PUERTO RICO COASTAL

DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

APPENDIX B
Geotechnical

March 2023

US Army Corps of Engineers ®
Jacksonville District

TABLE OF CONTENTS

1 BACKGROUND 6

2 GEOLOGY 6

2.1 Regional Geology 6

2.2 Local Geology 6

3 EXISTING BEACHES 7

4 SAND SOURCES 12

4.1 San Juan Nearshore and Offshore Sand Sources 12

4.1.1 La Esperanza Ecosystem Restoration – RSM Sand Source 13

4.1.2 San Juan Nearshore 17

4.1.3 Boca de Cangrejos Navigation Channel – RSM Sand Source 18

4.1.4 Loiza Unverified Offshore Sand Sources 19

4.1.5 Luquillo Potential Offshore Sand Sources 20

4.2 Rincon Nearshore and Offshore Sand Sources 25

4.2.1 Bajo Blanco Nearshore Sand Source 26

4.2.2 Rio Grande de Arecibo Shoal 28

4.2.3 Cabo Rojo Offshore Sand Source 30

4.3 Upland Sand Mines 32

4.3.1 Concretos De Puerto Rico, Inc. 32

4.3.2 Utando Sand Mine 34

4.3.3 Rincon Upland Sand Mine 35

4.3.4 Rincon Upland Sand Mines Sponsor provided 38

5 SAND SOURCE USABILITY AND COMPATIBILITY 39

5.1 San Juan Sand Source Usability and Compatibility 39

5.2 Rincon Sand Source Usability and Compatibility 42

6 ARMOR STONE 47

7 GEOTECHNICAL EVALUATION FOR SEAWALL 48

7.1 Pre-Construction Engineering & Design Geotechnical Investigations 48

7.2 Pre-Construction Investigations of Sand Sources 49

8 REFERENCES 50
9 BORING LOGS AND LABORATORY TESTING 51
9.1 San Juan Study Area 51
9.1.1 San Juan Beaches 51
9.1.2 La Esperanza RSM Sand Source 92
9.1.3 Boca de Cangrejos Navigation Channel 166
9.1.4 Upland Sand Mine: Concretos 170
9.1.5 Upland Sand Mine: Utuado 177
9.1.6 Composite Samples 184
9.1.6.1 Beach-Source Gradation Comparison Graphs 184
9.1.6.2 San Juan Beaches Composite Samples 187
9.1.6.3 San Juan Sand Sources Composite Samples 200
9.2 Rincon Study Area 205
9.2.1 Rincon Beaches 205
9.2.2 Rincon – Rio Grande de Arecibo Shoal 230
9.2.3 Rincon - Upland Mine 270
9.2.4 Rincon - Composite Samples 281
9.2.4.1 Beach-Source Gradation Comparison Graphs 281
9.2.4.2 Rincon Beaches Composite Samples 284
9.2.4.3 Rincon Sand Sources Composite Samples 295

INDEX OF TABLES

Table 1: Beach Sampling Locations 7
Table 2: San Juan Beach Sampling Results 9
Table 3: Rincon Beach Sampling Results 10
Table 4. La Esperanza Push Core Sample Locations 15
Table 5. La Esperanza Push Core Sample Grain Size Analysis Results 15
Table 6. Loiza Surficial Sample Locations 20
Table 7. Grain Size Analysis Results for Loiza 1&2 Sand Sources 20
Table 8. Luquillo Surficial Sample Locations 22
Table 9. Grain Size Analysis Results for Luquillo 1&2 Sand Sources 23

Table 10. Bajo Blanco Surficial Sample Locations (Rojas Vázquez C.A., 2016) 27
Table 11. Bajo Blanco Surficial Sample Grainsizes (Rojas Vázquez C.A., 2016) 27
Table 12. Arecibo Shoal Boring Locations 29
Table 13. Grain Size Analysis Results for Arecibo Shoal 30
Table 14. Cabo Rojo Sample Locations 31
Table 15. Concretos Sand Mine, Juncos, Sample Locations 32
Table 18. Concretos Sand Mine Grain Size Analysis Results 33
Table 16. Utuado Sand Source Sample Locations 34
Table 17. Utuado Sand Mine Grain-size Analysis Results 35
Table 19. Rincon Sand Mine Sample Locations 35
Table 20. Rincon Sand Mine Grainsize Analysis Results 36
Table 21: San Juan Grain Size Summary Composites for Beaches and Sand Sources 40
Table 22: Rincon Grain Size Summary for Beaches and Sand Sources 43
Table 23: San Juan Sand Source Evaluation Summary 45
Table 24: Rincon Sand Source Evaluation Summary 46

INDEX OF FIGURES

Figure 1-1. San Juan Beach Project Locations 6
Figure 3-1. San Juan Beach Sampling Profile Lines Locations 8
Figure 3-2. Rincon Beach Sampling Profile Lines Locations 8
Figure 3-3. Idealized Beach Transect with Sampling Locations 9
Figure 3-4. Composite Gradation Graphs for San Juan Beach Transects 11
Figure 3-5. Composite Gradation Graphs for Rincon Beach Transects 12
Figure 4-1. San Juan Offshore Sand Sources Overview 13
Figure 4-2. La Esperanza Potential Dredge Area 14
Figure 4-3. San Juan Nearshore Sand Thickness 17
Figure 4-4. Boca de Cangrejos Navigation Channel Location 18
Figure 4-5. Loiza Unverified Sand Sources 19

Figure 4-6. Luquillo Potential Sand Sources with side scan image 21
Figure 4-7. Luquillo Potential Sand Sources Sample Locations 23
Figure 4-8. Potential Sand Sources for Rincon 25
Figure 4-9. Bajo Blanco Potential Sand Source, Rincon 26
Figure 4-10. Rio Grande de Arecibo Shoal 29
Figure 4-11. Cabo Rojo Offshore Sand Source 30
Figure 4-12. Upland Sand Mine Locations 32
Figure 4-13. Sample Locations Concretos Sand Mine 33
Figure 4-14. Sample Locations Utuado Sand Source 34
Figure 4-15. Rincon Upland Sand Mine and Sample Locations 36
Figure 4-16. Rincon Upland Sand Mine Locations Provided by the Sponsor 38
Figure 5-1. San Juan Project Area and Evaluated Sand Sources Locations 39
Figure 5-2. Rincon Project Area with Upland and Offshore Sand Source Locations 42
Figure 6-1. Armor Stone Quarry Locations 47

1 BACKGROUND

The Coastal Storm Risk Management Integrated Feasibility Study and Environmental Assessment for Puerto Rico includes two coastal study areas: San Juan and Rincon, as depicted in **Figure 1-1** below.

Figure 1-1. San Juan Beach Project Locations

2 GEOLOGY

2.1 REGIONAL GEOLOGY

Puerto Rico is a volcanic island located within the boundaries of the Caribbean and North American tectonic plates and part of the clustered islands of the Greater Antilles which are in the Atlantic Ocean. The island is predominantly composed of volcanic and plutonic rock of Jurassic to Eocene age overlain by limestone and other sedimentary deposits of Oligocene to recent age. Since the island is wedged between two active tectonic plates, seismic activity is prevalent resulting in the potential for natural hazards such as earthquakes, tsunamis, and landslides.

2.2 LOCAL GEOLOGY

San Juan, on the northeast coast of the island, is located within an exposed shallow marine shelf that surrounds the Commonwealth of Puerto Rico. Recent beach sand composed of quartz and carbonate is deposited in pocket beaches formed between reef outcrops along the shoreline. Sand dunes originally present along on the landward side of the beaches were historically mined to build roads and buildings along San Juan's shoreline and no longer exist (https://pubs.usgs.gov/fs/sand-gravel/). Below the recent coastal deposits, localized occurrences

of Pleistocene aeolianite and reef rock are present but largely, the quaternary sediments are underlain by thick-bedded, dense limestone which is found at depths varying from 25 feet to more than 100 feet. The limestone unit is of early Miocene age and up to 950 feet thick. Periods of fluctuating sea levels occurred during the glacial periods at the end of the Neogene period exposing the limestone, allowing for weathering and erosion to occur. Sea level rose to its current position during the late Pleistocene age after the end of the last glacial period.

Rincon, on the west coast of the island, is similarly located within the exposed shallow marine shelf surrounding Puerto Rico. The coastal geology at Rincon is comprised of Quaternary age sandy beaches and reef out crops along the shore, and a narrow strip of alluvial deposits on the landward side of the coast. The Quaternary sediments are underlain unconformably by a complex, deformed series of sedimentary and igneous rocks.

3 EXISTING BEACHES

The project includes several beaches along the San Juan and Rincon coastline of Puerto Rico. The sand from San Juan beaches and dunes was mined for construction aggregate in the past and left the beaches altered from their natural state (https://pubs.usgs.gov/fs/sand-gravel/). Beach nourishments, to date, have not been conducted at either of the beaches.

The existing beaches were characterized through a beach sampling program conducted in March 2019. Beach samples were collected at the locations listed in **Table 1** and depicted in **Figure 3-1** and **Figure 3-2** below. The individually named beaches at San Juan are pocket beaches and separated by reef outcrops. The beaches at Rincon seamlessly blend into each other.

Table 1: Beach Sampling Locations

Study Area	Beach Locations	NAD83 State Plane, ft PR/V	
		Easting	Northing
San Juan	San Juan - Cangrejo	805200	878762
	San Juan - Isla Verde	781330	882912
	San Juan - Ocean Park	797908	878127
	San Juan - Parque	789768	881167
	San Juan - Condado	785938	881875
Rincon	Rincon - Corsega	374611	834611
	Rincon - Stella	371461	839810
	Rincon - Dona Lala	373482	834560

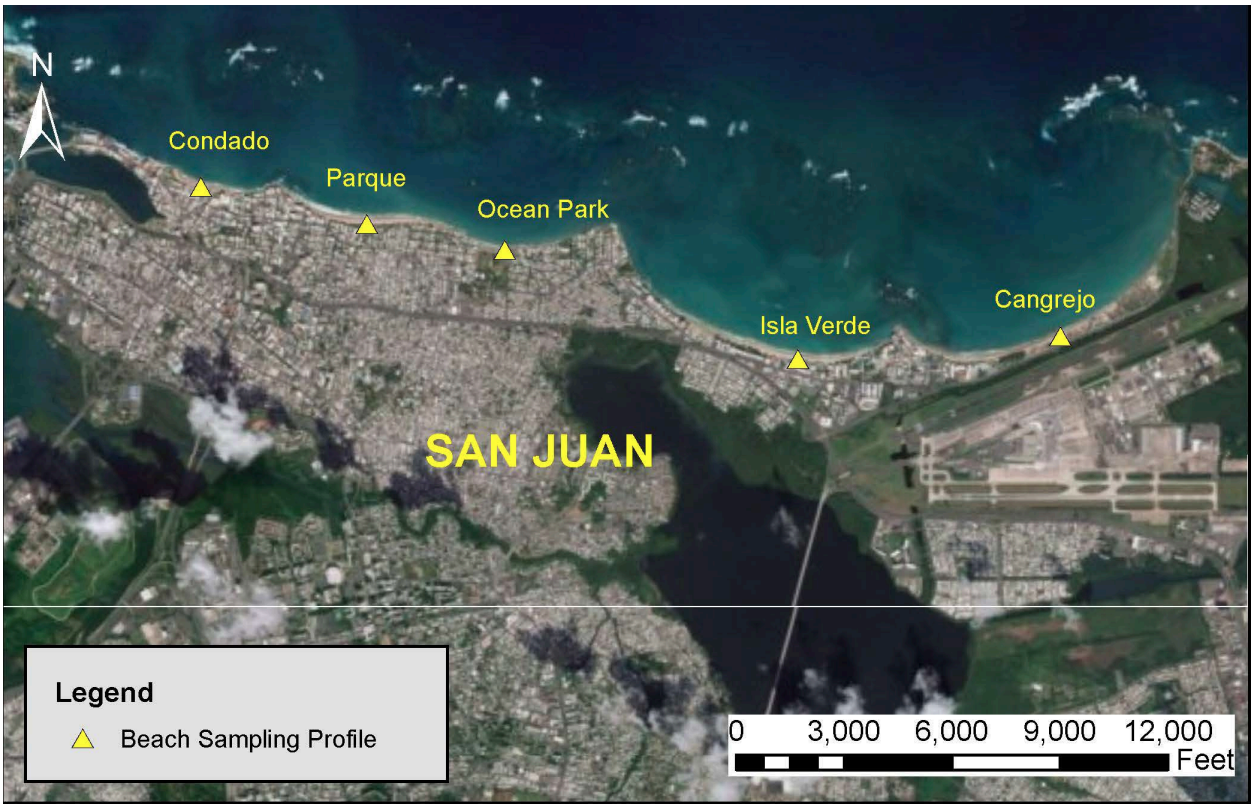


Figure 3-1. San Juan Beach Sampling Profile Lines Locations

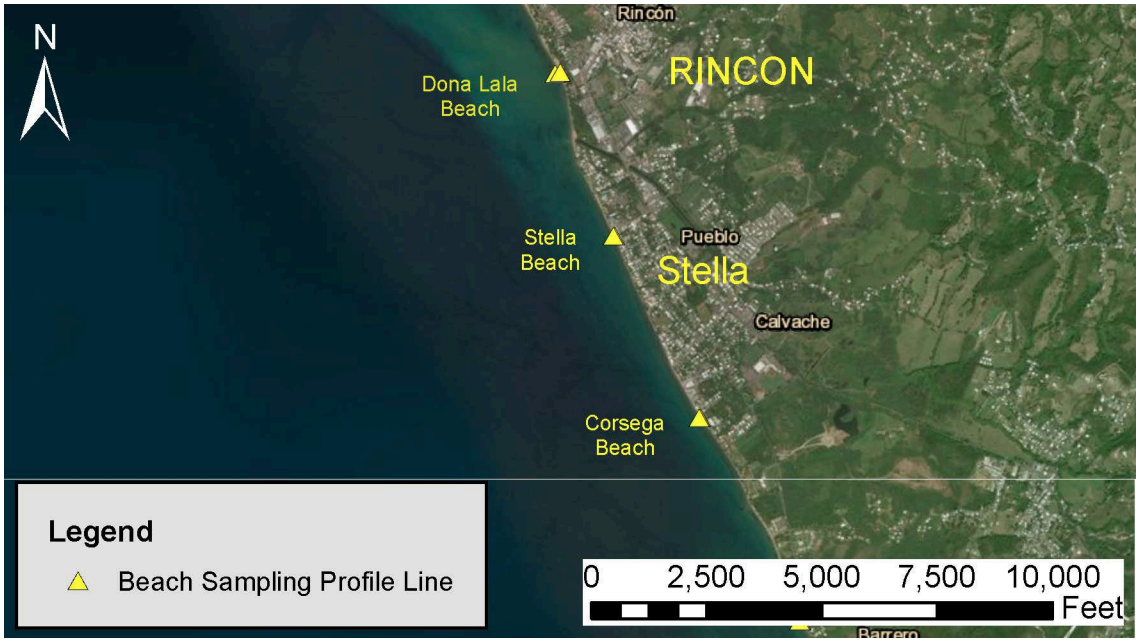


Figure 3-2. Rincon Beach Sampling Profile Lines Locations

Beach samples were collected at the following four locations along eight beach profiles: berm, mid-tide, -3 ft., -5 ft. below Mean Sea Level as shown in the diagram in **Figure 3-3**. The samples were collected from a depth of approximately 6-12 inches below ground surface. The Puerto Rico beaches have a lower gradient than that shown in the general drawing provided by **Figure 3-3** and buildings and roads were constructed at the location of the original dune. Therefore, dune samples could not be collected at any locations.

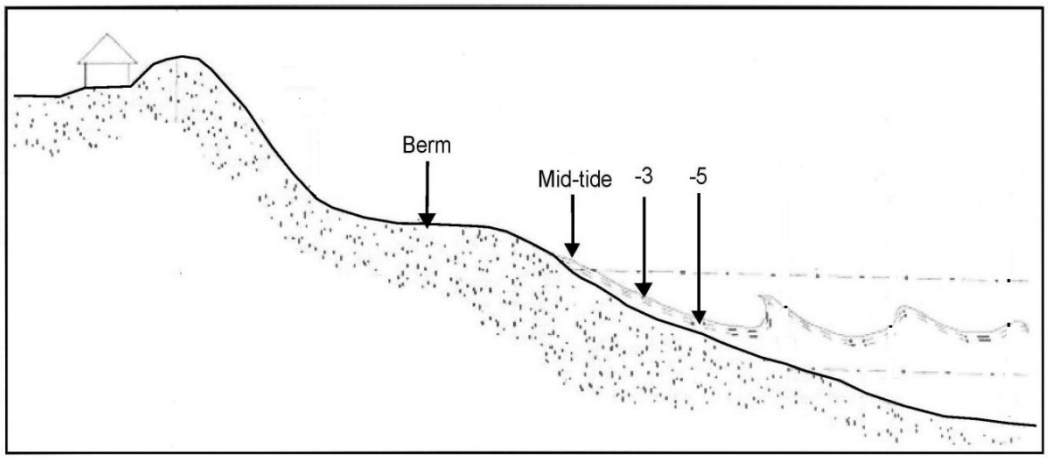


Figure 3-3. Idealized Beach Transect with Sampling Locations

Grain size and visual shell analyses were performed on all thirty-two (32) samples and carbonate analyses were performed on seven (7) representative samples. Gradation curves and granularmetric reports are attached in **Paragraph 9.1.1 and 9.2.1**.

A representative arithmetic composite sample was calculated for each study area using all samples. The granularmetric results using the method of moments for each sample and for the composite sample are summarized in **Table 2** for Sand Juan beaches and in **Table 3** for Rincon beaches.

Table 2: San Juan Beach Sampling Results

Beach Designation	Location	USCS*	Mean (mm)	Sorting (phi)	Retain. on # 4 Sieve %	Silt Pass. #230 Sieve %	Visual Shell in %*	$CaCO_3$* in %	Moist Munsell Color
San Juan - Condado	Berm	SP	0.28	0.57	0.00	0.90	11.1		10YR 7/3
San Juan - Condado	Mid-Tide	SP	0.27	0.59	0.00	1.22	21.1		10YR 6/3
San Juan - Condado	-3	SP	0.46	0.85	0.00	1.95	16.4		10YR 6/3
San Juan - Condado	-5	SP	0.19	0.63	0.00	2.04	39.5	46.56	10YR 6/3
San Juan - Isla Verde	Berm	SP	0.23	0.91	1.27	0.42	25.8	29.41	10YR 7/2
San Juan - Isla Verde	Mid-Tide	SP	0.25	0.74	0.00	0.83	17.2		10YR 6/3
San Juan - Isla Verde	-3	SP	0.14	0.48	0.00	1.62	8.7		2.5Y 6/3
San Juan - Isla Verde	-5	SP-SM	0.12	0.40	0.00	3.02	13.0		2.5Y 5/2
San Juan - Ocean Park	Berm	SP	0.28	0.68	0.00	0.63	12.5		2.5Y 6/3

Beach Designation	Location	USCS*	Mean (mm)	Sorting (phi)	Retain. on # 4 Sieve %	Silt Pass. #230 Sieve %	Visual Shell in %*	$CaCO_3$* in %	Moist Munsell Color
San Juan - Ocean Park	Mid-Tide	SP	0.37	0.67	0.00	1.31	43.8	47.24	10YR 6/2
San Juan - Ocean Park	-3	SP	0.16	0.49	0.00	2.02	11.1		2.5Y 5/2
San Juan - Ocean Park	-5	SP	0.16	0.51	0.00	2.06	12.3		2.5Y 6/2
San Juan - Parque	Berm	SP	0.31	0.62	0.00	0.49	17.0		10YR 7/2
San Juan - Parque	Mid-Tide	SP	0.25	0.55	0.00	1.09	18.6		10YR 6/3
San Juan - Parque	-3	SP	0.19	0.71	0.08	1.76	40.0	46.88	10YR 6/2
San Juan - Parque	-5	SP	0.22	1.02	1.73	1.65	24.3		2.5Y 6/2
San Juan - Cangrejo	Berm	SP	0.22	0.70	0.00	0.51	17.9		10YR 6/2
San Juan - Cangrejo	Mid-Tide	SP	0.19	0.70	0.00	1.14	16.7		10YR 5/2
San Juan - Cangrejo	-3	SP-SM	0.12	0.67	0.00	6.29	15.8		10YR 5/2
San Juan - Cangrejo	-5	SM	0.10	0.63	0.22	14.78	19.3		2.5Y 5/1
BEACH COMPOSITE SAN JUAN		**SP**	**0.21**	**0.86**	**0.16**	**2.29**	**20.11**	**42.52**	**Value 6**

*USCS = US Soil Classification System, $CaCO_3$ = Calcium Carbonate

Table 3: Rincon Beach Sampling Results

Beach Designation	Location	USCS*	Mean (mm)	Sorting (phi)	Retain. on # 4 Sieve %	Silt Pass. #230 Sieve %	Visual Shell in %*	$CaCO_3$* in %	Moist Munsell Color
Rincon – Corcega	Berm	SP	0.35	0.68	0.00	0.45	8.7		2.5Y 6/6
Rincon – Corcega	Mid-Tide	SP	0.39	0.60	0.00	0.89	18.1		2.5Y 6/3
Rincon - Corcega	-3	SP	0.76	1.09	1.54	1.30	33.9		2.5Y 5/2
Rincon - Corcega	-5	SP	0.23	0.54	0.00	1.03	34.2	24.55	10YR 5/3
Rincon - Doña Lala	Berm	SP	0.32	0.64	0.00	0.10	16.7		2.5Y 6/3
Rincon - Doña Lala	Mid-Tide	SP	0.33	0.76	0.00	0.97	33.6	36.11	10YR 4/3
Rincon - Doña Lala	-3	SP	0.45	0.87	0.00	0.86	38.0		2.5Y 5/3
Rincon - Doña Lala	-5	SP	0.18	0.39	0.00	1.25	23.9		2.5Y 5/3
Rincon - Stella	Berm	SP	0.33	0.64	0.00	0.26	33.1		10YR 5/3
Rincon - Stella	Mid-Tide	SP	0.30	0.62	0.00	1.04	35.6		10YR 5/2
Rincon - Stella	-3	SP	0.66	1.28	3.43	1.00	36.1	33.62	10YR 4/3
Rincon - Stella	-5	SP	0.17	0.37	0.00	1.05	18.6		2.5Y 5/3
BEACH COMPOSITE RINCON		**SP**	**0.34**	**0.97**	**0.41**	**0.85**	**27.54**	**31.43**	**Value 5**

*USCS = US Soil Classification System, $CaCO_3$ = Calcium Carbonate

The beach composite sample for San Juan Beaches was classified as clean, poorly-graded, fine-grained quartz sand (SP) with a mean grain size of or 0.21 mm, and a standard deviation of 0.86

phi. The average percentage of fines passing the #230 sieve is 2.29. The average visual shell percentage is 20.11 %, with a range from 8.7 % through 43.8 %. The typical moist Munsell Color value is 6 and color is described as light brownish gray. The graph with the composite sample for each of the various San Juan Beaches is shown in **Figure 3-4**. The graphs and granularmetric reports for each composite sample are attached in **Paragraph 9.1.6.**

The beach composite sample for <u>Rincon Beaches</u> was classified as clean, poorly-graded, fine-grained quartz sand (SP) with a mean grain size of or 0.34 mm, and a standard deviation of 0.97 phi. The average percentage of fines passing the #230 sieve is 0.85. The average visual shell percentage is 27.54 %, with a range from 8.7 % through 38 %. The typical moist Munsell Color value is 5 and color is described as grayish brown. The graph with the composite sample for each of the various Rincon is shown in **Figure 3-5**. The graphs and granularmetric reports for each composite sample are attached in **Paragraph 9.2.4.**

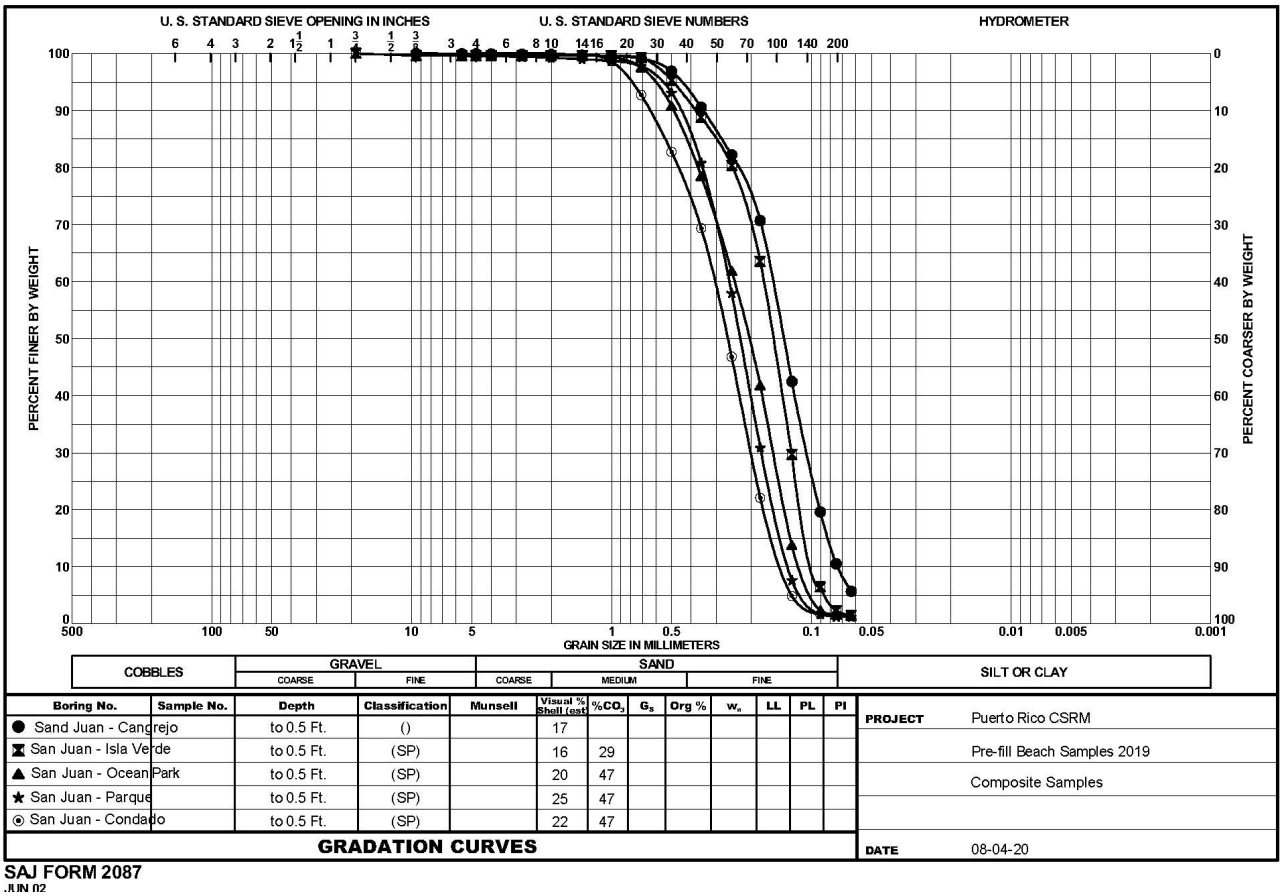


Figure 3-4. Composite Gradation Graphs for San Juan Beach Transects

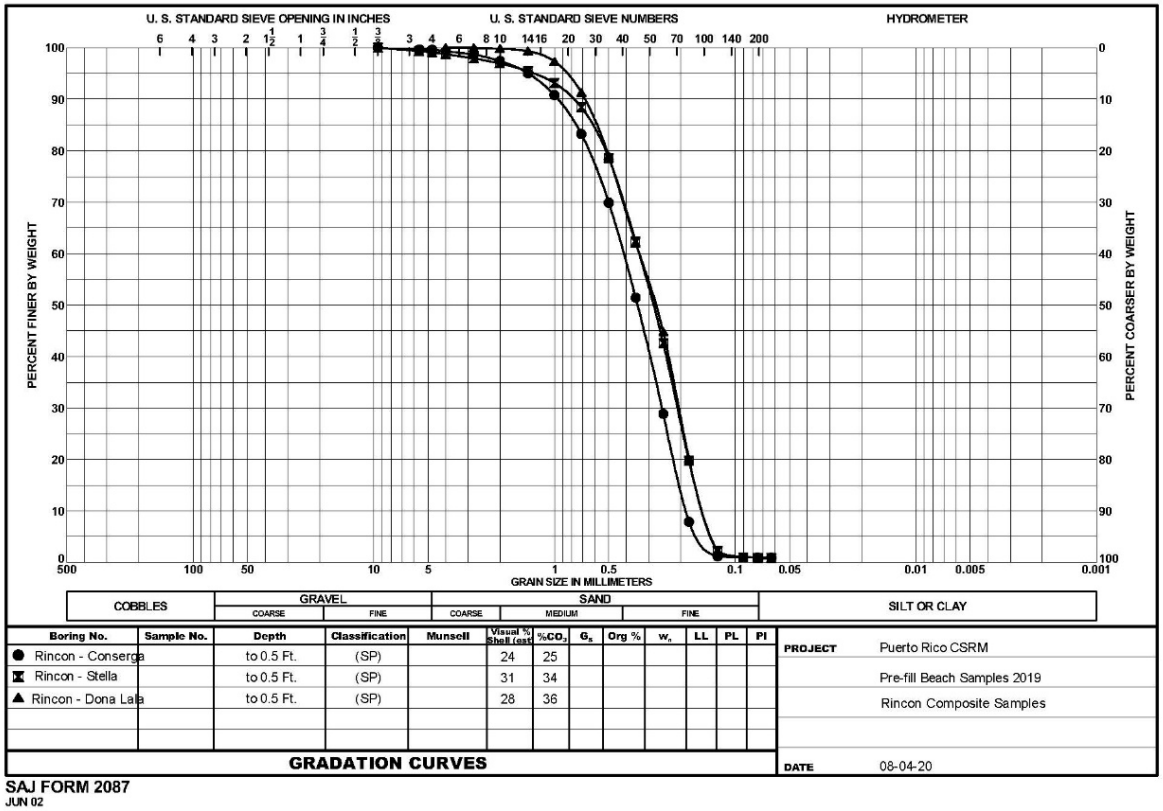


Figure 3-5. Composite Gradation Graphs for Rincon Beach Transects

4 SAND SOURCES

Nearshore and offshore sand sources, and upland sand mines were identified for both study areas and are discussed in the paragraphs below. Puerto Rico has no specific requirements for the beach fill quality. However, from an environmental and sustainability point of view the sand placed on the beach should have less than 5% silt, be similar to the sand of the existing beach and free of foreign matter, like rock, debris, and toxic material. Beach compatibility is discussed in greater detail in **Paragraph 5.**

4.1 SAN JUAN NEARSHORE AND OFFSHORE SAND SOURCES

The evaluation of offshore sand sources is based on existing data from other federal and non-federal agencies only. Available data are historic boring logs, push cores, and surficial samples collected by USGS in 1992 in the context of a geophysical investigation. Sampling of the potential offshore sand sources was not performed as part of this study.

The following five potential offshore and nearshore, and Regional Sediment Management (RSM) sand sources were explored for San Juan.

- La Esperanza (nearshore)
- Boca de Cangrejos Navigation Channel (RSM)

- Sand deposits within the nearshore of the San Juan study area
- Loiza unverified offshore sand sources
- Luquillo potential offshore sand sources

La Esperanza is approximately 5-10 Miles away from the San Juan Beaches. The San Juan nearshore deposits are located approximately 1-3 miles from the receiving beaches. The offshore sand sources Loiza 1&2 are located approximately 15 nautical miles east of San Juan, and Luquillo 1&2 are approximately 25 nautical miles east.

An overview map for the sand sources is included in **Figure 4-1** below, and the available information for each sand source is summarized in the following chapters.

Figure 4-1. San Juan Offshore Sand Sources Overview

4.1.1 LA ESPERANZA ECOSYSTEM RESTORATION – RSM SAND SOURCE

La Esperanza is an ecosystem restoration project (Environmental Assessment USACE 2015) and a Regional Sediment Management (RSM) sand source. The La Esperanza Peninsula is located in the northwestern side of the San Juan Harbor. The peninsula is manmade and was initiated through the placement of dredged material from San Juan Harbor construction dredging between 1962 and 1965. The dredged material has been migrating and changing in shape since placement due to prevailing winds, tides, and wave action, and has formed the shape and size of today's La Esperanza Peninsula (Figure 4-2). The long hook shape significantly impairs water circulation inside a shallow embayment by trapping and concentrating nutrients and sediment-laden water discharged by the Malaria Canal. In 2005, La Esperanza Peninsula was dredged by the USACE to restore water quality within the embayment. However, due to the littoral drift and wave action, La Esperanza Peninsula shoaled in quickly and is in need to be dredged again.

Figure 4-2. La Esperanza Potential Dredge Area

The USACE, Jacksonville District collected fifteen (15) push cores, each 2-5 feet deep in 2014 and lab analysis was performed on selected samples. The push core locations are depicted in **Figure 4-2** and listed in **Table 4**. Laboratory testing results are summarized in **Table 5**. Logs and gradation graphs of the samples are attached in **Paragraph 9.1.2**.

The borings and lab samples characterize the material as poorly graded fine-grained quartz sand with interbedded shell beds. The deposits have a mean grainsize of 0.36 mm and would be suitable for beach placement.

A specific dredge template cannot be designed at this time since the peninsula is ever changing and the dredge area must be configured considering the ecosystem restoration of the La Esperanza area. However, it is estimated that 70,000 cubic yards (CY) every 10 years could be dredged and used for San Juan beach nourishment.

Table 4. La Esperanza Push Core Sample Locations

Sand Source Designation	Sample	PR/VI State Plane NAD83 (US feet)		Hole Depth (US Feet)
		X	Y	
La Esperanza	SJH-HA-1	760121	881499	2.8
La Esperanza	SJH-HA-2	760347	881035	3.2
La Esperanza	SJH-HA-3	760590	880872	3.0
La Esperanza	SJH-LE-1	760284	881658	3.7
La Esperanza	SJH-LE-10	760619	880645	4.0
La Esperanza	SJH-LE-13A	759927	879462	1.5
La Esperanza	SJH-LE-15A	759896	879371	4.0
La Esperanza	SJH-LE-17	759927	879280	2.0
La Esperanza	SJH-LE-2	760715	881251	2.3
La Esperanza	SJH-LE-3	760255	881426	2.5
La Esperanza	SJH-LE-4	760464	881187	1.5
La Esperanza	SJH-LE-5	760245	881208	5.0
La Esperanza	SJH-LE-5A	760264	881220	5.0
La Esperanza	SJH-LE-6	760714	880918	5.0
La Esperanza	SJH-LE-7	760500	880973	5.0
La Esperanza	SJH-LE-8A	760354	880945	1.5
La Esperanza	SJH-LE-9	760780	880730	5.0

Table 5. La Esperanza Push Core Sample Grain Size Analysis Results

Core Designation	Sample Name	USCS	Mean (mm)	Sorting (phi)	Retain. on # 4 Sieve %	Silt Pass. #200 Sieve %	CaCo3* in %	Moist Munsell Color
SJH-LE-1	1	SP	0.38	1.59	8.3	1.5	61.5	2.5Y 5/2
SJH-LE-1	2	SP	0.41	1.90	9.6	3.3		2.5Y 4/2
SJH-LE-1	3	SP	0.42	1.25	0.5	3.1		2.5Y 5/1
SJH-LE-1	4	SP-SM	0.34	1.16	0.3	7.7		2.5Y 5/2
SJH-LE-2	1	SP	0.17	0.58	0.0	2.4		10YR 4/2
SJH-LE-2	2	SM	0.21	0.74	0.0	39.6		2.5Y 4/1
SJH-LE-2	3	MH						2.5Y 4/1
SJH-LE-3	1	SP	0.82	1.49	6.4	0.3		10YR 6/4
SJH-LE-3	2	SP	2.28	1.21	16.3	1.3	96.1	10YR 6/6

Core Designation	Sample Name	USCS	Mean (mm)	Sorting (phi)	Retain. on # 4 Sieve %	Silt Pass. #200 Sieve %	CaCo3* in %	Moist Munsell Color
SJH-LE-3	3	SP	0.24	1.80	6.4	3.3		2.5Y 5/2
SJH-LE-4	1	SP	0.69	1.93	10.3	0.6	73.4	10YR 5/2
SJH-LE-4	2	SP	0.22	1.32	1.8	3.0		2.5Y 5/2
SJH-LE-5	1	SP	0.30	1.06	1.3	4.3		2.5Y 7/2
SJH-LE-5	2	SP	0.62	1.54	9.0	1.1	69.9	2.5Y 6/4
SJH-LE-5	3	SP	0.66	1.57	6.1	1.6		2.5Y 5/2
SJH-LE-5	4	SP	0.21	0.98	0.6	2.9		2.5Y 5/2
SJH-LE-5A	1	SP	0.24	0.81	1.0	0.3		2.5Y 6/3
SJH-LE-5A	2	SP	0.46	1.34	2.7	0.6		2.5Y 6/3
SJH-LE-5A	3	SP	0.21	0.64	0.0	2.3		2.5Y 5/3
SJH-LE-5A	4	SP	0.24	0.94	0.3	1.9		2.5Y 5/3
SJH-LE-5A	5	SP-SM	0.16	0.77	0.0	7.7		2.5Y 5/2
SJH-LE-5A	6	SP-SM	0.15	0.80	0.0	10.3		2.5Y 5/2
SJH-LE-6	1	SP	0.24	0.69	0.6	0.4		2.5Y 5/3
SJH-LE-6	2	SP	0.55	1.89	8.2	1.5	77.4	10YR 5/2
SJH-LE-6	3	SP	0.95	1.58	12.1	0.9		2.5Y 5/3
SJH-LE-6	4	SP-SM	0.17	1.46	2.4	7.5		2.5Y 5/2
SJH-LE-6	5	SP-SM	0.33	1.19	0.6	11.4		2.5Y 5/2
SJH-LE-7	1	SP	0.34	1.36	2.8	0.1	59.2	2.5Y 7/2
SJH-LE-7	2	SP	0.73	2.13	18.3	0.9		2.5Y 6/3
SJH-LE-7	3	SP	0.36	1.52	5.8	0.6	62.4	2.5Y 5/3
SJH-LE-7	4	SW	1.60	1.85	26.6	0.9		2.5Y 5/3
SJH-LE-7	5	SP	0.82	1.69	20.2	1.6		2.5Y 5/2
SJH-LE-8A	1	SM	0.28	1.62	3.5	14.2		2.5Y 4/2
SJH-LE-8A	2	SP-SM	0.19	1.66	3.8	10.8	65.1	2.5Y 5/2
SJH-LE-9	1	SP	0.28	1.41	3.7	0.6		2.5Y 5/3
SJH-LE-9	2	SP	0.15	0.45	0.0	1.3	68.4	2.5Y 5/2
SJH-LE-9	3	SP	0.59	1.95	11.2	1.2		2.5Y 5/3
SJH-LE-10	1	SP	0.24	0.72	0.3	0.7		2.5Y 5/2
SJH-LE-10	2	SP	0.29	1.20	2.6	1.2	59.7	2.5Y 5/2
SJH-LE-10	3	SP	0.24	0.89	0.0	2.3		2.5Y 4/3
SJH-LE-13A	1	SP	0.32	1.42	5.4	2.9		2.5Y 5/2
SJH-LE-15A	1	SP	0.25	1.28	3.3	1.0		2.5Y 6/3
SJH-LE-15A	2	SP	0.29	1.29	2.4	2.0	68.5	2.5Y 5/2
SJH-LE-15A	3	SP	0.29	1.29	2.4	2.0		2.5Y 5/2
SJH-LE-17	1	SP	1.09	1.46	9.7	1.0		2.5Y 6/3
SJH-LE-17	2	SP	0.40	1.30	3.7	2.0		2.5Y 5/2
La Esperanza Composite		**SP**	**0.36**	**1.62**	**5.13**	**3.73**	**69.3**	**Light brown**

4.1.2 SAN JUAN NEARSHORE

The Coastal and Hydraulics Laboratory (CHL) of the USACE Engineer Research and Development Center (ERDC) collected sub bottom profiling data in the nearshore of San Juan in 2017. The purpose of the data collection was to study local sediment transport. The study team developed an isopach map showing the sand thicknesses over hard bottom (**Figure 4-3**).

The sand deposits are located between the outer San Juan longitudinal reef complex and the mainland which also has multiple reef outcrops at the ends each pocket beach. The maximum sand thicknesses are as follows:

- Condado: max. 5 feet
- Carolina: max. 35 feet
- Isla Verde: max. 15 feet
- Ocean Park: max. 18 feet

The seafloor slopes gently toward the reefs and the maximum water depth is approximately 30 feet at the landward boundary of the longitudinal reefs.

Figure 4-3. San Juan Nearshore Sand Thickness

The landward portions of the sand deposits are part of the submerged beach. Even though there seems to be an abundance of sand, these sand deposits are unlike offshore shoals, they are located beneath the gently sloped seafloor. Dredging those sand deposits would leave a dredge hole in the sediment starved coastal system of San Juan that may trigger erosion at the nearby beaches.

In summary, using the nearshore sand deposits as sand source for San Juan beaches is not recommended since it may not only trigger erosion at the nearby beaches, but also jeopardize the environmental resources in the immediate vicinity.

