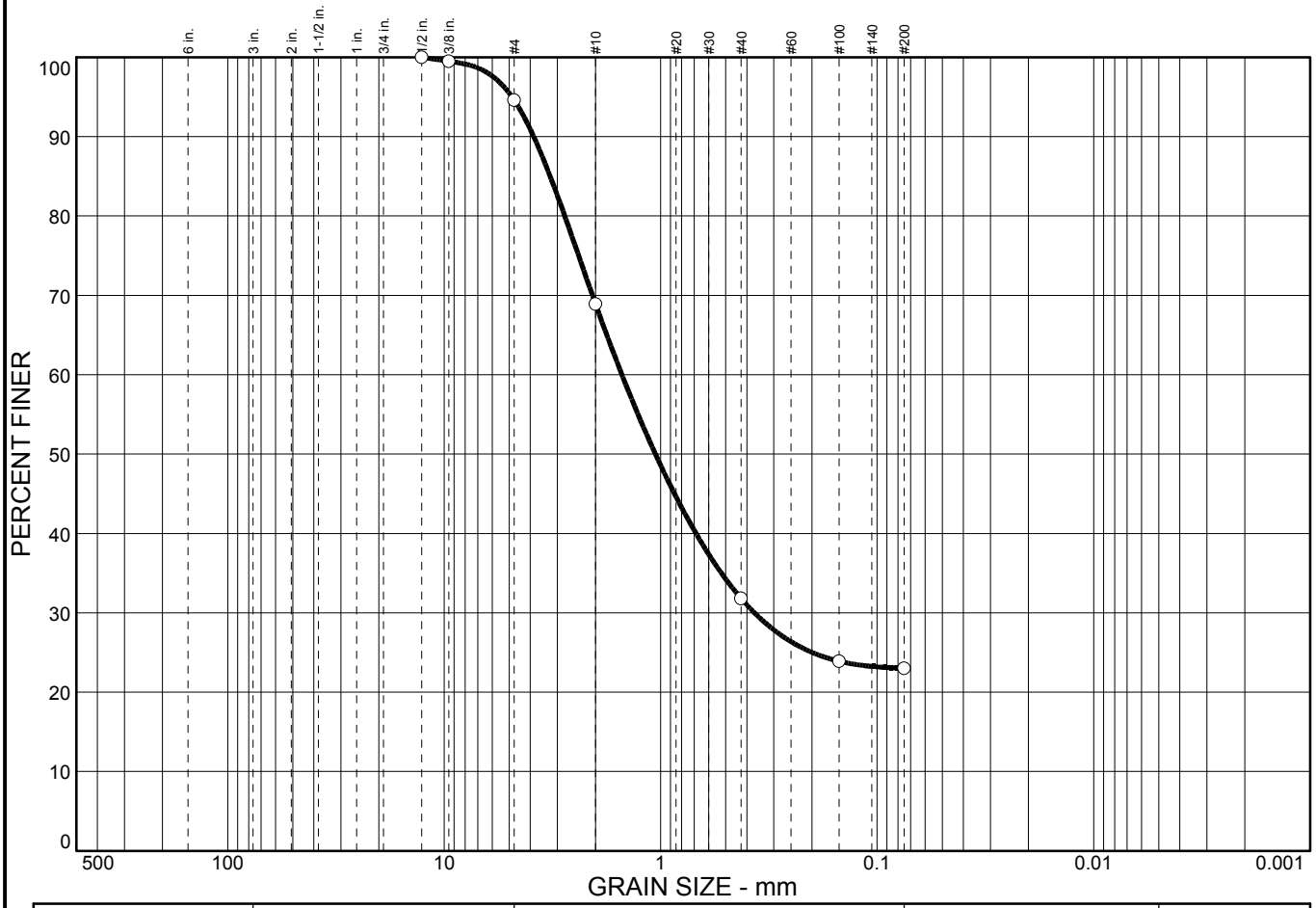
Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=0.05

Sample No.: Bo. 1 (Shelby) **Source of Sample:** Project Site **Date:** 1/11/17
Location: Mayaguez, PR **Elev./Depth:** 44-46'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	5.4	71.6	23.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5 in.	100.0		
.375 in.	99.5		
#4	94.6		
#10	68.9		
#40	31.8		
#100	23.9		
#200	23.0		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= 28 LL= 44 PI= 16

Coefficients

D_{85}= 3.24 D_{60}= 1.51 D_{50}= 1.06
D_{30}= 0.369 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-7(0)

Remarks

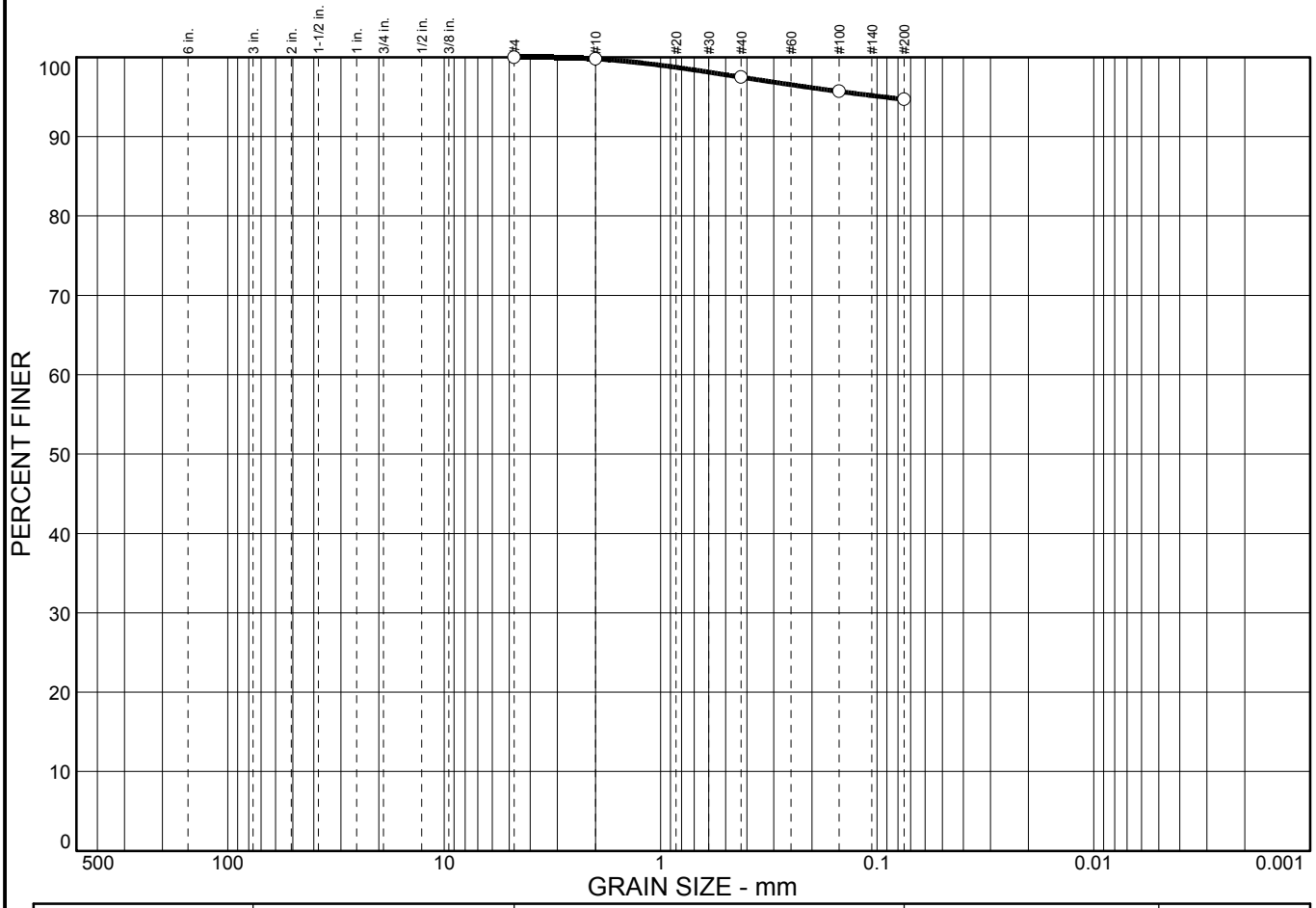
Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=0.82

Sample No.: Bo. 3 **Source of Sample:** Project Site **Date:** 2/2/17
Location: Mayaguez, PR **Elev./Depth:** 29-35.5'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	5.3	94.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#40	97.5		
#100	95.7		
#200	94.7		

* (no specification provided)

Material Description

Elastic silt

Atterberg Limits

PL= 34 LL= 71 PI= 37

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(43)