4.1.3 BOCA DE CANGREJOS NAVIGATION CHANNEL – RSM SAND SOURCE

Boca de Cangrejos navigation channel is located immediately northeast of the San Juan metropolitan area approximately 3 miles north of the San Juan International Airport. The channel includes a narrow inlet that connects the Atlantic Ocean with the Laguna Torecilla. The navigation channel has 2 sections, an outer channel and an inner channel as depicted in **Figure 4-4**. Each channel section is approximately 700-ft long and 50-ft wide at a depth of -8 ft MLLW. The channel's shoaling rate is approximately 22,000 CY every 1-2 years.

Three core borings drilled in 1970 are available within the channel footprint. The borings were not surveyed, and exact boring locations are not known. The boring logs indicate an upper layer of sand (SP) and silty sand (SM) to a depth of 8 to 12.6 feet MLLW underlain by peat. Boring Logs are attached in **Paragraph 9.1.3**. USACE recently completed a Planning Assistance to States (PAS) study that identified additional navigation channel alternatives to reduce maintenance dredging requirements of the channel and adjacent marina. The study identified numerous alternatives and indicated approximately 30,000 to 170,000 CY of beach quality sand may be available for beneficial uses on adjacent beaches. The volumes and beach compatibility of the sand deposits will need to be determined through vibracore borings before any beach placement.

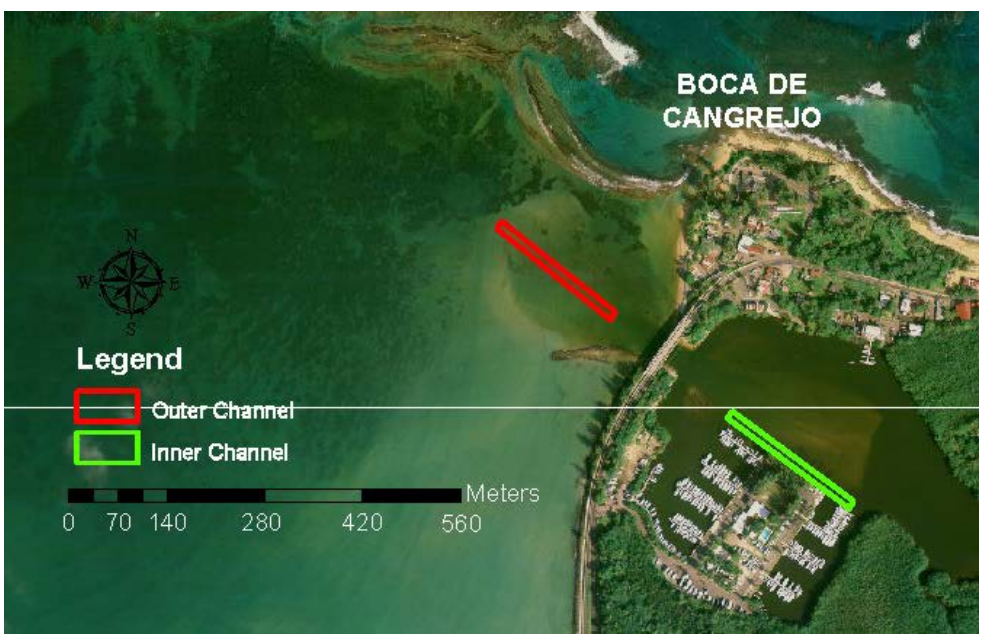


Figure 4-4. Boca de Cangrejos Navigation Channel Location

4.1.4 LOIZA UNVERIFIED OFFSHORE SAND SOURCES

The Loiza unverified offshore sand sources are located approximately 15 miles east of San Juan in water depths of 20-40 feet. They were identified based on flow vector models and laboratory testing results of three (3) surficial samples collected by USGS (Schwab et Al, 1996 and Cross et al, 1998). The flow vector model suggests the location of the local riverbeds (Loiza Rio Grande, and Rio Espiritu Sancto) extending into the ocean since the shoreline of Puerto Rico extended further into the present ocean before the sea level rise associated with the end of the last glacial period. Therefore, relict river channels, typically filled with sand, are now submerged and referred to as paleochannels. Typically, the terrestrial coarser sediments are overlain by finer marine sediments. Paleochannels are commonly sought after in the context of sand source investigations and are generally identified through geophysical surveys. **Figure 4-5** depicts the Loiza 1&2 sand sources, likely paleochannel locations, the flow vector model, the surficial sample locations, and the sand source design. The coordinates of the sample locations are listed in **Table 6**.

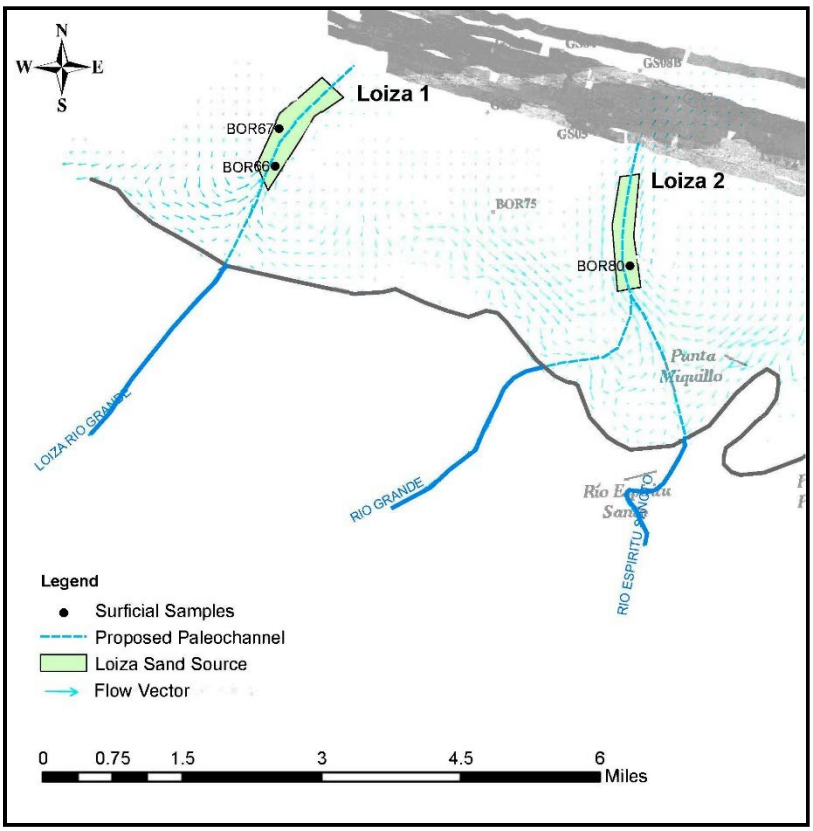


Figure 4-5. Loiza Unverified Sand Sources

Table 6. Loiza Surficial Sample Locations

Sand Source Designation	Sample Designation	NAD83 / UTM Zone 20N (Meters)	
		X	Y
Loiza 1	BOR66	196,751	2,042,829
Loiza 1	BOR67	196,835	2,043,473
Loiza 2	BOR80	202,876	2,040,997

The granularmetric data of the samples are summarized in **Table 7**. All sample data is derived directly from the USGS study (Schwab et al, 1996 and Cross et al, 1998). Sieve data, gradation curves and granularmetric reports are not available. The samples are classified as poorly graded sand (SP), poorly graded sand with silt (SP-SM), and silty sand (SM) with a mean grain size of 0.07-0.15mm, and percentage fines of 2.48, 11.04, and 29.89%, respectively. Thus, the surficial sediment samples are classified as very fine-grained sand and are not representative of beach compatible sand. Therefore, at this time Loiza 1&2 are not considered to be viable sand sources for this project. However, the evaluation is based on only three surficial samples. Geophysical surveys and vibracores would be required to properly characterize this unverified sand source.

Table 7. Grain Size Analysis Results for Loiza 1&2 Sand Sources

Sand Source Designation	Sample ID	USCS	%Gravel	%Sand	%Silt	%Clay	Mean (mm)	Standard Deviation (phi)
Loiza 1	BOR66	SP	0.23	97.29	1.58	0.90	0.15	0.91
	BOR67	SP-SM	0.00	88.96	4.67	6.37	0.09	1.77
Loiza 2	BOR80	SM	0.52	69.61	26.36	3.50	0.07	0.79

1 Grain size analysis results are directly derived from Schwab et al, 1996 publication

4.1.5 LUQUILLO POTENTIAL OFFSHORE SAND SOURCES

The Luquillo 1&2 potential offshore sand sources are located approximately 25 miles east of San Juan in water depths of 40-60 feet. They were identified based on geophysical data and laboratory testing results of surficial samples collected by USGS (Schwab et al, 1996 and Cross et al, 1998). The flow vector model suggests the location of local river channels (Rio Mameyes, Rio Pitahaya) extending into the ocean as paleochannels as depicted in **Figure 4-6**. The geophysical survey results revealed low backscatter sand, which indicates relatively fine-grained material, at the Luquillo 1 sand source, and high backscatter sand, indicating coarse-grained material, at Luquillo 2. A detailed map showing the potential sand source and the sample numbers is included as **Figure 4-7**. The coordinates of the sample locations are listed in

Table 8.

A conservative estimate of 5-foot sand thickness is used for the volume estimates since borings are not available for the sand sources and the vertical extent of the sand cannot be verified at this time. The granularmetric data of the samples are summarized in

Table 9. All sample data is derived directly from the USGS study (Schwab et al, 1996 and Cross et al, 1998). Sieve data, gradation curves and granularmetric reports are not available.

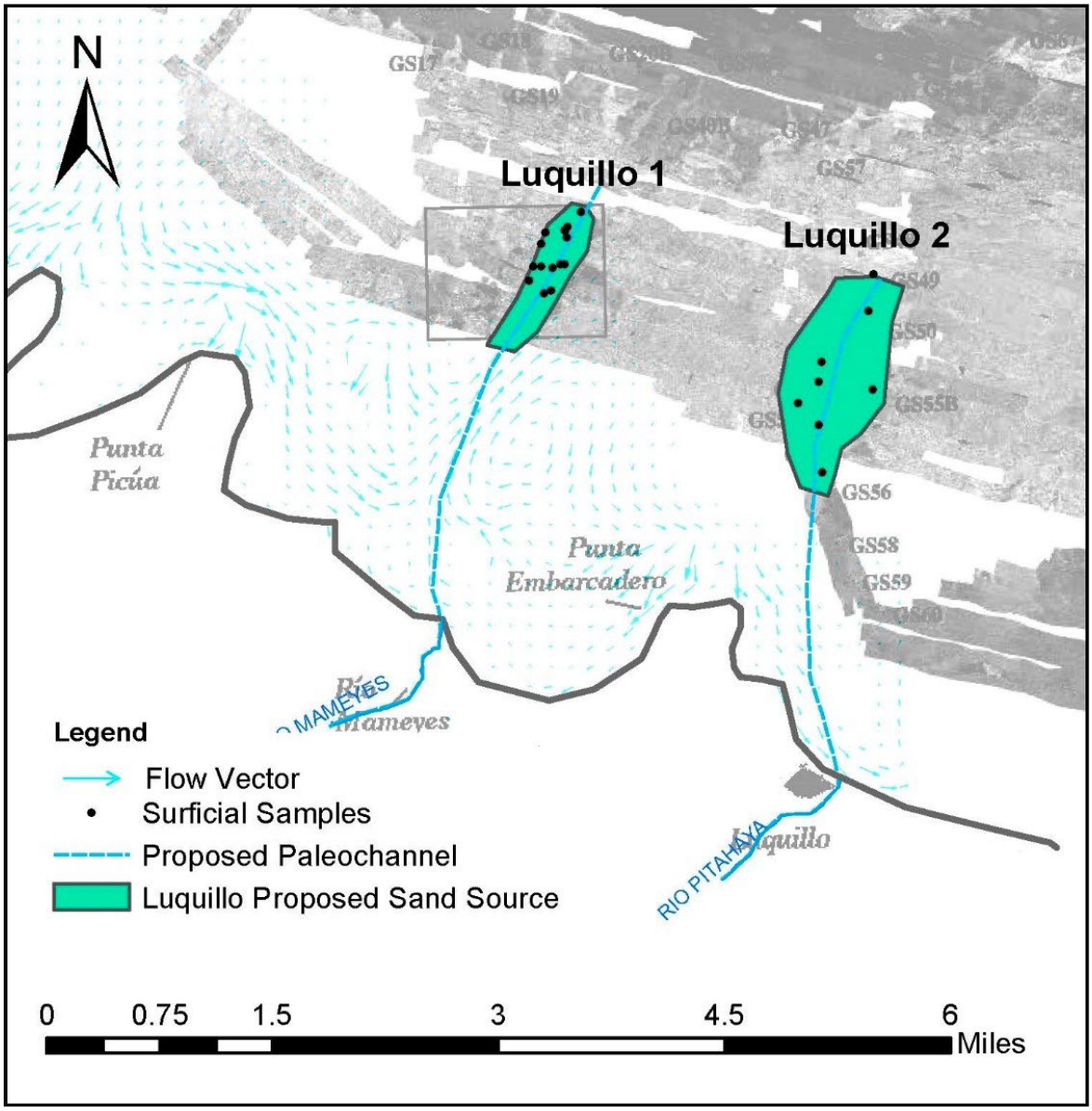


Figure 4-6. Luquillo Potential Sand Sources with side scan image

Table 8. Luquillo Surficial Sample Locations

Sand Source Designation	Sample Designation	NAD83 / UTM Zone 20N (Meters)	
		X	Y
Luquillo-1	BOR09	210,446	2,038,956
Luquillo-1	BOR13	210,835	2,039,490
Luquillo-1	BOR17	210,579	2,039,347
Luquillo-1	BOR34	210,867	2,039,526
Luquillo-1	BOR35	210,845	2,039,490
Luquillo-1	BOR38	210,677	2,038,847
Luquillo-1	BOR43	210,787	2,039,122
Luquillo-1	BOR44	210,702	2,039,086
Luquillo-1	BOR45	210,575	2,039,107
Luquillo-1	BOR46	210,491	2,039,108
Luquillo-1	GS34	210,603	2,038,818
Luquillo-1	GS35	210,829	2,039,125
Luquillo-1	GS36	210,855	2,039,412
Luquillo-1	GS37	210,634	2,039,471
Luquillo-1	GS38	211,018	2,039,687
Luquillo-2	GS49	214,125	2,038,953
Luquillo-2	GS50	214,067	2,038,556
Luquillo-2	GS51	213,551	2,038,021
Luquillo-2	GS52	213,516	2,037,811
Luquillo-2	GS53	213,291	2,037,581
Luquillo-2	GS54	213,509	2,037,346
Luquillo-2	GS55B	214,096	2,037,713
Luquillo-2	GS56	213,533	2,036,836

There are fifteen (15) surficial samples available for Luquillo 1. An arithmetic composite sample was created using the 15 samples. The composite sample classifies as poorly graded medium-grained sand (SP) with a mean grain size of 0.58 mm, and 1.58 percent fines (silt and clay fractions).

There are eight (8) surficial samples available for Luquillo 2. An arithmetic composite sample was created using the 8 samples. The composite sample classifies as poorly graded medium-grained sand (SP) with a mean grain size of 0.59 mm, and 0.08 percent fines (silt and clay fractions).

In summary, the geophysical survey and laboratory test results indicate the presence of beach compatible sand in Luquillo 1 & 2 potential sand sources. The vertical extent of the beach compatible sand deposits needs to be determined through vibracore borings.

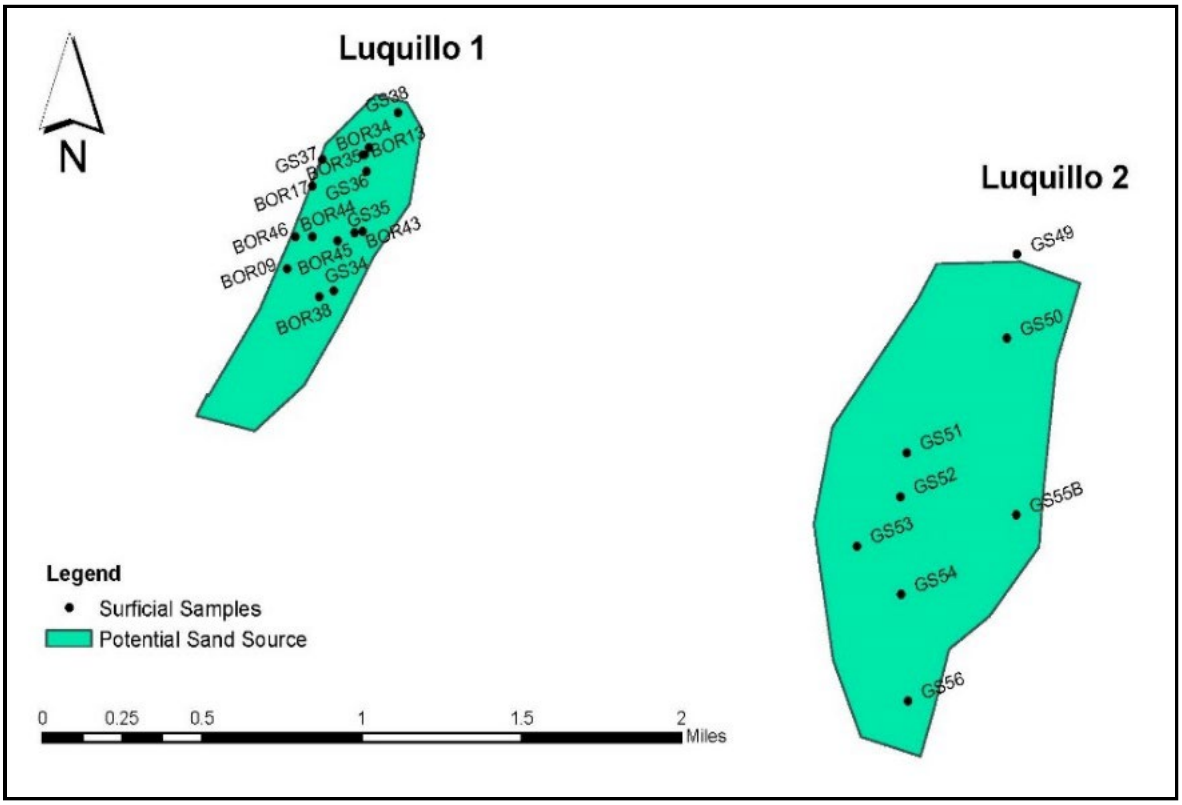


Figure 4-7. Luquillo Potential Sand Sources Sample Locations

Table 9. Grain Size Analysis Results for Luquillo 1&2 Sand Sources

Sand Source Designation	Sample ID	USCS	% Gravel	% Sand	% Silt	%Clay	Mean (mm)	Standard Deviation (phi)
Luquillo 1	GS34	SP	0.10	99.75	0.15	-	0.18	0.72
	GS35	SP	9.74	90.26	-	-	0.65	1.14
	GS36	SP	1.28	95.24	3.47	-	0.18	1.19
	GS38	SP	0.29	99.71	-	-	0.53	0.57
	BOR13	SP	7.17	91.02	0.56	1.25	0.79	1.41
	BOR34	SP	1.95	96.22	0.58	1.25	0.62	1.26
	BOR35	SP	23.26	75.19	0.48	1.06	1.11	1.49
	BOR38	SP	0.12	98.30	0.94	0.65	0.43	1.00
	BOR43	SP	2.02	95.68	1.60	0.69	0.55	1.30
	BOR44	SP	0.47	97.16	1.69	0.69	0.48	1.15

Sand Source Designation	Sample ID	USCS	% Gravel	% Sand	% Silt	%Clay	Mean (mm)	Standard Deviation (phi)
	BOR45	SP	1.01	96.95	0.55	1.49	0.55	1.34
	GS37	SP	4.80	95.14	0.06	-	0.73	0.84
	BOR09	SP	5.45	91.94	0.82	1.78	0.54	1.57
	BOR17	SP	5.12	93.60	0.45	0.83	0.80	1.16
	BOR46	SP	1.20	96.16	1.33	1.31	0.52	1.35
Luquillo 2	GS49	SP	1.30	98.47	0.23	-	0.35	0.75
	GS50	SP	2.82	97.18	-	-	0.80	0.68
	GS51	SP	6.13	93.87	-	-	0.79	0.78
	GS52	SP	10.64	89.36	-	-	0.71	1.13
	GS53	SP	2.18	97.82	-	-	0.50	0.80
	GS54	SP	5.16	94.84	-	-	0.68	0.90
	GS55B	SP	0.25	99.49	0.26	-	0.34	0.87
	GS56	SP	1.89	97.97	0.13	-	0.52	0.90
COMPOSITE Luquillo 1		**SP**	**4.27**	**94.15**	**0.85**	**0.73**	**0.58**	**1.17**
COMPOSITE Luquillo 2		**SP**	**3.80**	**96.13**	**0.08**	**-**	**0.59**	**0.85**

1 Grain size analysis results are directly derived from Schwab et Al, 1996 publication

Sand volumes are conservatively estimated as follows:

- Luquillo 1 is approximately 170 acres in size. The sand thickness is conservatively estimated to be 5 feet, resulting in approximately 1.2 million CY of sand.
- Luquillo 2 is approximately 480 acres in size. The sand thickness is conservatively estimated to be 5 feet, resulting in approximately 3.5 million CY of sand.

4.2 RINCON NEARSHORE AND OFFSHORE SAND SOURCES

The evaluation of offshore sand sources is based on existing data from other federal and non-federal agencies. Available data are boring logs with laboratory data, push cores, and surficial samples collected by USGS in 1992 in the context of a geophysical investigation.

The following three potential offshore, nearshore, and RSM sand sources were explored for the Rincon project area.

- Bajo Blanco nearshore sand shoal (Rincon)
- Rio Grande de Arecibo (RSM)
- Cabo Rojo potential offshore sand source

Bajo Blanco is approximately 1-2 miles offshore Rincon beaches, Rio Grande de Arecibo (RSM) is approximately 70 miles away from Rincon, and Cabo Rojo is located 25 nautical miles south of Rincon.

An overview map for the sand sources is included in **Figure 4-8** below and the available information for each sand source is summarized in the following chapters.

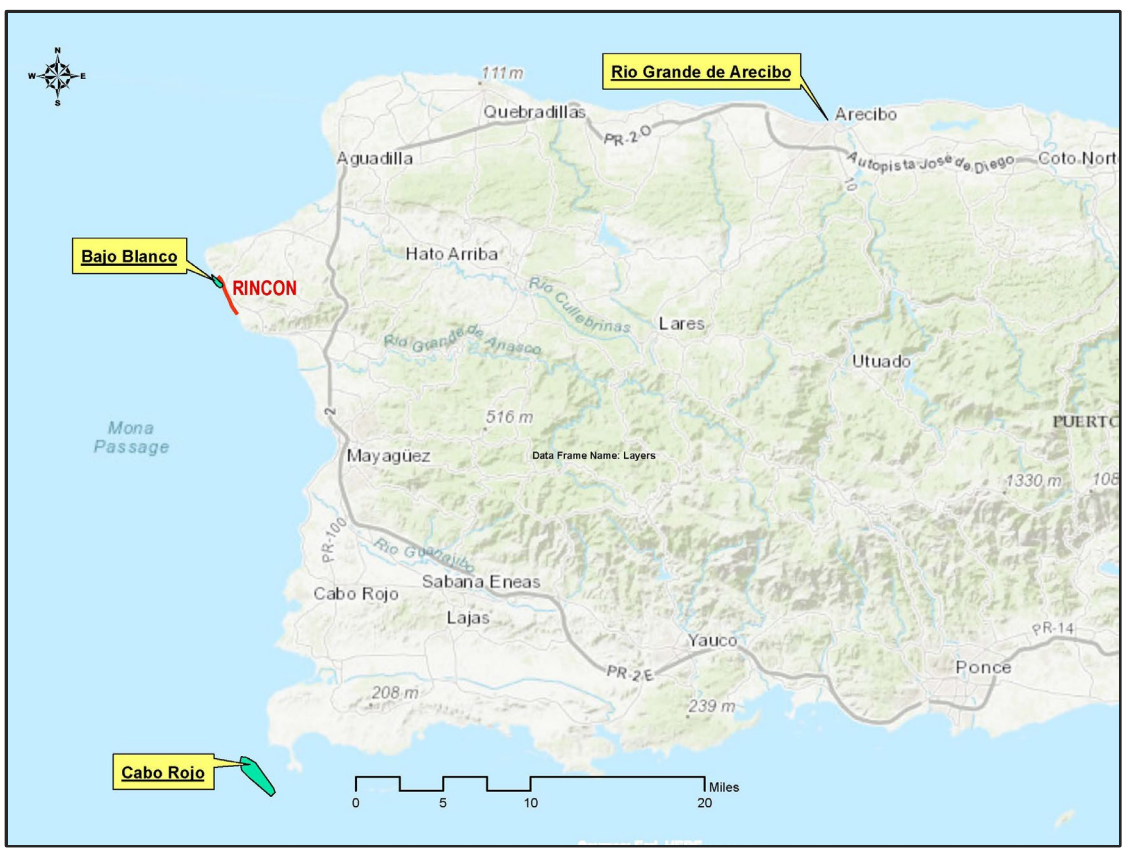


Figure 4-8. Potential Sand Sources for Rincon

4.2.1 BAJO BLANCO NEARSHORE SAND SOURCE

The evaluation of the Rincon offshore sand source is based on existing data collected by the University of Puerto Rico - Mayaguez Campus which collected geophysical data and surficial samples at the Bajo Blanco (Canals M. Ph et al, 2018; Rojas Vázquez C.A., 2016). Bajo Blanco is an approximately 5,000-foot-long sand shoal located less than 500 feet offshore the northern part of Rincon beaches and immediately south of the Tres Palmas Marine Preserve (**Figure 4-9**). The water depths of the shoal are 0 to 5 feet.

Eighteen (18) surficial samples and four (4) 2-feet deep push core samples were collected in the context of the geophysical investigation (Rojas Vázquez C.A., 2016) within the Bajo Blanco sand source. Grain-size analysis data is available from the eighteen (18) surficial samples collected. The sample locations are depicted in **Figure 4-9** and listed in **Table 10**.

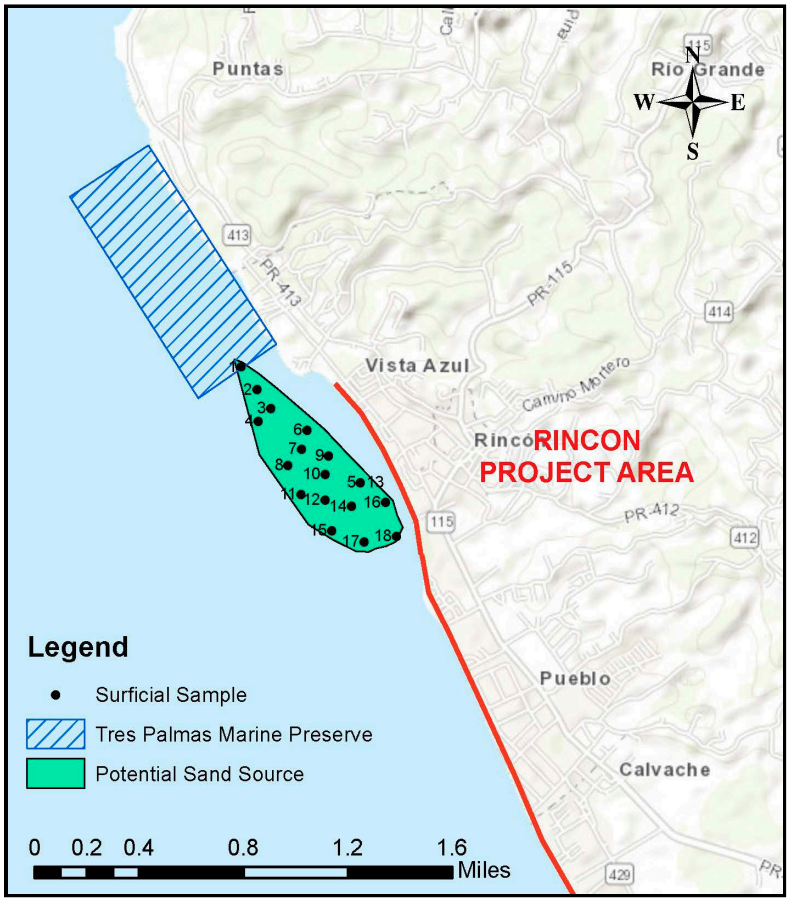


Figure 4-9. Bajo Blanco Potential Sand Source, Rincon

Table 10. Bajo Blanco Surficial Sample Locations (Rojas Vázquez C.A., 2016)

Samples Designation	Latitude	Longitude
1	18.344550	-67.263767
2	18.343300	-67.262850
3	18.342267	-67.262050
4	18.341567	-67.262767
5	18.338233	-67.256783
6	18.341100	-67.259933
7	18.340050	-67.260233
8	18.339167	-67.261017
9	18.339700	-67.258650
10	18.338680	-67.258860
11	18.337567	-67.260250
12	18.337283	-67.258833
13	18.338233	-67.256783
14	18.336933	-67.257317
15	18.335583	-67.258450
16	18.337150	-67.255317
17	18.334983	-67.256550
18	18.335300	-67.254670

The available granularmetric data of the samples are summarized in **Table 11**. All sample data is derived directly from Rojas Vázquez C.A., 2016. Sieve data, gradation curves and granularmetric reports are not available for the dataset. The available granularmetric data of the individual samples shows that the Bajo Blanco sand deposit is very homogeneous. The arithmetic composite sample created using all 18 samples characterizes the material as poorly graded fine-grained sand (SP) with a mean grain size of 0.24 mm. Color data was not available.

Table 11. Bajo Blanco Surficial Sample Grainsizes (Rojas Vázquez C.A., 2016)

Sample Designation	Mean Grainsize (mm)	Standard Deviation (phi)
Sample#/1	0.22	0.49
Sample#/2	0.24	0.62
Sample#/3	0.23	0.65
Sample#/4	0.22	0.49
Sample#/5	0.24	0.58
Sample#/6	0.36	1.04

Sample Designation	Mean Grainsize (mm)	Standard Deviation (phi)
Sample#/7	0.23	0.58
Sample#/8	0.25	0.61
Sample#/9	0.23	0.53
Sample#l0	0.24	0.68
Sample#/11	0.22	0.51
Sample#/12	0.22	0.47
Sample#/13	0.22	0.49
Sample #/14	0.24	0.55
Sample#/15	0.25	0.62
Sample#/16	0.23	0.52
Sample#/17	0.23	0.55
Sample#/18	0.22	0.58
COMPOSITE	**0.24**	**0.59**

The Bajo Blanco sand shoal has an estimated volume of 300,000 CY of sand.

Even though the available data shows that the sand deposits from Bajo Blanco are beach compatible, its use as sand source may be deemed unfeasible because of the potential adverse effects dredging the shoal may have on shoreline erosion or the adjacent Tres Palmas Marine preserve.

4.2.2 RIO GRANDE DE ARECIBO SHOAL

Arecibo is located approximately 80 Miles west of San Juan on the Atlantic Ocean (**Figure 4-8**). Rio Grande de Arecibo Shoal is located at the river mouth of the Rio Grande de Arecibo located on the eastern boundary of the town of Arecibo (**Figure 4-10**).

The shoal extends vertically approximately 3-4 feet above the mean-high water line. The encroachment of the flood shoal is narrowing the Rio Grande de Arecibo River mouth and impeding the outflow contributing to the flooding problems of Arecibo. Therefore, the excess flood shoal material needs to be dredged on a regular basis. The flood shoal is accessible through dry land since it is located immediately next to route 680.

USACE collected four borings within the flood shoal in 2020 as shown on **Figure 4-10** and listed in **Table 12**.

Figure 4-10. Rio Grande de Arecibo Shoal

Table 12. Arecibo Shoal Boring Locations

Boring Designation	PR/VI State Plane NAD83 (Meters)	
	X	Y
CB-RGA-20-01	170653	270617
CB-RGA-20-61A	170643	270703
CB-RGA-20-62A	170634	270638
CB-RGA-20-63A	170682	270731

Grainsize analysis performed on selected samples indicate that the material consists of beach compatible, poorly graded medium-grained sand with few gravel-sized shell with an average mean grainsize of 0.80 mm and 3% silt retained in the #200 sieve. The material is deemed beach compatible with no adverse effect on the beach even though it is coarser than the receiving beach which consists of fine-grained sand. Laboratory data are summarized in **Table 13**. Boring Logs and gradation graphs of the samples are attached in **Paragraph 9.2.2.**

The dredge volumes are approximately 3,000-10,000 CY per year. The material is planned to be excavated and stockpiled nearby. For the use at Rincon, the material would need to be truck hauled approximately 50 miles.

Table 13. Grain Size Analysis Results for Arecibo Shoal

Boring ID	Sample #	USCS	Silt %	Mean (mm)	Standard Deviation (ph)
CB-RGA-20-01	0	SP	1.5	0.39	1.21
CB-RGA-20-01	4	SP	2.6	0.41	0.76
CB-RGA-20-01	8	SP	2.6	0.86	1.34
CB-RGA-20-61A	4	SP	2.3	1.41	2.16
CB-RGA-20-61A	10	SP	1.6	0.73	1.31
CB-RGA-20-62A	2	SP	7.8	0.35	0.93
CB-RGA-20-62A	8	SP	4.0	0.68	1.25
CB-RGA-20-63A	6	SP	3.0	0.82	0.97
CB-RGA-20-63A	12	SP	1.8	2.75	2.67
Composite Sample		**SP**	**3.0**	**0.80**	**1.73**

4.2.3 CABO ROJO OFFSHORE SAND SOURCE

Cabo Rojo is a potential offshore sand source located approximately 25 miles south of Rincon, 2-3 miles offshore Cabo Rojo in water depths of 30-50 feet.

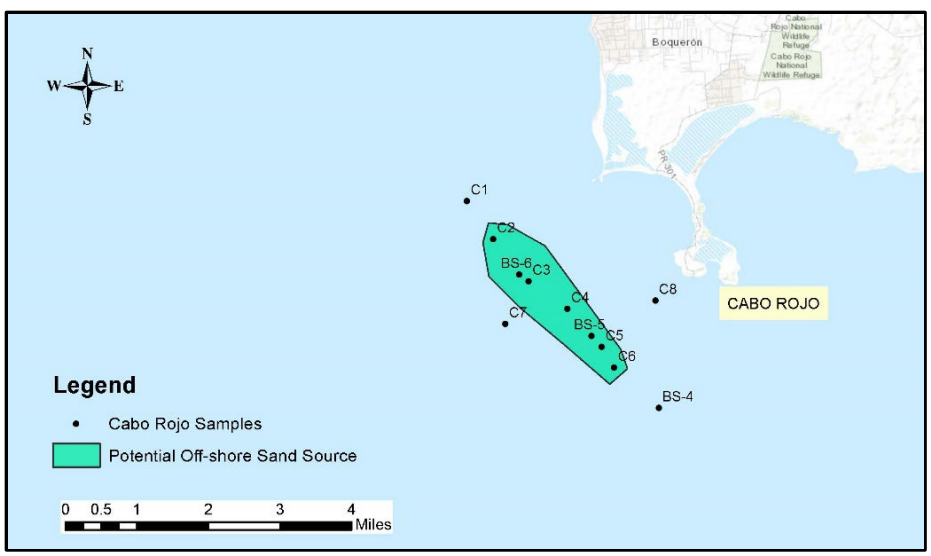


Figure 4-11. Cabo Rojo Offshore Sand Source

The borrow area was identified based on USGS investigations (Shideler, L., Gerald, 1980, and Trumbull, V.A., James et al, 1982). Investigations include geophysical surveys, three (3) surficial bulk samples, eight (8) 10-foot deep vibracores with a recovery of 2 to 6.5 feet, and a few grainsize samples from vibracores and bulk samples. Vibracore and bulk sample locations are depicted on **Figure 4-11** and listed in **Table 14**.

Table 14. Cabo Rojo Sample Locations

Sample Designation	Sample Type	PR/VI State Plane NAD83 (US feet)	
		X	Y
C5	vibracore	385407	687634
C7	vibracore	378297	689326
C8	vibracore	389363	691044
C4	vibracore	382905	690419
C3	vibracore	380028	692448
C2	vibracore	377431	695575
C1	vibracore	375463	698362
C6	vibracore	386347	686084
C5	vibracore	385407	687634
BS-4	surficial bulk sample	389624	683110
BS-5	surficial bulk sample	384676	688440
BS-6	surficial bulk sample	379345	692969

Two of three bulk samples are located within the borrow area. The publication includes sieve analysis results of the bulk samples which indicates coarse grained sand-sized sediments. The publication also includes a figure showing vibracore logs. Each log has a mean mm/depth graph next to it, but actual grainsize data are not included. The vibracore logs and grainsize diagrams give a good indication of the characteristics of the Cabo Rojo sediments and were used as base for the sand source evaluation rather than the grainsize data of the two surficial bulk samples which only apply to the upper 0.5 feet of the sediments.

The Cabo Rojo sediment types are sand, gravelly sand, and silt. The sand composition is biogenetic (molluscan, coral fragments) with <5% silt, and mean grain sizes of 0.3-0.8mm. The average sand thickness assessed via geophysical methods is 10-12 feet. The vibracores show up to 6.5 feet of sand. The material is deemed beach compatible, with no adverse effect on the beach even though the composition is 100% carbonate while the receiving beach has only 30% carbonate.

The potential sand source area with beach compatible sand is 400,000 square yards with a conservatively estimated sand thickness of 6-8 feet resulting in a volume 3 million CY

4.3 UPLAND SAND MINES

There are upland sand sources available for both project areas. The location of the upland sand mines are depicted in **Figure 4-12** and **Figure 4-16** and described in the paragraphs below.

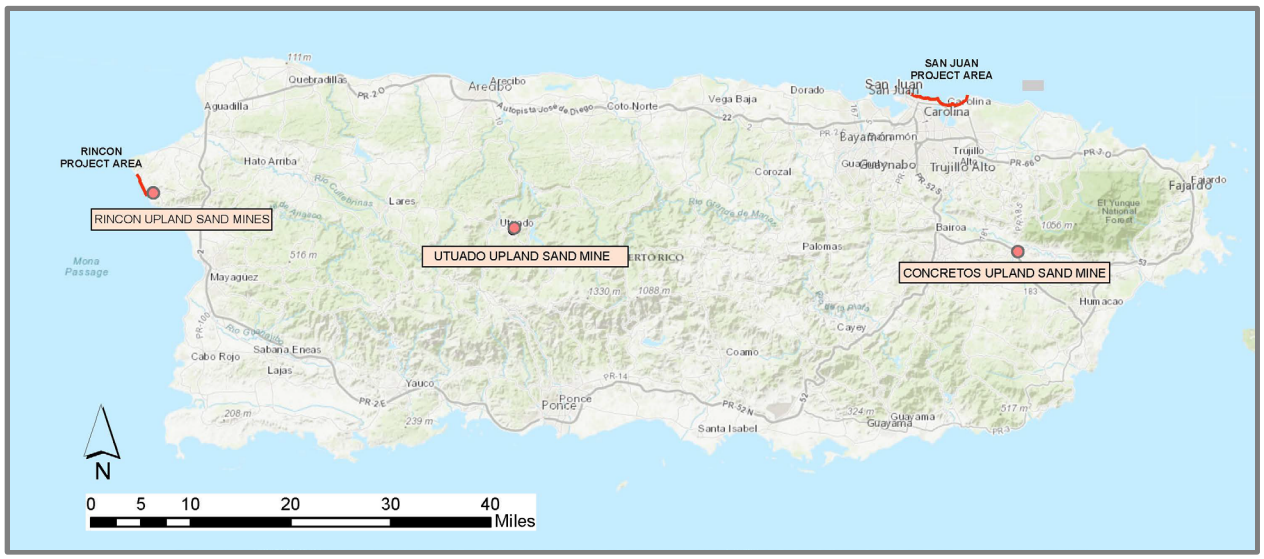


Figure 4-12. Upland Sand Mine Locations

4.3.1 CONCRETOS DE PUERTO RICO, INC.

The sand mine closest to the San Juan project site is the San Juan project site is the Concretos De Puerto Rico, Inc. sand mine located in Juncos, approximately 30 miles south of San Juan (**Figure 4-12**). The sand mine is located in the immediate vicinity of the river Rio Valenciano and the sand is derived from the alluvial flood plain. The sand mine has a sand washing and sorting plant to customize the grain size distribution.

USACE representatives visited the sand mine and collected three representative sand samples. Two samples, Concretos 1 and Concretos 2, were collected from the mined land and were in unprocessed condition. One sample was collected from a stockpile after it was processed (washed). The samples were collected approximately 0.5 to1.0 foot below ground surface. The locations of the sand samples are listed in **Table 15** and depicted in **Figure 4-13**.

Table 15. Concretos Sand Mine, Juncos, Sample Locations

Sample Designation	PR VI State Plane NAD83 US Foot	
	X	Y
Concretos 1	836501	803791
Concretos 2	834870	801163
Stockpile 3	836703	800362

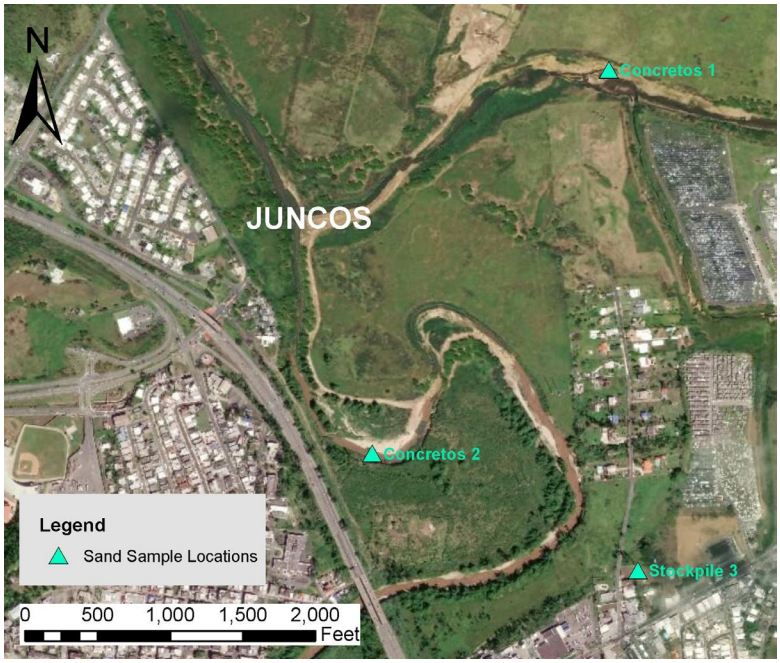


Figure 4-13. Sample Locations Concretos Sand Mine

Grain size analyses were performed on all three (3) samples. The granularmetric data of the samples are summarized in **Table 16**. Gradation curves and granularmetric reports are attached in **Paragraph 9.1.4**.

Table 16. Concretos Sand Mine Grain Size Analysis Results

Designation	USCS*	Mean (mm)	Sorting (phi)	Retain. on # 4 Sieve %	Silt Pass. #230 Sieve %	Visual Shell in %*	CaCo3* in %	Moist Munsell Color
Concretos 1	SP-SM	0.37	0.99	0.86	5.97	2.70	0.00	10YR 4/3
Concretos 2	SP-SM	0.30	0.92	0.37	5.75		0.00	10YR 5/3
Stockpile 3	SP	0.58	1.08	1.15	4.51	2.40	0.00	10YR 6/3
Composite	**SP**	**0.40**	**1.07**	**0.79**	**5.41**	**2.55**	**0.00**	**brown**

The unprocessed samples Concretos 1 and Concretos 2 are characterized as poorly graded, fine-grained sand with silt (SP-SM) with a mean grain size of 0.37 mm and 0.30 mm respectively, 6% percent fines (or less) passing the #230 sieve, and brown in color. The processed sample, Stockpile 3, is classified as poorly graded medium-grained sand (SP) with a mean grain size of 0.58 mm, 4.5 percent of fines passing the #230 sieve, and pale brown in color.

The Concretos upland sand mine is equipped to produce customized beach compatible sand and has sufficient volume for a 50-year project available.

4.3.2 UTANDO SAND MINE

The Utuado sand source is located approximately 65 Miles west of San Juan and 40 Miles east of Rincon (**Figure 4-12**) at the outskirts of Utuado situated within the central part of Puerto Rico.

The USACE and a representative from the Puerto Rico DRNA visited the sand source in February 2020 and collected three representative sand samples Utuado 1 through 3. The samples were collected from approximately 1.0 to 2.0 foot below ground surface. The location of the sand samples are listed in **Table 17** and depicted in **Figure 4-14**.

Table 17. Utuado Sand Source Sample Locations

Sample Designation	PR VI State Plane NAD83 US Foot	
	X	Y
Utuado 1	568758	812270
Utuado 2	568854	812270
Utuado 3	568951	812370

Figure 4-14. Sample Locations Utuado Sand Source

Grain size analysis was performed on all three (3) samples. The granularmetric data of the samples are summarized in **Table 18**. Gradation curves or granularmetric reports are attached in **Paragraph 9.1.5**. The Utuado composite sample is characterized as poorly-graded, medium-grained silty sand (SM) with a mean grain size of or 0.63mm, 14.6% percent fines passing the

#230 sieve, and light brown in color. The visual shell content of the sand is 0%, whereas the calcium carbonate content averages in 10.6%. This is an indication that the carbonate content is present in very fine-grained fractions.

The silt content ranges from 10.7 to 18.3% which significantly exceeds the recommended 5% for the use as beach fill, and thus the Utuado sand source is not recommended for beach nourishment at this time.

Table 18. Utuado Sand Mine Grain-size Analysis Results

Designation	USCS*	Mean (mm)	Sorting (phi)	Retain. on # 4 Sieve %	Silt Pass. #230 Sieve %	Visual Shell in %*	CaCo3* in %	Moist Munsell Color
Utuado 1	SM	0.63	1.5	0.88	18.27	0	12.28	10YR 7/1
Utuado 2	SP-SM	0.71	1.44	0.51	10.67	0	10.05	10YR 6/3
Utuado 3	SM	0.56	1.38	0.43	14.91	0	9.49	10YR 6/3
Composite	**SM**	**0.63**	**1.44**	**0.61**	**14.62**	**0**	**10.61**	**Light Brown**

4.3.3 RINCON UPLAND SAND MINE

An upland sand mine which is currently not operated is located approximately 2 miles south of Rincon (**Figure 4-15**). The sand mine was visited by USACE personnel in fall 2019. The mine was not actively operated at the time; therefore, two samples were collected from the old quarry site (M-3) and a sand mine parcel (M-2). Three additional samples (Sample 1 through 3) were collected during a second visit in November 2019 from a property on the southern boundary of the mine, assuming that the material would be similar to the material in the mine since it is geologically from the same unit. The location of the sand samples are listed in **Table 19** and depicted in **Figure 4-15**.

Table 19. Rincon Sand Mine Sample Locations

Mine	Sample Designation	PR VI State Plane NAD83 US Foot	
		X	Y
Rincon Sand Mine	Rincon M-1	377560	830857
	Rincon M-2	376711	830548
Rincon Private Property	Sample 1	376195	831387
	Sample 2	376194	831185
	Sample 3	376193	830983

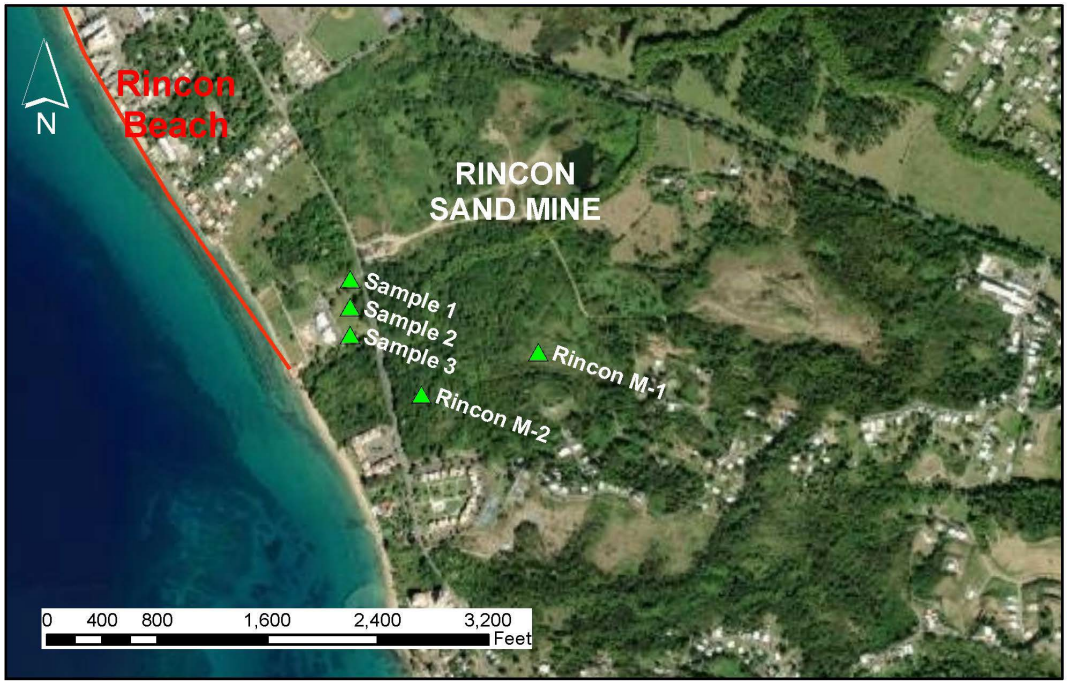


Figure 4-15. Rincon Upland Sand Mine and Sample Locations

Grain size analyses were performed on all five (5) samples. The granularmetric data of the samples are summarized in **Table 20**. Gradation curves and granularmetric reports are attached in **Paragraph 9.2.2**.

The samples from the mine, M-1 and M-2, are characterized as poorly graded, fine to medium-grained sand (SP) with a mean grain size of 0.52 and 0.38 mm, respectively, less than 2% percent fines passing the #230 sieve, and brown and gray in color, respectively. The three samples (Sample 1 through 3) from the private property outside the mine are very similar and are characterized as poorly graded medium-grained sand (SP) with a mean grain size of or 0.43, 0.44, and 0.47 mm, respectively, with 3.25 percent (or less) of fines passing the #230 sieve, and grayish brown in color.

Table 20. Rincon Sand Mine Grainsize Analysis Results

Location	Sample Name	USCS	Mean (mm)	Sorting (phi)	Retain. on # 4 Sieve %	Silt Pass. #230 Sieve %	Visual Shell in %*	CaCo3* in %	Moist Munsell Color
Rincon Mine	Rincon M-1	SP	0.52	0.67	0.46	0.0	19.2	25.3	10YR 4/2
Rincon Mine	Rincon M-2	SP	0.38	0.75	0.00	1.62	0.0	14.7	10YR 5/1
Private Property	Sample-1	SP	0.43	0.72	0.00	2.38	20.8	1.8	10YR 5/6
Private Property	Sample-2	SP	0.44	0.85	0.29	3.25	0.0	11.9	10YR 6/3
Private Property	Sample-3	SP	0.47	0.73	0.00	2.62	31.0	8.5	10YR 5/4
RINCON UPLAND COMPOSITE		**SP**	**0.45**	**0.75**	**0.15**	**2.47**	**12.44**	**23.67**	**Grayish Brown**

The property is owned by Coloso Development Inc. Part of the property was used as a rock quarry. The rock quarry is permitted until 2024. The sand quarry is not permitted. No additional information regarding permitting activities, sand quality and volume is available. However, local's familiar with the site have indicated the site does not contain a sufficient volume of sediment to meet the (50-yr) needs of potential beach restoration measured along the Rincon project area.

4.3.4 RINCON UPLAND SAND MINES SPONSOR PROVIDED

The Non-Federal Sponsor (NFS) provided a map showing the locations of 3 upland mines (**Figure 4-16**):

- Rincon Sand Mine (discussed in **Paragraph 4.3.3**)
- Aguada Sand Mine
- Añasco Sand Mine

No additional information regarding permitting status, sand quality, or volume was provided.

Figure 4-16. Rincon Upland Sand Mine Locations Provided by the Sponsor

5 SAND SOURCE USABILITY AND COMPATIBILITY

The compatibility and usability of the San Juan and Rincon beaches with the sand sources are summarized in the paragraphs below. Gradation graphs and granularmetric tables for the composite samples are included in **Paragraph 9.1.6** and **Paragraph 9.2.4** .

Beach compatibility for this study is defined as below.

- Silt content < 5%
- Gravel-sized fragments (shell or rock) not in excess of the receiving beach.
- Mean grainsize similar to existing beach
- Composition similar to the existing beach
- Color similar to the existing beach

The available Geotech data to evaluate the sand sources for San Juan and Rincon are very limited and allow only a preliminary evaluation of the sand sources.

5.1 SAN JUAN SAND SOURCE USABILITY AND COMPATIBILITY

Six potential sand sources were identified for the San Juan project area beaches, as depicted in **Figure 5-1** and listed below.

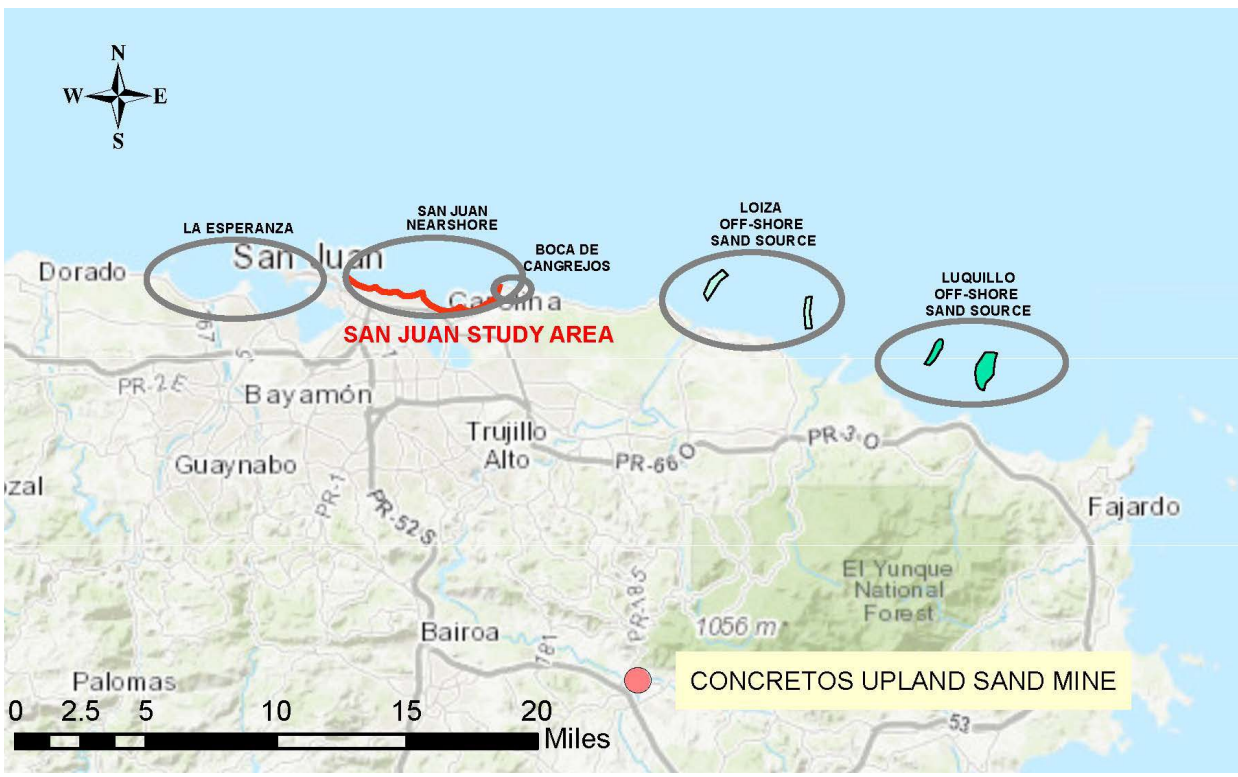


Figure 5-1. San Juan Project Area and Evaluated Sand Sources Locations

San Juan Sand Source List:

- La Esperanza Shoaling at Ecosystem Restauration (RSM)
- San Juan Nearshore
- Boca de Cangrejos Navigation Channel (RSM)
- Loiza Unverified Offshore Sand Sources
- Luquillo Potential Offshore Sand Sources
- Concretos (Juncos) Upland Sand Mine
- Utuado Sand Mine (Location see **Figure 4-12**)

Existing geotechnical data (geophysical surveys, surficial samples, and borings) from each sand source were evaluated and detailed described in **Paragraphs 4.1 and 4.2.** Arithmetic composite calculations were completed for the beach, nearshore, offshore, RSM, and upland sand deposits where grain-size data were available. The arithmetic composite samples' granularmetric parameters are summarized in **Table 21**. Comparing composite gradation graphs depicting San Juan beaches and La Esperanza material and the upland mine Concretos material are included in **Paragraph 9.1.6.1**. Comparing composite gradation graphs could not be completed for Loiza, Luquillo, and Boca de Cangrejos sand sources since individual sieve data were not available.

Table 21: San Juan Grain Size Summary Composites for Beaches and Sand Sources

SOURCE	USCS[1]	Gravel[2] %	Silt[3] %	Mean (mm)	Standard Deviation (phi)
BEACH					
San Juan Beaches	SP	0.16	2.29	0.21	0.86
San Juan - Ocean Park	SP	0.0	1.51	0.23	0.80
RSM SAND SOURCES					
La Esperanza	SP	5.13	3.73	0.36	1.62
Boca de Cangrejos[4]	SP/SM	n/a	n/a	n/a	n/a
POTENTIAL OFFSHORE SAND SOURCE					
Luquillo 1	SP	4.27	1.58	0.58	1.17
Luquillo 2	SP	3.80	0.08	0.59	0.85
UPLAND SAND SOURCE					
Concretos Sand Mine	SP	0.79	5.41	0.40	1.07
Utuado Sand Mine	SM	0.61	14.62	0.63	1.44

[1] *United Soil Classification System*
[2] *Gravel % = Percent Retained #4 Sieve*
[3] *Silt % = Percent Passing #200/230 Sieve*
[4] *Grain-size analysis data are not available*

In summary, the beach deposits consist of poorly graded fine-grained sand with a mean grain size of 0.21 mm, and 2.2% silt. The evaluation of the limited data from the nearshore, offshore, and upland sand sources indicated the sources material consist of poorly graded fine to medium-grained sand with mean grain sizes of 0.36, 0.58, 0.59, and 40 mm, respectively. Grain size data are not available for Boca de Cangrejos.

Even though the sand from the evaluated sand sources is slightly coarser than the existing beach, the sand sources are deemed suitable since the silt content is <5% for off-shore and nearshore sources and can be customized from the upland sand source. Comprehensive investigations will be necessary for an appropriate evaluation.

Besides beach compatibility, volume, environmental, and economical considerations are as important to evaluate the usability of a sand source. Additionally, the risk of basing the sand source evaluation on limited data must be considered when evaluating which sand source is most suitable for the project. Usability considerations for the San Juan sand sources are summarized in **Table 23** and described below.

The RSM sand sources, La Esperanza and Boca de Cangrejos are 4-7 Miles away from the placement beach and could be potentially used as sand source, but both sources have limited volumes and hydraulic placement concerns.

San Juan Nearshore sand bars are 2 nautical miles away from the Ocean Park project area. Concerns are that dredging the sand bars will likely cause beach erosion and impact environmental resources (reefs). The sponsor requested to include this source in the report.

The Loiza sand sources is an unverified offshore sand source located approximately 15 nautical miles east of San Juan. The evaluation is based on only three surficial samples and a flow vector model suggesting the existence of a paleo channel. Besides the lack of sufficient data, Loiza sand source bears also environmental concerns with the location at the Loiza River mouth and hydraulic placement and makes this sand source unusable.

The Luquillo sand sources are potential offshore sand sources located approximately 25 nautical miles east of San Juan. The evaluation is based on geophysical surveys, surficial samples and a flow vector model suggesting the existence of paleo channels. Environmental concerns with nearby environmental resources (such as coral reefs) and hydraulic placement makes this sand source unusable.

The Concretos upland sand mine is equipped to customize the sand and sufficient volume for a 50-year project is available. It is the only sand source without impasses even though there are concerns with the long-distance trucking from the source to the receiving beach.

The Utuado upland sand mine is a permitted sand mine located 65 Miles west of Sand Juan, and 45 Miles east of Rincon. The sponsor provided sand samples from the sand mine. Lab testing revealed that the sand has an average of 14% silt and does not meet beach quantity standards.

5.2 RINCON SAND SOURCE USABILITY AND COMPATIBILITY

Four potential sand sources were identified for Rincon project area as listed below and depicted in **Figure 5-2**.

- Bajo Blanco Nearshore Sand Source
- Rio Grande de Arecibo Shoal (RSM)
- Cabo Rojo Offshore Sand Source
- Rincon Upland Sand Mine

Existing geotechnical data (geophysical surveys, surficial samples, and borings) from each sand source were evaluated and described in **Paragraphs 4.2, 4.3.3, and 4.3.4.** Arithmetic composite calculations were completed for the beach, nearshore, offshore, RSM, and upland sand deposits where grain size data were available. The arithmetic composite samples' granularmetric parameters are summarized in **Table 22**. Composite gradation comparison graphs depicting Rincon beaches, sand from Rio Grande de Arecibo, and the upland Rincon mine are included in **Paragraph 9.2.4.1**. Composite gradation comparison graphs could not be completed for Bajo Blanco nearshore sand source and Cabo Rojo offshore sand source since individual sieve data were not available.

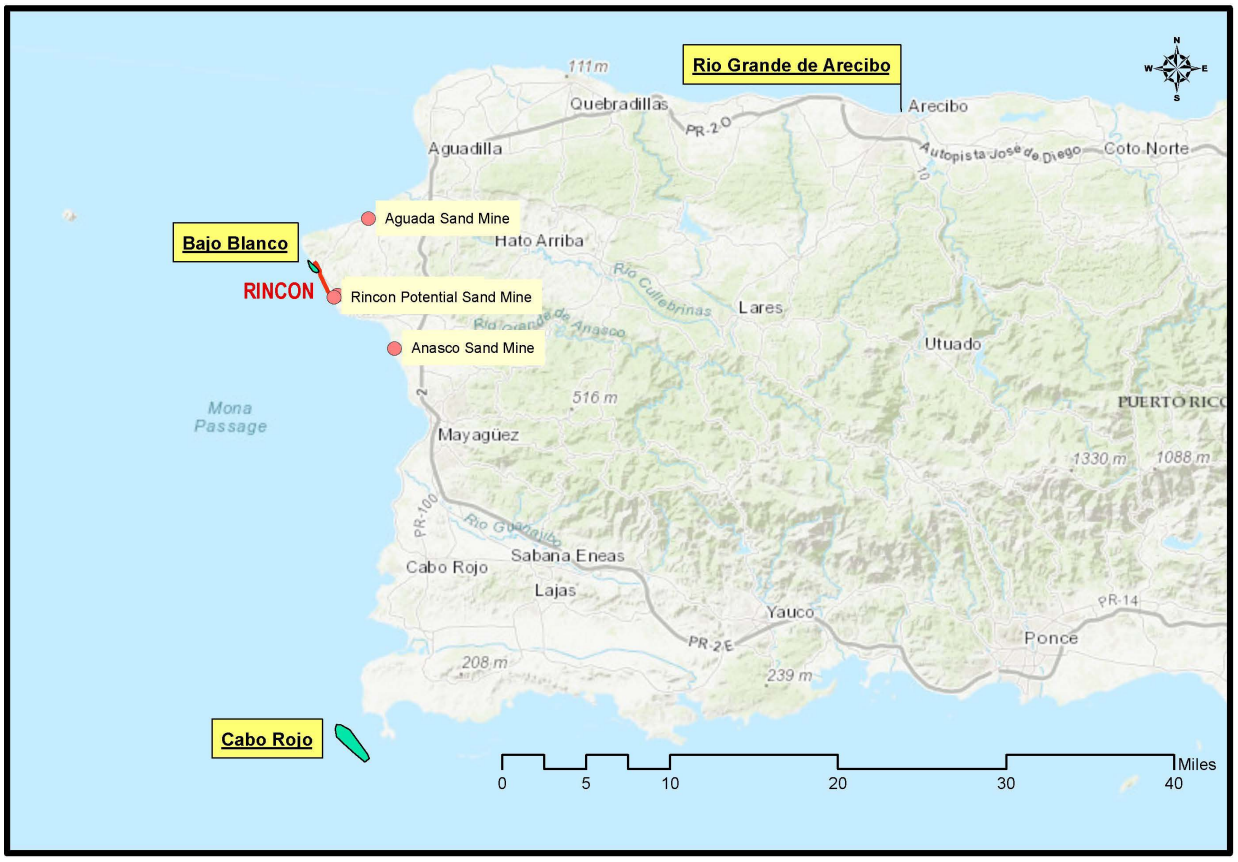


Figure 5-2. Rincon Project Area with Upland and Offshore Sand Source Locations

The beach deposits consist of poorly graded fine-grained sand with a mean grain size of 0.34 mm with 0.8% silt. The limited existing data from the nearshore, offshore, RSM, and upland sand sources indicate that the material from Rio Grande de Arecibo and from the Cabo Rojo offshore sand source is coarser than the existing beach sediments and consists of poorly graded medium-grained sand with a mean grain size of 0.8 mm, and 0.3-0.8 mm respectively. The coarser grain size of the off/nearshore sediments is due to the gravel-sized shell content. Bajo Blanco and the Rincon sand mine are similar in grain size to the existing beach with mean grain size of 0.24 mm, and 0.45 mm respectively. All sand sources have <5% silt. No grainsize data are available from the Aguada and the Añasco upland sand mines.

Even though the mean grain size of the evaluated sand sources varies from the existing beach, the sand is considered beach compatible since the silt content is <5%. Comprehensive investigations will be necessary for an appropriate evaluation.

Besides beach compatibility volume, environmental, and economical considerations are as important to evaluate the usability of a sand source. Additionally, the risk of basing the sand source evaluation on limited data must be considered to decide which sand source is most suitable for the project. Usability considerations for the Rincon sand sources are summarized in **Table 24** and described below.

Table 22: Rincon Grain Size Summary for Beaches and Sand Sources

SOURCE	USGS[1]	Gravel[2] %	Silt[3] %	Mean (mm)	Standard Deviation (phi)
BEACH					
Rincon Beaches	SP	0.41	0.85	0.34	0.97
RSM SAND SOURCES					
Rio Grande de Arecibo	SP	8.87	3.0	0.80	1.73
POTENTIAL NEAR SHORE SAND SOURCE					
Bajo Blanco	SP	n/a	n/a	0.24	0.59
POTENTIAL OFFSHORE SAND SOURCE					
Cabo Rojo	SP	n/a	<5%	03.-0.8	n/a
UPLAND SAND SOURCE					
Rincon Sand Mines	SP	0.15	2.47	0.45	0.75
Aguada Sand Mine	n/a	n/a	n/a	n/a	n/a
Añasco Sand Mine	n/a	n/a	n/a	n/a	n/a

[1] *United Soil Classification System*

[2] *Gravel % = Percent Retained #4 Sieve*

[3] *Silt % = Percent Passing #200/230 Sieve*

Bajo Blanco is a nearshore sand source located approximately 2 nautical miles northwest of the Rincon placement area. Bajo Blanco sand and the Rincon beach sand are from within the same system and are similar. However, environmental concerns regarding beach erosion caused by dredging the shoal, and with impacting the adjacent marine preserve deem the shoal unusable as sand source for the Rincon beaches.

Rio Grande de Arecibo Shoal is a renewable sand source with a volume of approximately 3,000 to 10,000 CY a year. The sand shoal is above sea level and can be excavated and transported with upland methods (excavating and truck hauling). The limited volume and the distance of 80 miles to the receiving Rincon beach deem the shoal unusable as sand source for the Rincon beaches.

Cabo Rojo is a potential offshore sand source located approximately 25 nautical miles south of Rincon. The sand source identification is based on geophysical surveys, a few vibracores, and surficial samples. The evaluation suggests that 3,000,000 CY of beach compatible sand is available at Cabo Rojo. Comprehensive geotechnical investigations are needed to confirm volumes and beach compatibility. Concerns exist that nearby environmental recourses at the Arrecifes de Tourmaline Nature Reserve and the marine extensions of Finca Belvedere and Punta Guaniquilla Nature Reserves could be impacted by dredging the Cabo Rojo borrow area.

Three upland mines (Rincon, Aguada, Añasco) were identified by the sponsor, located 2-7 miles upland from the project site. The sponsor provided sand samples from the sand mine in Rincon, which confirmed the existence of beach compatible sand at the Rincon upland mine. Grain size data are not available from Aguada or Añasco sand mines. All three sand mines are currently not operating and not permitted. Information regarding the owners, permitting application activities, and volumes are not available. Because of the lack of information, the upland sand mines are deemed as not useable for the Rincon beaches.

Table 23: San Juan Sand Source Evaluation Summary

Source name	Type	Volume (CY)	Evaluation – Pros + and Cons -	Risk	Usable Yes/No/ Possibly
La Esperanza Shoaling at Ecosystem Restoration	RSM	70,000/10yr	+ 7 Nautical miles to Ocean Park project area + Renewable shoaling Material within San Juan Bay, - Most Geotech Data is available, and dredging is already permitted - Limited Volume - Environmental concerns with hydraulic placement	Low-Medium	Possibly
Boca de Cangrejos Navigation Channel	RSM	22,000/2yr	+ 4 Nautical miles to Ocean Park project area + Renewable: Shoaling material for navigation channel - Limited Volume - No lab data available. More Geotech Information is needed to confirm beach compatibility - Environmental concerns with hydraulic placement	Medium	Possibly
San Juan Nearshore Sandbars	Nearshore	n/a	+ 2 Nautical miles to Ocean Park project area - Dredging the sand bars likely to cause beach erosion - Concerns with nearby environmental recourses (reefs) - Sponsor requested to include sand bars into the evaluation	High	No
Loiza 1&2 Unverified Sand Source	Offshore	n/a	- 15 Nautical miles to Ocean Park project area - Very limited Geotech - only three surficial samples available - More Geotech Information is needed to confirm beach compatibility - Environmental concerns with the location at the Loiza River mouth and hydraulic placement	High	No
Luquillo 1 & 2 Potential Sand Source	Offshore	4,700,000	- 25 Nautical miles to Ocean Park project area - Limited Geotech data: Geophysics and Surficial samples - More Geotech Information is needed to confirm beach compatibility - Concerns with nearby environmental recourses (reefs) - Environmental concerns at the beaches with hydraulic placement	High	No
Concretos (Juncos) Sand Mine	Upland	>1,000,000	+ Sufficient Sand for 50-year Ocean Park Project + Sand quality can be customized through washing/sieving - 30 Miles Truck hauling	Low	Yes
Utuado Sand Mine	Upland	n/a	- Sand is not beach quality/beach compatible (average 14% silt) - 65 Miles Truck hauling to San Juan, and 45 Miles to Rincon	High	No

Table 24: Rincon Sand Source Evaluation Summary

Source name	Type	Volume (CY)	Evaluation – Pros + and Cons -	Risk	Usable Yes/No/ Possibly
Bajo Blanco Nearshore Shoal	Nearshore	300,000	- 2 Nautical miles to Rincon project area - Limited Geotech data: Lab data from surficial samples - Dredging the sand shoal likely to cause beach erosion - Environmental concerns with impacting adjacent marine preserve	High	No
Rio Grande de Arecibo Shoal Navigation Channel	RSM	6,000/yr	+ Renewable: Shoaling material for navigation channel + Borings and lab data available, beach compatibility proven - Limited Volume - 80 Miles truck hauling	High	No
Cabo Rojo Potential Sand Source	Offshore	3,000,000	- 25 Nautical miles to Rincon project area - Limited geotech data: Geophysics and surficial samples - More geotech information is needed to confirm beach compatibility - Concerns regarding impacting nearby marine environmental resources + Sufficient volume for 50-year project available	High	Possibly
Rincon Sand Mine	Upland	n/a	+ 3 miles truck hauling - Currently not operating and permitted. - Owned by Coloso Development Inc. - Information about permit application activities, and volume are not available	High	No
Aguada Sand Mine	Upland	n/a	+ 7 miles truck hauling - Currently not operating. Information about owner, permit application activities, and volume not available	High	No
Añasco Sand Mine	Upland	n/a	+ 7 miles truck hauling - Environmental concerns because the sand mine is located at the river mouth of the Rio Grande de Añasco. - Currently not operating. Information about owner, permit application activities, and volume not available	High	No

6 ARMOR STONE

Armor stone for revetments is available for the San Juan and Rincon project areas from the armor stone quarries listed below and depicted in **Figure 6-1Error! Reference source not found.**. The quarries listed were either used or are being considered for use in other USACE projects in Puerto Rico. USACE has reached out to these mines during the study and confirmed the capability to produce rock in the gradations (2-6 tons), density (160 pcf), and volumes as required in the preliminary design. The distance to project sites is 25-35 miles.

- Cantera La Montana, Cadena
- Cantera Carraizo, Trujillo Alto
- Empresas Ortiz Brunet, Guaynabo

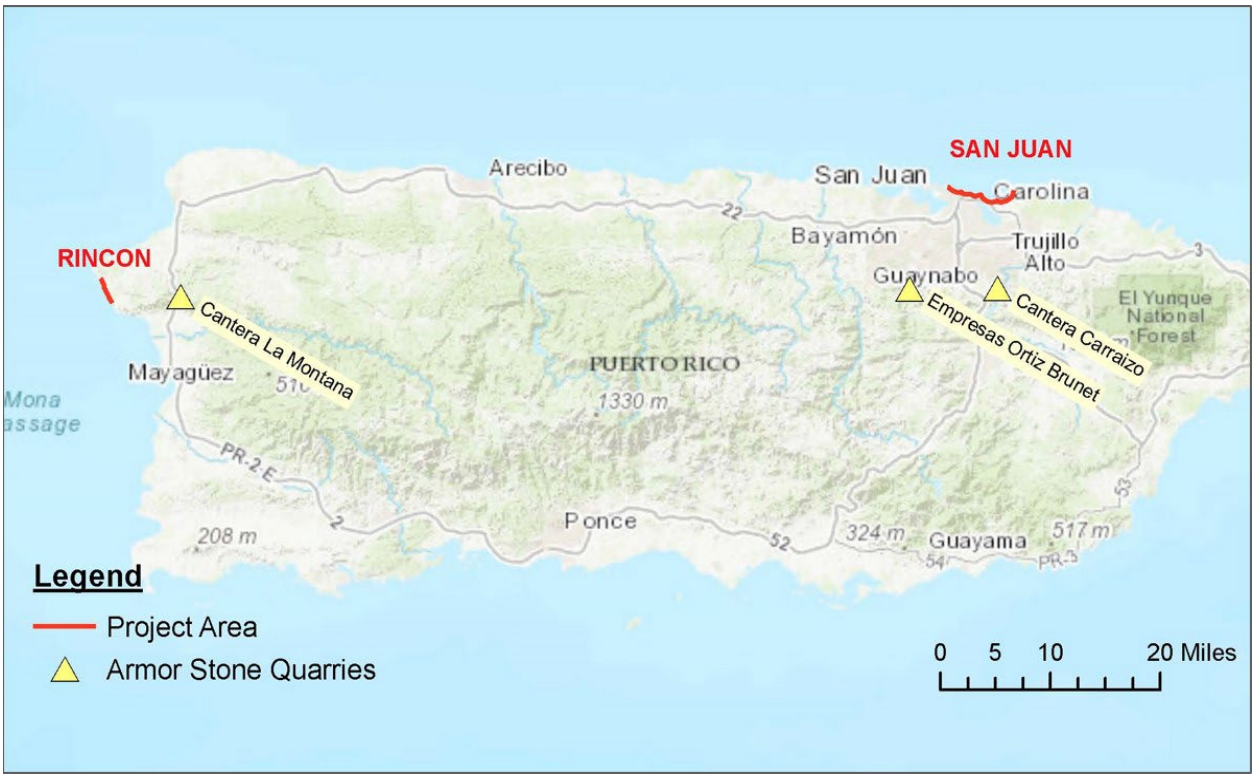


Figure 6-1. Armor Stone Quarry Locations

7 GEOTECHNICAL EVALUATION FOR SEAWALL

Geotechnical review and analysis for the Ocean Park seawall are provided in the Engineering Appendix.

7.1 PRE-CONSTRUCTION ENGINEERING & DESIGN GEOTECHNICAL INVESTIGATIONS

For the design of the proposed seawall geotechnical investigations are needed. The following scope is recommended:

- Maximum of 500 ft. (150 m) spacing between borings along alignment, with a minimum of 3 borings along alignment per reach. One sample per investigation per geologic unit (if different geology units are expected). Recommended spacing is 250 -300 feet due to expected variability of the Eolianite rock.
- The borings shall be staggered along the seawall alignment.
- Sampling should be continuous in the upper 10 ft. (3 m) and continued at a maximum of 5-foot (1.5 m) intervals for greater depths.
- Clay is not expected at this site, but if clay material is encountered, undisturbed sampling should be performed.
- At a minimum, borings should extend to the deeper of the two depths described below. Explorations should extend through all soft clay layers (if encountered) to competent material and to the greater of:
    - A depth in excess of three times the total height of protection above the original ground.
    - Five times the exposed wall height.
- Hydraulic Conductivity (Permeability) tests shall be performed in the Eolianite rock material (at least two to three tests).
- One to two borings shall be drilled to a depth of 100 feet and seismic study shall be conducted (at least one geophysical downhole test).
- Eolianite rock is expected at the project site area. This rock is characterized for having poor quality recovery during drilling operations. Rock cores shall be obtained in accordance with ASTM D 2113 Standard Practice for Diamond Core Drilling for Site Exploration, using a double or triple wall core barrel equipped with diamond or tungsten-carbide tipped bits. Single tube core barrels are not allowable. Triple Tube Core Barrel preserves fractured and poor-quality rock cores. The minimum allowable rock core size shall be 3.75 inch. It is highly recommended to use a high-performance polymer drilling fluid to obtain good recoveries.
- Laboratory Tests
    - Sandy Soils
        - Sieve Analysis (ASTM D6913)
        - Carbonate Content (ASTM D4373)
    - Clayey Soils
        - Organic Content (ASTM D2974)
        - Moisture Content (ASTM D2216)
        - Atterberg Limits (ASTM D4318)

        - Sieve Analysis (ASTM D6913)
        - One-Dimensional Consolidation Test (ASTM D2435)
        - Consolidated-Undrained (CU) Triaxial Test (R Test with pore pressure measurements, a minimum of 3 specimens per sample shar be tested per ASTM D4767)
    - Rock
        - Unit Weight (RTH 109-93)
        - Unconfined Compression Test (ASTM D7012) – The minimum length-to-diameter ratio shall be 2.0 when testing.
        - Splitting Tensile Strength Test (ASTM D3967) - The minimum t/D (length-to-diameter) ratio shall be 1.0 when testing.

Reference:

EM 1110-2-2502 "Floodwalls and Other Hydraulic Retaining Walls", 01 August 2022, Department of the Army

EM 1110-1-1804 "Geotechnical Investigation", 01 January 2001, Department of the Army

EM 1110-1-2908 "Rock Foundations", 30 November 1994, Department of the Army

Rock Testing Handbook (RTH), 1993, US Army Engineer Waterways Experiment Station

7.2 PRE-CONSTRUCTION INVESTIGATIONS OF SAND SOURCES

The following investigations are recommended before the use of any offshore or RSM sand source. Note, the recommendations below may be modified by the project team depending on the proposed source, volume of material, adjacent features, or other criteria.

- Borings: 20-foot vibracores in 1,000 foot spacing.
- Laboratory Testing: Sieve Analysis (ASTM D6913), Carbonate Content (ASTM D4373), and Munsell Color.

Before the use of any offshore or RSM sand source before the use of any sand mine:

- Site visit to ensure adequate production facilities and sand volumes are available. Representative sampling of stockpiles and insitu material.
- Laboratory Testing: Sieve Analysis (ASTM D6913), Carbonate Content (ASTM D4373), and Munsell Color.

8 REFERENCES

Cross V.A., Schwab W.C., and Raker B.A., 1998, High-resolution marine geologic maps showing sediment distribution on the insular shelf off Luquillo, Puerto Rico; U.S. Geological Survey, U. S. Geological Survey Open-File Report 98-204, https://pubs.usgs.gov/of/1998/of98-204/

Canals M. Ph.D., Rodriguez S. Ph.D., 2018, Towards Potential Beach Nourishment in Rincón: Seamless RTK, Surveying and Sediment Compatibility Analysis Report; University of Puerto Rico Mayaguez Campus, Department of Engineering Science and Materials, Project Number: R/77-1-14, 34 p.

Rojas Vázquez C.A., 2016, Evaluation of the Bajo Blanco sand shoal as a beach nourishment borrow site for eroding beaches at Rincón, Puerto Rico, Master Thesis; University of Puerto Rico Mayaguez Campus, Department of Engineering Science and Materials, 135 p.

Shideler, L., Gerald, 1980, U.S. Geological Survey Miscellaneous Field Studies, Map MF-1258, Maps showing composition of surficial sediments on the insular shelf of southwestern Puerto Rico.

Schwab, W.C., Rodríguez, R.W., Danforth, W.W., Gowen, M.H., Thieler, E.R., and O'Brien, T.F., 1996b, High-resolution marine geologic maps showing sediment distribution on the insular shelf off Luquillo, Puerto Rico; U.S. Geological Survey Miscellaneous Field Studies Map MF-2276, 16 p. and 4 sheets.

Trumbull, V.A., James and Trias, L. Juan, 1982, U.S. Geological Survey Miscellaneous Field Studies, Map MF-1393, Maps showing the characteristics of Cabo Rojo west offshore sand deposit, southwestern Puerto Rico.