Remarks

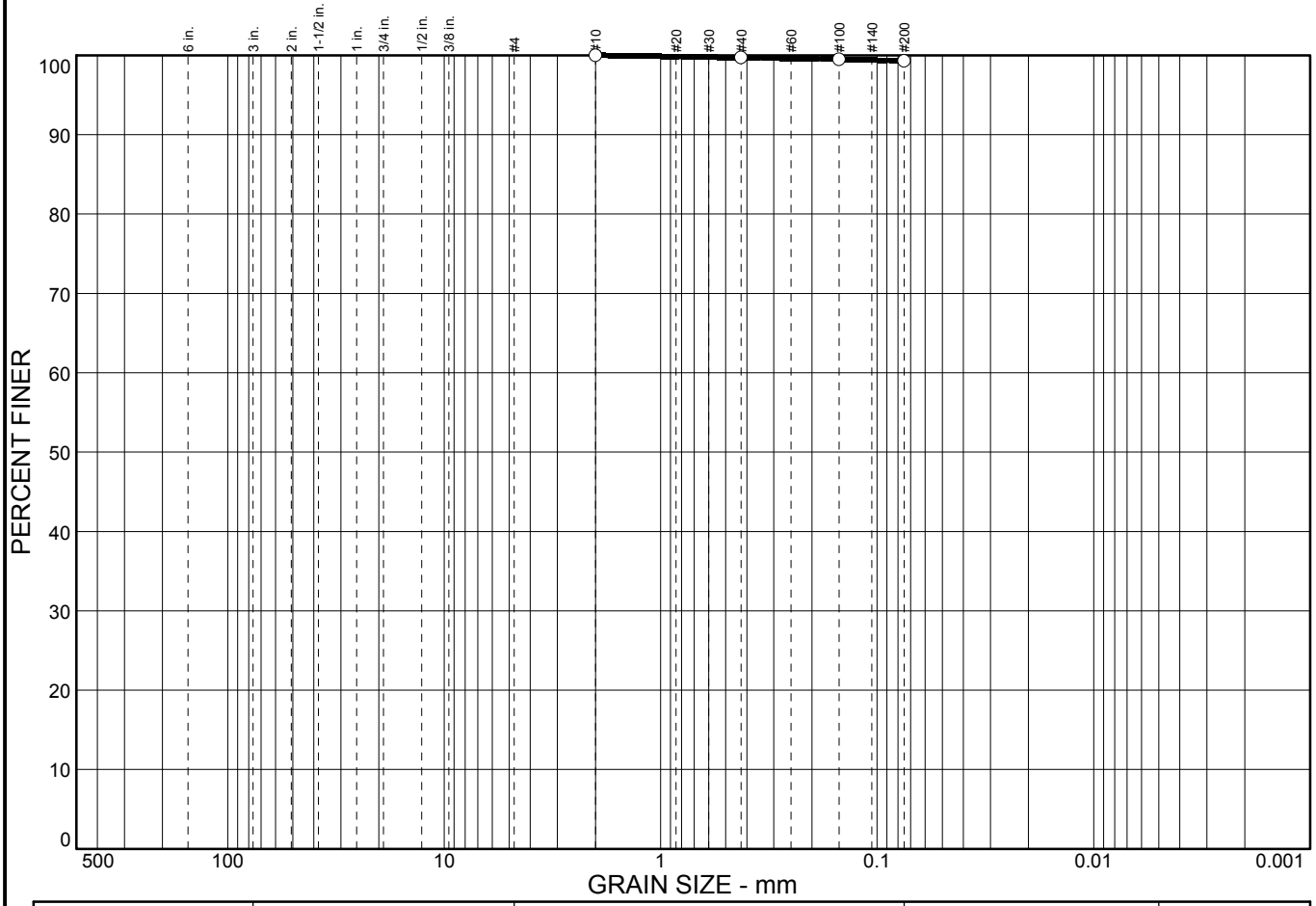
Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=0.04

Sample No.: Bo. 4 **Source of Sample:** Project Site **Date:** 2/2/17
Location: Mayaguez, PR **Elev./Depth:** 19-25.5'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.7	99.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.7		
#100	99.5		
#200	99.3		

* (no specification provided)

Material Description

Fat clay

Atterberg Limits

PL= 28 LL= 68 PI= 40

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(47)

Remarks

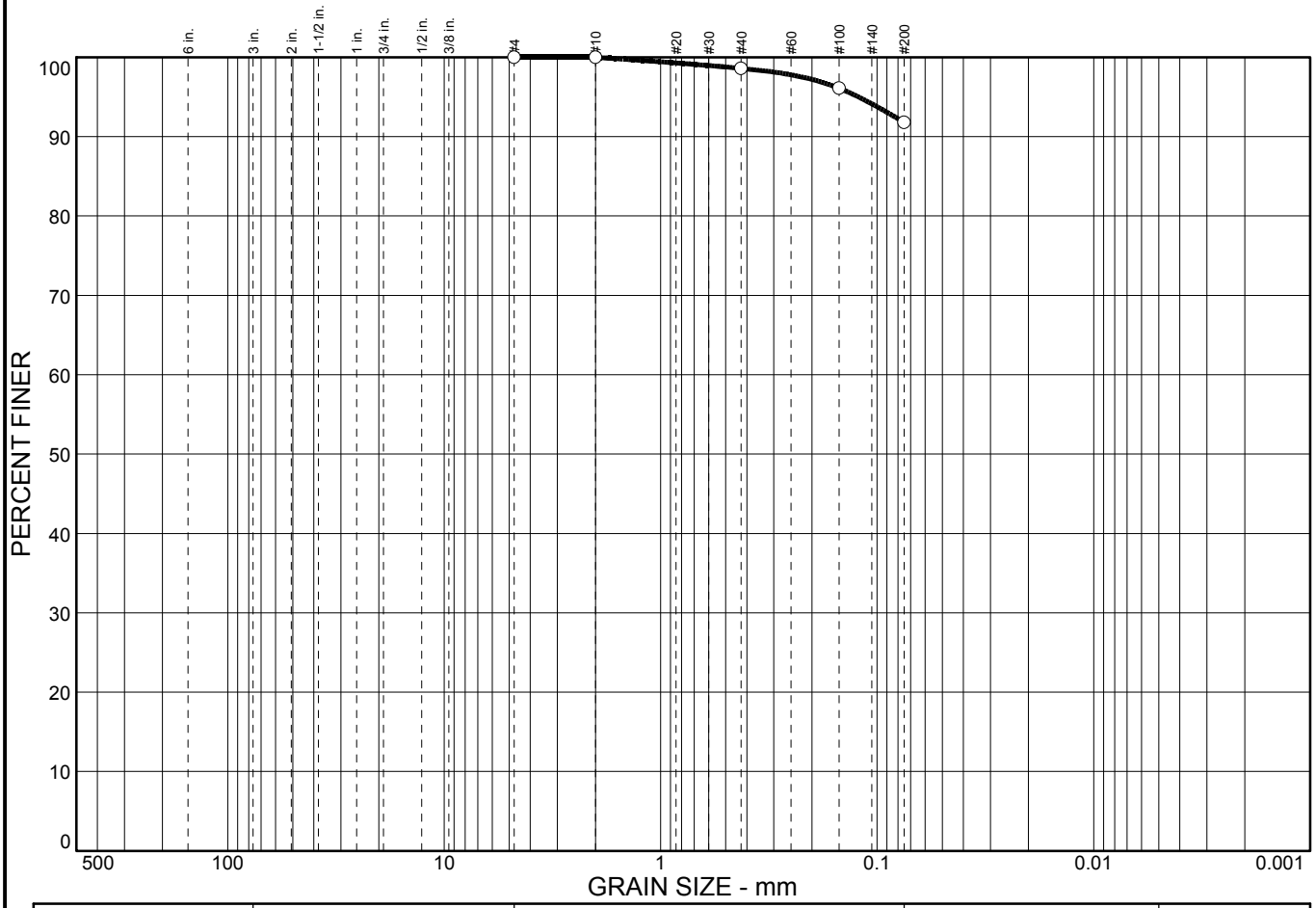
Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=0.00

Sample No.: Bo. 5 **Source of Sample:** Project Site **Date:** 2/2/17
Location: Mayaguez, PR **Elev./Depth:** 19-25.5'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	8.2	91.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#40	98.6		
#100	96.1		
#200	91.8		

* (no specification provided)

Material Description

Elastic silt

Atterberg Limits

PL= 37 LL= 53 PI= 16

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(20)

Remarks

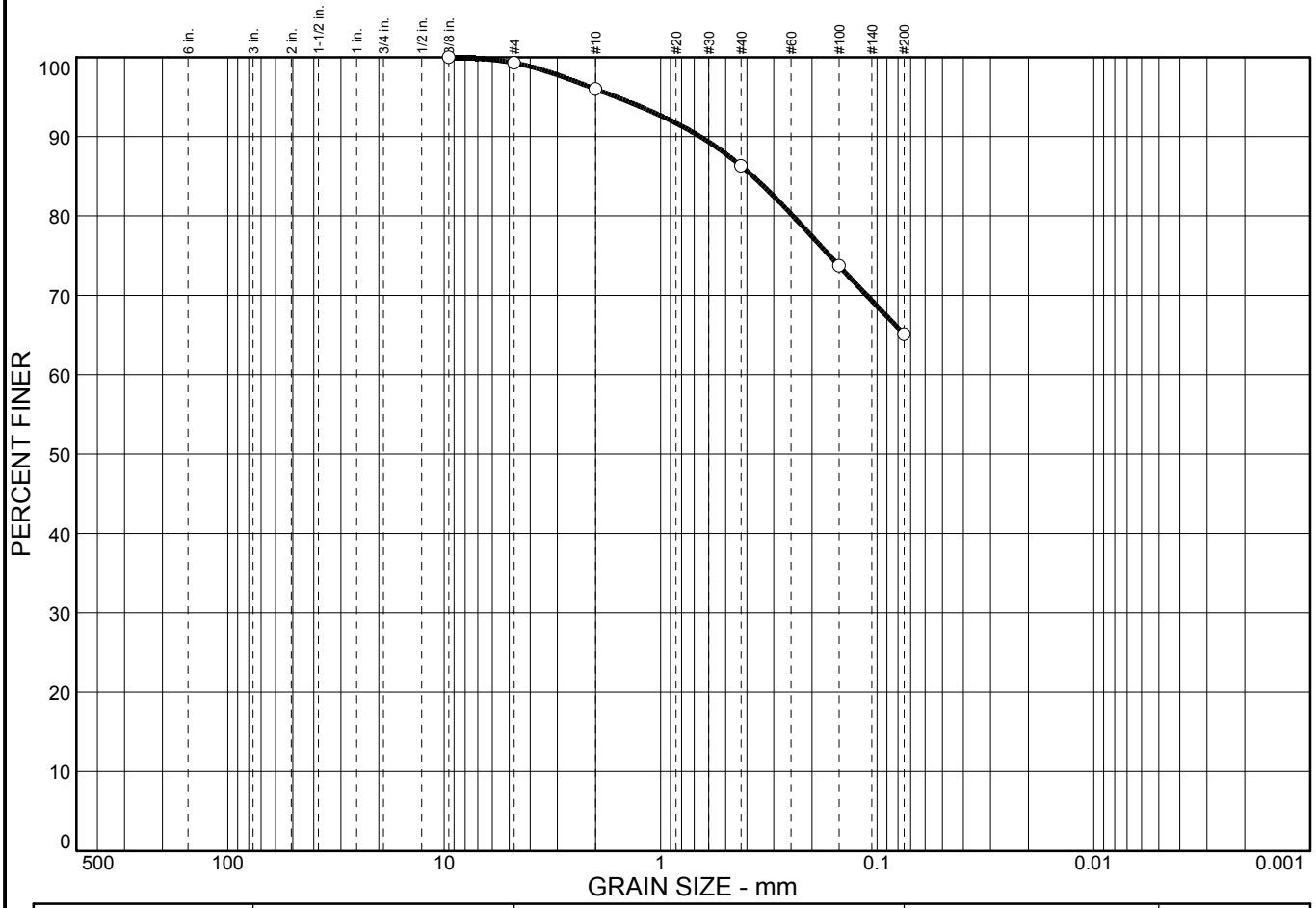
Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=0.04