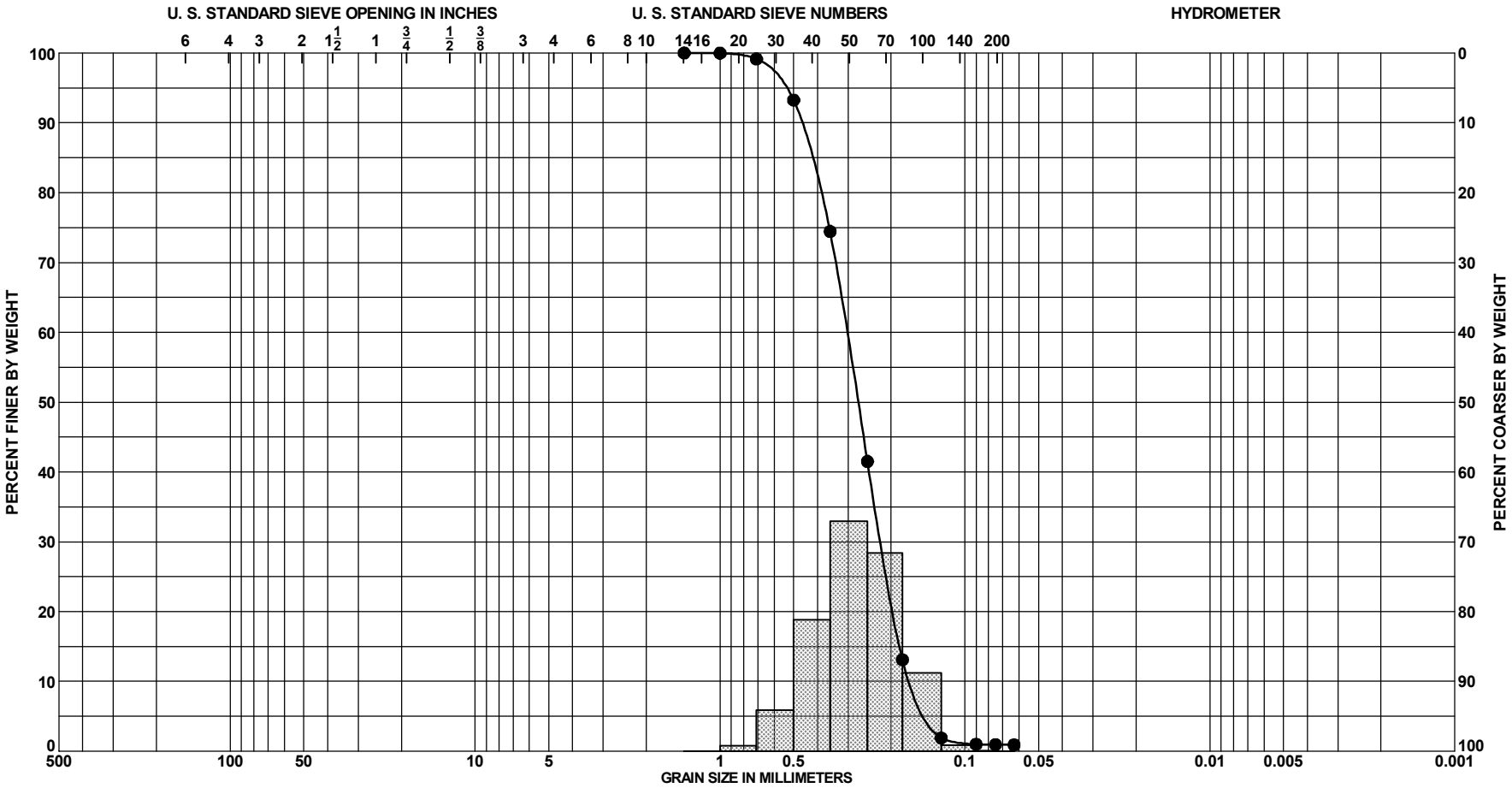
US Army Corps of Engineers, Jacksonville District, 2015, Environmental Assessment, Sand Juan Harbor, Puerto Rico, Submerged Aquatic Vegetation Mitigation.

9 BORING LOGS AND LABORATORY TESTING

9.1 SAN JUAN STUDY AREA

9.1.1 SAN JUAN BEACHES

- Gradation Graphs
- Granularmetric Reports

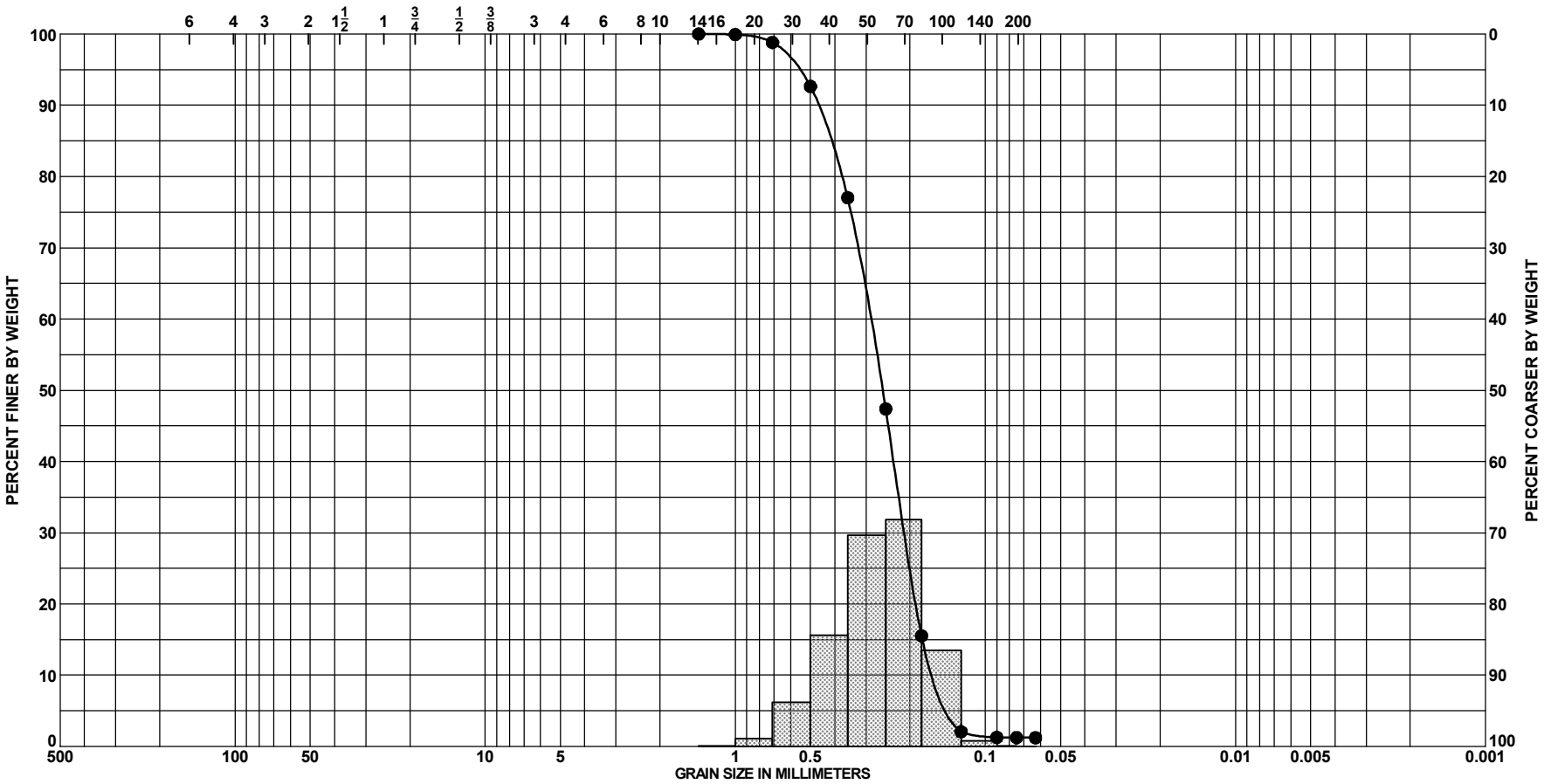


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Berm	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few fine to medium-grained sand-sized shell fragments, very pale brown (SP)	10YR 7/3	11							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - CONDADO
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

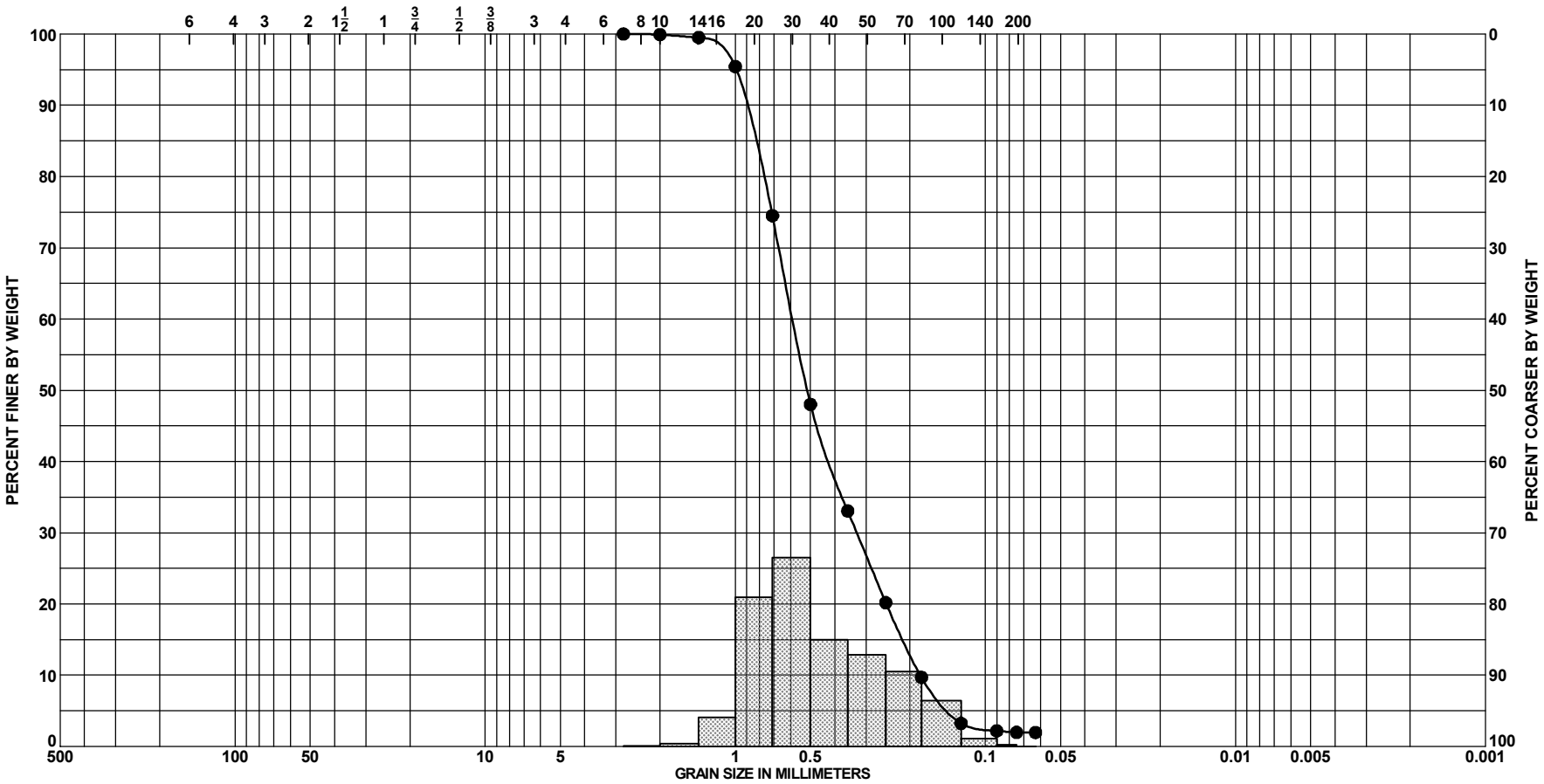


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Mid-Tide	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace silt, pale brown (SP)	10YR 6/3	21							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - CONDADO
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

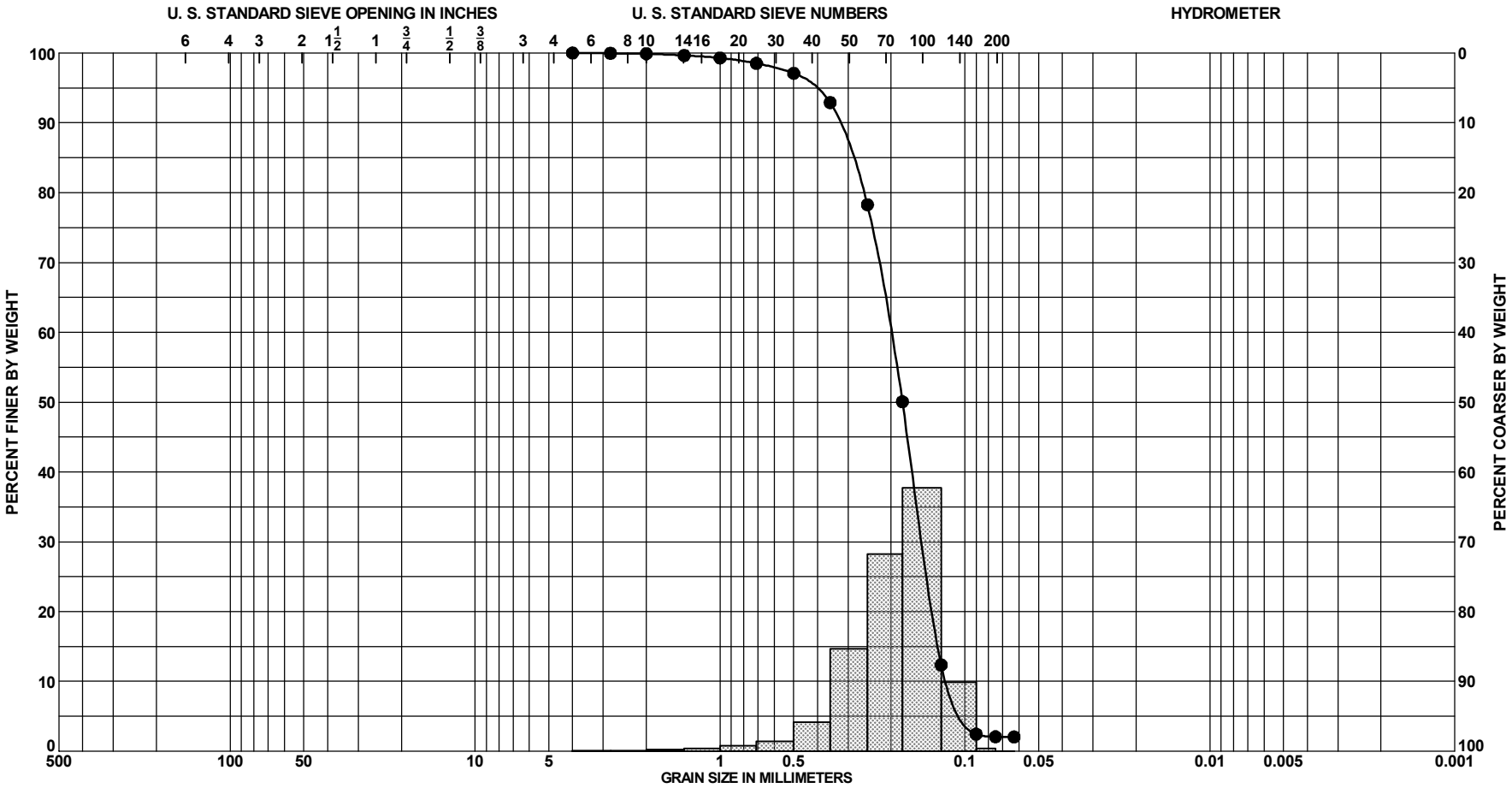


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -3	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace silt, pale brown (SP)	10YR 6/3	16							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - CONDADO
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

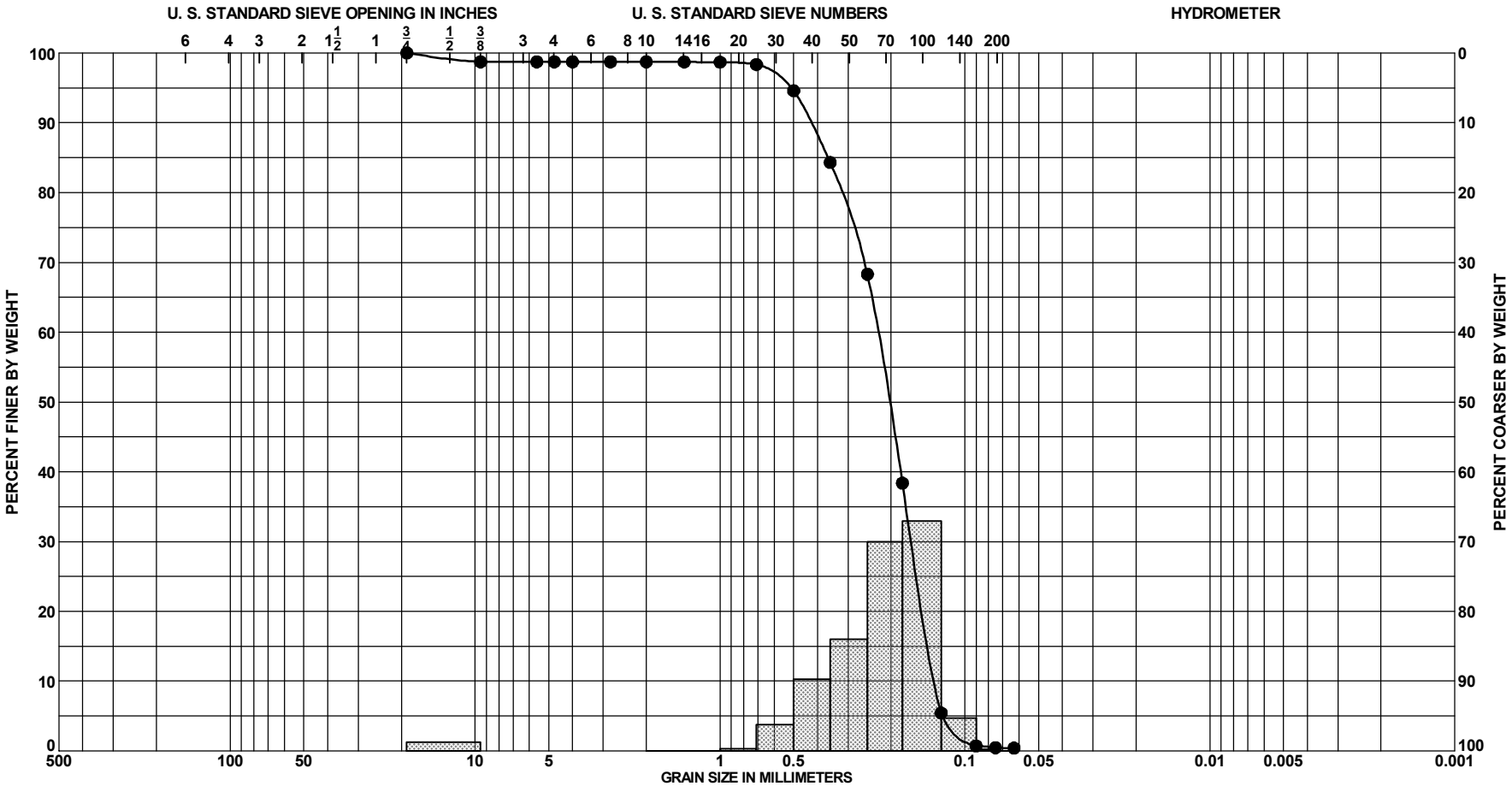


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -5	to 0.5 Ft.	SAND, poorly-graded, mostly	10YR 6/3	40	47						
		fine-grained sand-sized quartz, some									
		fine to medium-grained sand-sized									
		shell fragments, trace silt, pale brown									
		(SP)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - CONDADO
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

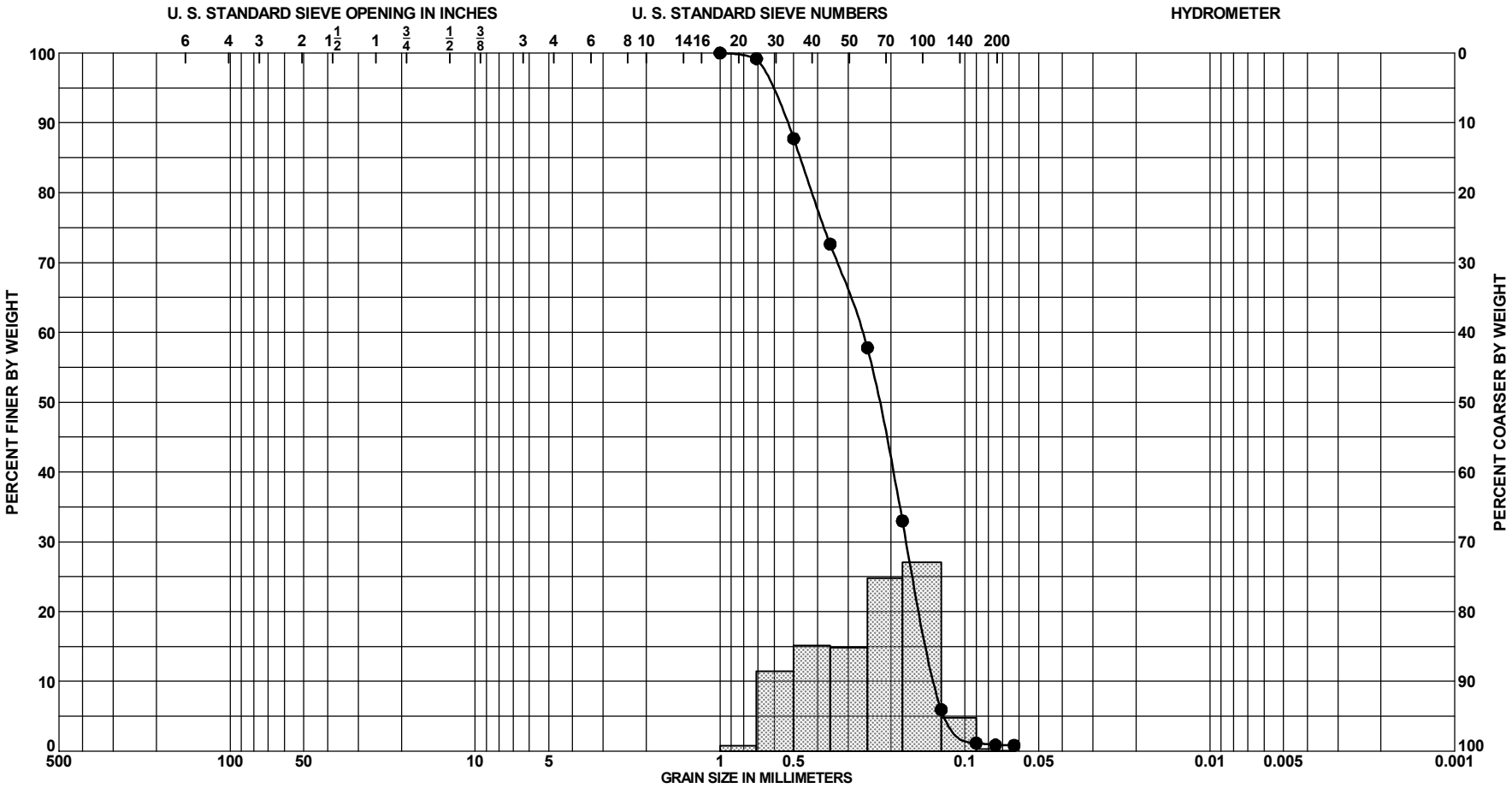


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Berm	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace rock fragments, light gray (SP)	10YR 7/2	26	29						

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - ISLA VERDE
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

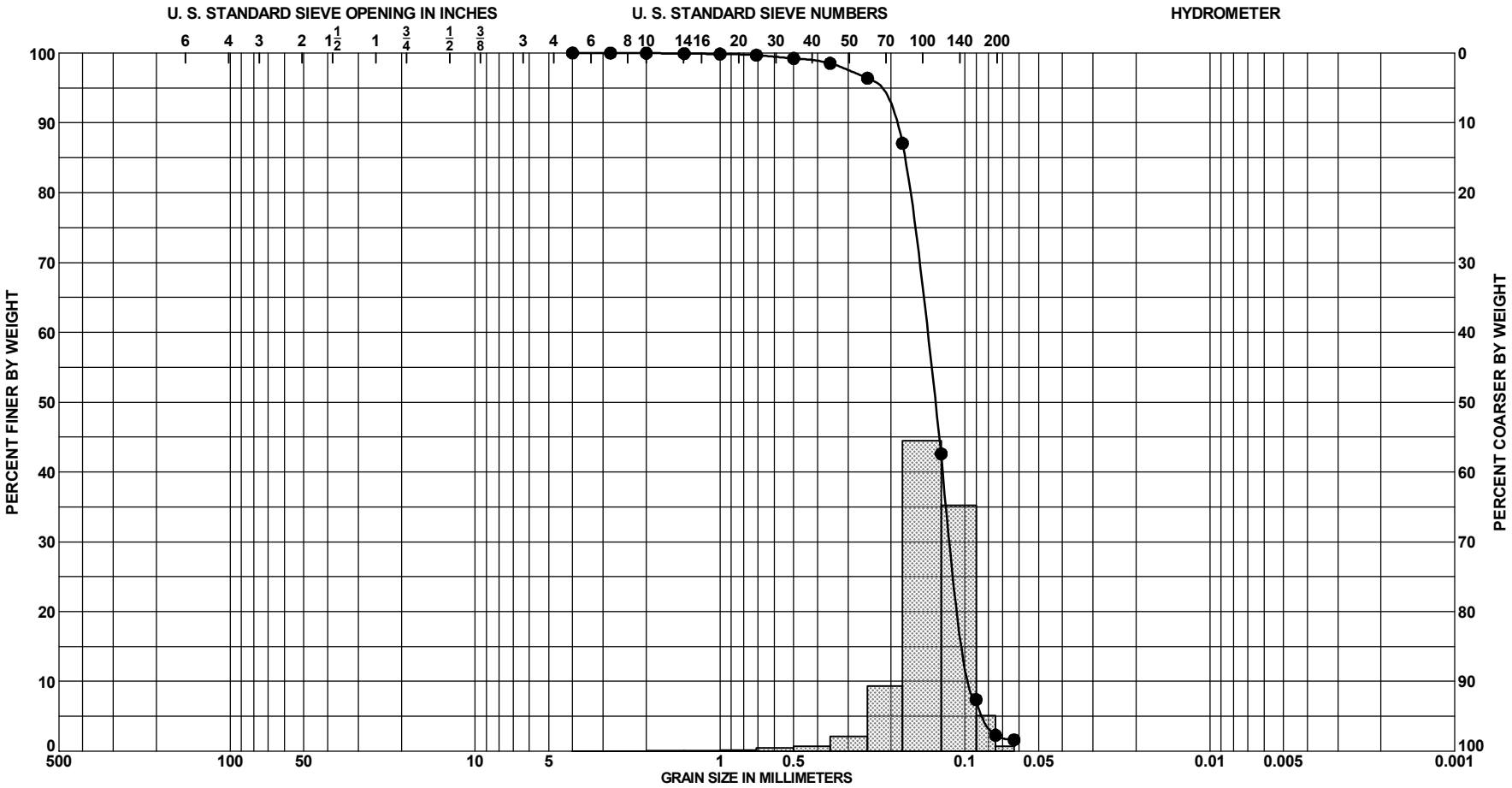


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Mid-Tide	to 0.5 Ft.	SAND, poorly, graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, pale brown (SP)	10YR 6/3	17							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - ISLA VERDE
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

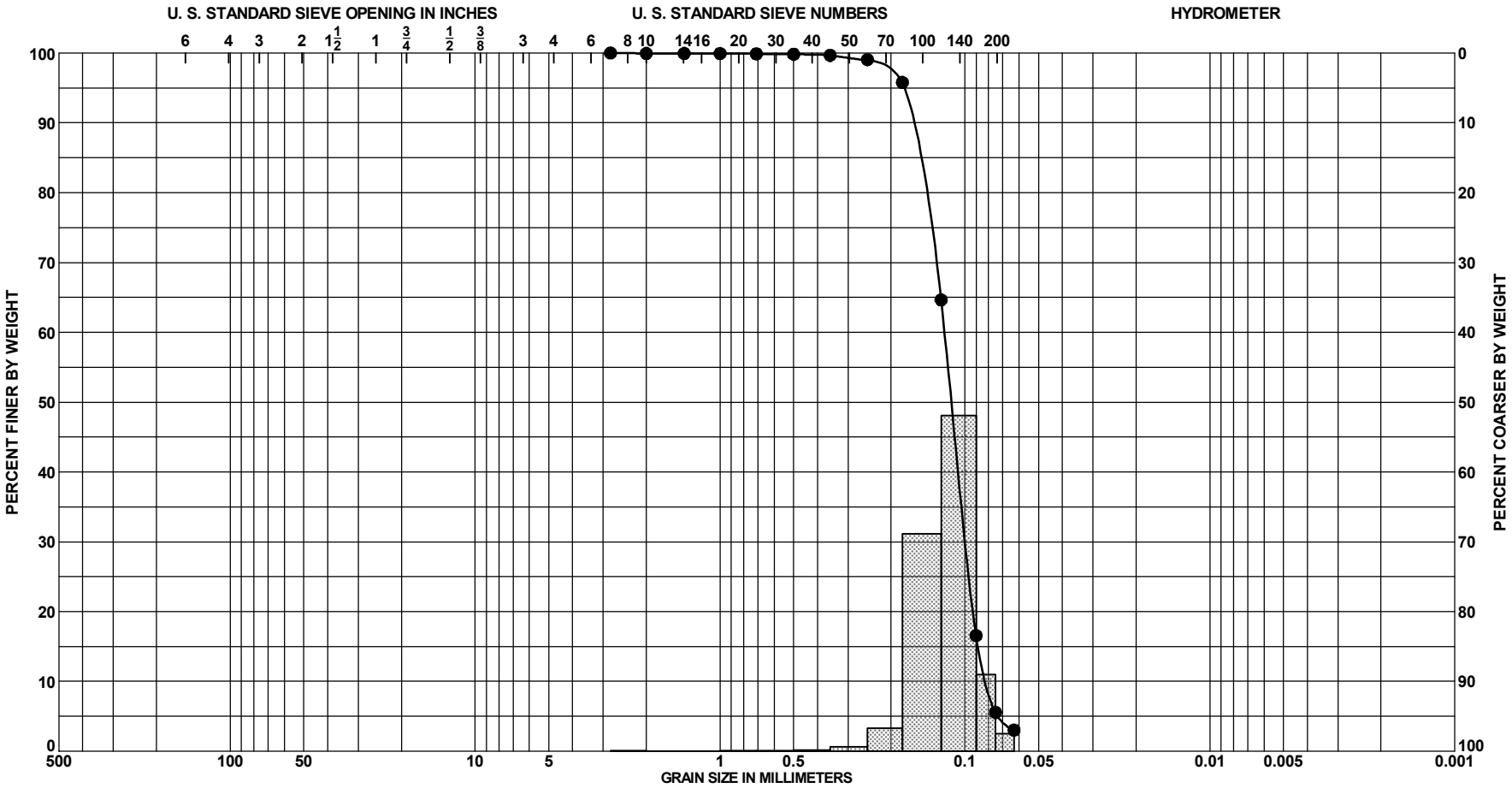


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -3	to 0.5 Ft.	SAND, poorly-graded, mostly	2.5Y 6/3	9							
		fine-grained sand-sized quartz, few									
		fine-grained sand-sized shell									
		fragments, trace silt, light yellowish									
		brown (SP)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - ISLA VERDE
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

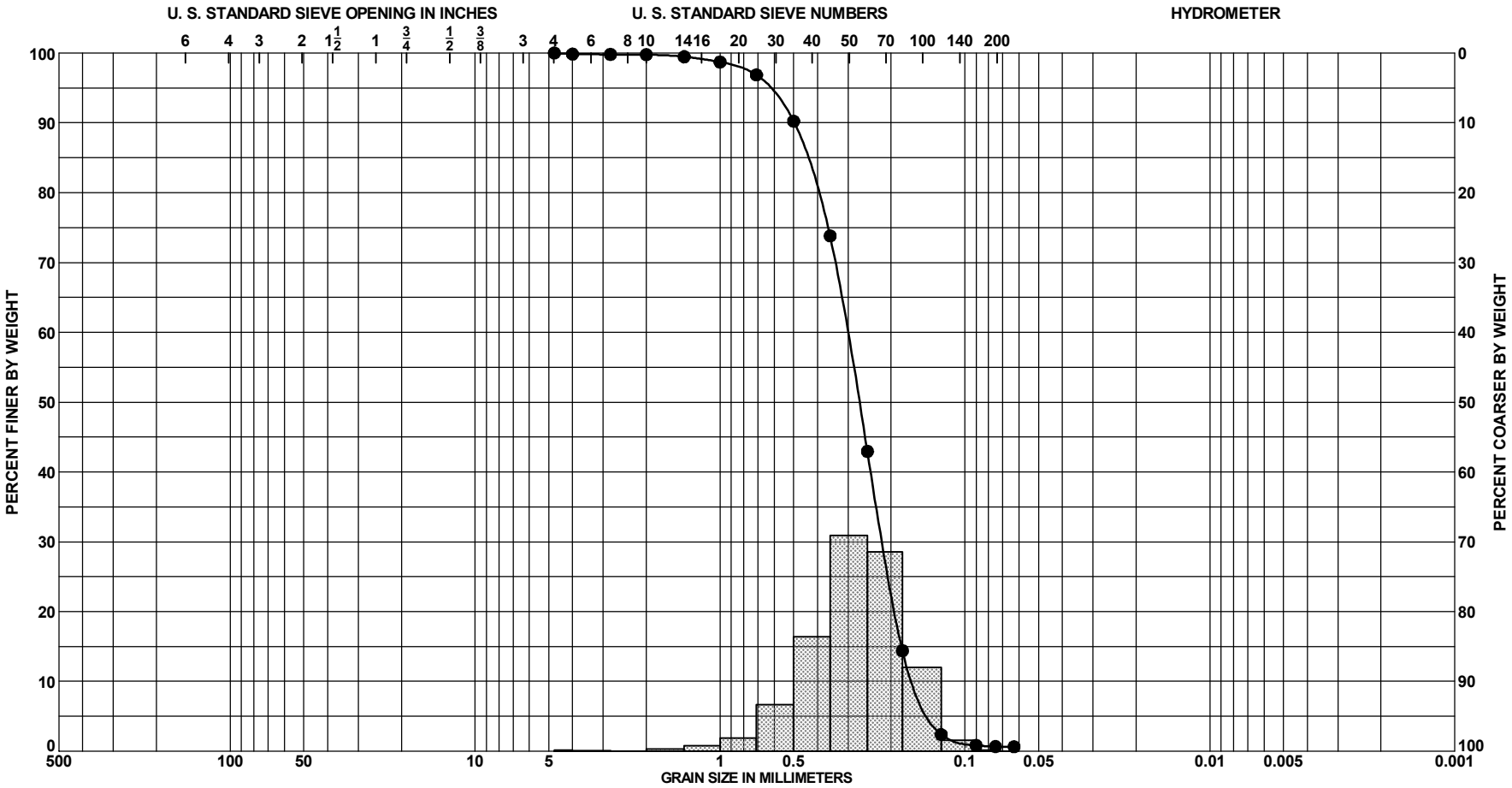


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -5	to 0.5 Ft.	SAND, poorly-graded with silt, mostly	2.5Y 5/2	13							
		fine-grained sand-sized quartz, little									
		fine-grained sand-sized shell									
		fragments, few silt, grayish brown									
		(SP-SM)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - ISLA VERDE
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

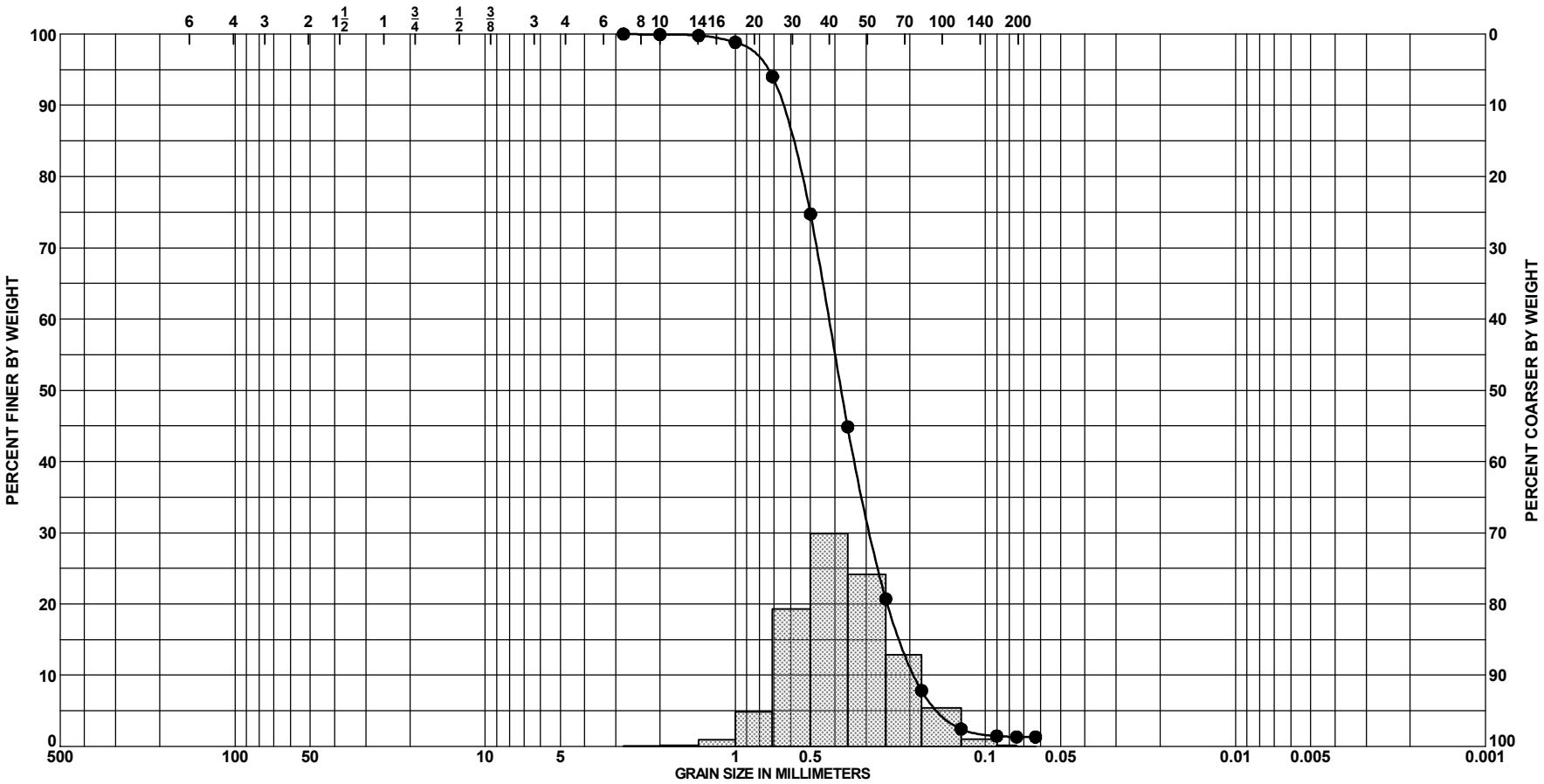


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Berm	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few fine to medium-grained sand-sized shell fragments, light yellowish brown (SP)	2.5Y 6/3	13							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - OCEAN PARK
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

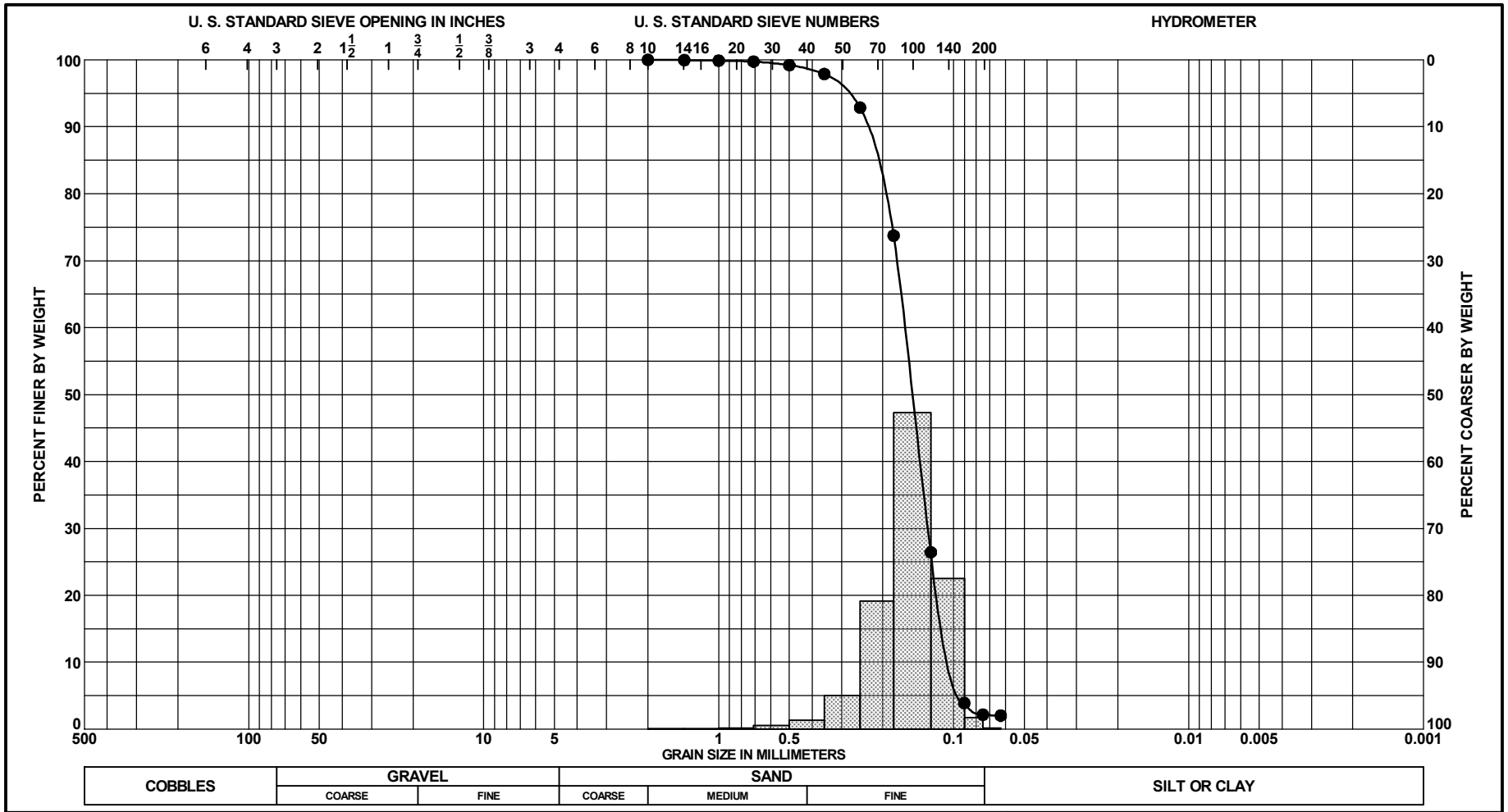


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Mid-Tide	to 0.5 Ft.	SAND, poorly-graded, mostly fine to	10YR 6/2	44	47						
		medium-grained sand-sized quartz,									
		some fine to medium-grained									
		sand-sized shell fragments, trace rock									
		fragments, trace silt, light brownish									
		gray									