Sample No.: Bo. 5 (Shelby) **Source of Sample:** Project Site **Date:** 1/11/17
Location: Mayaguez, PR **Elev./Depth:** 40-42'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.7	34.2	65.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.3		
#10	96.0		
#40	86.3		
#100	73.7		
#200	65.1		

* (no specification provided)

Material Description

Sandy silt

Atterberg Limits

PL= 38 LL= 46 PI= 8

Coefficients

D_{85}= 0.375 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-5(6)

Remarks

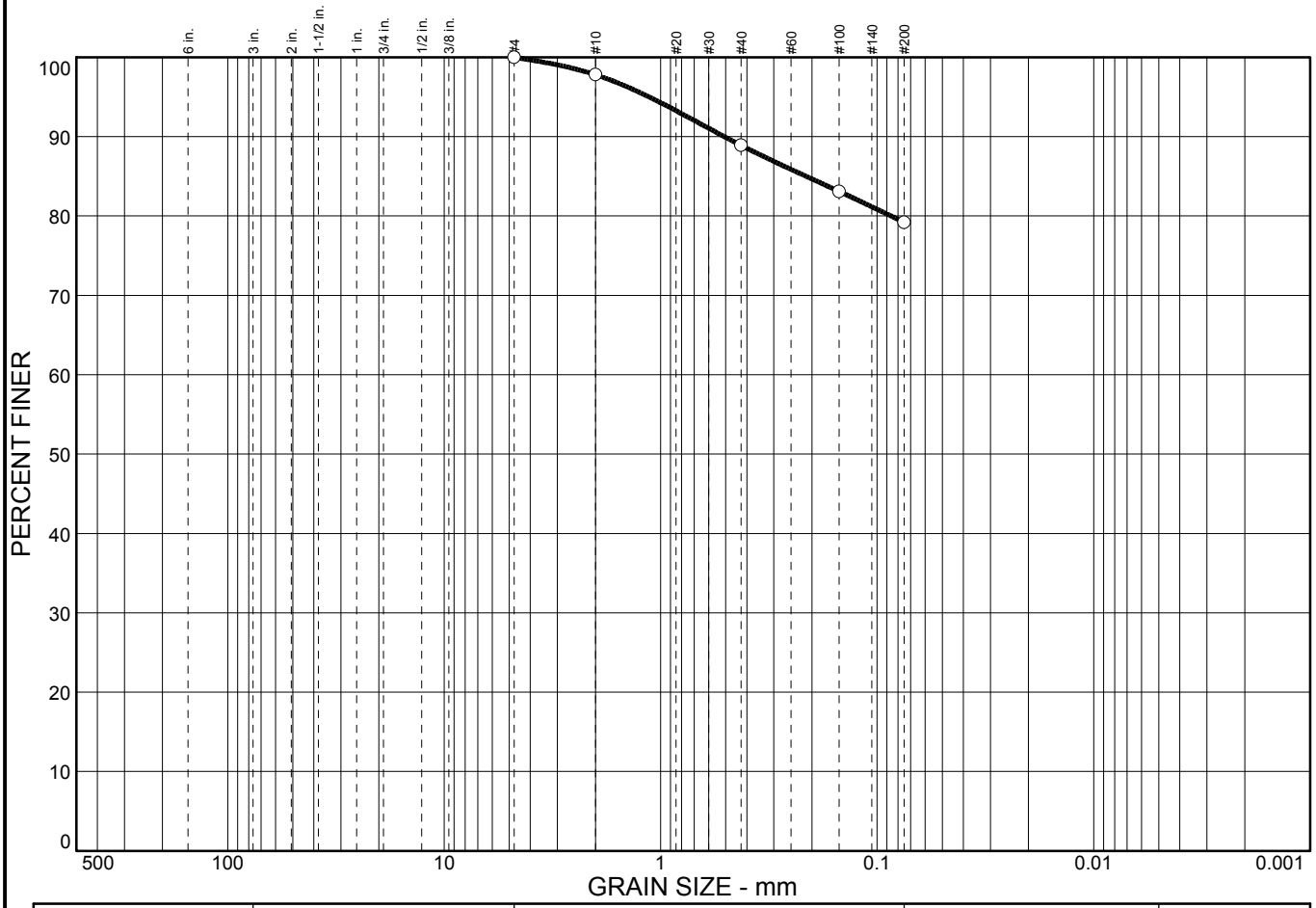
Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=0.27

Sample No.: Bo. 5 (Shelby) **Source of Sample:** Project Site **Date:** 1/11/17
Location: Mayaguez, PR **Elev./Depth:** 50-52'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	20.8	79.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	97.8		
#40	88.9		
#100	83.1		
#200	79.2		

* (no specification provided)

Material Description

Elastic silt with sand

Atterberg Limits

PL= 35 LL= 50 PI= 15

Coefficients

D_{85}= 0.213 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO= A-7-5(14)

Remarks

Tested by: S. Perez
Checked by: Rommel Cintron Aponte, MSCE, PE
F.M.=0.17

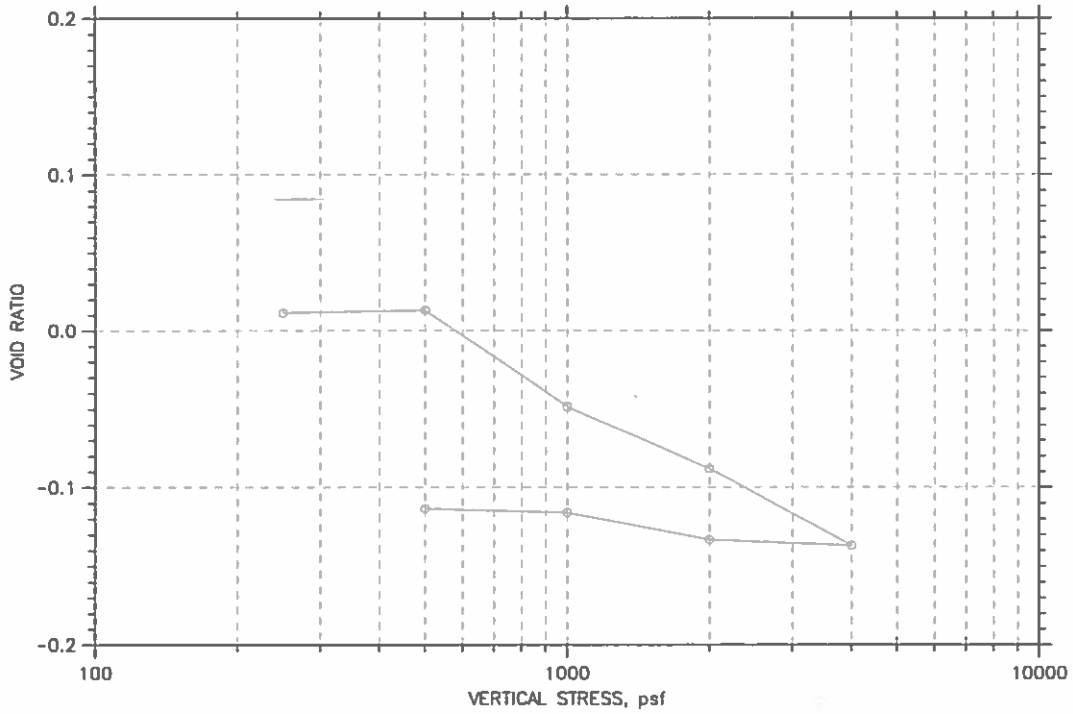
Sample No.: Bo. 6 **Source of Sample:** Project Site **Date:** 2/2/17
Location: Mayaguez, PR **Elev./Depth:** 4-7.5'