GRADATION CURVES

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - OCEAN PARK
BORING ELEV.	Not Determined
DATE	4/25/2019

SAJ FORM 2087
JUN 02

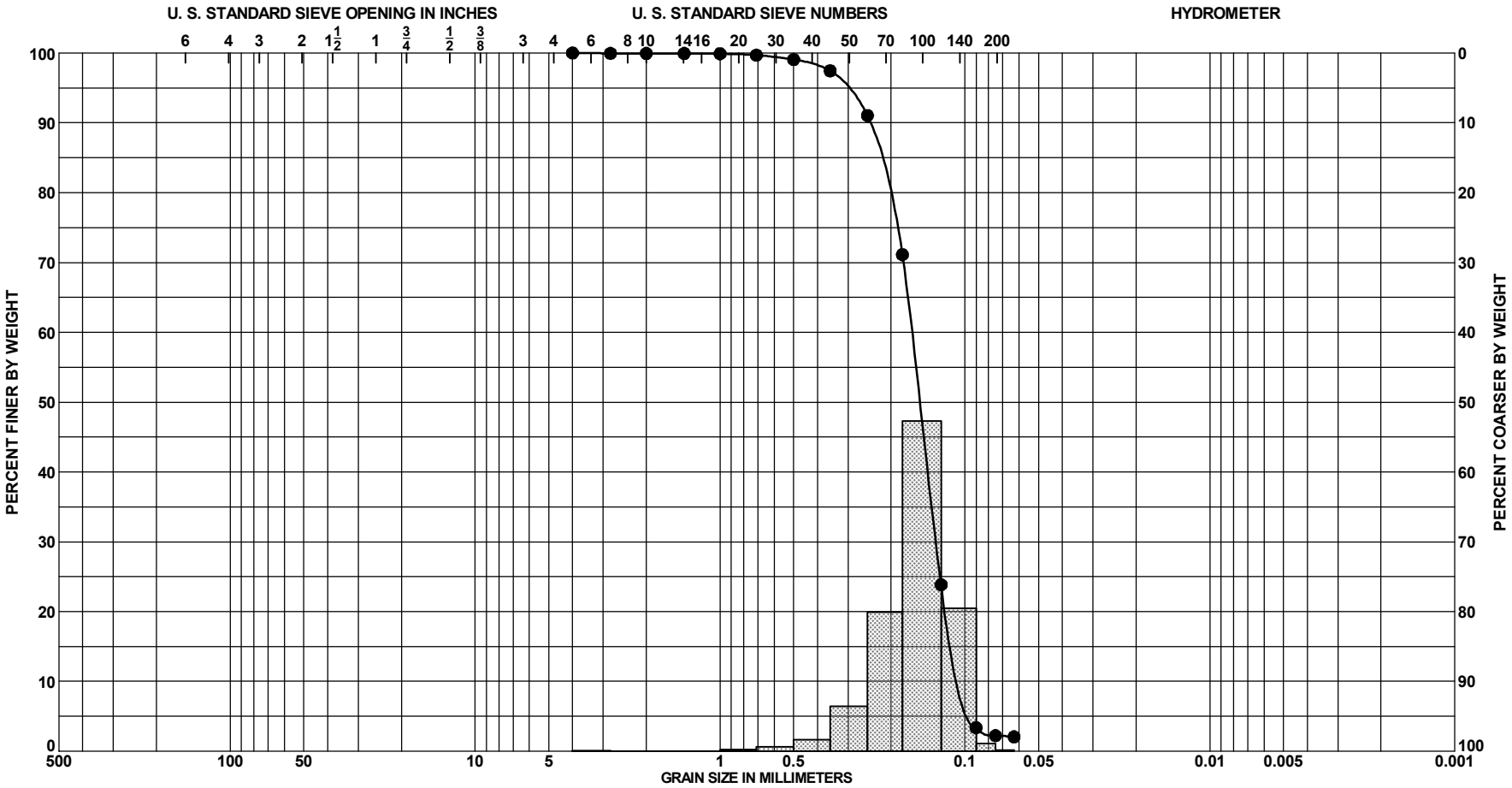


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -3	to 0.5 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2	11							
		fine-grained sand-sized quartz, few									
		fine-grained sand-sized shell									
		fragments, trace silt, grayish brown									
		(SP)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - OCEAN PARK
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

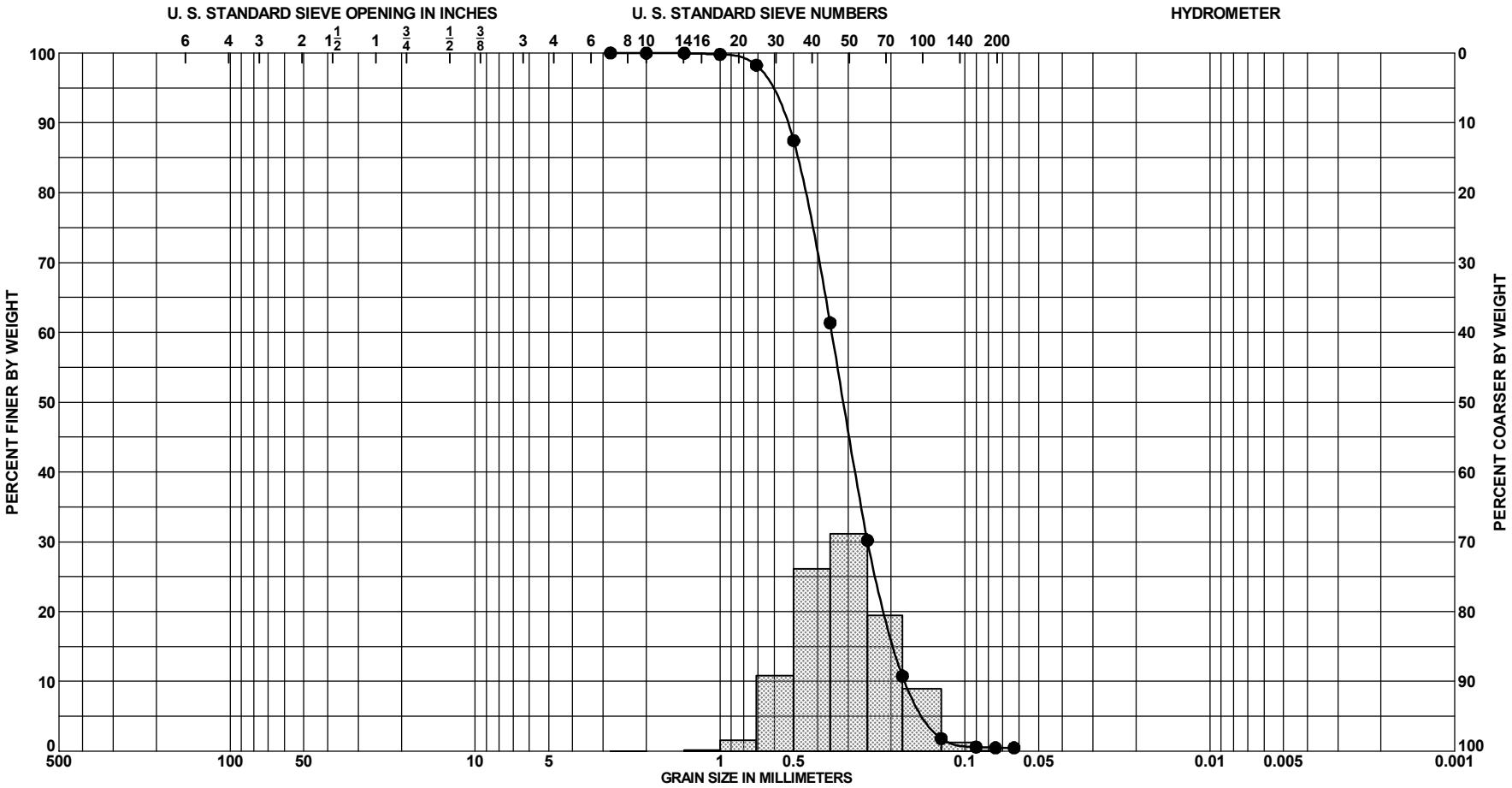


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -5	to 0.5 Ft.	SAND, poorly-graded, mostly	2.5Y 6/2	12							
		fine-grained sand-sized quartz, few									
		fine-grained sand-sized shell									
		fragments, trace silt, light brownish									
		gray (SP)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - OCEAN PARK
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

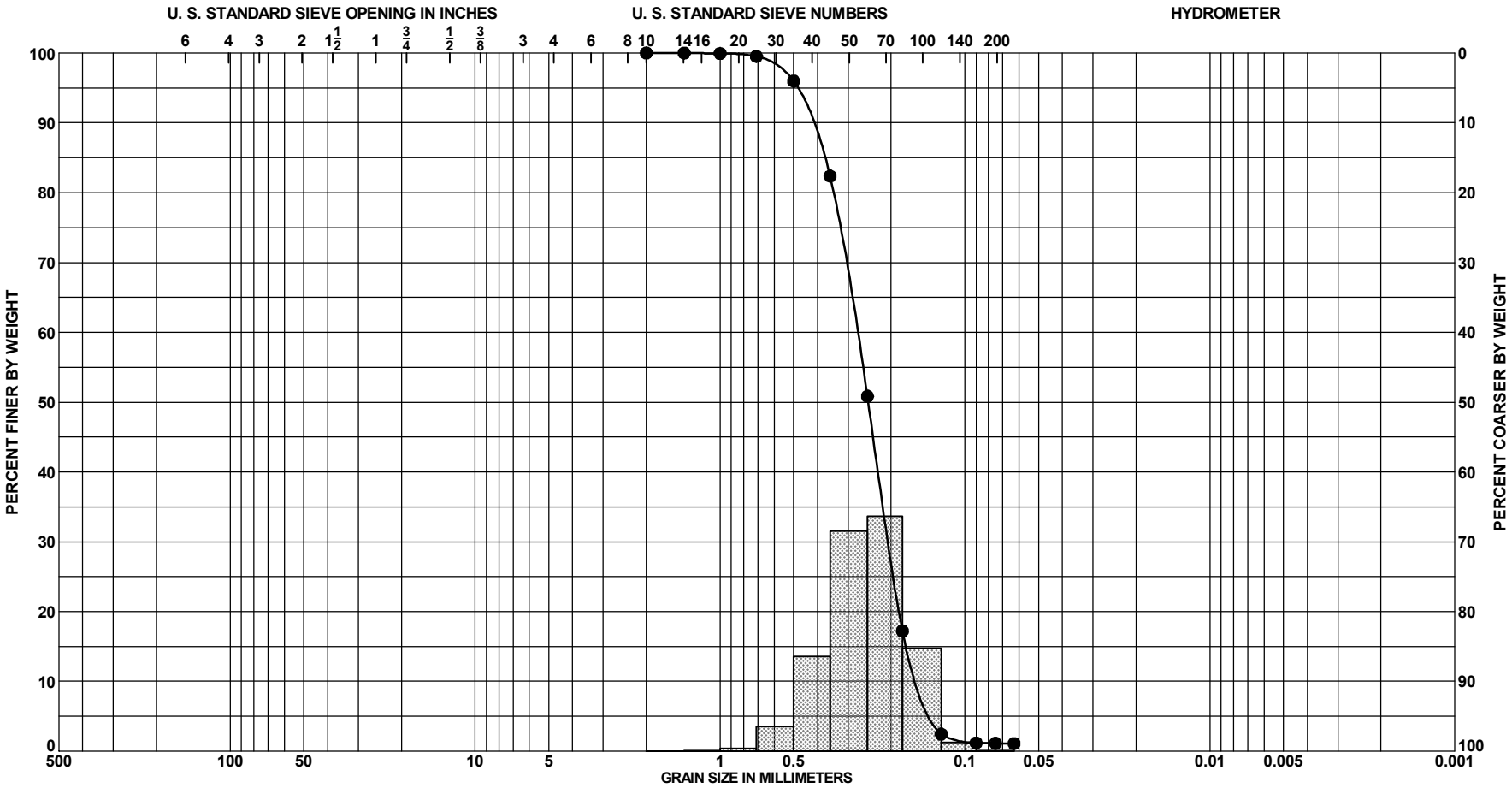


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Berm	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, light gray (SP)	10YR 7/2	17							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - PARQUE
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

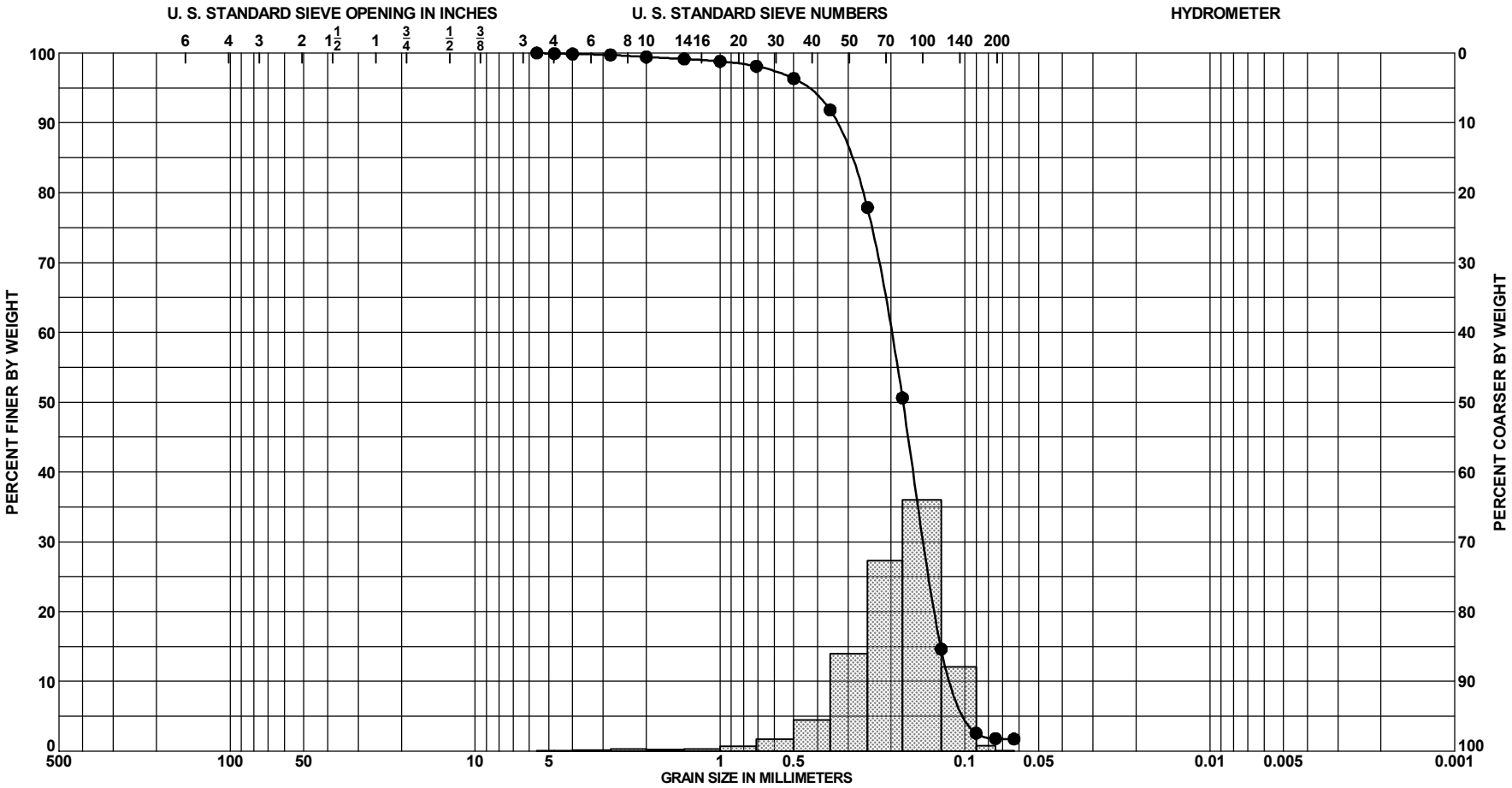


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Mid-Tide	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace silt, pale brown (SP)	10YR 6/3	19							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - PARQUE
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

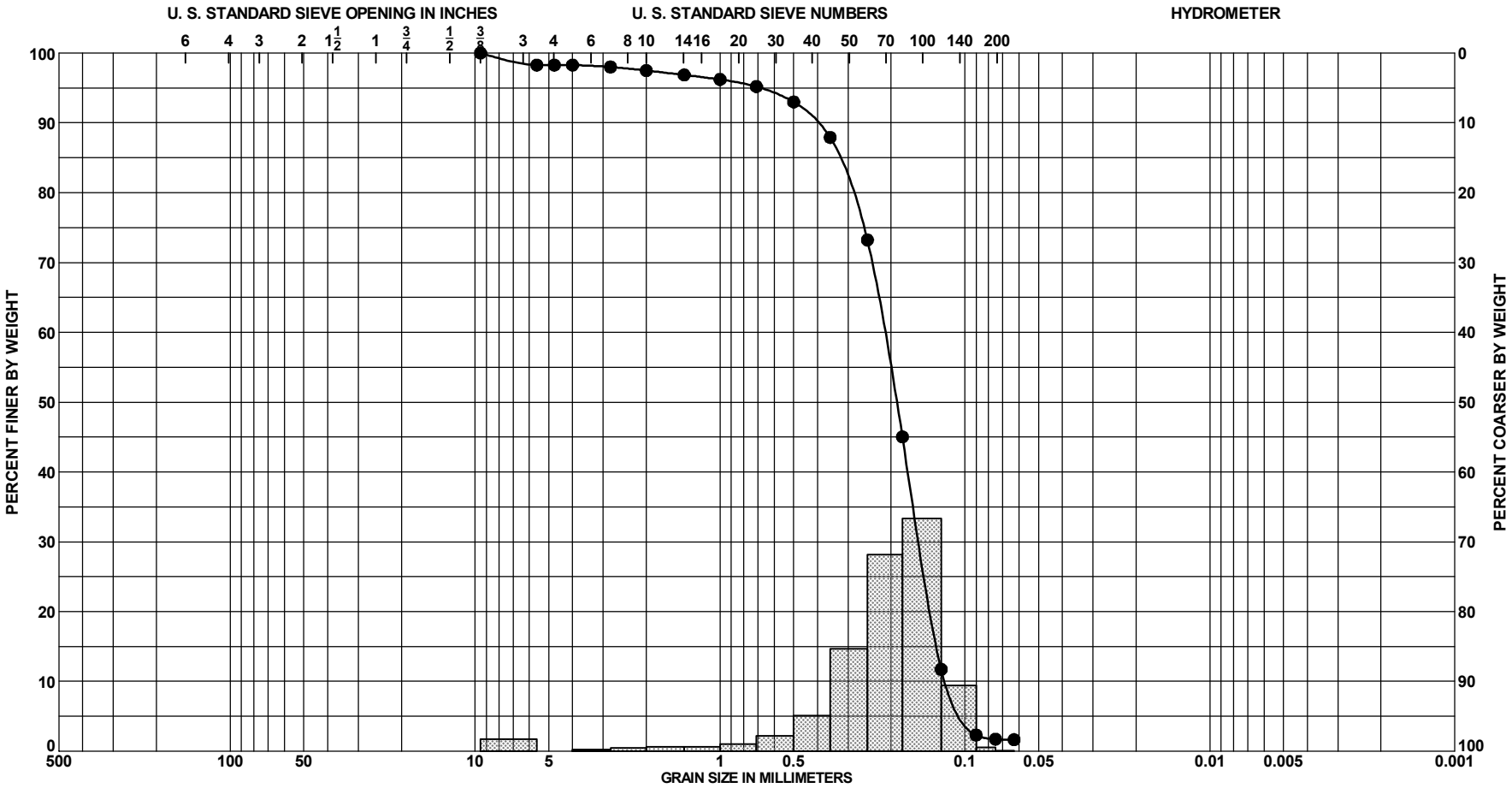


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -3	to 0.5 Ft.	SAND, poorly-graded, mostly	10YR 6/2	40	47						
		fine-grained sand-sized quartz, some									
		fine to medium-grained sand-sized									
		shell fragments, trace silt, light									
		brownish gray (SP)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - PARQUE
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

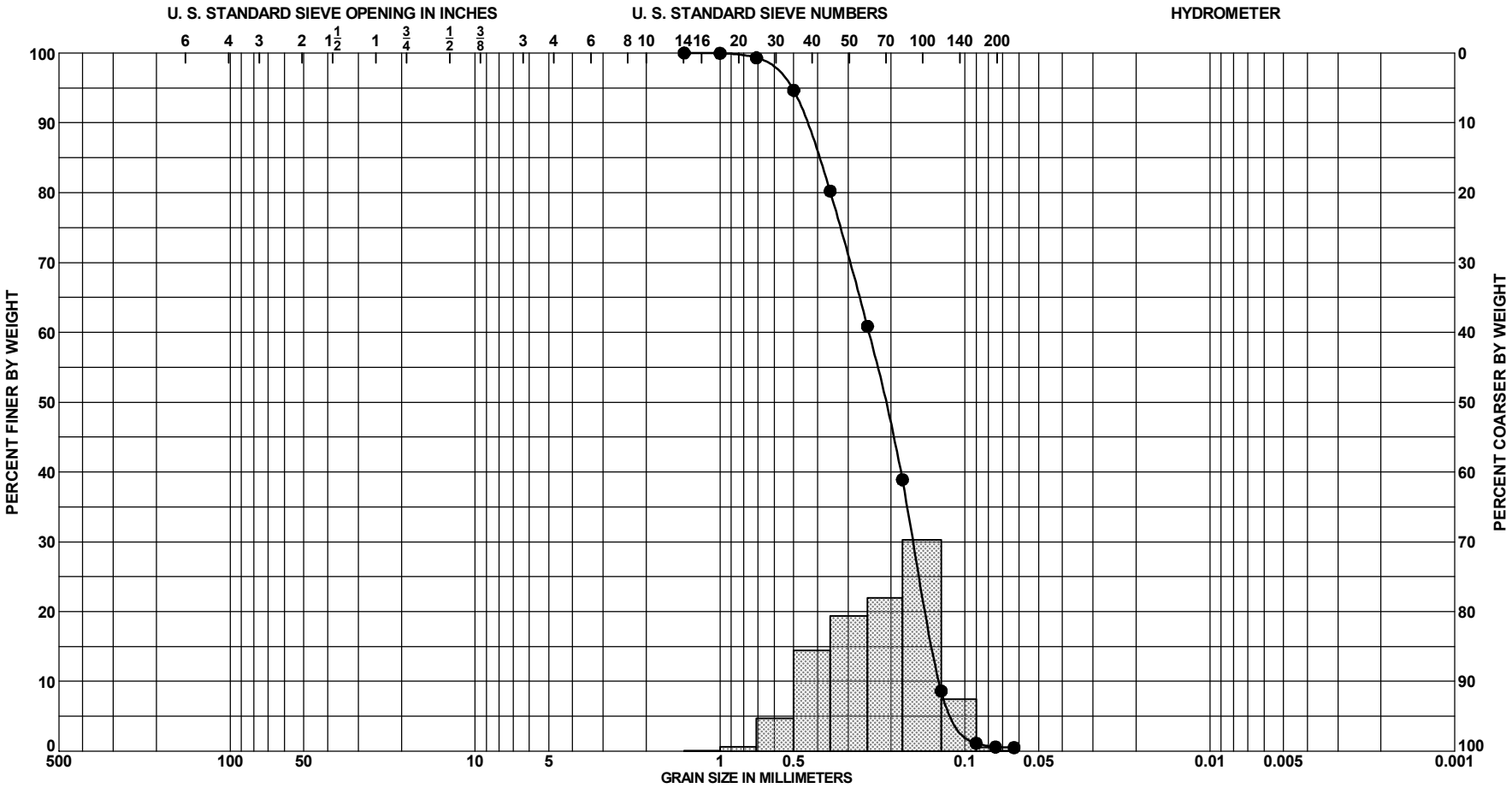


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -5	to 0.5 Ft.	SAND, poorly-graded, mostly	2.5Y 6/2	24							
		fine-grained sand-sized quartz, little									
		fine to coarse-grained sand-sized shell									
		fragments, trace silt, light brownish									
		gray (SP)									

GRADATION CURVES

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - PARQUE
BORING ELEV.	Not Determined
DATE	4/25/2019

SAJ FORM 2087
JUN 02

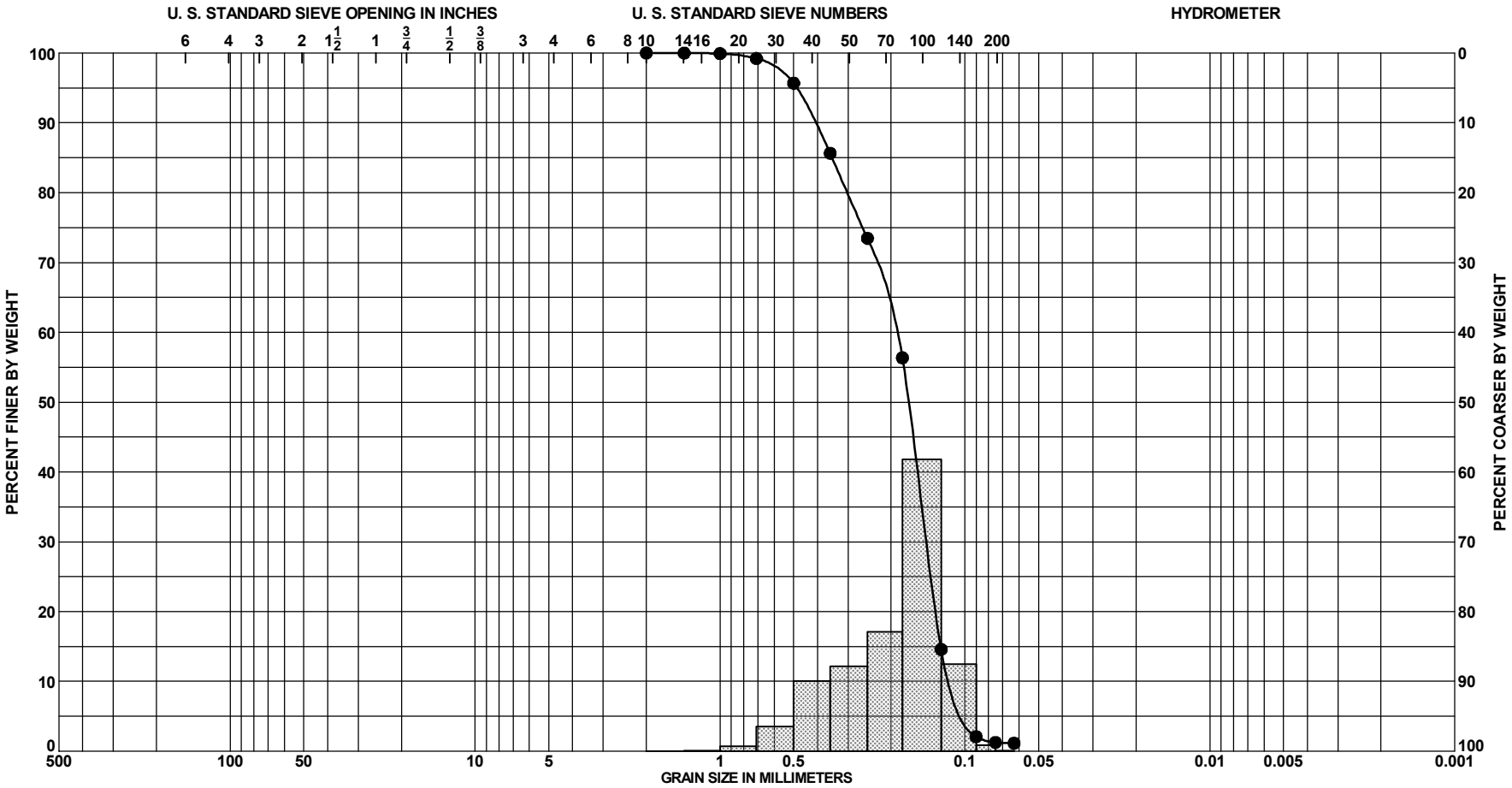


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Berm	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, light brownish gray (SP)	10YR 6/2	18							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - CANGREJO
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

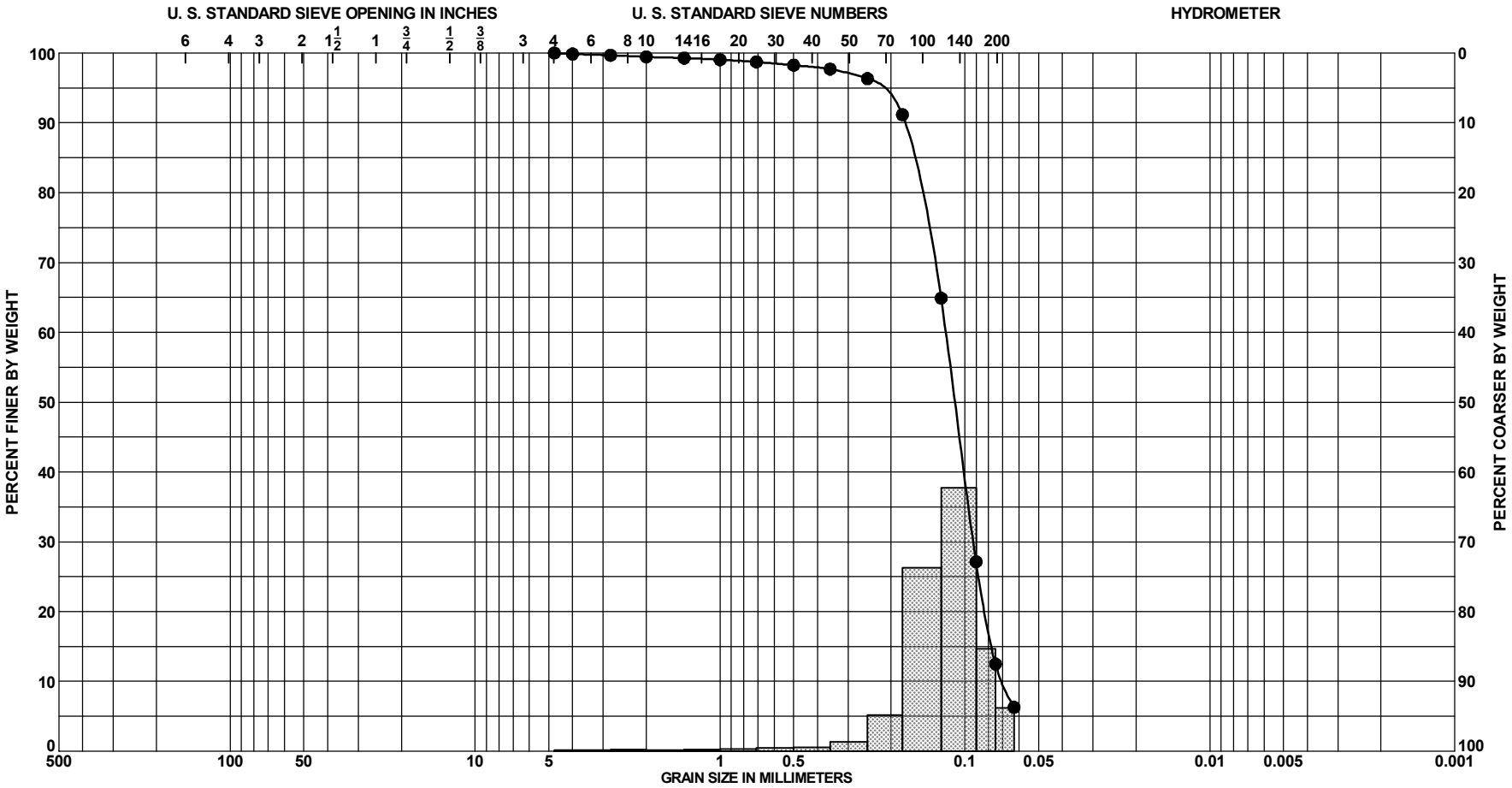


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Mid-Tide	to 0.5 Ft.	SAND, poorly-graded, mostly	10YR 5/2	17							
		fine-grained sand-sized quartz, little									
		fine to medium-grained sand-sized									
		shell fragments, trace silt, grayish									
		brown (SP)									

GRADATION CURVES

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - CANGREJO
BORING ELEV.	Not Determined
DATE	4/25/2019

SAJ FORM 2087
JUN 02

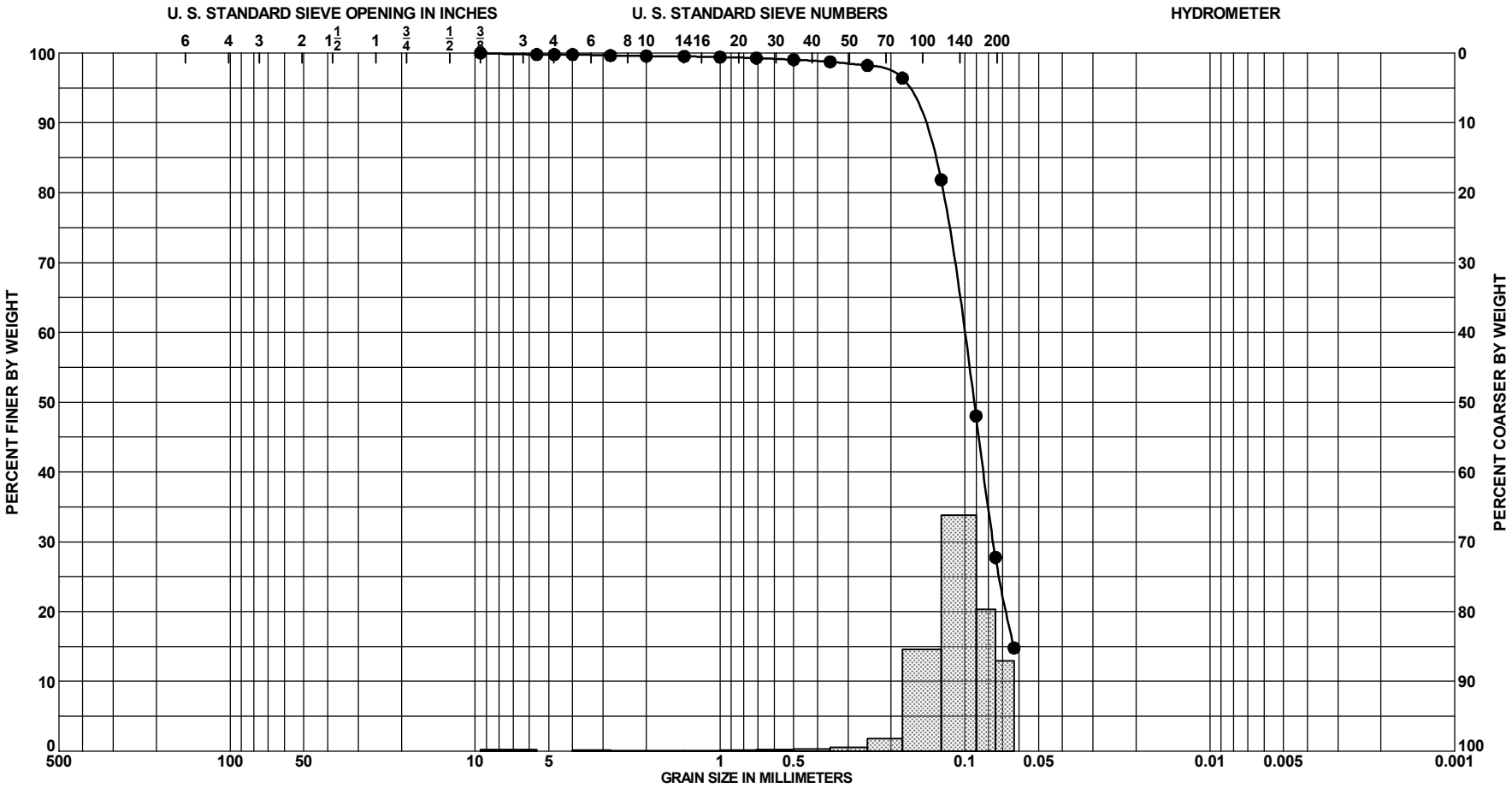


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -3	to 0.5 Ft.	SAND, poorly-graded with silt, mostly	10YR 5/2	16							
		fine-grained sand-sized quartz, little									
		fine-grained sand-sized shell									
		fragments, few silt, grayish brown									
		(SP-SM)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - CANGREJO
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -5	to 0.5 Ft.	SAND, silty, mostly fine-grained	2.5Y 5/1	19							
		sand-sized quartz, little silt, little									
		fine-grained sand-sized shell									
		fragments, gray (SM)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	SAN JUAN - CANGREJO
BORING ELEV.	Not Determined
DATE	4/25/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Condado @ 0.016 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
781,330	882,912	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 7/3	#200 - 0.93 #230 - 0.90			11.1

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#14	-0.50	1.40	0.00	0.00
#18	0.00	1.00	0.03	0.03
#25	0.50	0.71	0.82	0.85
#35	1.00	0.50	5.90	6.75
#45	1.50	0.36	18.80	25.55
#60	2.00	0.25	32.94	58.49
#80	2.50	0.18	28.41	86.91
#120	3.00	0.13	11.20	98.11
#170	3.50	0.09	0.90	99.01
#200	3.75	0.08	0.06	99.07
#230	4.00	0.06	0.03	99.10

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.86	2.45	2.29	1.87	1.49	1.25	0.85

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.85	0.28	1.87	0.27	0.57	-0.16	2.84

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Condado @ 0.017 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
781,330	882,912	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/3	#200 - 1.23 #230 - 1.22			21.1

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#14	-0.50	1.40	0.00	0.00
#18	0.00	1.00	0.08	0.08
#25	0.50	0.71	1.10	1.18
#35	1.00	0.50	6.17	7.35
#45	1.50	0.36	15.62	22.97
#60	2.00	0.25	29.64	52.62
#80	2.50	0.18	31.85	84.47
#120	3.00	0.13	13.46	97.93
#170	3.50	0.09	0.80	98.73
#200	3.75	0.08	0.05	98.77
#230	4.00	0.06	0.01	98.78

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.89	2.49	2.35	1.96	1.53	1.28	0.81

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.90	0.27	1.96	0.26	0.59	-0.38	2.91

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Condado @ 0.018 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
781,330	882,912	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/3	#200 - 1.98 #230 - 1.95			16.4

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.80	0.00	0.00
#10	-1.00	2.00	0.09	0.09
#14	-0.50	1.40	0.41	0.49
#18	0.00	1.00	4.07	4.57
#25	0.50	0.71	20.94	25.51
#35	1.00	0.50	26.48	51.99
#45	1.50	0.36	14.96	66.95
#60	2.00	0.25	12.87	79.82
#80	2.50	0.18	10.49	90.31
#120	3.00	0.13	6.45	96.76
#170	3.50	0.09	1.06	97.82
#200	3.75	0.08	0.20	98.02
#230	4.00	0.06	0.02	98.05

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.86	2.20	1.81	0.96	0.49	0.27	0.01

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.13	0.46	0.96	0.51	0.85	0.48	2.51

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Condado @ 0.019 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
781,330	882,912	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/3	#200 - 2.07 #230 - 2.04		46.56	39.5

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.04	0.04
#10	-1.00	2.00	0.06	0.11
#14	-0.50	1.40	0.24	0.35
#18	0.00	1.00	0.36	0.71
#25	0.50	0.71	0.77	1.48
#35	1.00	0.50	1.43	2.91
#45	1.50	0.36	4.19	7.09
#60	2.00	0.25	14.64	21.73
#80	2.50	0.18	28.21	49.94
#120	3.00	0.13	37.70	87.64
#170	3.50	0.09	9.90	97.54
#200	3.75	0.08	0.39	97.93
#230	4.00	0.06	0.02	97.96

SAND, poorly-graded, mostly fine-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.37	2.95	2.83	2.50	2.06	1.80	1.25

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.37	0.19	2.50	0.18	0.63	-1.37	6.9

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Isla Verde @ 0.004 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
797,908	878,127	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW	10YR 7/2	#200 - 0.45 #230 - 0.42		29.41	25.8

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
19	-4.25	19.00	0.00	0.00
9.5	-3.25	9.50	1.27	1.27
5.6	-2.50	5.60	0.00	1.27
4.75	-2.25	4.75	0.00	1.27
4	-2.00	4.00	0.00	1.27
2.8	-1.50	2.80	0.00	1.27
2	-1.00	2.00	0.00	1.27
1.4	-0.50	1.40	0.02	1.29
1	0.00	1.00	0.02	1.30
0.71	0.50	0.71	0.35	1.65
0.5	1.00	0.50	3.76	5.41
0.355	1.50	0.36	10.27	15.68
0.25	2.00	0.25	16.02	31.70
0.18	2.50	0.18	29.92	61.63
0.125	3.00	0.13	32.93	94.56
0.09	3.50	0.09	4.72	99.28
0.075	3.75	0.08	0.26	99.55
0.063	4.00	0.06	0.03	99.58

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace rock fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.05	2.84	2.70	2.31	1.79	1.51	0.95

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.14	0.23	2.31	0.20	0.91	-3.55	23

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Isla Verde @ 0.005 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
797,908	878,127	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/3	#200 - 0.89 #230 - 0.83			17.2

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#18	0.00	1.00	0.00	0.00
#25	0.50	0.71	0.81	0.81
#35	1.00	0.50	11.45	12.26
#45	1.50	0.36	15.10	27.37
#60	2.00	0.25	14.85	42.22
#80	2.50	0.18	24.80	67.02
#120	3.00	0.13	27.03	94.05
#170	3.50	0.09	4.78	98.83
#200	3.75	0.08	0.28	99.11
#230	4.00	0.06	0.06	99.17

SAND, poorly, graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.10	2.81	2.65	2.16	1.42	1.12	0.68

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.02	0.25	2.16	0.22	0.74	-0.35	2.12

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Isla Verde @ 0.006 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
797,908	878,127	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 6/3	#200 - 2.29 #230 - 1.62			8.7

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.01	0.01
#10	-1.00	2.00	0.01	0.02
#14	-0.50	1.40	0.06	0.08
#18	0.00	1.00	0.06	0.14
#25	0.50	0.71	0.16	0.31
#35	1.00	0.50	0.46	0.77
#45	1.50	0.36	0.71	1.47
#60	2.00	0.25	2.13	3.60
#80	2.50	0.18	9.32	12.92
#120	3.00	0.13	44.48	57.40
#170	3.50	0.09	35.21	92.61
#200	3.75	0.08	5.10	97.71
#230	4.00	0.06	0.68	98.38

SAND, poorly-graded, mostly fine-grained sand-sized quartz, few fine-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.62	3.38	3.25	2.92	2.64	2.53	2.07

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.88	0.14	2.92	0.13	0.48	-1.71	10.73

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Isla Verde @ 0.007 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
797,908	878,127	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
	2.5Y 5/2	#200 - 5.56 #230 - 3.02			13

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.80	0.00	0.00
#10	-1.00	2.00	0.05	0.05
#14	-0.50	1.40	0.01	0.06
#18	0.00	1.00	0.01	0.07
#25	0.50	0.71	0.05	0.12
#35	1.00	0.50	0.06	0.18
#45	1.50	0.36	0.15	0.33
#60	2.00	0.25	0.62	0.95
#80	2.50	0.18	3.26	4.21
#120	3.00	0.13	31.14	35.35
#170	3.50	0.09	48.08	83.43
#200	3.75	0.08	11.01	94.44
#230	4.00	0.06	2.53	96.98

SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, little fine-grained sand-sized shell fragments, few silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.80	3.51	3.41	3.15	2.83	2.69	2.51

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	3.10	0.12	3.15	0.11	0.4	-1.58	13.93

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Ocean Park @ 0.008 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
789,768	881,167	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 6/3	#200 - 0.66 #230 - 0.63			12.5

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	4.00	0.16	0.16
#7	-1.50	2.80	0.04	0.20
#10	-1.00	2.00	0.03	0.23
#14	-0.50	1.40	0.30	0.53
#18	0.00	1.00	0.76	1.29
#25	0.50	0.71	1.84	3.13
#35	1.00	0.50	6.64	9.77
#45	1.50	0.36	16.42	26.19
#60	2.00	0.25	30.87	57.06
#80	2.50	0.18	28.55	85.61
#120	3.00	0.13	12.01	97.62
#170	3.50	0.09	1.57	99.18
#200	3.75	0.08	0.16	99.34
#230	4.00	0.06	0.03	99.37

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.89	2.47	2.31	1.89	1.46	1.19	0.64

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.83	0.28	1.89	0.27	0.68	-0.86	5.55

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Ocean Park @ 0.009 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
789,768	881,167	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/2	#200 - 1.33 #230 - 1.31		47.24	43.8

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.80	0.00	0.00
#10	-1.00	2.00	0.07	0.07
#14	-0.50	1.40	0.14	0.21
#18	0.00	1.00	0.94	1.15
#25	0.50	0.71	4.83	5.98
#35	1.00	0.50	19.30	25.28
#45	1.50	0.36	29.86	55.14
#60	2.00	0.25	24.15	79.28
#80	2.50	0.18	12.87	92.15
#120	3.00	0.13	5.40	97.55
#170	3.50	0.09	0.99	98.55
#200	3.75	0.08	0.12	98.67
#230	4.00	0.06	0.02	98.69

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, trace rock fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.76	2.18	1.91	1.41	0.99	0.76	0.40

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.44	0.37	1.41	0.38	0.67	0.15	3.15

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Ocean Park @ 0.01 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
789,768	881,167	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 5/2	#200 - 2.16 #230 - 2.02			11.1

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#10	-1.00	2.00	0.00	0.00
#14	-0.50	1.40	0.04	0.04
#18	0.00	1.00	0.07	0.12
#25	0.50	0.71	0.15	0.27
#35	1.00	0.50	0.53	0.80
#45	1.50	0.36	1.31	2.11
#60	2.00	0.25	5.03	7.13
#80	2.50	0.18	19.12	26.25
#120	3.00	0.13	47.32	73.57
#170	3.50	0.09	22.54	96.11
#200	3.75	0.08	1.73	97.84
#230	4.00	0.06	0.14	97.98

SAND, poorly-graded, mostly fine-grained sand-sized quartz, few fine-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.48	3.23	3.03	2.75	2.47	2.23	1.79

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.69	0.15	2.75	0.15	0.49	-1.2	6.67

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Ocean Park @ 0.011 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
789,768	881,167	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 6/2	#200 - 2.23 #230 - 2.06			12.3

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.05	0.05
#10	-1.00	2.00	0.01	0.06
#14	-0.50	1.40	0.01	0.07
#18	0.00	1.00	0.04	0.10
#25	0.50	0.71	0.20	0.31
#35	1.00	0.50	0.62	0.93
#45	1.50	0.36	1.62	2.55
#60	2.00	0.25	6.41	8.96
#80	2.50	0.18	19.93	28.89
#120	3.00	0.13	47.27	76.15
#170	3.50	0.09	20.50	96.65
#200	3.75	0.08	1.13	97.77
#230	4.00	0.06	0.17	97.94

SAND, poorly-graded, mostly fine-grained sand-sized quartz, few fine-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.46	3.19	2.99	2.72	2.40	2.18	1.69

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.65	0.16	2.72	0.15	0.51	-1.35	8

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Parque @ 0.012 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
785,938	881,875	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 7/2	#200 - 0.49 #230 - 0.49			17

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.80	0.00	0.00
#10	-1.00	2.00	0.03	0.03
#14	-0.50	1.40	0.00	0.03
#18	0.00	1.00	0.16	0.19
#25	0.50	0.71	1.56	1.76
#35	1.00	0.50	10.80	12.56
#45	1.50	0.36	26.08	38.64
#60	2.00	0.25	31.17	69.81
#80	2.50	0.18	19.42	89.23
#120	3.00	0.13	8.96	98.19
#170	3.50	0.09	1.22	99.41
#200	3.75	0.08	0.11	99.51
#230	4.00	0.06	0.00	99.51

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.82	2.37	2.13	1.68	1.24	1.07	0.65

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.69	0.31	1.68	0.31	0.62	0.07	2.88

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Parque @ 0.013 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
785,938	881,875	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/3	#200 - 1.13 #230 - 1.09			18.6

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#10	-1.00	2.00	0.00	0.00
#14	-0.50	1.40	0.01	0.01
#18	0.00	1.00	0.06	0.07
#25	0.50	0.71	0.41	0.48
#35	1.00	0.50	3.54	4.02
#45	1.50	0.36	13.59	17.62
#60	2.00	0.25	31.54	49.16
#80	2.50	0.18	33.63	82.79
#120	3.00	0.13	14.75	97.54
#170	3.50	0.09	1.28	98.82
#200	3.75	0.08	0.04	98.87
#230	4.00	0.06	0.04	98.91

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.91	2.54	2.38	2.01	1.62	1.44	1.04

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.98	0.25	2.01	0.25	0.55	-0.28	3.11

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Parque @ 0.014 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
785,938	881,875	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/2	#200 - 1.80 #230 - 1.76		46.88	40

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.60	0.00	0.00
#4	-2.25	4.75	0.08	0.08
#5	-2.00	4.00	0.06	0.14
#7	-1.50	2.80	0.14	0.27
#10	-1.00	2.00	0.30	0.57
#14	-0.50	1.40	0.27	0.85
#18	0.00	1.00	0.35	1.19
#25	0.50	0.71	0.71	1.90
#35	1.00	0.50	1.75	3.65
#45	1.50	0.36	4.51	8.16
#60	2.00	0.25	13.97	22.13
#80	2.50	0.18	27.26	49.38
#120	3.00	0.13	35.99	85.38
#170	3.50	0.09	12.06	97.44
#200	3.75	0.08	0.76	98.20
#230	4.00	0.06	0.04	98.24

SAND, poorly-graded, mostly fine-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.40	2.98	2.86	2.51	2.05	1.78	1.15

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.37	0.19	2.51	0.18	0.71	-1.83	9.81

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Parque @ 0.015 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
785,938	881,875	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW	2.5Y 6/2	#200 - 1.72 #230 - 1.65			24.3

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	1.73	1.73
#4	-2.25	4.75	0.00	1.73
#5	-2.00	4.00	0.00	1.73
#7	-1.50	2.80	0.27	2.00
#10	-1.00	2.00	0.50	2.50
#14	-0.50	1.40	0.63	3.13
#18	0.00	1.00	0.66	3.79
#25	0.50	0.71	1.01	4.80
#35	1.00	0.50	2.21	7.01
#45	1.50	0.36	5.08	12.09
#60	2.00	0.25	14.69	26.78
#80	2.50	0.18	28.19	54.97
#120	3.00	0.13	33.30	88.28
#170	3.50	0.09	9.41	97.69
#200	3.75	0.08	0.59	98.28
#230	4.00	0.06	0.07	98.35

SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine to coarse-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.36	2.94	2.80	2.41	1.94	1.63	0.54

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.19	0.22	2.41	0.19	1.02	-2.76	13.1

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Cangrejo @ 0 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
805,200	878,762	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/2	#200 - 0.59 #230 - 0.51			17.9

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#14	-0.50	1.40	0.00	0.00
#18	0.00	1.00	0.04	0.04
#25	0.50	0.71	0.64	0.68
#35	1.00	0.50	4.67	5.35
#45	1.50	0.36	14.43	19.77
#60	2.00	0.25	19.37	39.14
#80	2.50	0.18	21.97	61.12
#120	3.00	0.13	30.27	91.38
#170	3.50	0.09	7.48	98.86
#200	3.75	0.08	0.55	99.41
#230	4.00	0.06	0.08	99.49

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.24	2.88	2.73	2.25	1.63	1.37	0.96

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.16	0.22	2.25	0.21	0.7	-0.37	2.42

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Cangrejo @ 0.001 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
805,200	878,762	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 5/2	#200 - 1.25 #230 - 1.14			16.7

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#10	-1.00	2.00	0.00	0.00
#14	-0.50	1.40	0.01	0.01
#18	0.00	1.00	0.06	0.07
#25	0.50	0.71	0.71	0.78
#35	1.00	0.50	3.54	4.33
#45	1.50	0.36	10.04	14.36
#60	2.00	0.25	12.18	26.54
#80	2.50	0.18	17.11	43.65
#120	3.00	0.13	41.77	85.42
#170	3.50	0.09	12.49	97.92
#200	3.75	0.08	0.84	98.75
#230	4.00	0.06	0.10	98.86

SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.38	2.98	2.88	2.58	1.94	1.57	1.03

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.37	0.19	2.58	0.17	0.7	-0.82	3.07

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Cangrejo @ 0.002 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
805,200	878,762	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
	10YR 5/2	#200 - 12.50 #230 - 6.29			15.8

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	4.00	0.13	0.13
#7	-1.50	2.80	0.19	0.32
#10	-1.00	2.00	0.23	0.55
#14	-0.50	1.40	0.17	0.72
#18	0.00	1.00	0.24	0.96
#25	0.50	0.71	0.32	1.28
#35	1.00	0.50	0.47	1.75
#45	1.50	0.36	0.55	2.30
#60	2.00	0.25	1.36	3.66
#80	2.50	0.18	5.17	8.83
#120	3.00	0.13	26.28	35.11
#170	3.50	0.09	37.75	72.86
#200	3.75	0.08	14.64	87.50
#230	4.00	0.06	6.21	93.71

SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, little fine-grained sand-sized shell fragments, few silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.69	3.54	3.20	2.81	2.64	2.13

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	3.05	0.12	3.20	0.11	0.67	-3.2	20.11

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: San Juan - Cangrejo @ 0.003 ft

Analysis Date: 4/25/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
805,200	878,762	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
	2.5Y 5/1	#200 - 27.75 #230 - 14.78			19.3

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.22	0.22
#4	-2.25	4.75	0.00	0.22
#5	-2.00	4.00	0.00	0.22
#7	-1.50	2.80	0.15	0.36
#10	-1.00	2.00	0.07	0.43
#14	-0.50	1.40	0.05	0.48
#18	0.00	1.00	0.11	0.59
#25	0.50	0.71	0.14	0.72
#35	1.00	0.50	0.23	0.96
#45	1.50	0.36	0.30	1.26
#60	2.00	0.25	0.52	1.78
#80	2.50	0.18	1.81	3.59
#120	3.00	0.13	14.57	18.16
#170	3.50	0.09	33.81	51.98
#200	3.75	0.08	20.28	72.25
#230	4.00	0.06	12.97	85.22

SAND, silty, mostly fine-grained sand-sized quartz, little silt, little fine-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.98	3.80	3.47	3.10	2.93	2.55

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	3.27	0.10	3.47	0.09	0.63	-4.46	36.85

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

9.1.2 LA ESPERANZA RSM SAND SOURCE

- Boring Logs
- Gradation Graphs

Boring Designation SJH-HA-1

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1 SHEETS

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-HA-1
LOCATION COORDINATES	X = 760,121 Y = 881,499
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	2.8 Ft.
9. SIZE AND TYPE OF BIT	See Notes
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 3 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	-2.2 Ft.
15. DATE BORING	STARTED 11-15-13 / COMPLETED 11-15-13
16. ELEVATION TOP OF BORING	-2.0 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-2.0	0.0						-2.0		
			SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some medium to coarse-grained sand-sized shell, trace silt, trace fine gravel-sized coral, trace plant debris, wet, 5Y 4/3 olive (SP)		1				
-3.2	1.2				2				
-3.5	1.5		From El. -2.7 to -3.8 Ft., mostly medium to coarse-grained sand-sized quartz, little shell, few coral, 5Y 5/2 olive gray				Hand Auger		
					3				
-4.8	2.8		SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized dark minerals, few fine to medium-grained sand-sized shell (SP-SM)				-4.8		
			SAND, well-graded, mostly fine to coarse-grained sand-sized sand, some sand to gravel-sized shell, little fine gravel-sized coral, 5Y 5/1 gray (SW) From El. -4.0 to -4.8 Ft., trace silt, moist, about 25% shell						

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. GPS Coordinates: N18.45363, W-66.13337

0 5 10 15

SAJ FORM 1836
JUN 02

Boring Designation SJH-HA-2

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1 SHEETS

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-HA-2
LOCATION COORDINATES	X = 760,347 Y = 881,035
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	3.2 Ft.
9. SIZE AND TYPE OF BIT	See Notes
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 0 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	-2.8 Ft.
15. DATE BORING	STARTED 11-15-13 / COMPLETED 11-15-13
16. ELEVATION TOP OF BORING	-2.0 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-2.0	0.0								
-3.0	1.0		SAND, poorly-graded, mostly fine-grained sand-sized dark minerals, few fine gravel-sized shell, trace plant debris, trace silt, moist, 5Y 4/3 olive (SP)						
-3.5	1.5		SHELL, mostly sand to gravel-sized shell, some fine-grained sand-sized dark minerals, little sand to gravel-sized coral, trace plant debris, wet, 2.5Y 5/1 gray						
-4.3	2.3		SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to coarse-grained sand-sized flat shell, few sand to gravel-sized coral, trace silt (SP) At El. -4.0 Ft., increasing silt content (10%)						
-5.0	3.0		SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized dark minerals, few fine gravel-sized shell, 10YR 5/2 grayish brown (SP-SM)						
-5.2	3.2		SAND, well-graded, mostly fine to coarse-grained sand-sized dark minerals, some medium to coarse-grained sand-sized coral, little shell, trace silt (SW)				-5.2		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. GPS Coordinates: N18.45242, W-66.13274

0
5
10
15

SAJ FORM 1836
JUN 02

Boring Designation SJH-HA-3

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1 SHEETS

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-HA-3
LOCATION COORDINATES	X = 760,590 Y = 880,872
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	3.0 Ft.
9. SIZE AND TYPE OF BIT	See Notes
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 0 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	-2.7 Ft.
15. DATE BORING	STARTED 11-15-13 / COMPLETED 11-15-13
16. ELEVATION TOP OF BORING	-2.0 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-2.0	0.0								
-3.3	1.3		SAND, well-graded, mostly fine to coarse-grained sand-sized sand, some sand to gravel-sized coral, little sand to gravel-sized shell, trace silt, moist, few garbage and rubble (includes cans, construction debris, plastic), 10YR 5/3 brown (SW)						
-3.5	1.5		At El. -2.7 Ft., some sand to gravel-sized shell, few sand to gravel-sized coral						
-4.3	2.3		SAND, poorly-graded, mostly fine to medium-grained sand-sized dark minerals, little medium to coarse-grained sand-sized shell, discontinue coral, wet, hole collapsing at 0.75", 5Y 5/2 olive gray (SP)						
-5.0	3.0		SAND, well-graded, mostly fine to coarse-grained sand-sized sand, some fine to coarse-grained sand-sized shell, little medium to coarse-grained sand-sized coral (SW)				-5.0		
			SAND, poorly-graded, mostly fine to medium-grained sand-sized dark minerals, little medium to coarse-grained sand-sized shell, trace silt (SP)						

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. GPS Coordinates: N18.451900, W-66.132022

0 5 10 15

SAJ FORM 1836
JUN 02

DRILLING LOG

DIVISION South Atlantic		**INSTALLATION** Jacksonville District	**SHEET** 1 **OF** 2 **SHEETS**
1. PROJECT Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area		**9. SIZE AND TYPE OF BIT** See Remarks	
		10. COORDINATE SYSTEM/DATUM State Plane, PR/VI (U.S. Ft.)	**HORIZONTAL** NAD83 / **VERTICAL** PRVD02
2. BORING DESIGNATION SJH-LE-1	**LOCATION COORDINATES** X = 760,284 Y = 881,658	**11. MANUFACTURER'S DESIGNATION OF DRILL**	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY Corps of Engineers - CESAJ	**CONTRACTOR FILE NO.**	**12. TOTAL SAMPLES**	**DISTURBED** 5 / **UNDISTURBED (UD)** 0
4. NAME OF DRILLER Bernard J Seifert		**13. TOTAL NUMBER CORE BOXES** 0	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED	**DEG. FROM VERTICAL** / **BEARING**	**14. ELEVATION GROUND WATER** N/A	
		15. DATE BORING	**STARTED** 04-22-14 / **COMPLETED** 04-22-14
6. THICKNESS OF OVERBURDEN N/A		**16. ELEVATION TOP OF BORING** -0.2 Ft.	
7. DEPTH DRILLED INTO ROCK N/A		**17. TOTAL RECOVERY FOR BORING** N/A	
8. TOTAL DEPTH OF BORING 3.7 Ft.		**18. SIGNATURE AND TITLE OF INSPECTOR** Bernard J Seifert, P.G., Geologist	

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-0.2	0.0						-0.2		
-1.8	1.6		SAND, poorly-graded, mostly quartz, 2.5Y 5/2 grayish brown (SP)		1		-1.8		
-2.3	2.1		SAND, poorly-graded with silt, 2.5Y 2.5/1 black (SP-SM)		2		-2.3		
-3.3	3.1		SHELL, mostly medium to coarse-grained sand-sized shell, few fine to medium-grained sand-sized quartz, few silt, from 2.4' to 3.1',		3		-3.3		
-3.6	3.4		increasing silt content, 2.5Y 4/1 dark gray		4		-3.6		
-3.9	3.7		SAND, silty, mostly angular to subangular fine-grained sand-sized shell, few fine to medium-grained sand-sized coral (SM)		5		-3.9		
			SILT, inorganic-L, low plasticity, soft, mostly silt, no odor, 5Y 4/1 dark gray (ML)				Abbreviations:		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

6. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 760,284 Y = 881,658	-0.2 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			1 0.0/1.5 SP* 2 1.6/2.1 SP* 3 2.1/3.0 SP* 4 3.1/3.3 SP-SM* *Lab visual classification based on gradation curve SAMPLE DEPTH / LABORATORY SOIL TESTING / RESULT / UNIT 3.4 Atterberg (PI) 30						

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-2
LOCATION COORDINATES	X = 760,715 Y = 881,251
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	2.3 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 3 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	N/A
15. DATE BORING	STARTED 04-23-14 / COMPLETED 04-23-14
16. ELEVATION TOP OF BORING	-1.6 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-1.6	0.0						-1.6		
			SAND, poorly-graded with silt, mostly subangular to subrounded fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, few silt, trace fine gravel-sized coral, 2.5Y 4/2 dark grayish brown (SP-SM)		1				
-2.9	1.3		At El. -2.1 Ft., lensed with silty sand, 2.5Y 2.5/1 black				-2.9		
-3.2	1.7		At El. -2.3 Ft., increasing silt content, grades to SM at 1.3'		2		-3.3		
-3.9	2.3		SHELL, mostly angular to subangular medium-grained sand-sized shell, some silt		3		-3.9		
			SILT, inorganic-L, low plasticity, soft, mostly silt, few fine-grained sand-sized shell, 5GY 3/2 grayish olive green (ML)				Abbreviations:		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. There was 1.6' of water at this location at time of drilling.

6. Boring sealed with available sediment.

7. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 760,715 Y = 881,251	-1.6 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			1 0.0/0.5 SP* 2 1.3/1.6 SM* 3 1.7/2.0 MH *Lab visual classification based on gradation curve SAMPLE DEPTH / LABORATORY SOIL TESTING / RESULT / UNIT 1.7 Atterberg (PI) 23						

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, PR/VI (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: PRVD02
2. BORING DESIGNATION: SJH-LE-3	LOCATION COORDINATES: X = 760,255 Y = 881,426	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Corps of Engineers - CESAJ	CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 3 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Bernard J Seifert		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER: N/A	
		15. DATE BORING	STARTED: 04-22-14 / COMPLETED: 04-22-14
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: -1.1 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 2.5 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: Bernard J Seifert, P.G., Geologist	

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-1.1	0.0						-1.1		
-1.9	0.8		SHELL, mostly angular to subangular fine to coarse-grained sand-sized shell, few subangular to subrounded fine to medium-grained sand-sized quartz, trace fine to coarse gravel-sized coral, 2.5Y 5/3 light olive brown		1		-1.9		
					2		-2.5		
			SHELL, mostly angular to subrounded coarse-grained sand-sized shell, trace silt, SHELL hash layer, 2.5Y 6/8 olive yellow		3				
-3.6	2.5		At El. -2.8 Ft., trace fine gravel-sized shell, 2.5Y 4/1 dark gray				-3.6		

Abbreviations:

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. There was 0.6' of water at this location at time of drilling.

6. Boring sealed with available sediment.

7. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/0.7	SP*
2	0.8/1.1	SP*
3	1.4/2.0	SP*

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT Puerto Rico Coastal Project	COORDINATE SYSTEM/DATUM State Plane, PR/VI (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL PRVD02
LOCATION COORDINATES X = 760,255 Y = 881,426	ELEVATION TOP OF BORING -1.1 Ft.		

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			*Lab visual classification based on gradation curve						

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area	9. SIZE AND TYPE OF BIT	See Remarks
		10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.) — HORIZONTAL: NAD83 — VERTICAL: PRVD02
2. BORING DESIGNATION	SJH-LE-4 — LOCATION COORDINATES: X = 760,464 Y = 881,187	11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY	Corps of Engineers - CESAJ — CONTRACTOR FILE NO.	12. TOTAL SAMPLES	DISTURBED: 2 — UNDISTURBED (UD): 0
4. NAME OF DRILLER	Bernard J Seifert	13. TOTAL NUMBER CORE BOXES	0
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED — DEG. FROM VERTICAL: — BEARING:	14. ELEVATION GROUND WATER	N/A
		15. DATE BORING	STARTED: 04-22-14 — COMPLETED: 04-22-14
6. THICKNESS OF OVERBURDEN	N/A	16. ELEVATION TOP OF BORING	-2.2 Ft.
7. DEPTH DRILLED INTO ROCK	N/A	17. TOTAL RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	1.5 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-2.2	0.0						-2.2		
-2.4	0.2		SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz (SP)		1		-2.9		
-3.7	1.5		SHELL, mostly sand to gravel-sized flat shell, trace sand to gravel-sized coral, 2.5Y 4/2 dark grayish brown -At El. -2.5 Ft., mostly sand to gravel-sized shell -At El. -2.8 Ft., stratified up to 1/2", shell hash layer -At El. -2.9 Ft., mostly fine-grained sand-sized shell, little silt		2		-3.7		

Abbreviations:

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. There was 1.7' of water at this location at time of drilling.

6. Boring sealed with available sediment.

7. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/0.6	SP*
2	0.7/1.4	SP*

*Lab visual classification based on gradation

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT Puerto Rico Coastal Project	COORDINATE SYSTEM/DATUM State Plane, PR/VI (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL PRVD02
LOCATION COORDINATES X = 760,464 Y = 881,187	ELEVATION TOP OF BORING -2.2 Ft.		

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			curve						

15
20
25
30
35

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-5
LOCATION COORDINATES	X = 760,245 Y = 881,208
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	5.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 4 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	0.0 Ft.
15. DATE BORING	STARTED 04-25-14 / COMPLETED 04-25-14
16. ELEVATION TOP OF BORING	2.4 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
2.4	0.0						2.4		
1.3	1.2		SAND, poorly-graded, mostly subangular to subrounded fine-grained sand-sized quartz, some sand to gravel-sized shell, dry, about 35% shell, 2.5Y 6/2 light brownish gray (SP) At El. 1.6 Ft., some medium-grained sand-sized shell, about 40-45% shell		1		1.2		
-0.7	3.2		SHELL, mostly sand to gravel-sized shell and coral, some fine to medium-grained sand-sized quartz, trace silt From El. 0.1 to 0.0 Ft., stratified with silty sand up to 1-3/8", about 15% silt, organic odor, 5Y 2.5/1 black At El. 0.0 Ft. From El. -0.2 to -0.3 Ft., stratified with shell up to 1-1/4", SHELL HASH layer, 5Y 4/2 olive gray At El. -0.3 Ft., trace silt At El. -0.6 Ft., trace coarse gravel-sized coral SHELL, mostly medium-grained sand-sized shell, some fine-grained sand-sized quartz At El. -0.9 Ft., mostly fine-grained sand-sized shell, some fine-grained sand-sized quartz, about 30% quartz At El. -1.8 Ft., stratified with shell up to 1/4", SHELL HASH layer, flat, medim to coarse coarse grained sand-sized		2 3		-0.1 -0.8		
-2.6	5.0				4		-2.6		

Abbreviations:

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 760,245 Y = 881,208	2.4 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE

5. Boring sealed with available sediment.

6. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/0.8	SP*
2	1.2/2.0	SP*
3	2.5/2.8	SP*
4	3.2/4.5	SP*

*Lab visual classification based on gradation curve

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-5A
LOCATION COORDINATES	X = 760,264 Y = 881,220
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	5.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 6 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	0.0 Ft.
15. DATE BORING	STARTED 04-23-14 / COMPLETED 04-23-14
16. ELEVATION TOP OF BORING	2.2 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
2.2	0.0						2.2		
1.3	0.9		SAND, poorly-graded, mostly subangular to subrounded fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell, trace plant debris, dry, 2.5Y 5/2 grayish brown (SP)		1		1.3		
			SHELL, mostly fine to medium-grained sand-sized shell, trace coarse-grained sand-sized flat shell		2		0.0		
			At El. 0.9 Ft., trace coarse gravel-sized shell, trace coarse gravel-sized coral		3		-0.3		
-1.4	3.6		At El. 0.6 Ft., little fine to medium-grained sand-sized quartz		4		-1.4		
-1.8	4.0		At El. 0.3 Ft., trace manufactured debris		5		-1.8		
			From El. 0.0 to -0.4 Ft., little silt, stratified up to 1/4", no odor, 5Y 4/3 olive		6				
-2.8	5.0		From El. -0.3 to -1.2 Ft., mostly fine-grained sand-sized shell, few quartz, 5Y 5/2 olive gray				-2.8		
			SAND, silty, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell, little silt, 5Y 2.5/1 black (SM)				Abbreviations:		
			SHELL, mostly fine-grained sand-sized shell, 5Y 4/2 olive gray						
			At El. -2.1 Ft., mostly fine to medium-grained sand-sized shell						

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT -

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 760,264 Y = 881,220	2.2 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			Adjustment 2011 and PRVD02, respectively***						
			5. Boring sealed with available sediment.						
			6. Laboratory Testing Results						

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/0.9	SP*
2	0.9/1.9	SP*
3	2.2/2.4	SP*
4	2.5/3.5	SP*
5	3.6/3.9	SP-SM*
6	4.0/4.3	SP-SM*

*Lab visual classification based on gradation curve

15 20 25 30 35

SAJ FORM 1836-A
JUN 02

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-6
LOCATION COORDINATES	X = 760,714 Y = 880,918
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	5.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 5 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	-0.2 Ft.
15. DATE BORING	STARTED 04-23-14 / COMPLETED 04-23-14
16. ELEVATION TOP OF BORING	1.8 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
1.8	0.0						1.8		
0.6	1.2		SAND, poorly-graded, mostly subangular to subrounded fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell, 2.5Y 5/2 grayish brown (SP)		1				
			SHELL, mostly fine to medium-grained sand-sized shell, about 15% quartz sand From El. 0.0 to -0.7 Ft., few sand to gravel-sized flat shell, trace elongated coral				0.0		
					2		-0.8		
-1.5	3.3		At El. -1.2 Ft., trace plant debris, trace coarse gravel-sized coral, stratified up to 1.5" SHELL HASH, coarse sand to fine gravel-sized		3		-1.5		
-2.0	3.8				4		-2.0		
-3.2	5.0		SAND, poorly-graded with silt, mostly subangular quartz, about 5-7% silt, about 25% fine sand-sized shell, 5Y 4/1 dark gray (SP-SM) From El. -1.6 to -1.8 Ft., trace wood debris, trace subrounded fine gravel-sized coral, organic odor		5		-3.2		
			SHELL, mostly medium-grained sand-sized shell, little fine to medium-grained sand-sized quartz, trace fine gravel-sized flat shell, about 25% quartz, 5Y 3/1 very dark gray From El. -2.6 to -2.7 Ft., mostly fine sand-sized shell, about 10% silt, 5Y 4/1 dark gray				Abbreviations:		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT -

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 760,714 Y = 880,918	1.8 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE

Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

6. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/1.1	SP*
2	1.8/2.5	SP*
3	2.6/3.2	SP*
4	3.3/3.6	SP-SM*
5	3.8/4.4	SP-SM*

*Lab visual classification based on gradation curve

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-7
LOCATION COORDINATES	X = 760,500 Y = 880,973
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	5.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 5 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	0.2 Ft.
15. DATE BORING	STARTED 04-23-14 / COMPLETED 04-23-14
16. ELEVATION TOP OF BORING	2.2 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
2.2	0.0						2.2		
1.7	0.5		SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine-grained sand-sized shell, 2.5Y 6/3 light yellowish brown (SP)		1		1.7		
			SHELL, mostly sand to gravel-sized shell, some sand to gravel-sized coral At El. 1.2 Ft., discontinue fine gravel-sized coral, discontinue fine gravel-sized shell From El. 1.0 to 0.8 Ft., trace fine gravel-sized shell		2		1.1		
					3		-0.1		
-0.7	2.9				4		-0.7		
			At El. 0.7 Ft., mostly fine-grained sand-sized shell, about 25% quartz At El. 0.1 Ft., trace fine gravel-sized intact coral and flat shell From El. -0.1 to -0.6 Ft., mostly sand to gravel-sized shell, trace fine gravel-sized coral		5				
-2.8	5.0						-2.8		
			SAND, poorly-graded, mostly fine-grained sand-sized quartz, about 25% fine to medium sand-sized shell, trace fine gravel-sized coral, 2.5Y 2.5/1 black (SP) At El. -2.1 Ft., discontinue coral, 5Y 5/3 olive				Abbreviations:		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

6. Laboratory Testing Results

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 760,500 Y = 880,973	2.2 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/0.4	SP*
2	0.5/0.9	SP*
3	1.1/2.1	SP*
4	2.3/2.8	SW*
5	2.9/4.4	SP*

*Lab visual classification based on gradation curve

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

Boring Designation SJH-LE-8A

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 1 SHEETS

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-8A
LOCATION COORDINATES	X = 760,354 Y = 880,945
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	1.5 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 2 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	N/A
15. DATE BORING	STARTED 04-22-14 / COMPLETED 04-22-14
16. ELEVATION TOP OF BORING	-1.8 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-1.8	0.0						-1.8		
-2.3	0.5		SAND, silty, mostly angular to subrounded fine to medium-grained sand-sized shell, some silt, trace fine gravel-sized elongated coral, 5Y 2.5/1 black (SM)		1				
							-2.8		
-3.3	1.5		SHELL, little fine-grained sand-sized quartz, few coarse gravel-sized shell, 5Y 4/1 dark gray At El. -2.8 Ft., trace silt, trace coarse gravel-sized coral, 5Y 5/1 gray		2		-3.3		

Abbreviations:

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

6. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/0.5	SM*
2	1.0/1.4	SP-SM*

*Lab visual classification based on gradation curve

0
5
10
15

SAJ FORM 1836
JUN 02

Boring Designation SJH-LE-9

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-9
LOCATION COORDINATES	X = 760,780 Y = 880,730
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	5.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 3 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	0.0 Ft.
15. DATE BORING	STARTED 04-23-14 / COMPLETED 04-23-14
16. ELEVATION TOP OF BORING	1.4 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
1.4	0.0						1.4		
0.2	1.2		SHELL, mostly subangular fine-grained sand-sized shell, some fine-grained sand-sized quartz, stratified, trace algae, 2.5Y 5/3 light olive brown		1		0.2		
-1.2	2.6		At El. 0.8 Ft., stratified with shell up to 1/2", coarse sand-sized SHELL HASH layer At El. 0.6 Ft., mostly fine to medium-grained sand-sized shell At El. 0.3 Ft., stratified with shell up to 1", coarse angular to rounded fine sand-sized to fine gravel-sized SHELL HASH layer		2		-1.2		
-3.6	5.0		SAND, poorly-graded, mostly subangular to subrounded fine-grained sand-sized quartz, little fine to medium-grained sand-sized shell, 5Y 5/2 olive gray (SP) SHELL, mostly fine to coarse-grained sand-sized shell, trace fine to coarse gravel-sized coral At El. -2.0 Ft., stratified with shell up to 1/2", coarse sand-sized SHELL HASH layer		3		-3.6		

Abbreviations:

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

6. Laboratory Testing Results

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 760,780 Y = 880,730	1.4 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			SAMPLE ID / SAMPLE DEPTH / LABORATORY CLASSIFICATION 1 0.0/1.1 SP* 2 1.2/2.2 SP* 3 2.6/3.6 SP* *Lab visual classification based on gradation curve						

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

Boring Designation SJH-LE-10

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-10
LOCATION COORDINATES	X = 760,619 Y = 880,645
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	4.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 3 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	N/A
15. DATE BORING	STARTED 04-23-14 / COMPLETED 04-23-14
16. ELEVATION TOP OF BORING	1.4 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
1.4	0.0								
1.3	0.2		SAND, poorly-graded with silt, mostly subangular to subrounded fine to medium-grained sand-sized quartz, little medium-grained sand-sized shell, trace coarse gravel-sized shell, 2.5Y 4/3 olive brown (SP-SM)		1		1.2		
			SAND, poorly-graded, mostly angular to subrounded fine to medium-grained sand-sized quartz, little fine to coarse-grained sand-sized shell, 20-25% shell, 2.5Y 5/2 grayish brown (SP)		2		-0.6		
			At El. -0.6 Ft., little fine gravel-sized flat shell, trace subangular fine gravel-sized coral, trace silt, broken flat shell fragments, 2.5Y 4/1 dark gray		3		-1.5		
-2.6	4.0		At El. -1.0 Ft., trace plant debris At El. -1.4 Ft., discontinue plant debris, discontinue silt, about 35-40% medium to coarse sand-sized shell, 2.5Y 5/2 grayish brown At El. -1.7 Ft., stratified with shell up to 1/2", 1/2" layer of SHELL HASH				-2.6		

Abbreviations:

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: 14-020-01; NORTHING (ft): 881807.03; EASTING (ft): 760509.76; Elevation (ft): 4.79
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

6. Laboratory Testing Results

(Continued)

SAJ FORM 1836
JUN 02

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 760,619 Y = 880,645	1.4 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			SAMPLE ID / SAMPLE DEPTH / LABORATORY CLASSIFICATION 1 0.2/1.5 SP* 2 2.0/2.6 SP* 3 2.9/3.4 SP* *Lab visual classification based on gradation curve						

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

Boring Designation SJH-LE-13A

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-13A
LOCATION COORDINATES	X = 759,927 Y = 879,462
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	1.5 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 1 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	N/A
15. DATE BORING	STARTED 04-23-14 / COMPLETED 04-23-14
16. ELEVATION TOP OF BORING	-1.4 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-1.4	0.0						-1.4		
-2.9	1.5		SHELL, mostly angular to subrounded fine-grained sand-sized shell, few silt, trace coarse gravel-sized coral, trace plant debris, about 10% fines, 2.5Y 2.5/1 black		1		-2.9		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: SJH-24; NORTHING (ft): 879246.93; EASTING (ft): 759647.15; Elevation (ft): 3.39
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

6. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/1.0	SP*

*Lab visual classification based on gradation curve

Abbreviations:

0
5
10
15

SAJ FORM 1836
JUN 02

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area
2. BORING DESIGNATION	SJH-LE-15A
LOCATION COORDINATES	X = 759,896 Y = 879,371
3. DRILLING AGENCY	Corps of Engineers - CESAJ
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	Bernard J Seifert
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	4.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	☐ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 3 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	0.3 Ft.
15. DATE BORING	STARTED 04-23-14 / COMPLETED 04-23-14
16. ELEVATION TOP OF BORING	1.0 Ft.
17. TOTAL RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
1.0	0.0						1.0		
			SHELL, mostly sand to gravel-sized shell, trace plant debris, trace fine to coarse gravel-sized coral, trace silt, about 20% quartz sand, discontinue roots below 0.70', 2.5Y 6/3 light yellowish brown From El. -0.2 to -0.7 Ft., some fine-grained sand-sized quartz, discontinue coral, about 40% quartz, 2.5Y 6/2 light brownish gray From El. -1.0 to -1.3 Ft., trace coarse gravel-sized flat shell, discontinue silt At El. -1.3 Ft., mostly fine to medium-grained sand-sized shell, about 15% fine to medium sand-sized quartz		1		-0.2		
					2		-1.2		
					3				
-3.0	4.0						-3.0		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: SJH-24; NORTHING (ft): 879246.93; EASTING (ft): 759647.15; Elevation (ft): 3.39
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

6. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/1.0	SP*
2	1.2/2.0	SP*
3	2.2/3.8	SP*

Abbreviations:

0 5 10 15

SAJ FORM 1836
JUN 02

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
Puerto Rico Coastal Project	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 759,896 Y = 879,371	1.0 Ft.