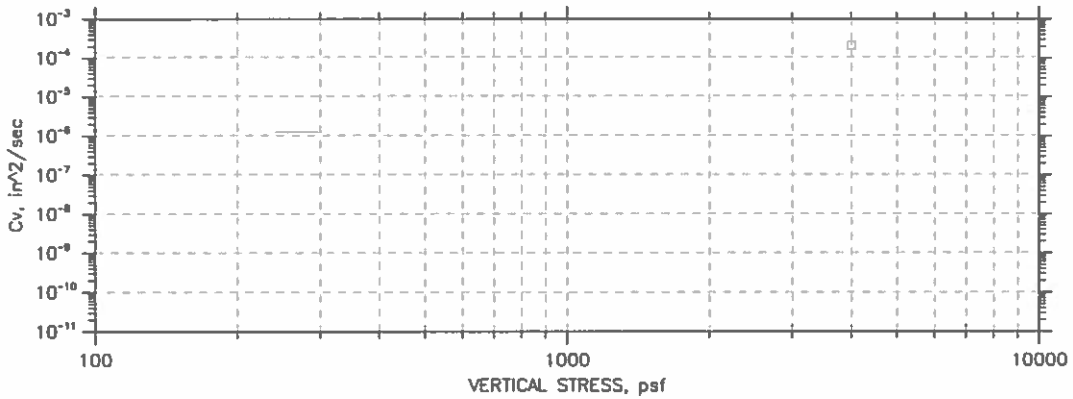
JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

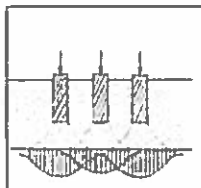
Client: Jose A. Batlle & Associates
Project: Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance, La Vita)-Mayaguez, PR
Project No: 7716 **Figure**

CONSOLIDATION TEST DATA

SUMMARY REPORT



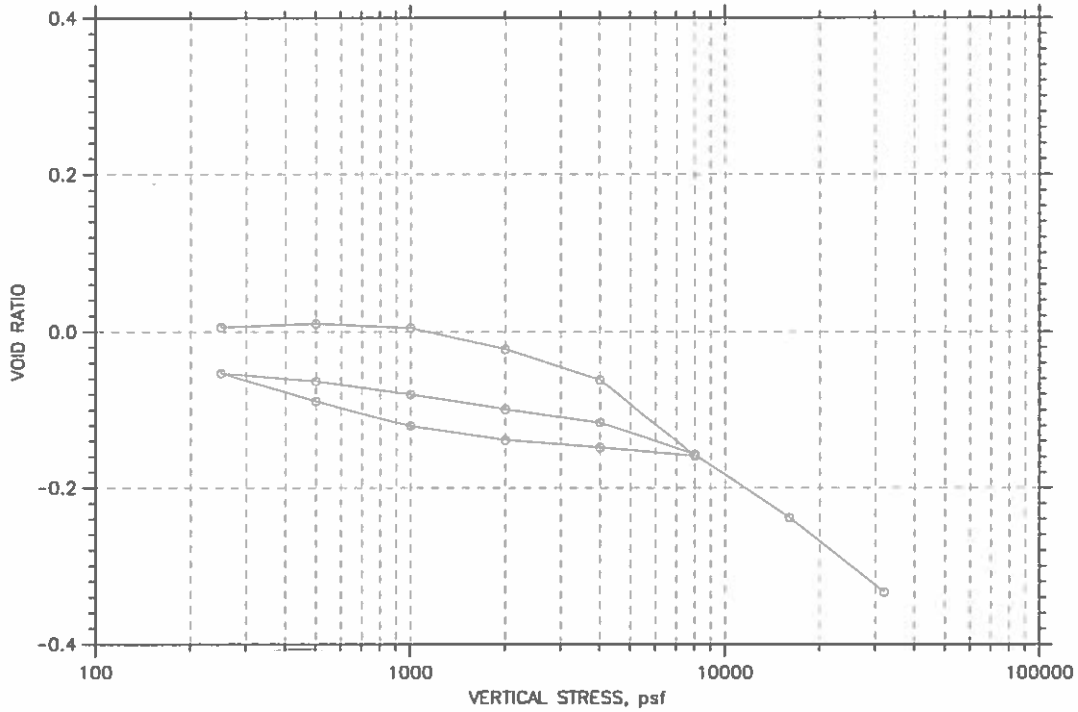


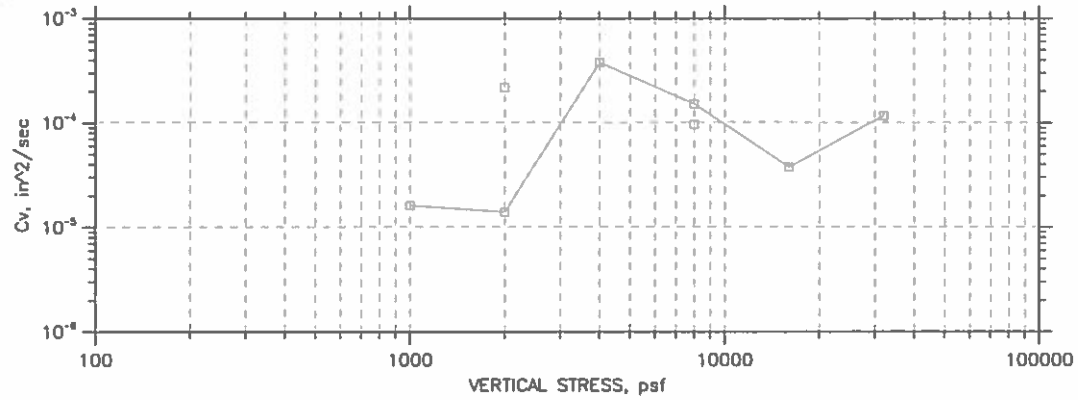


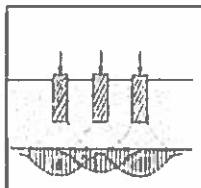
Project: RUM Entrance, La Vita	Location: Mayaguez, PR	Project No.: 7716
Boring No.: 1	Tested By: M Mendoza	Checked By: J Garcia
Sample No.: -	Test Date: 21-Dec-16	Depth: 34'-36'
Test No.: 1	Sample Type: Undisturbed	Elevation: -
Description: Fat Clay		
Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT



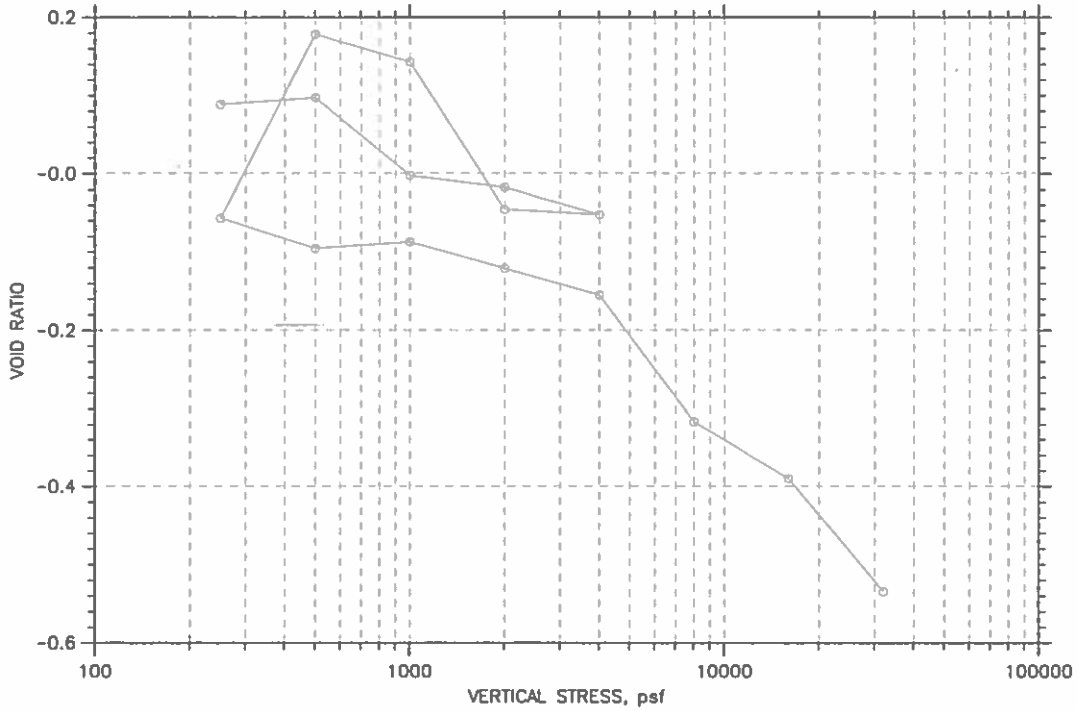


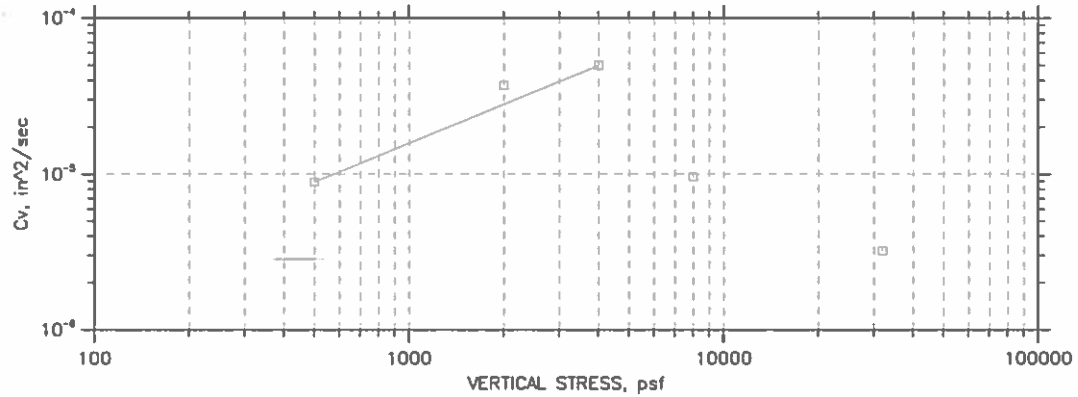


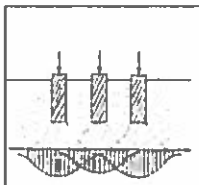
Project: RUM Entrance, La Vita	Location: Mayaguez, PR	Project No.: 7716
Boring No.: 1	Tested By: M Mendoza	Checked By: J Garcia
Sample No.: -	Test Date: 10-Jan-17	Depth: 44'-46'
Test No.: 1	Sample Type: Undisturbed	Elevation: -
Description: Elastic Silt		
Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT