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
			*Lab visual classification based on gradation curve						

15
20
25
30
35

SAJ FORM 1836-A
JUN 02

Boring Designation SJH-LE-17

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS
	South Atlantic	Jacksonville District	

1. PROJECT	Puerto Rico Coastal Project La Esperanza Peninsula Borrow Area	9. SIZE AND TYPE OF BIT	See Remarks
		10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
		HORIZONTAL	NAD83
		VERTICAL	PRVD02
2. BORING DESIGNATION	SJH-LE-17	LOCATION COORDINATES	X = 759,927 Y = 879,280
11. MANUFACTURER'S DESIGNATION OF DRILL		☐ AUTO HAMMER ☐ MANUAL HAMMER	
3. DRILLING AGENCY	Corps of Engineers - CESAJ	CONTRACTOR FILE NO.	
12. TOTAL SAMPLES	DISTURBED: 2	UNDISTURBED (UD): 0	
4. NAME OF DRILLER	Bernard J Seifert	13. TOTAL NUMBER CORE BOXES	0
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL	BEARING
14. ELEVATION GROUND WATER	N/A		
15. DATE BORING	STARTED: 04-23-14	COMPLETED: 04-23-14	
6. THICKNESS OF OVERBURDEN	N/A	16. ELEVATION TOP OF BORING	-1.3 Ft.
7. DEPTH DRILLED INTO ROCK	N/A	17. TOTAL RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	2.0 Ft.	18. SIGNATURE AND TITLE OF INSPECTOR	Bernard J Seifert, P.G., Geologist

ELEV. (ft)	DEPTH (ft)	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 1 FT.	N-VALUE
-1.3	0.0						-1.3		
			SHELL, mostly medium to coarse-grained sand-sized shell, few subangular to subrounded fine to medium-grained sand-sized quartz, trace fine gravel-sized coral		1				
							-2.9		
-3.3	2.0		At El. -2.8 Ft., stratified with shell up to 1/2", SHELL HASH layer At El. -2.9 Ft., mostly fine-grained sand-sized shell, lensed with poorly-graded sand with silt, pockets of black sand with silt (<10% silt) At El. -3.0 Ft., trace plant debris		2		-3.3		

Abbreviations:

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Due to accessibility to the boring locations in shallow-tidal controlled marine zone, the drilling method employed was by pushing a plastic liner 5' long, 2.5" diameter into soil using a 14-lb metal fence post driver.

4. Top of hole elevations were obtained using existing survey monument and tide measurement at time of drilling. Survey monument data:
DESCRIPTION: SJH-24; NORTHING (ft): 879246.93; EASTING (ft): 759647.15; Elevation (ft): 3.39
*** Horizontal and vertical datum is NAD 83FT - Adjustment 2011 and PRVD02, respectively***

5. Boring sealed with available sediment.

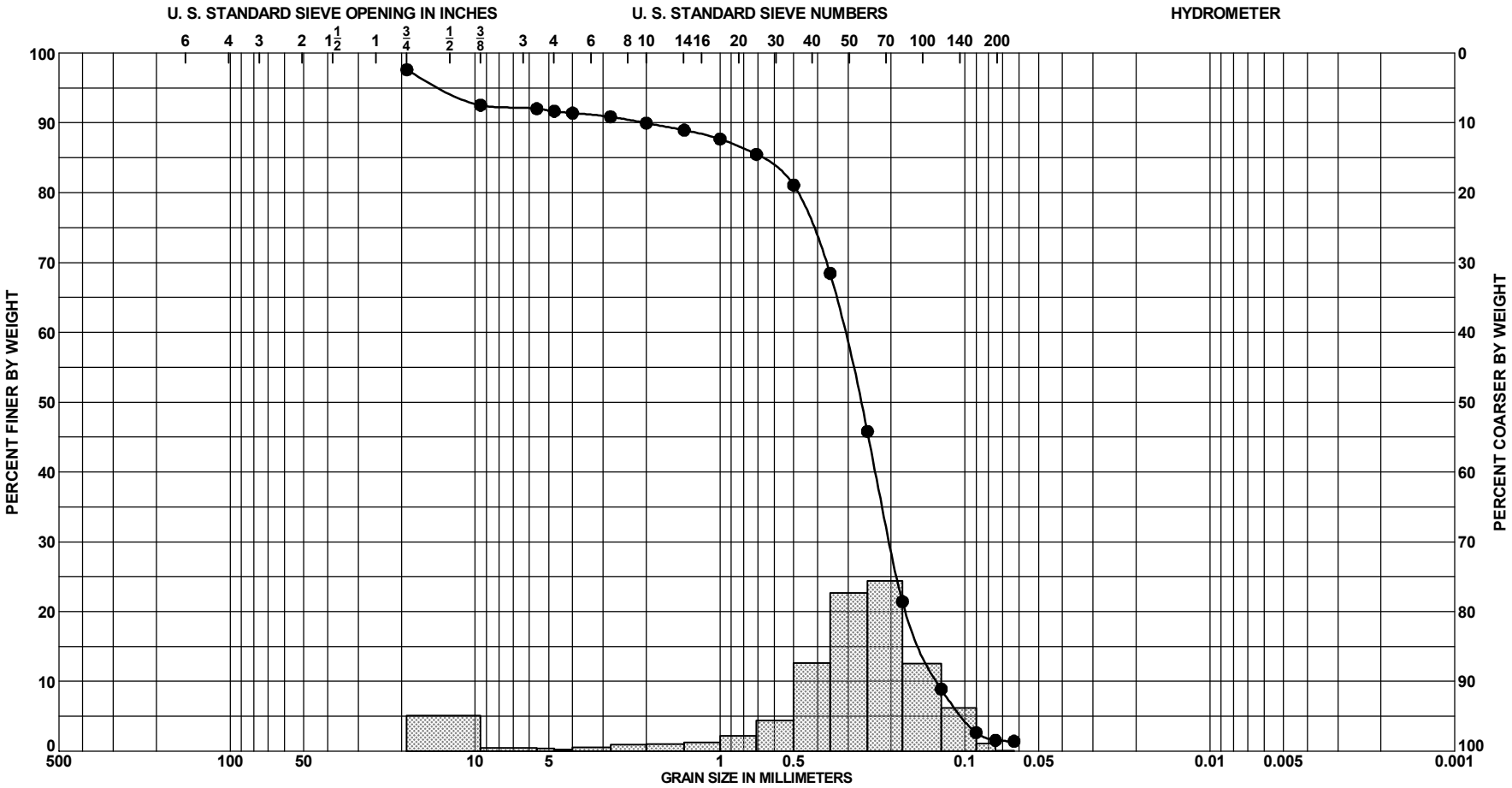
6. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/1.0	SP*
2	1.6/1.8	SP*

*Lab visual classification based on gradation curve

0 5 10 15

SAJ FORM 1836
JUN 02

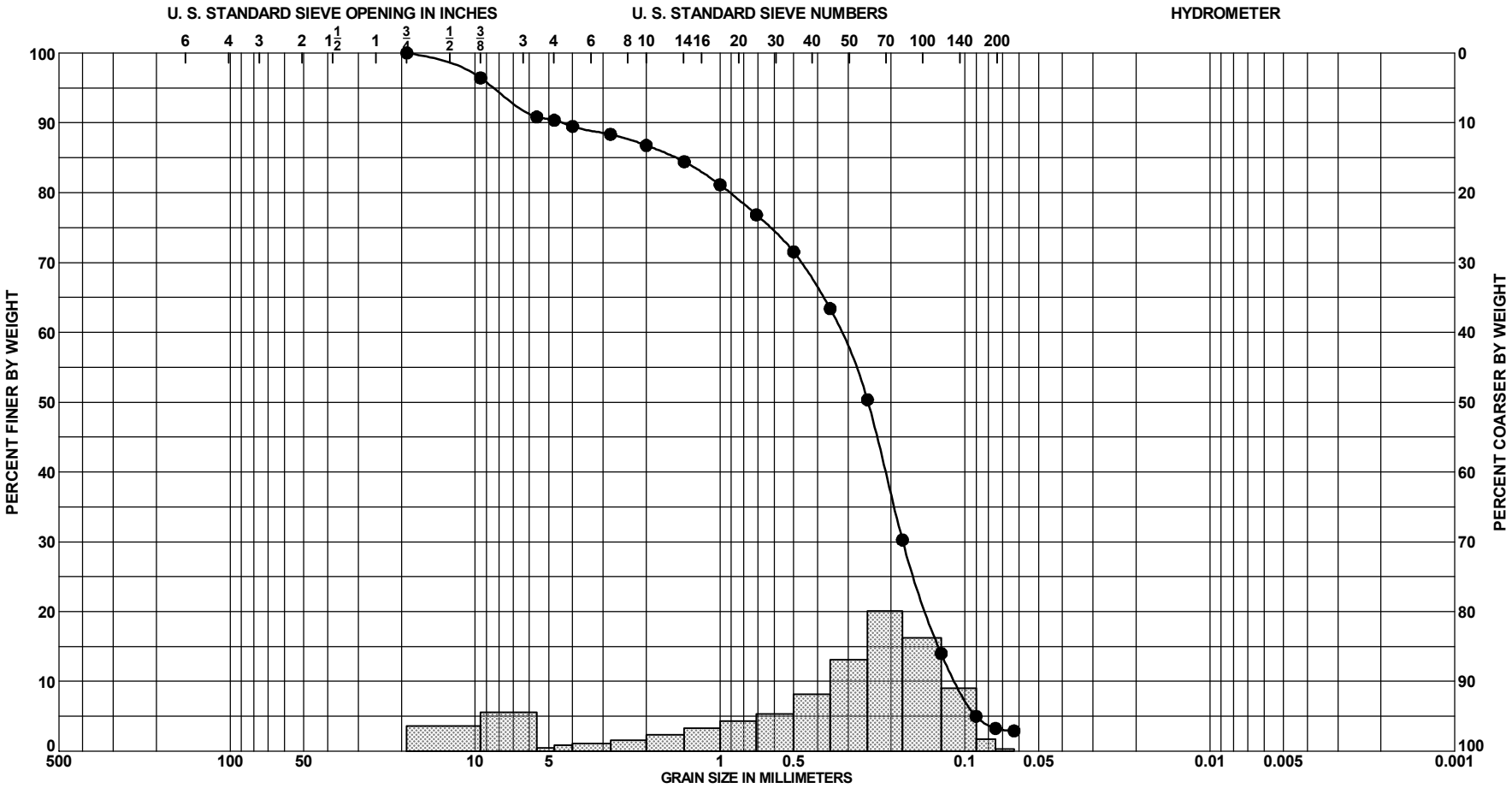


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 1.5 Ft.	SAND, poorly-graded, mostly fine-grained sand-sized quartz, some sand to gravel-sized shell, trace silt, grayish brown (SP)	2.5Y 5/2		61						

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-1
BORING ELEV.	-0.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

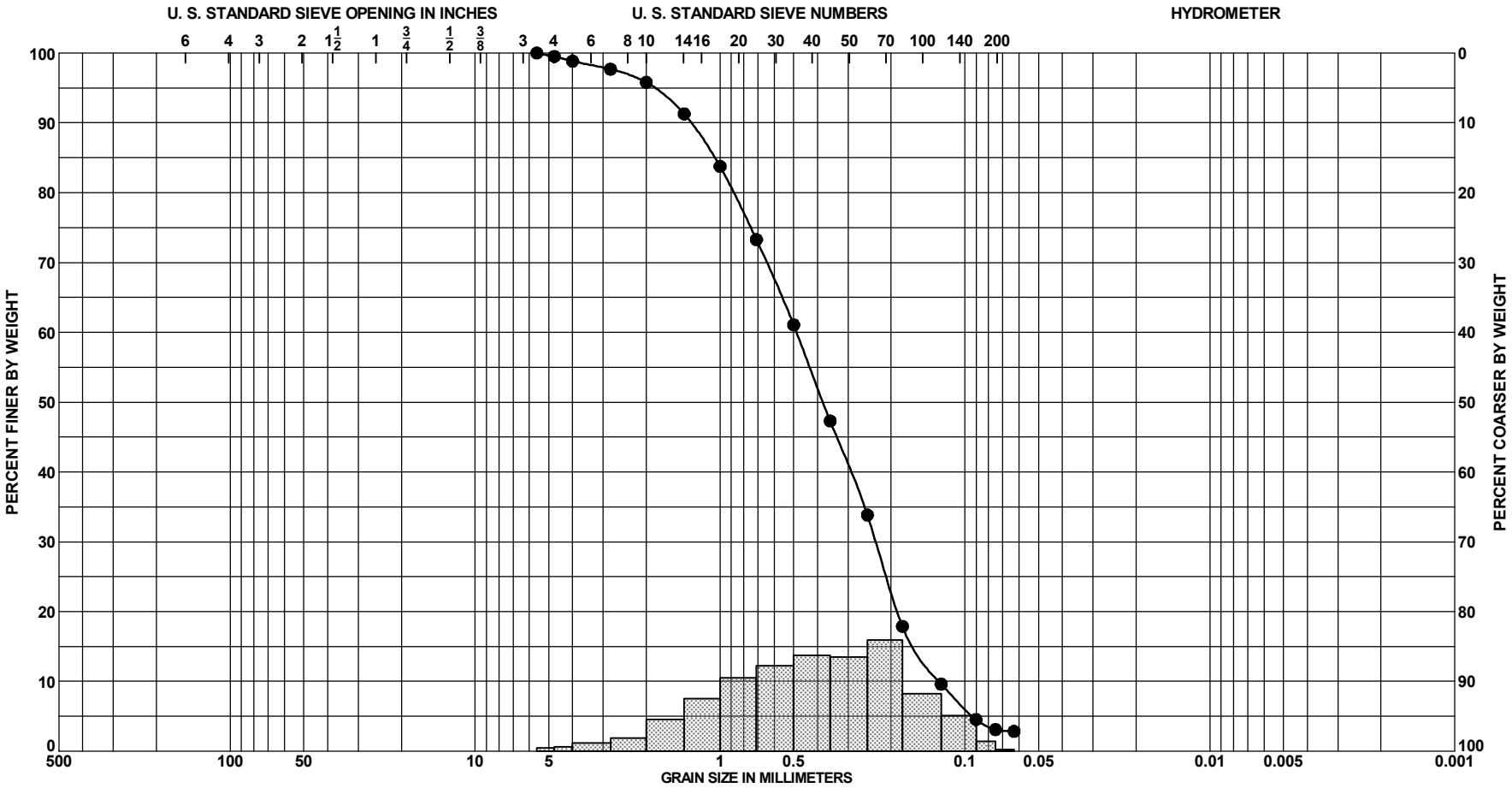


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	1.6 to 2.1 Ft.	SAND, poorly-graded, mostly sand to gravel-sized shell, some fine-grained sand-sized quartz, trace silt, dark grayish brown (SP)	2.5Y 4/2								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-1
BORING ELEV.	-0.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

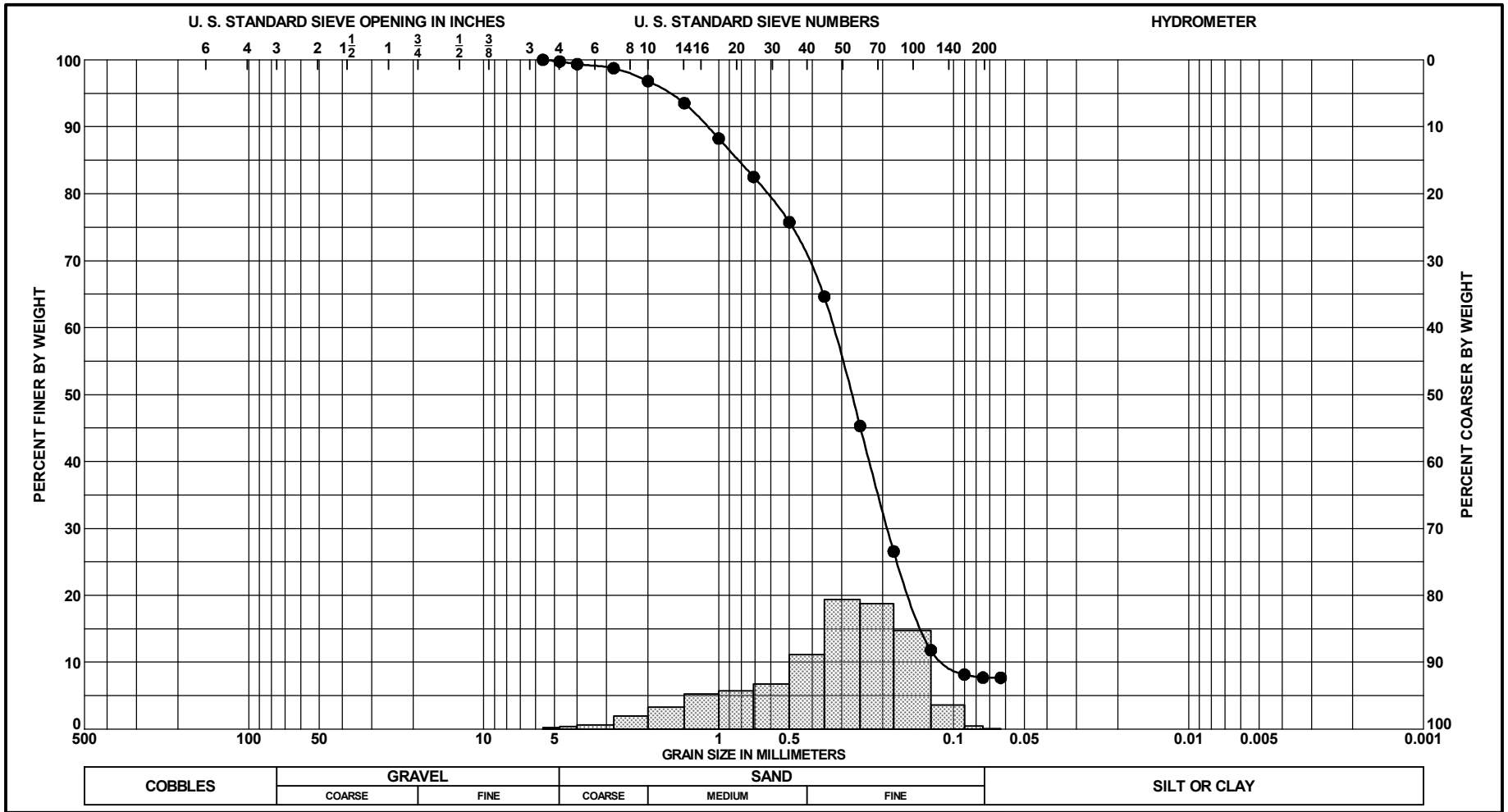


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	2.1 to 3.0 Ft.	SAND, poorly-graded, moslty fine to medium-grained sand-sized shell, some fine-grained sand-sized quartz, trace silt, gray (SP)	2.5Y 5/1								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-1
BORING ELEV.	-0.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

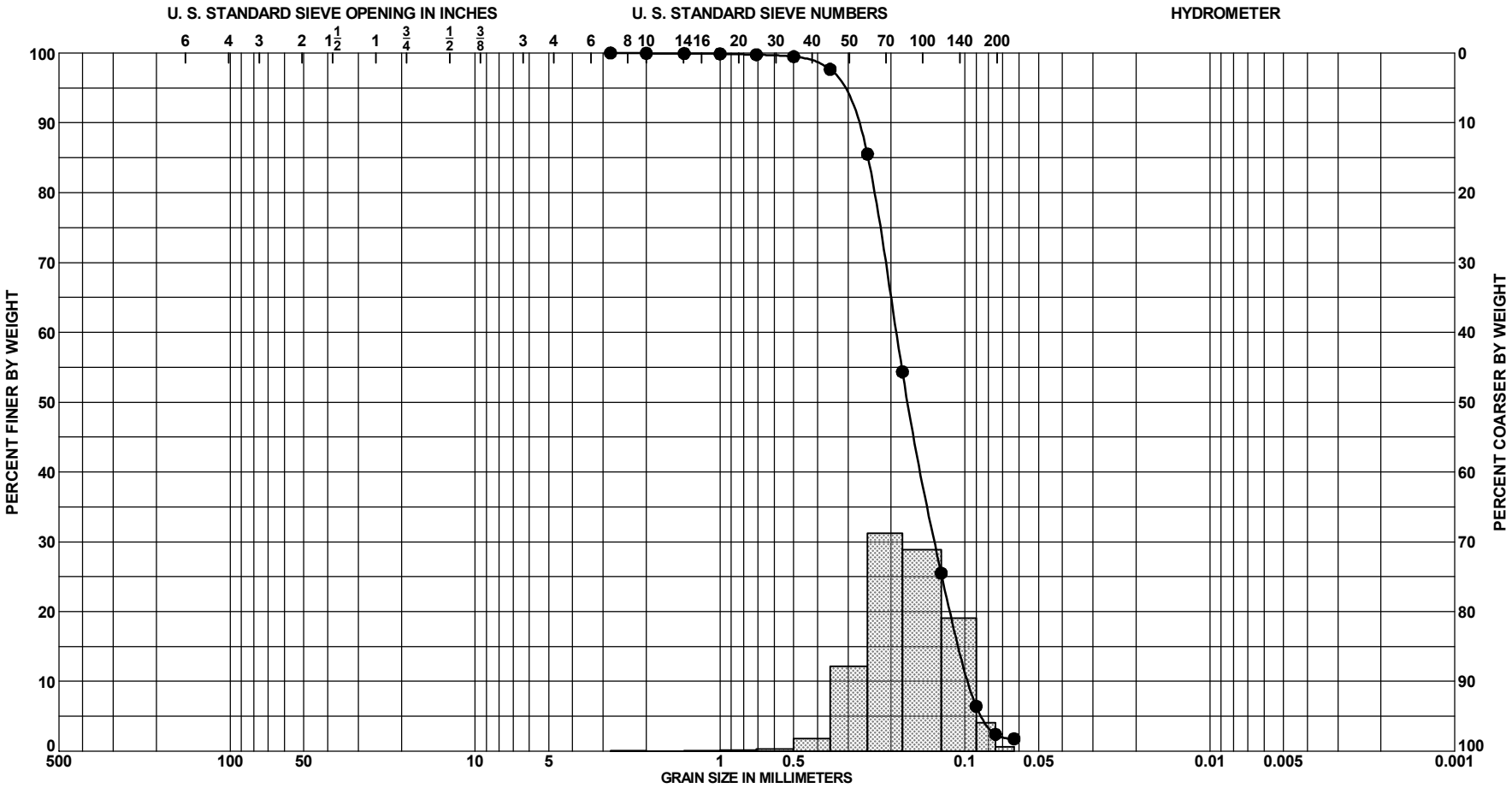


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 4	3.1 to 3.3 Ft.	SAND, poorly-graded with silt, mostly	2.5Y 5/2								
		fine to medium-grained sand-sized									
		shell, some fine-grained sand-sized									
		quartz, few silt, grayish brown									
		(SP-SM)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-1
BORING ELEV.	-0.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

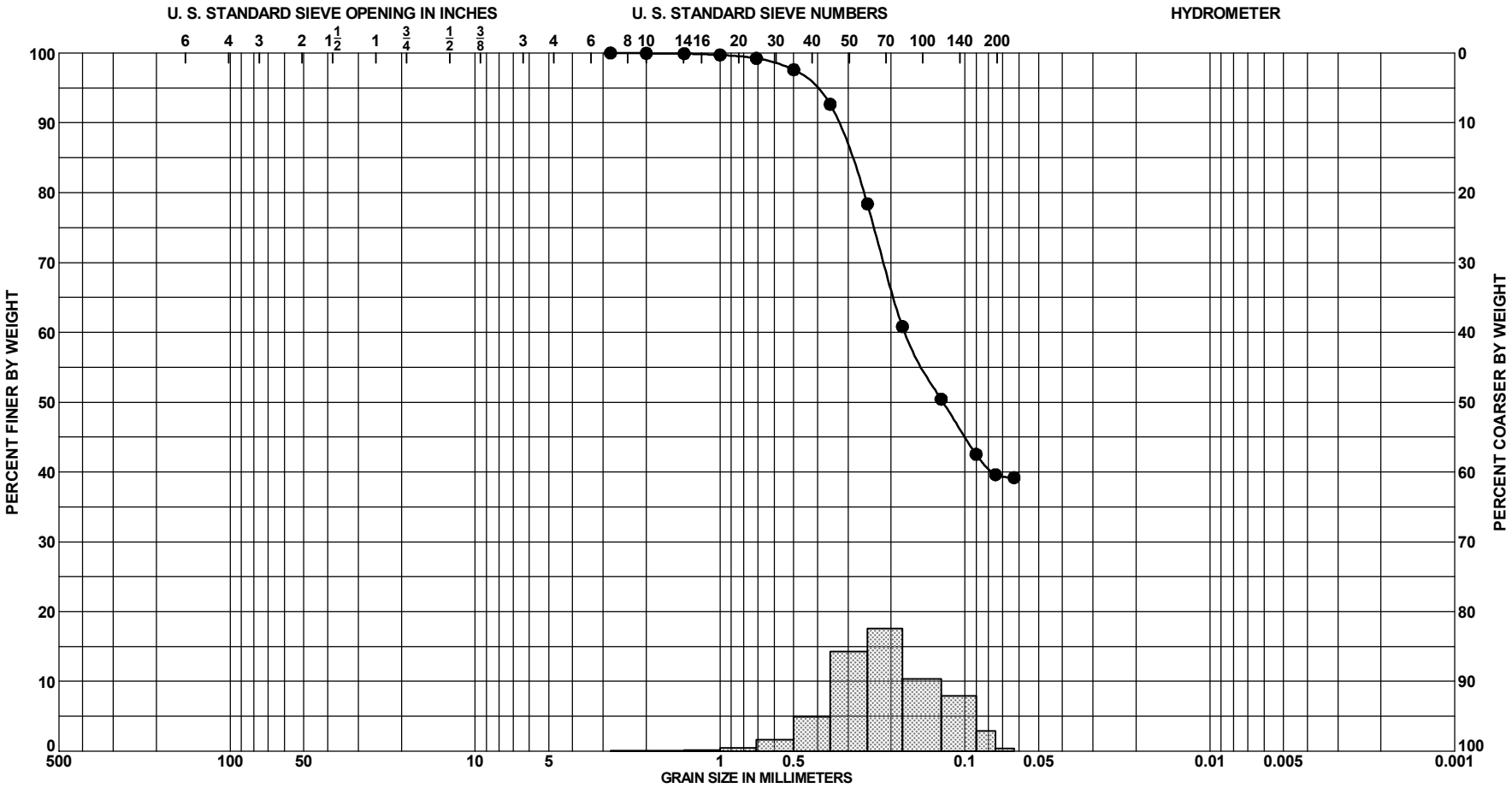


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.5 Ft.	SAND, poorly-graded, mostly	10YR 4/2								
		fine-grained sand-sized shell, little									
		fine-grained sand-sized quartz, trace									
		silt, dark grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-2
BORING ELEV.	-1.6 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

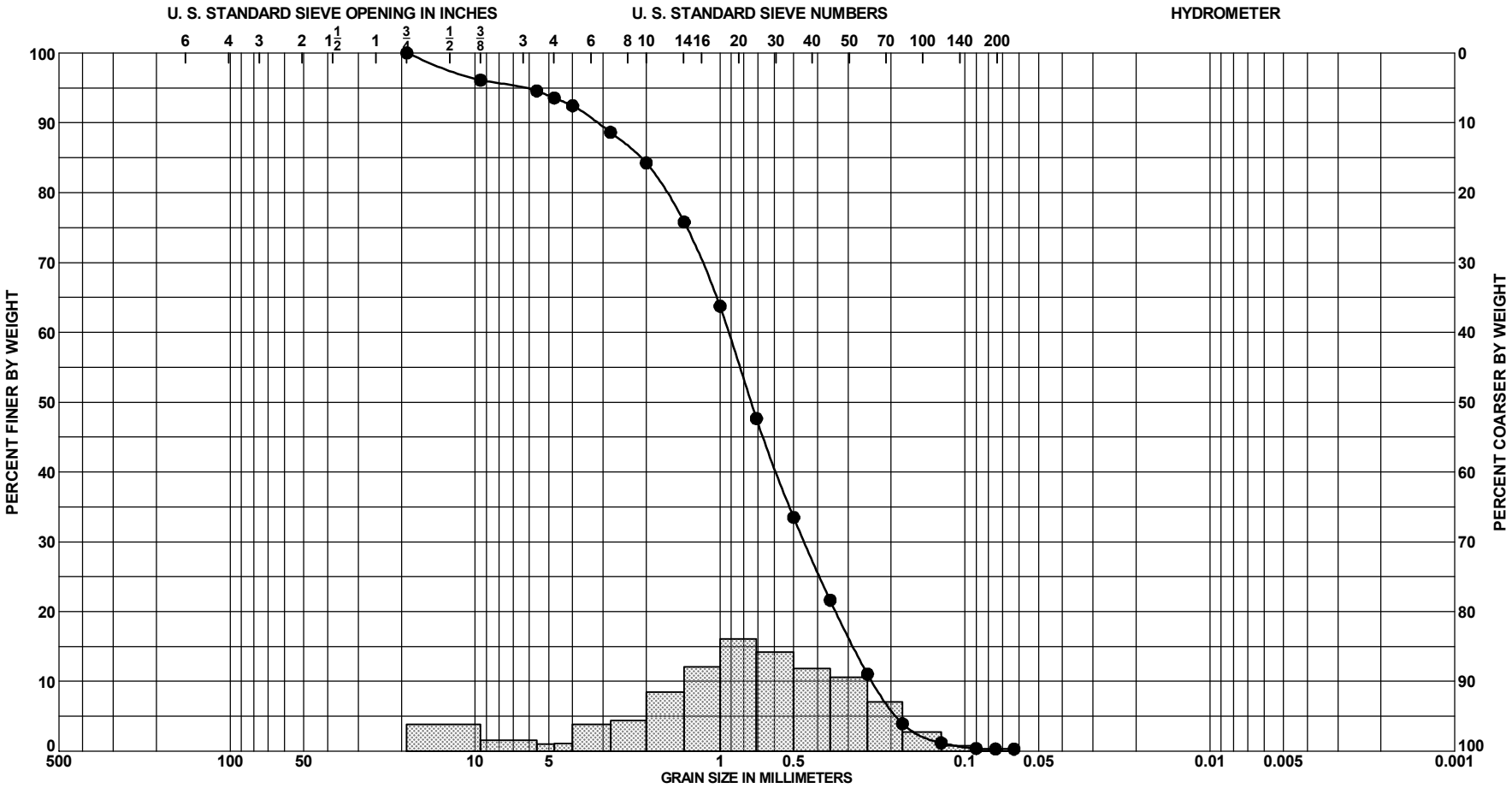


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	1.3 to 1.6 Ft.	SAND, silty, mostly fine-grained sand-sized quartz, some silt, few fine-grained sand-sized shell, dark gray (SM)	2.5Y 4/1								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-2
BORING ELEV.	-1.6 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

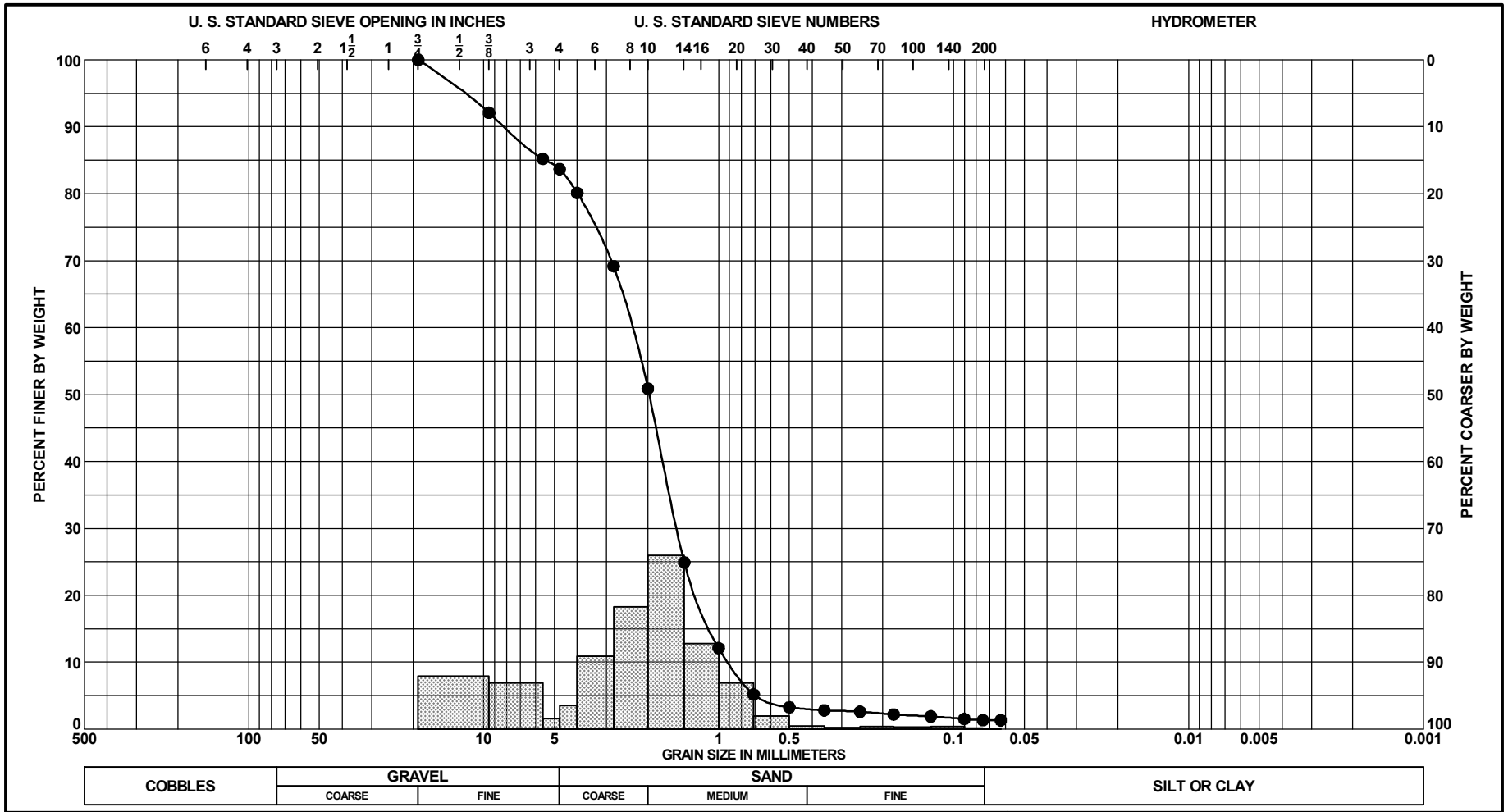


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.7 Ft.	SAND, poorly-graded, mostly sand to gravel-sized shell, some fine to medium-grained sand-sized quartz, light yellowish brown (SP)	10YR 6/4								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-3
BORING ELEV.	-1.1 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

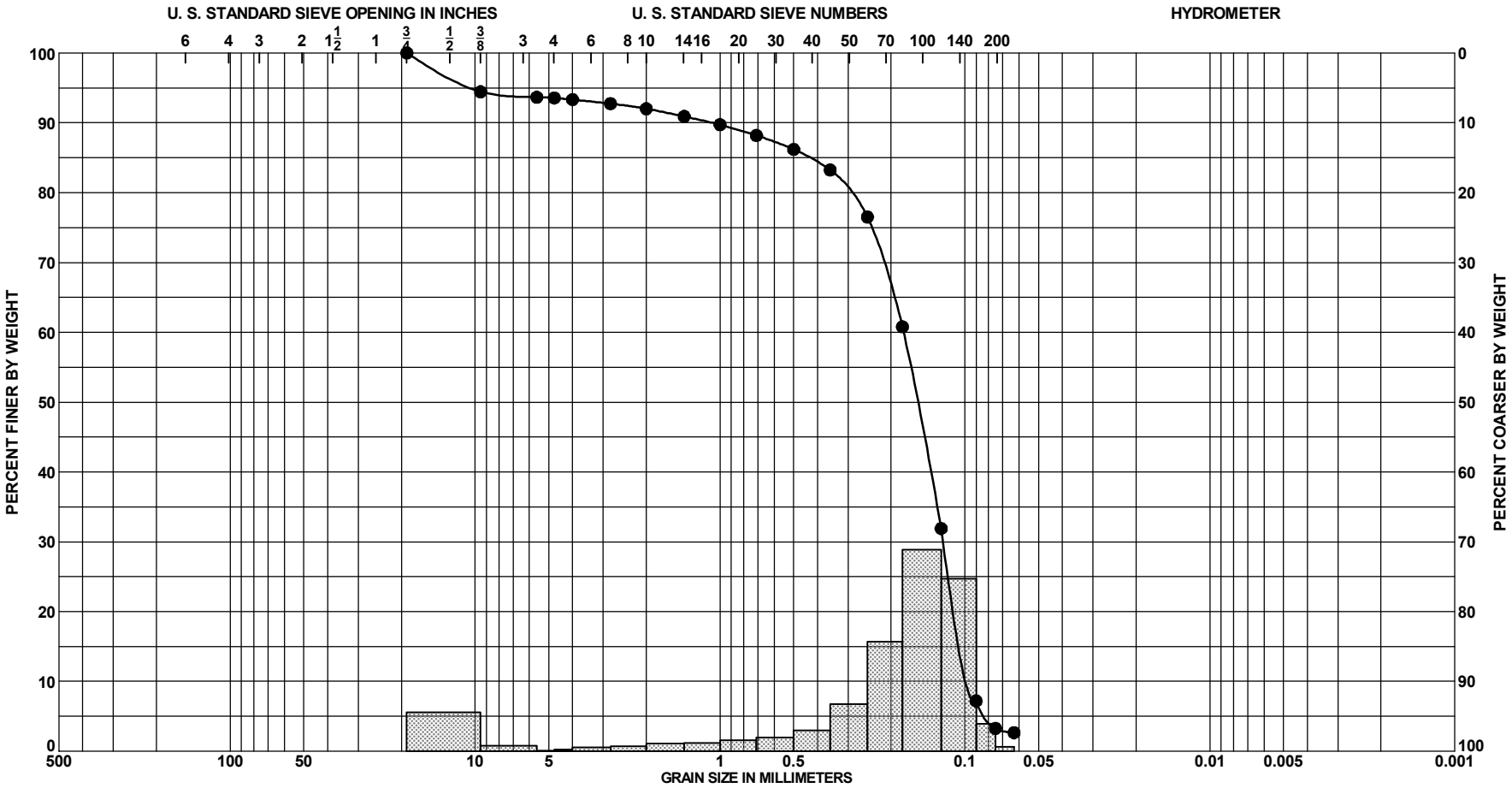


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	0.8 to 1.1 Ft.	SAND, poorly-graded, mostly sand to gravel-sized shell, trace silt, brownish yellow (SP)	10YR 6/6		96						

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-3
BORING ELEV.	-1.1 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

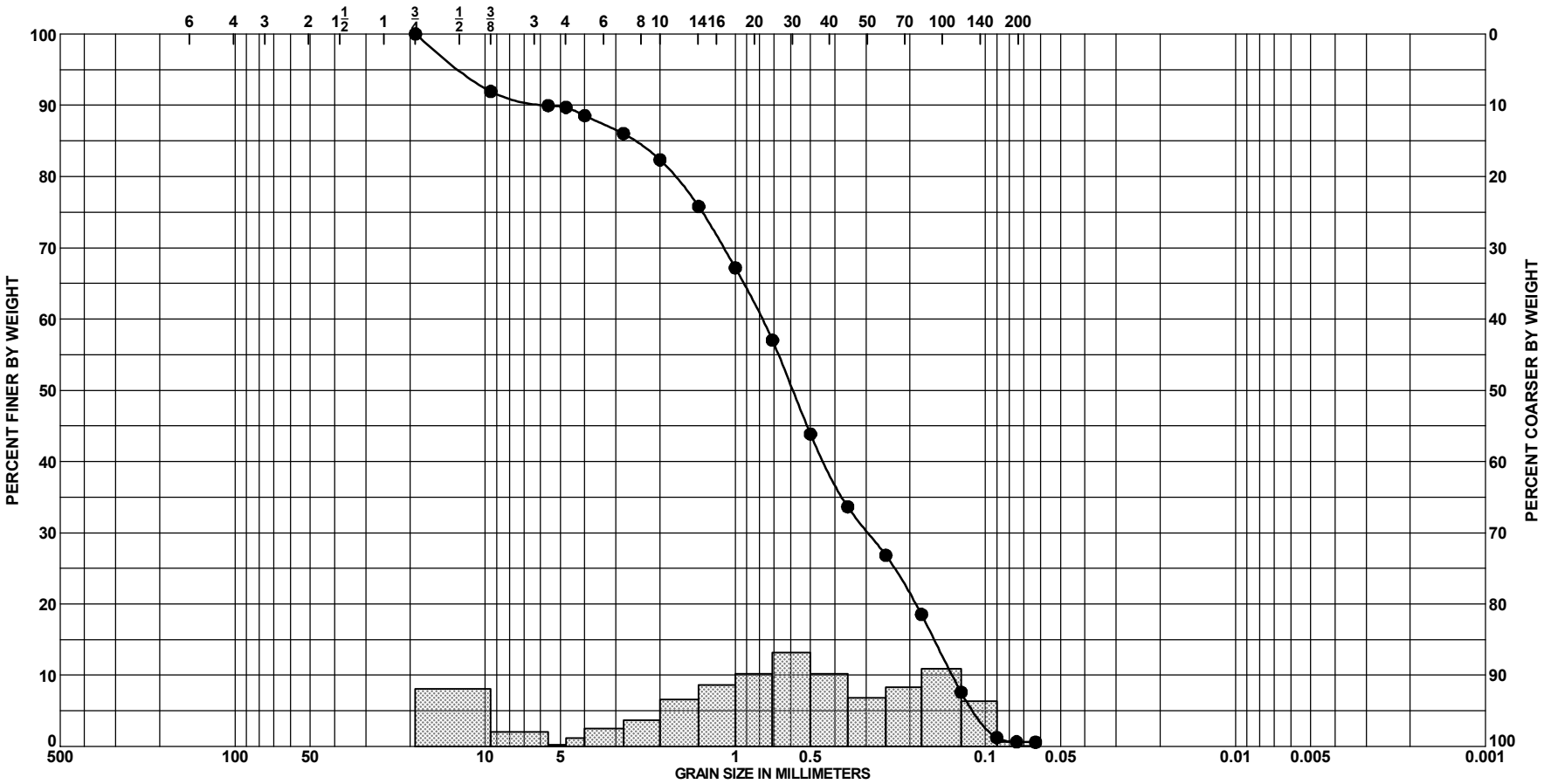


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	1.4 to 2.0 Ft.	SAND, poorly-graded, mostly fine-grained sand-sized quartz, some sand to gravel-sized shell, trace silt, grayish brown (SP)	2.5Y 5/2								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-3
BORING ELEV.	-1.1 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