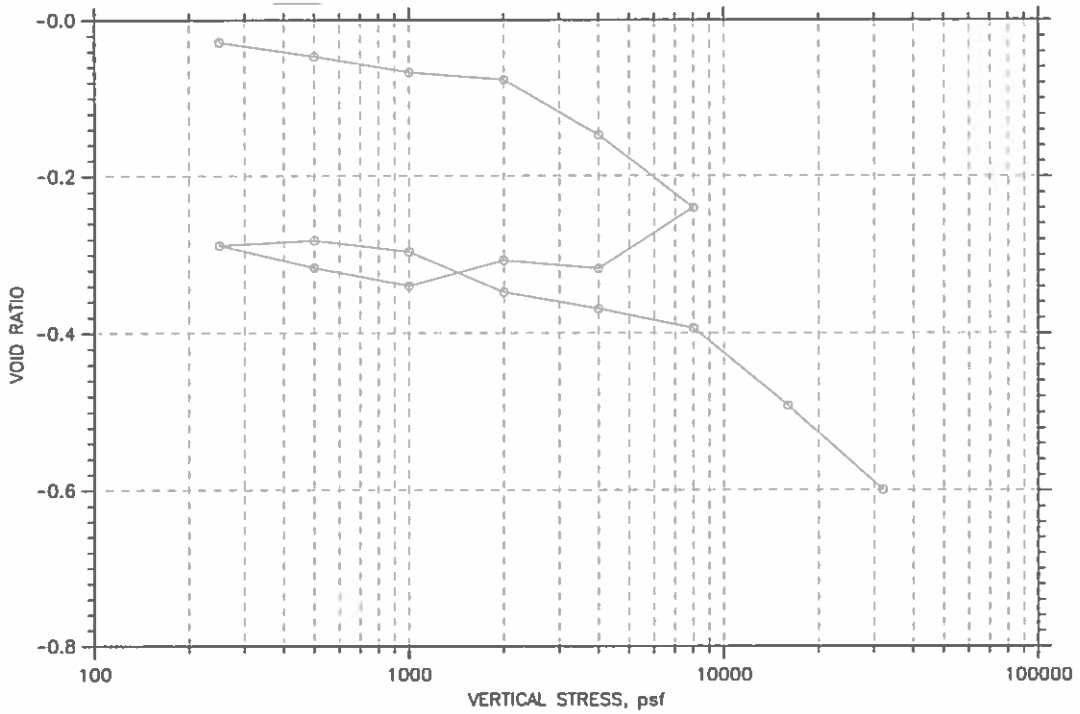


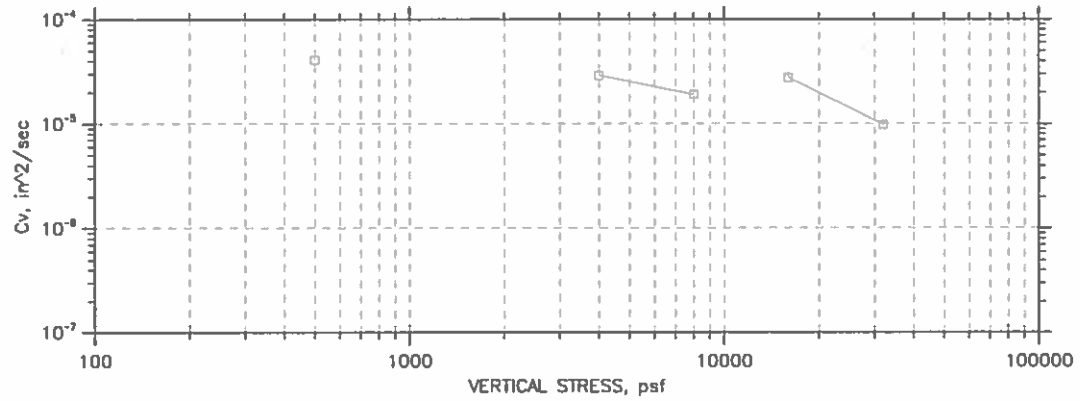


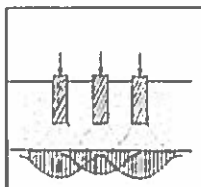
Project: RUM Entrance, La Vita	Location: Mayaguez, PR	Project No.: 7716
Boring No.: 5	Tested By: M Mendoza	Checked By: J Garcia
Sample No.: -	Test Date: 23-DEC-16	Depth: 40'-42'
Test No.: 1	Sample Type: Undisturbed	Elevation: -
Description: Elastic Silt		
Remarks:		

CONSOLIDATION TEST DATA

SUMMARY REPORT

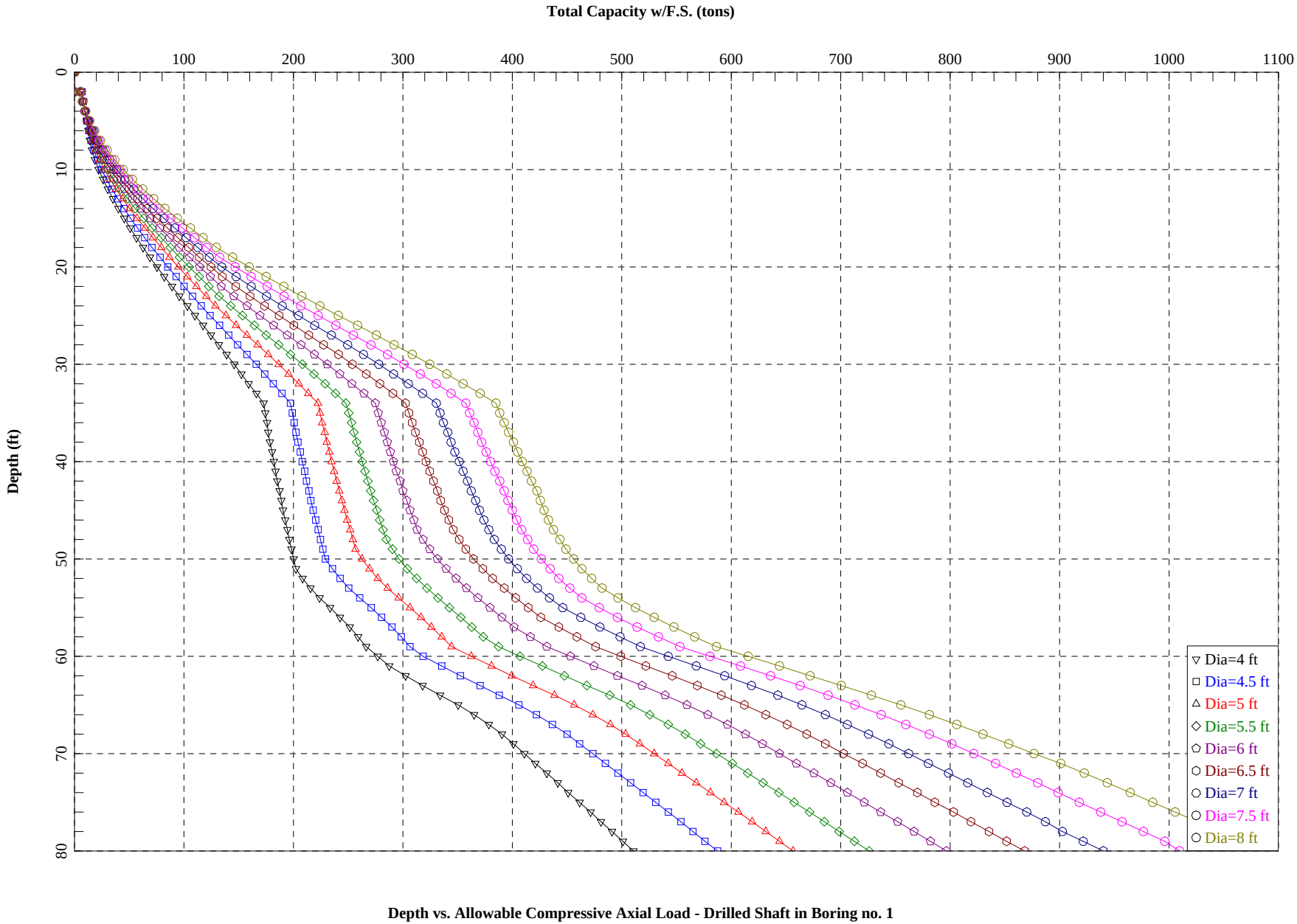




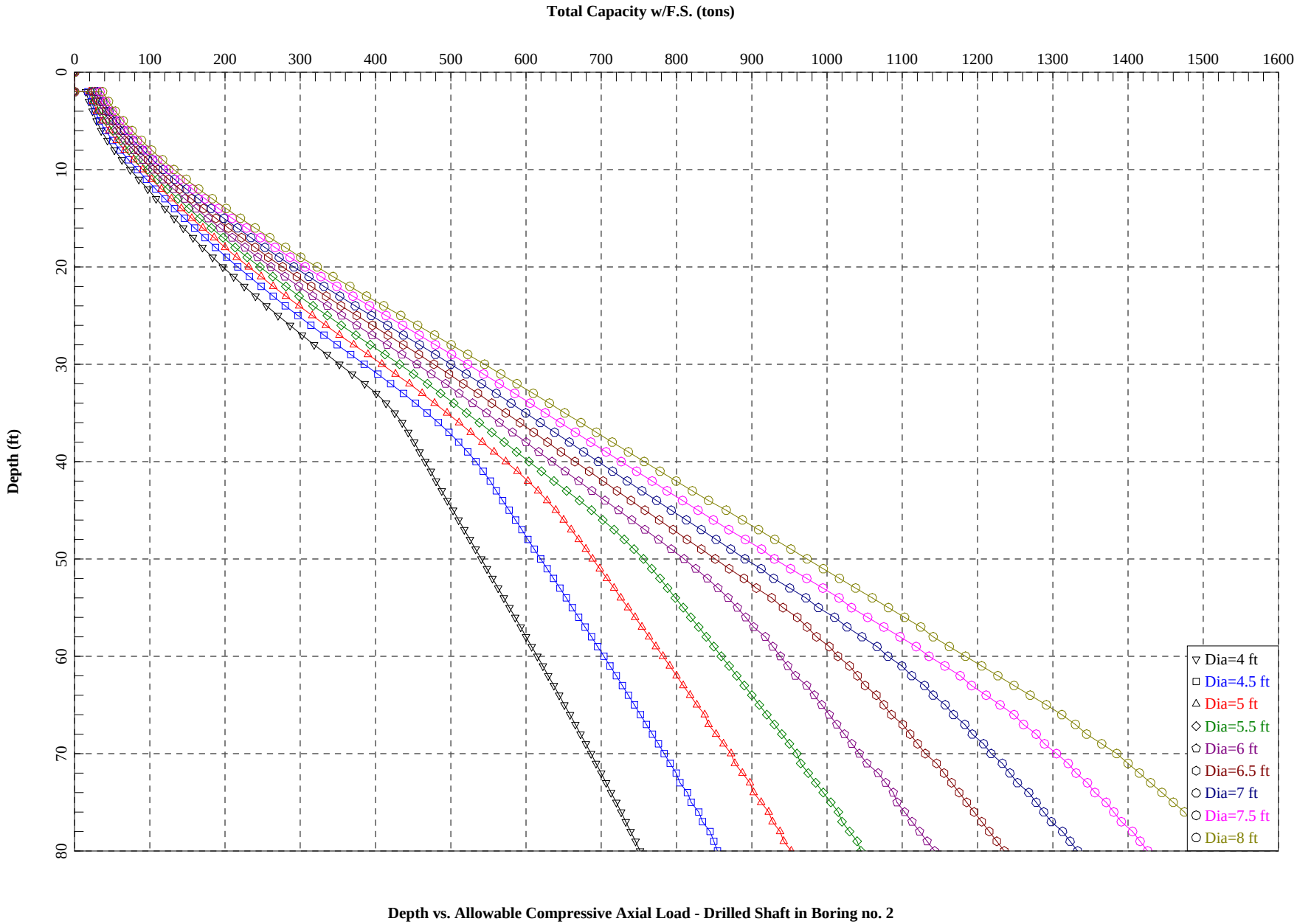


Project: RUM Entrance, La Vita	Location: Mayaguez, PR	Project No.: 7716
Boring No.: 5	Tested By: M Mendoza	Checked By: J Garcia
Sample No.: -	Test Date: 29-Dec-16	Depth: 50'-52'
Test No.: 1	Sample Type: Undisturbed	Elevation: -
Description: Sandy Silt		
Remarks:		

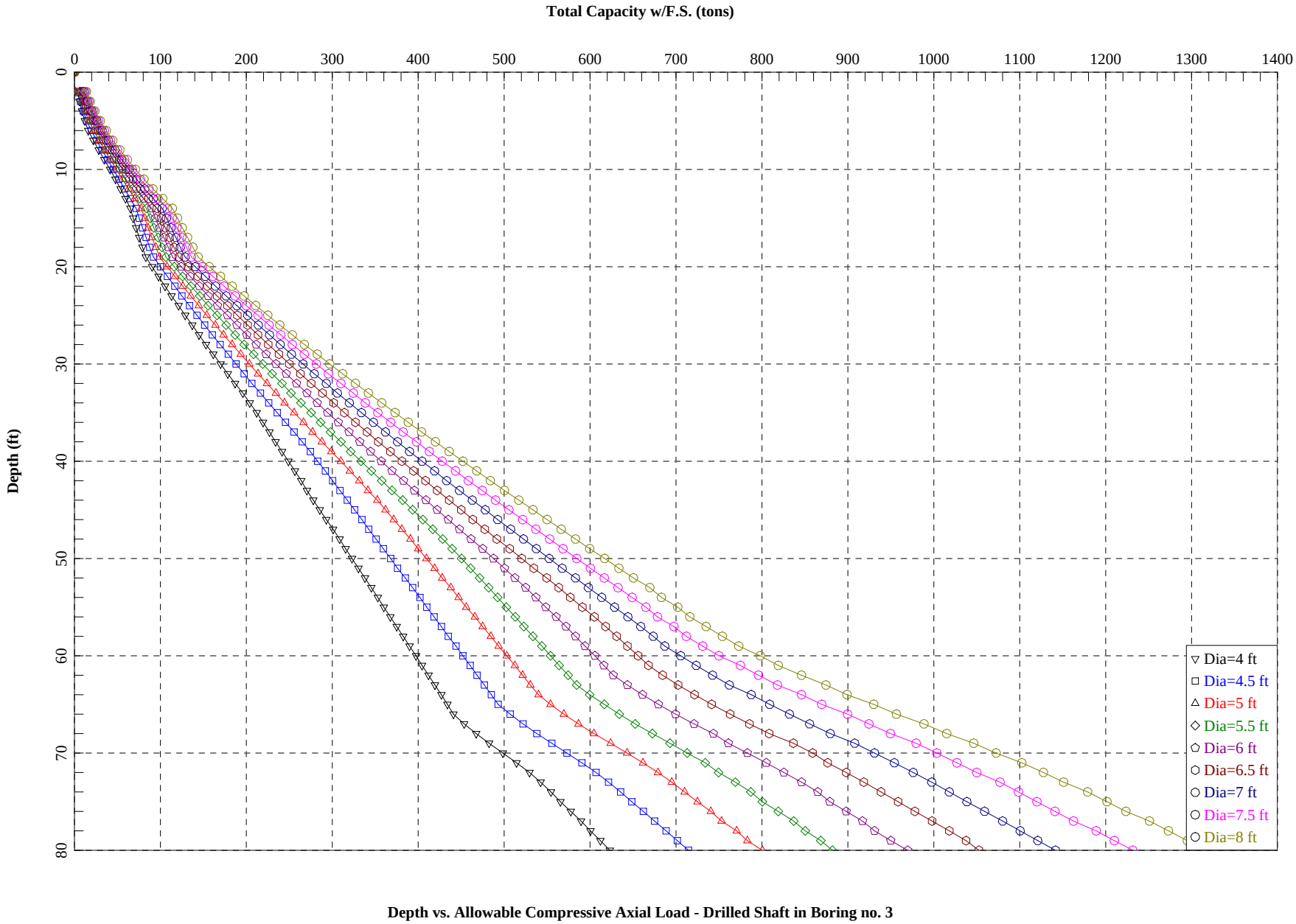
Appendix C:
SHAFT v5.0 Software Graphs



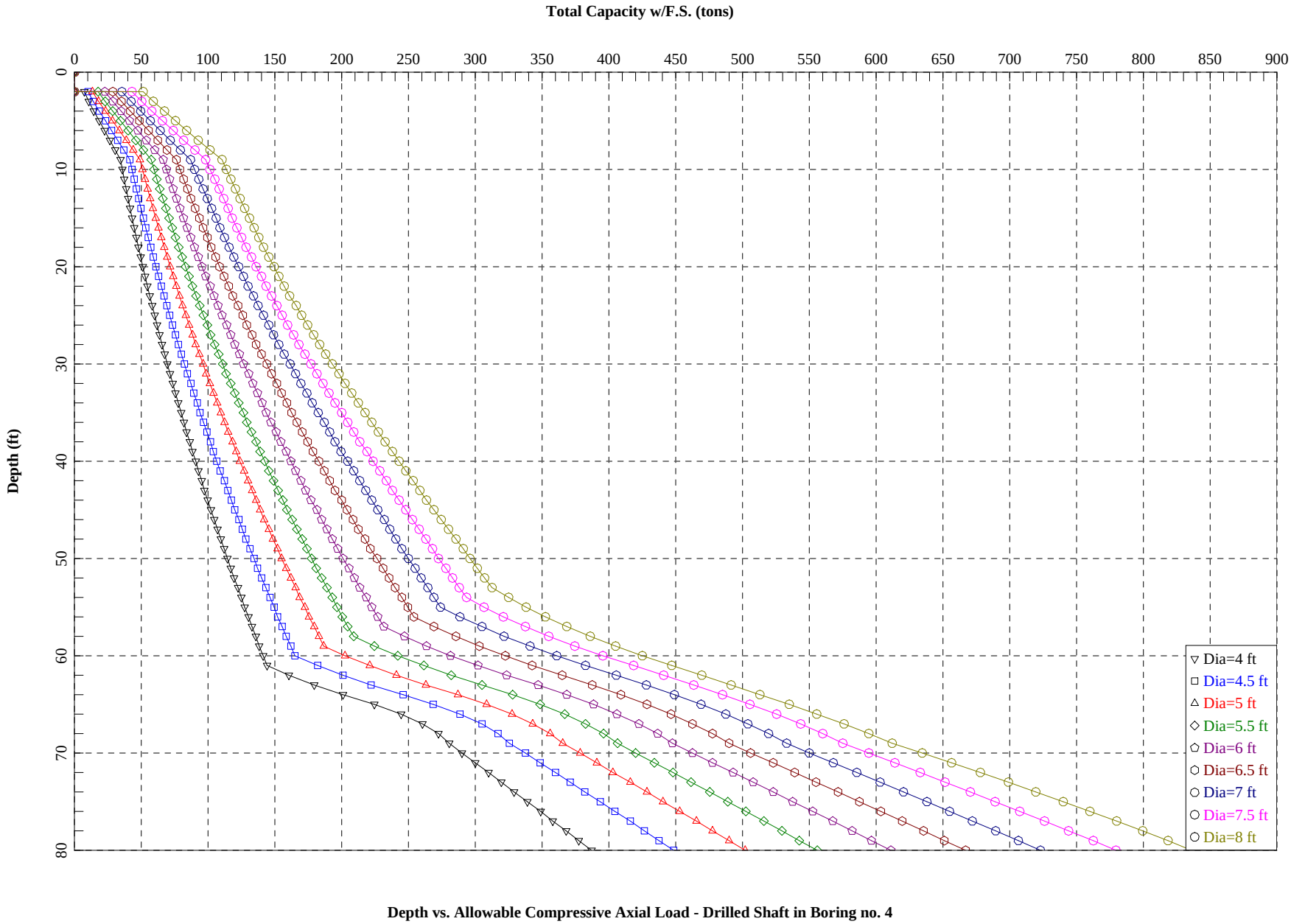
Depth vs. Allowable Compressive Axial Load - Drilled Shaft in Boring no. 1



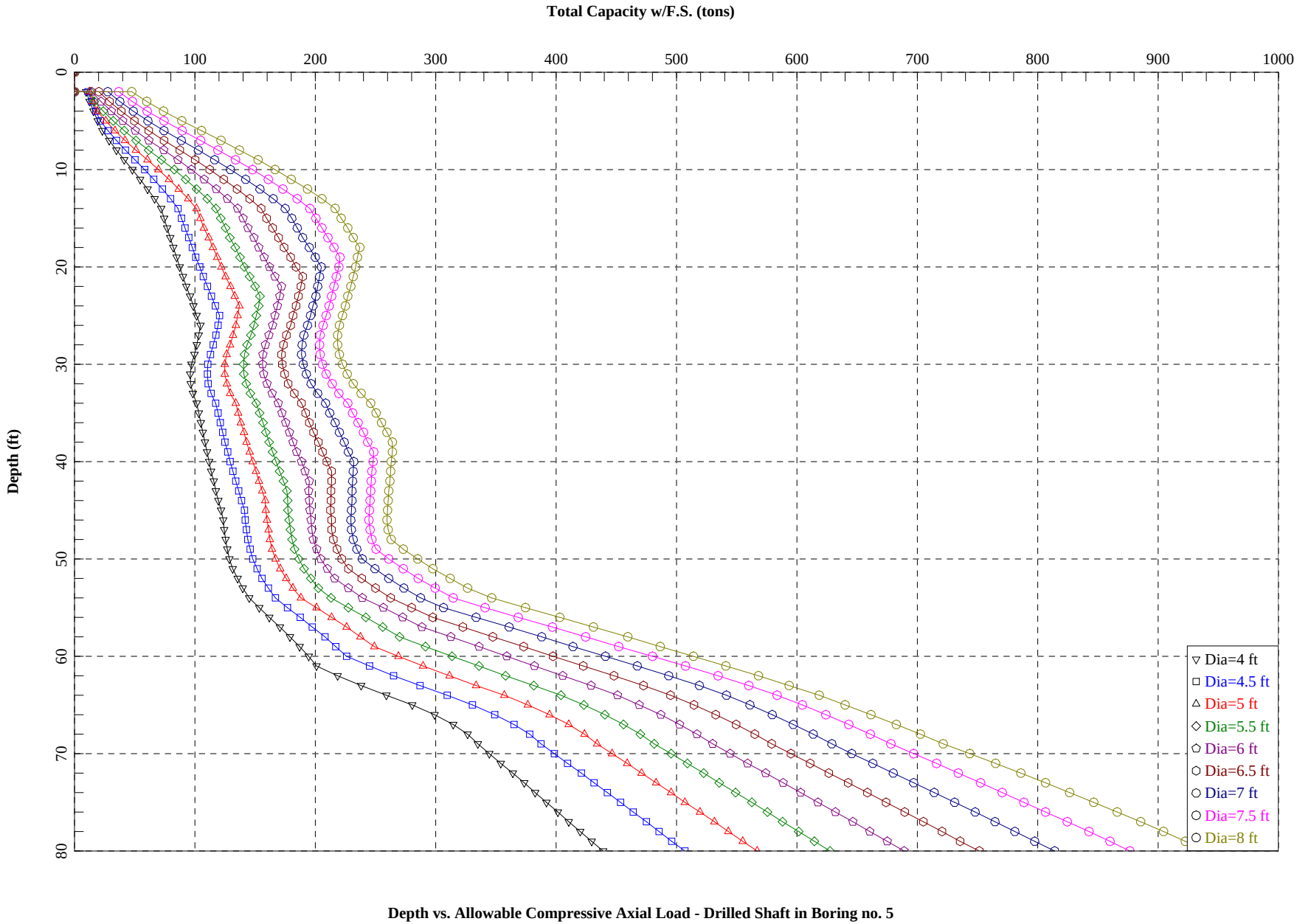
Depth vs. Allowable Compressive Axial Load - Drilled Shaft in Boring no. 2



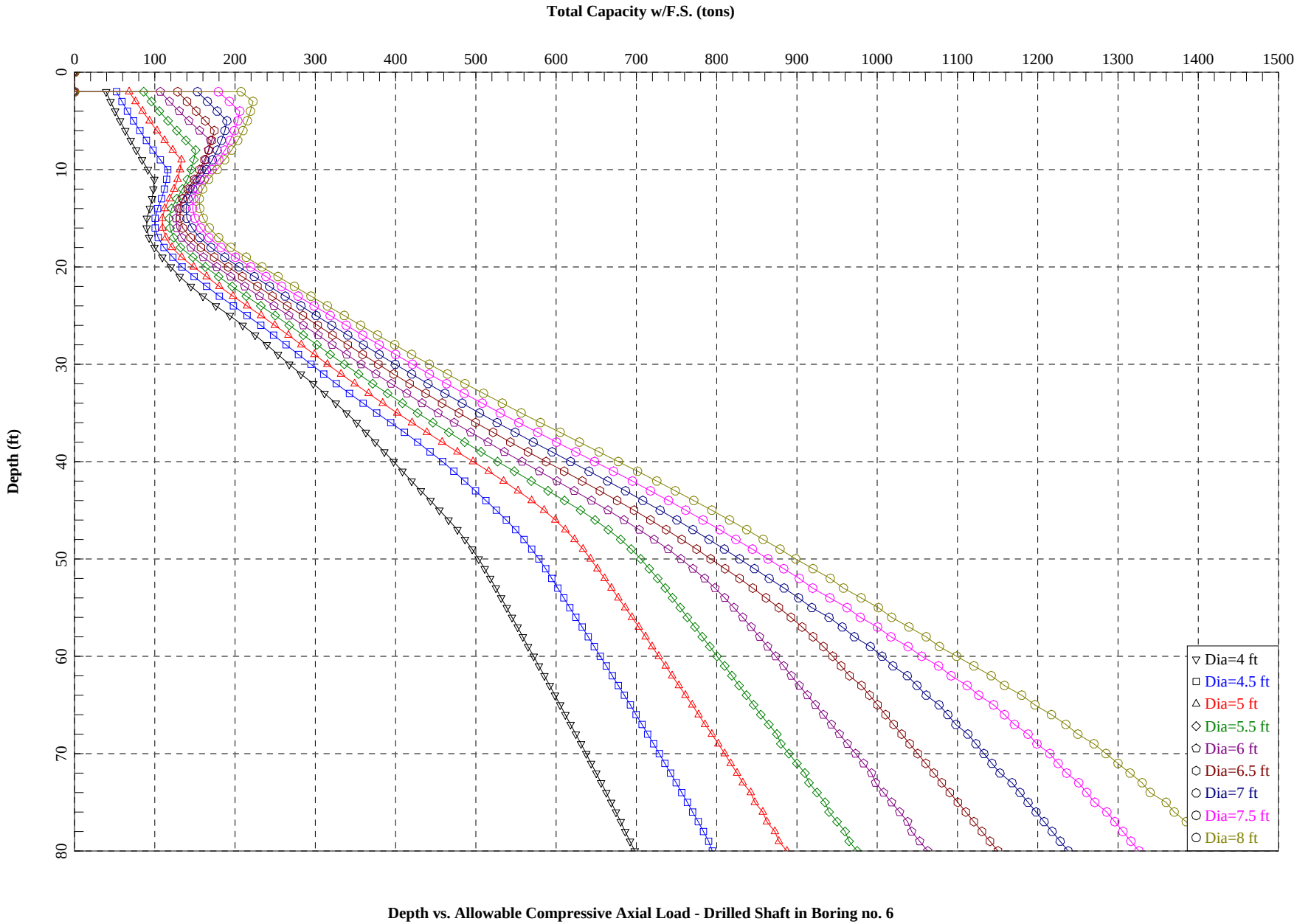
Depth vs. Allowable Compressive Axial Load - Drilled Shaft in Boring no. 3



Depth vs. Allowable Compressive Axial Load - Drilled Shaft in Boring no. 4



Depth vs. Allowable Compressive Axial Load - Drilled Shaft in Boring no. 5



Depth vs. Allowable Compressive Axial Load - Drilled Shaft in Boring no. 6

Appendix D:
LPILE 2013 Software Tables

Project: Improvements to Intersection PR-2, 2R and San Juan St. (RUM Entrance, La Vita
Location: Mayaguez, PR *Job no.:* 7616

JACA & SIERRA
Testing Laboratories
Geotechnical Engineers

Soil Parameters for LPILE 2013 Software – Boring no. 1

Stratum no.	Depth Range (ft)	Soil Type	Effective Unit Weight - γ' (pcf)	Angle of Internal Friction - ϕ (°)	k Value (pci)	Undrained Cohesion - c (psf)	Strain Factor ε_{50}
1	0-11	Sand	110-115	30-32	90	-	-
2	11-15	Sand	115	29	25	-	-
3	15-34	Sand	50-55	29-31	20-60	-	-
4	34-59	Soft Clay	40-45	-	-	500-1000	0.01
5	59-69	Sand	55-65	33-36	60-125	-	-
6	69-100	Sand	65-75	37-42	125	-	-

Soil Parameters for LPILE 2013 Software – Boring no. 2

Stratum no.	Depth Range (ft)	Soil Type	Effective Unit Weight - γ' (pcf)	Angle of Internal Friction - ϕ (°)	k Value (pci)	Undrained Cohesion - c (psf)	Strain Factor ε_{50}
1	0-2	Sand	115	30	25	-	-
2	2-14	Sand	55-65	33-36	90-225	-	-
3	14-45	Sand	65-75	37-42	125	-	-
4	45-100	Sand	75	42	125	-	-

Soil Parameters for LPILE 2013 Software – Boring no. 3

Stratum no.	Depth Range (ft)	Soil Type	Effective Unit Weight - γ' (pcf)	Angle of Internal Friction - ϕ (°)	k Value (pci)	Undrained Cohesion - c (psf)	Strain Factor ε_{50}
1	0-4	Sand	110	31	90	-	-
2	4-14	Sand	110-115	30-32	90	-	-
3	14-19	Sand	55	32	60	-	-
4	19-74	Sand	55-75	33-36	60-125	-	-
5	74-100	Sand	75	37-42	125	-	-

Project: **Improvements to Intersection PR-2, 2R and San Juan St. (RUM Entrance, La Vita**
Location: **Mayaguez, PR** *Job no.:* **7616**

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Geotechnical Engineers

Soil Parameters for LPILE 2013 Software – Boring no. 4

Stratum no.	Depth Range (ft)	Soil Type	Effective Unit Weight - γ' (pcf)	Angle of Internal Friction - ϕ (°)	k Value (pci)	Undrained Cohesion - c (psf)	Strain Factor ε_{50}
1	0-9	Sand	110-115	30-32	90	-	-
2	9-15	Soft Clay	100	-	-	500	0.01
3	15-39	Soft Clay	35-45	-	-	500-1000	0.01
4	39-69	Stiff Clay	45-55	-	500	1000-1500	0.007
5	69-100	Sand	65-75	37-42	125	-	-

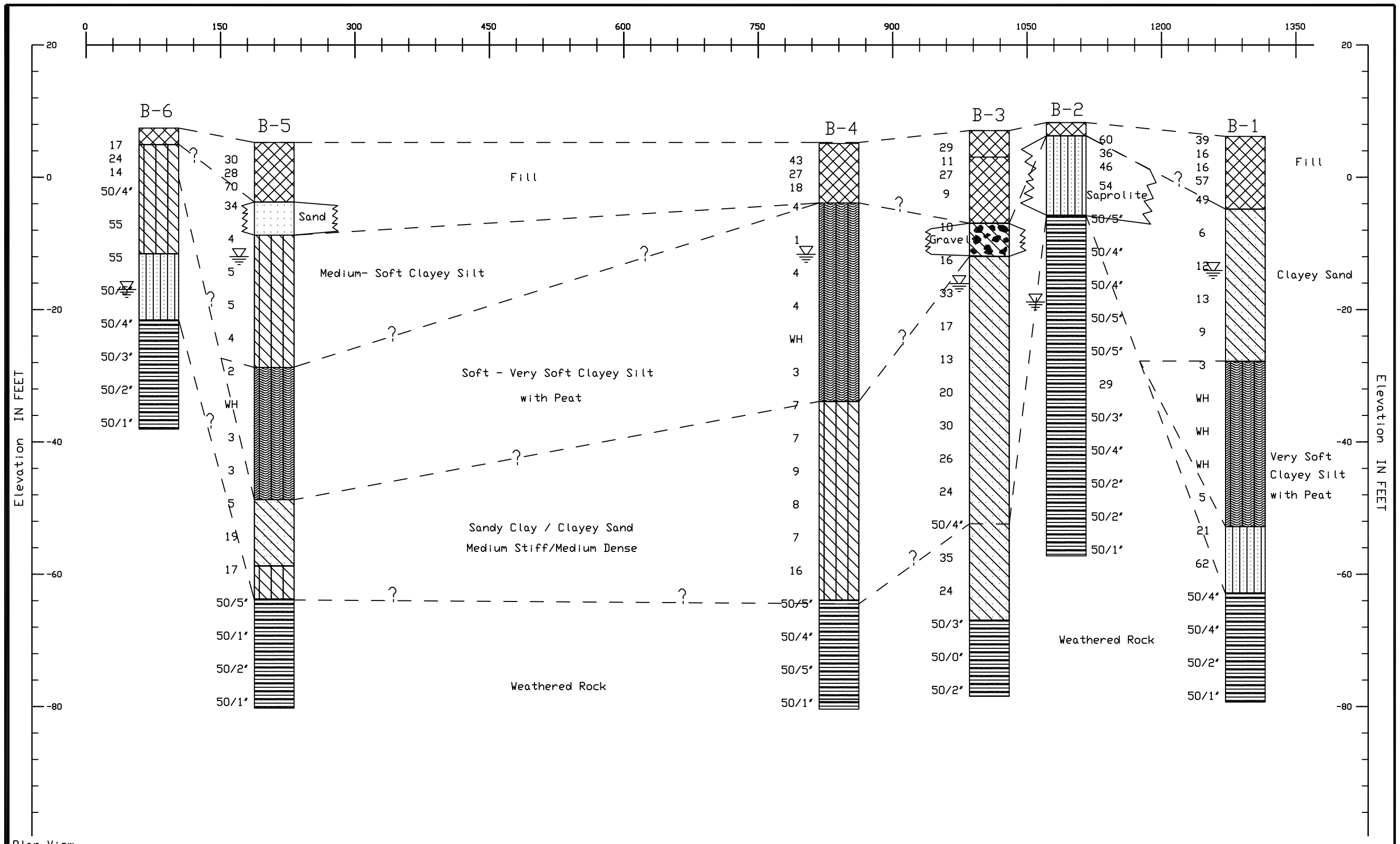
Soil Parameters for LPILE 2013 Software – Boring no. 5

Stratum no.	Depth Range (ft)	Soil Type	Effective Unit Weight - γ' (pcf)	Angle of Internal Friction - ϕ (°)	k Value (pci)	Undrained Cohesion - c (psf)	Strain Factor ε_{50}
1	0-9	Sand	110-115	31-33	90	-	-
2	9-14	Sand	110	33	90	-	-
3	14-34	Stiff Clay	40-45	-	500	1000-1500	0.007
4	34-54	Soft Clay	35-40	-	-	500-1000	0.01
5	54-64	Sand	50-55	31-33	60	-	-
6	64-69	Stiff Clay	55	-	500-1000	2000	0.007-0.005
7	69-100	Sand	55-65	37-42	125	-	-

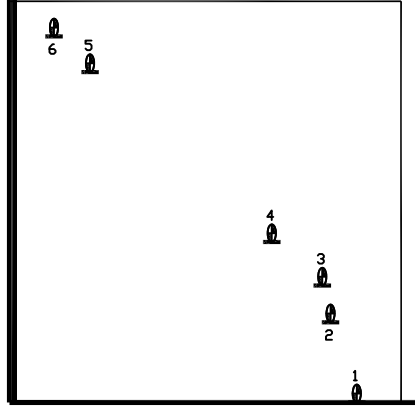
Soil Parameters for LPILE 2013 Software – Boring no. 6

Stratum no.	Depth Range (ft)	Soil Type	Effective Unit Weight - γ' (pcf)	Angle of Internal Friction - ϕ (°)	k Value (pci)	Undrained Cohesion - c (psf)	Strain Factor ε_{50}
1	0-2	Sand	110	30	25	-	-
2	2-13	Stiff Clay	110-120	-	500-1000	1000-3000	0.007-0.005
3	13-19	Stiff Clay	55	-	1000	3000	0.005
4	19-29	Sand	55-65	33-36	60-125	-	-
5	29-60	Sand	65-75	37-42	125	-	-
6	60-100	Sand	75	42	125	-	-

Appendix E:
Generalized Soil Profile



Plan View



JACA & SIERRA TESTING LABORATORIES

GENERALIZED SOIL PROFILE

HORIZONTAL SCALE: 1"=	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=20'		2/6/2017

Improvements to Intersection PR-2, 2R & San Juan St. (RUM Entrance)

PROJECT NO. 7716

FIGURE NUMBER