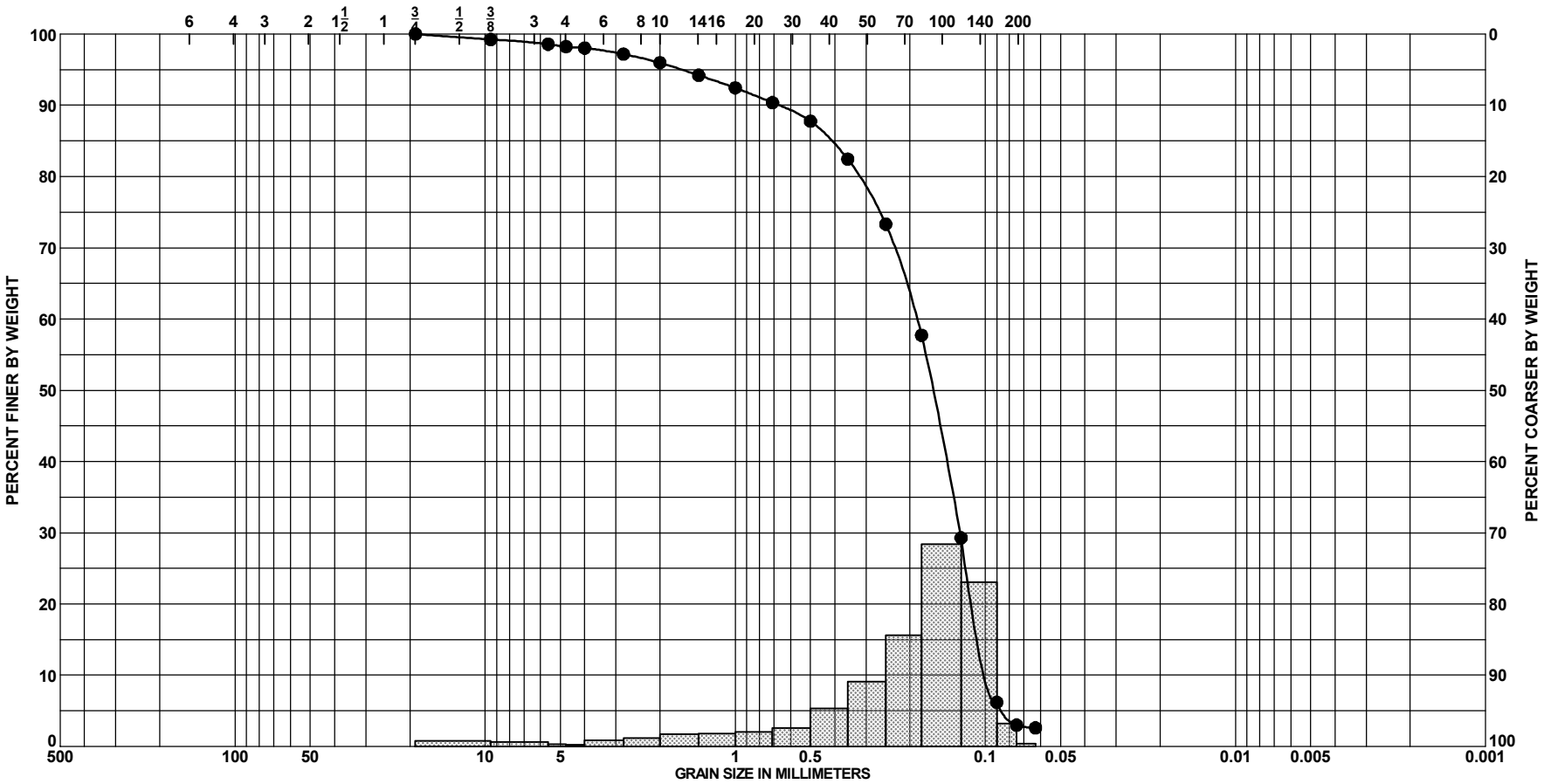


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.6 Ft.	SAND, poorly-graded, mostly sand to gravel-sized shell, some fine to medium-grained sand-sized quartz, grayish brown (SP)	10YR 5/2		73						

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-4
BORING ELEV.	-2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

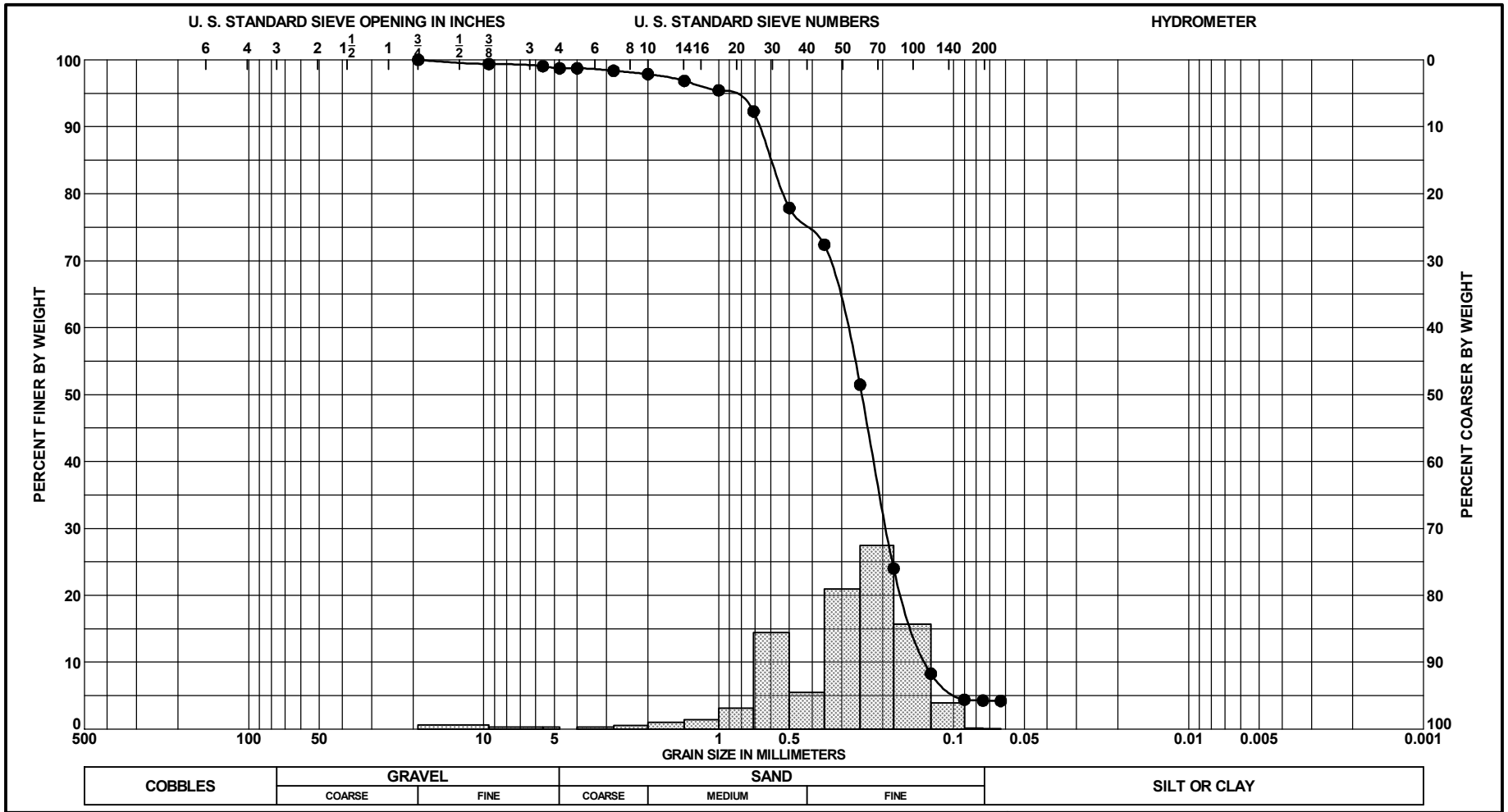


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	0.7 to 1.4 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2								
		fine-grained sand-sized quartz, little									
		fine to medium-grained sand-sized									
		shell, trace silt, grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-4
BORING ELEV.	-2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

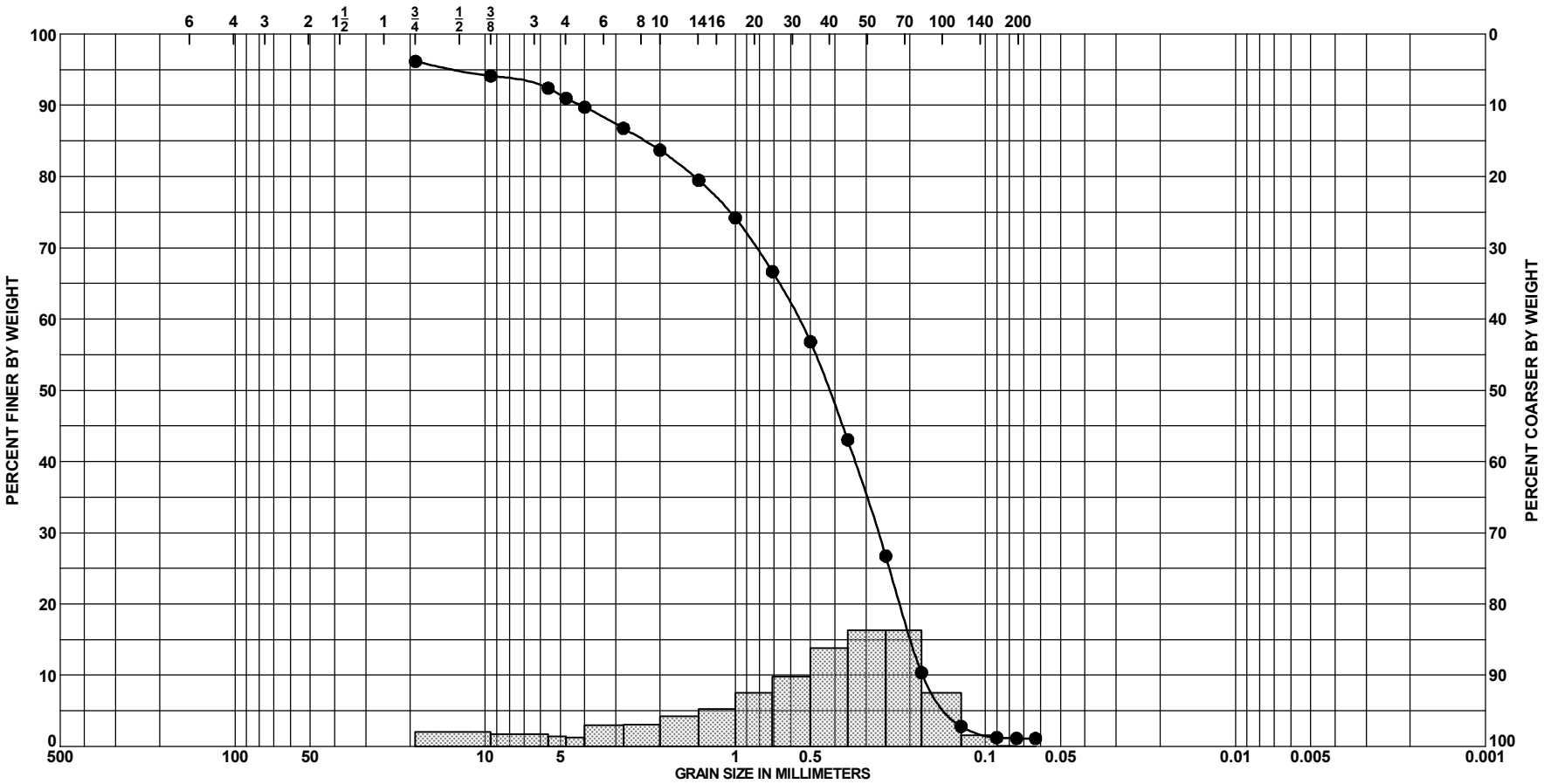


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.8 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized shell, some fine-grained sand-sized quartz, trace silt, light gray (SP)	2.5Y 7/2								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5
BORING ELEV.	2.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

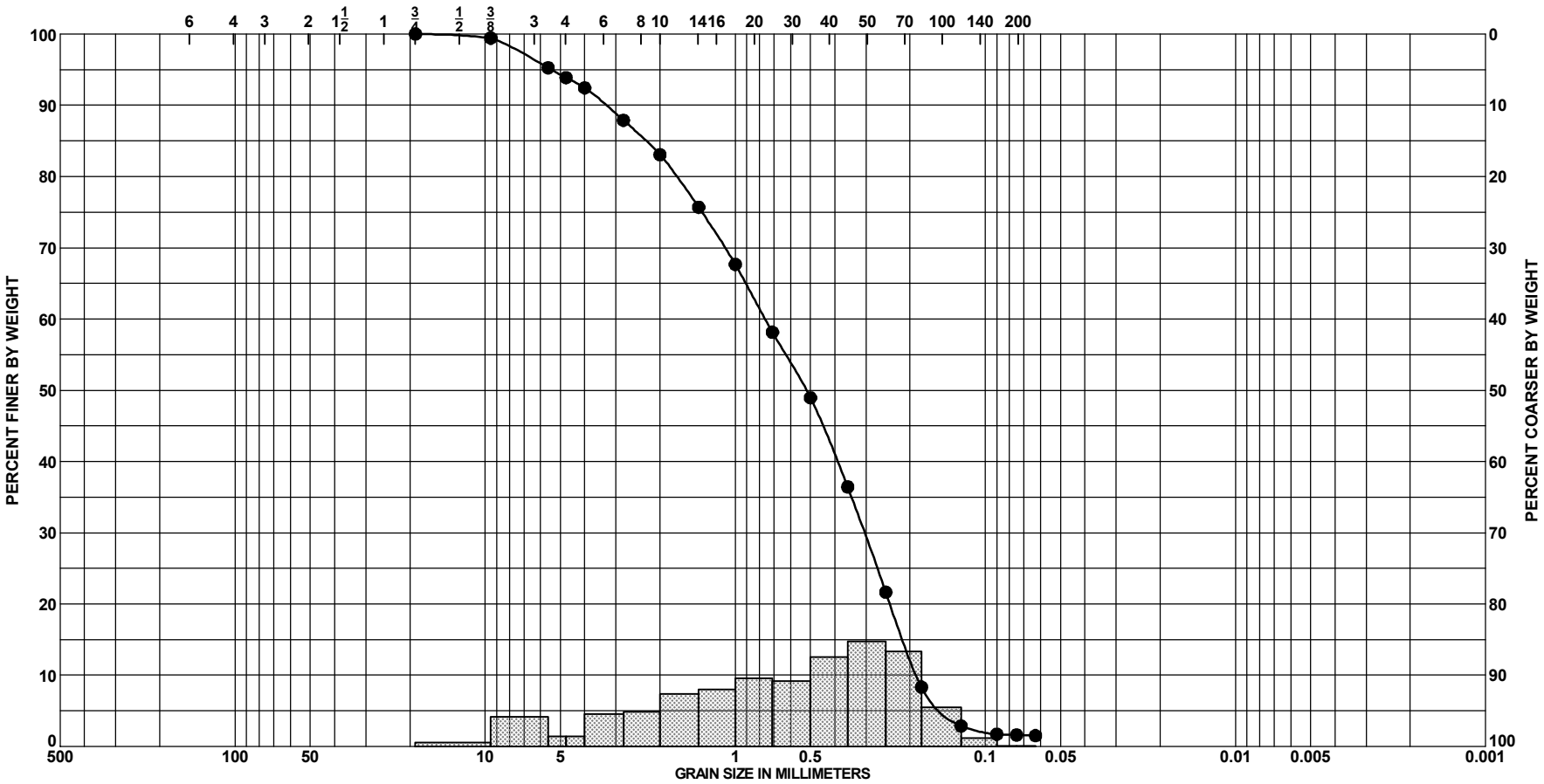


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	1.2 to 2.0 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some sand to gravel-sized shell, trace silt, light yellowish brown (SP)	2.5Y 6/4		70						

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5
BORING ELEV.	2.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

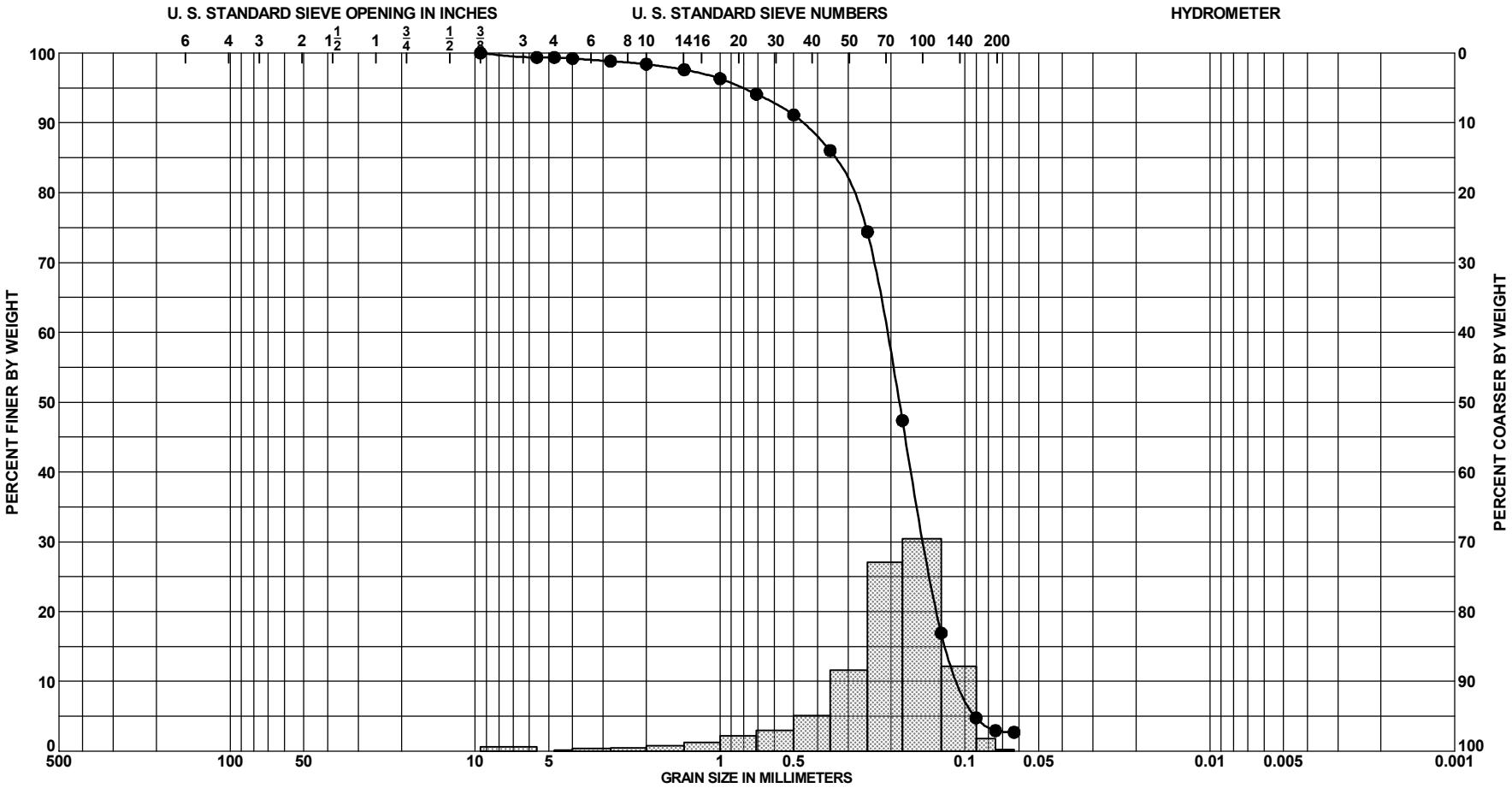


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	2.5 to 2.8 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some sand to gravel-sized shell, trace silt, grayish brown (SP)	2.5Y 5/2								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5
BORING ELEV.	2.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

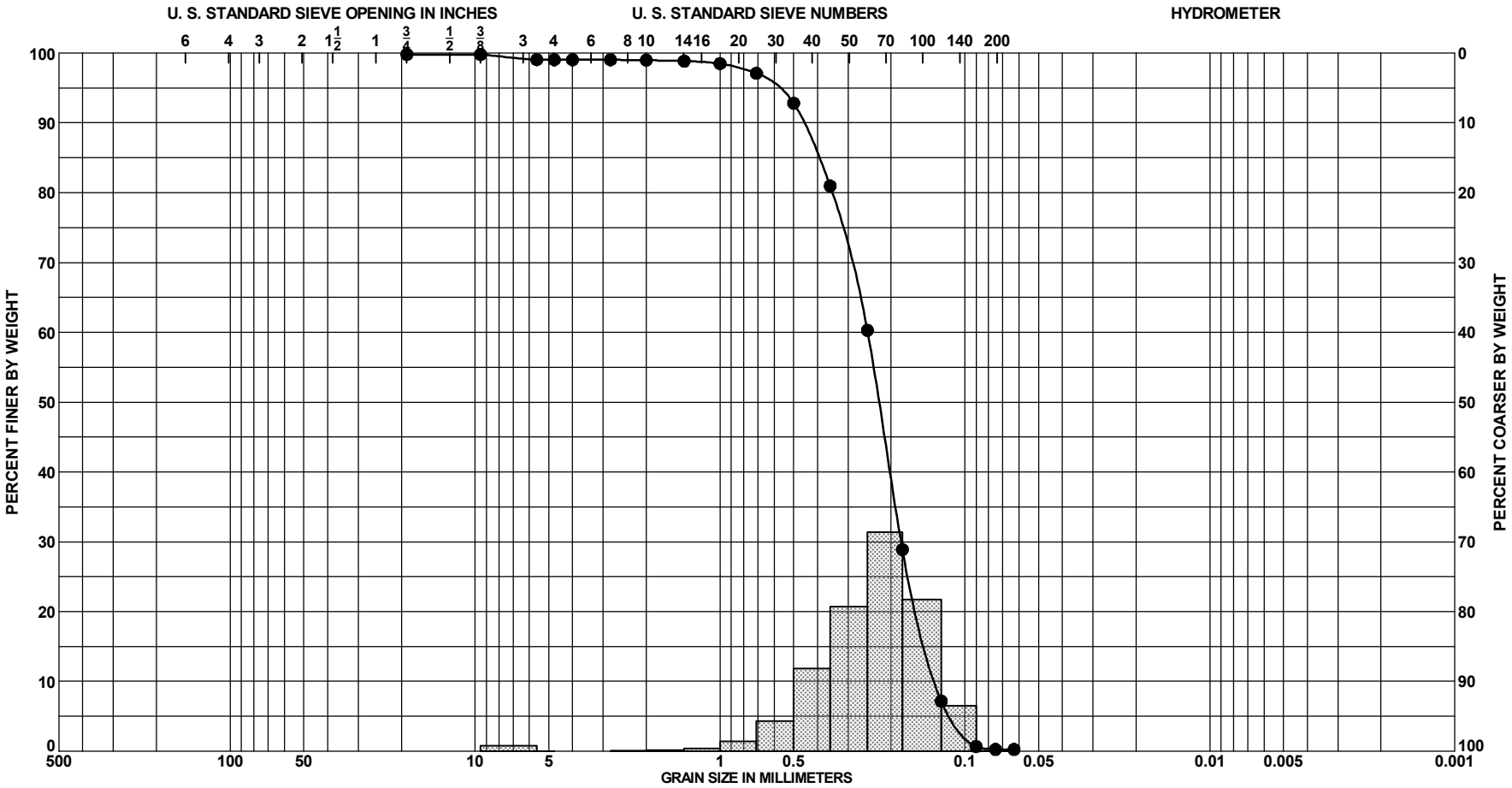


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 4	3.2 to 4.5 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2								
		fine-grained sand-sized quartz, little									
		fine to medium-grained sand-sized									
		shell, trace silt, grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5
BORING ELEV.	2.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

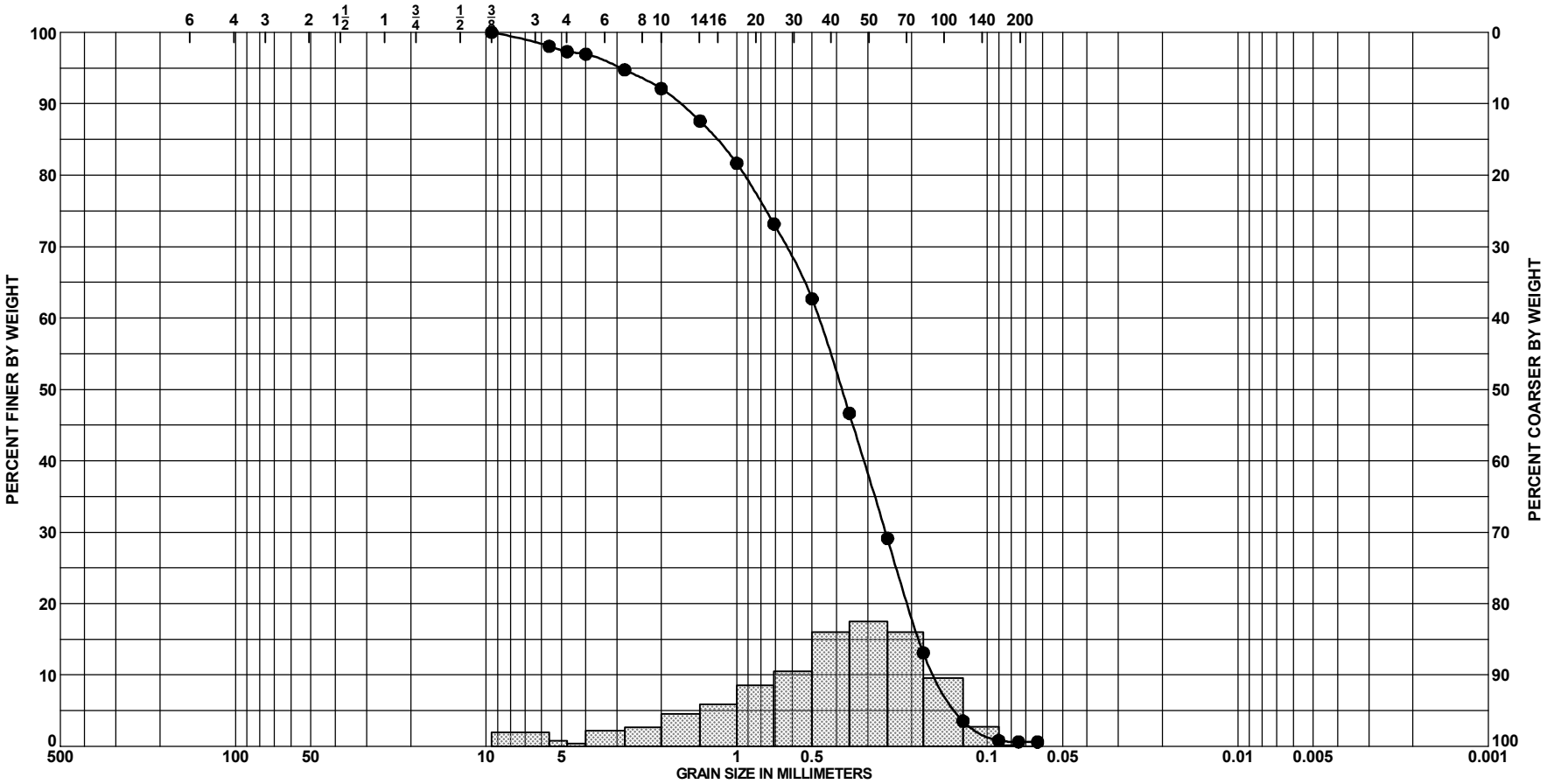


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.9 Ft.	SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine-grained sand-sized shell, light yellowish brown (SP)	2.5Y 6/3								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5A
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

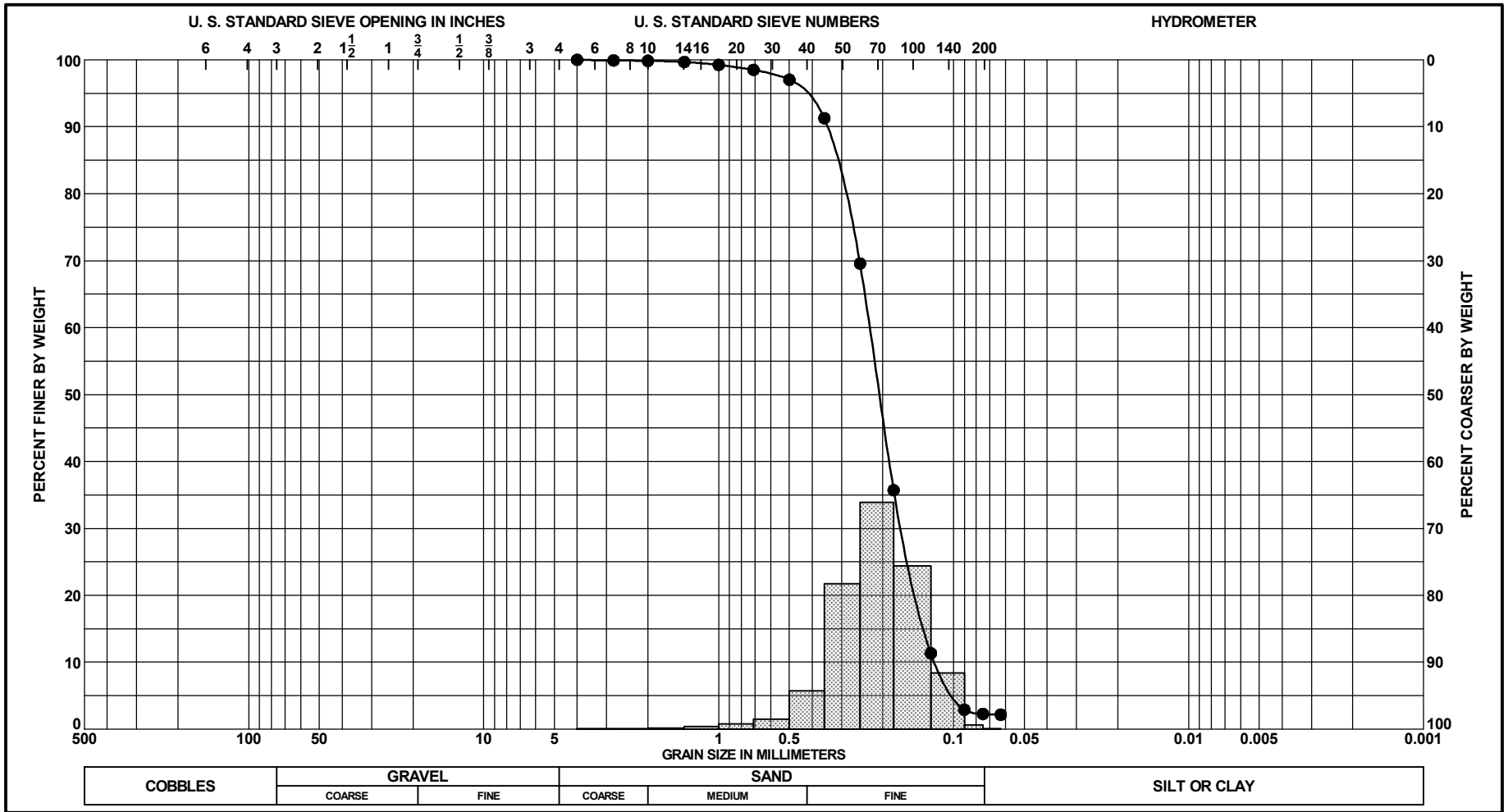


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	0.9 to 1.9 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to coarse-grained sand-sized shell, light yellowish brown (SP)	2.5Y 6/3								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5A
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

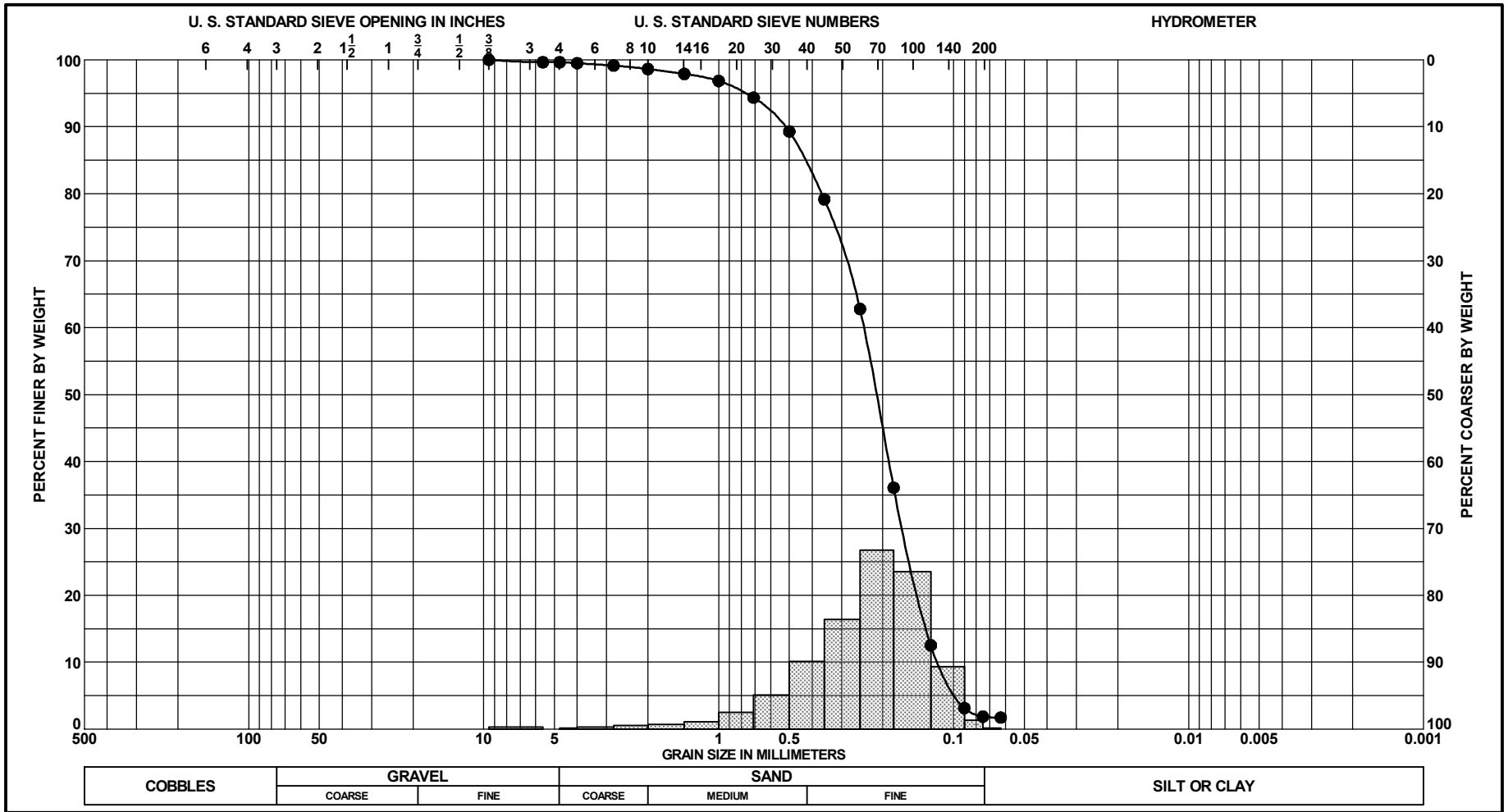


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	2.2 to 2.4 Ft.	SAND, poorly-graded, mostly	2.5Y 5/3				2				
		fine-grained sand-sized quartz, little									
		fine-grained sand-sized shell, trace									
		silt, light olive brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5A
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

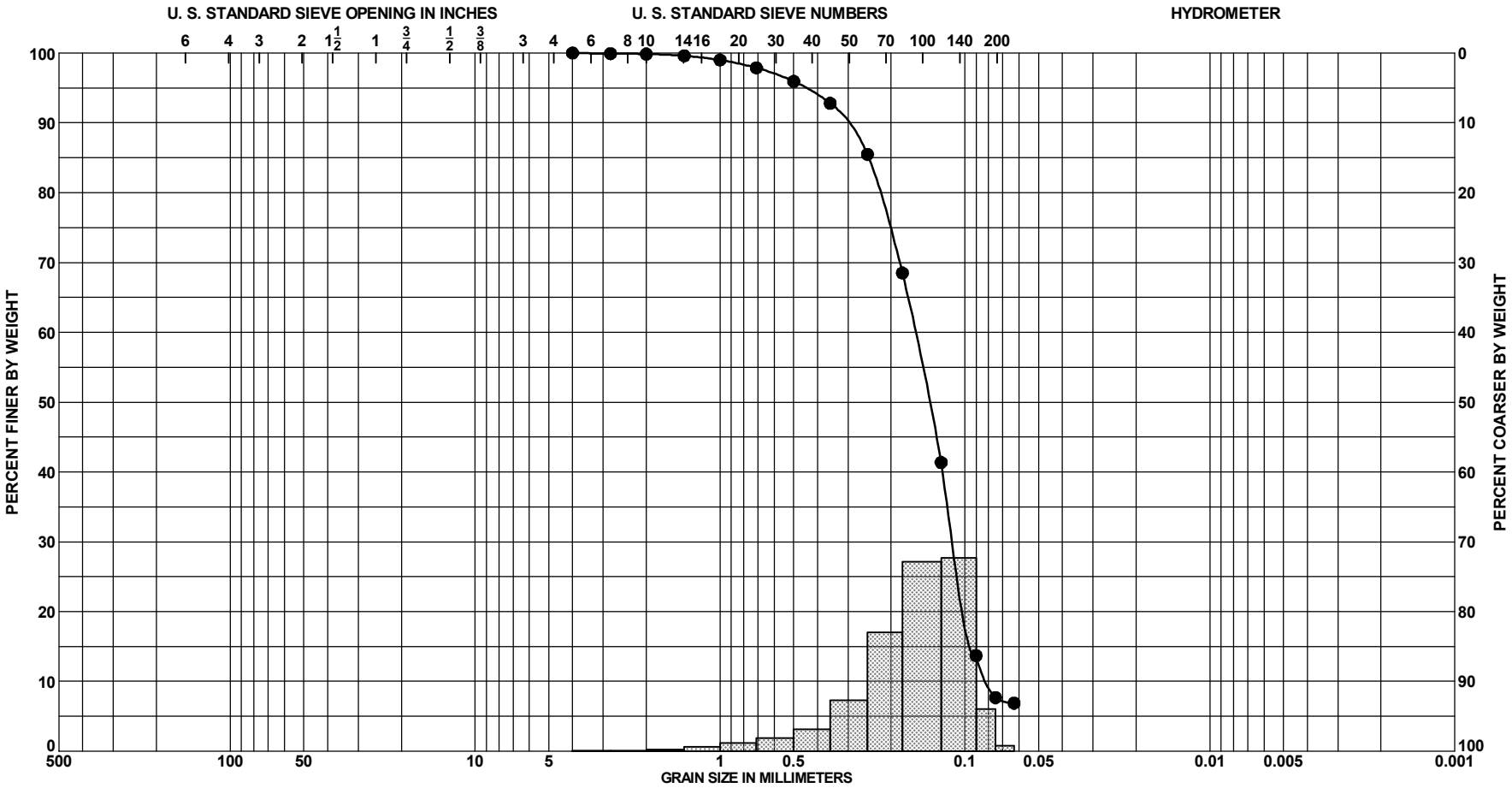


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 4	2.5 to 3.5 Ft.	SAND, poorly-graded, mostly	2.5Y 5/3								
		fine-grained sand-sized quartz, little									
		fine to medium-grained sand-sized									
		shell, trace silt, light olive brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5A
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

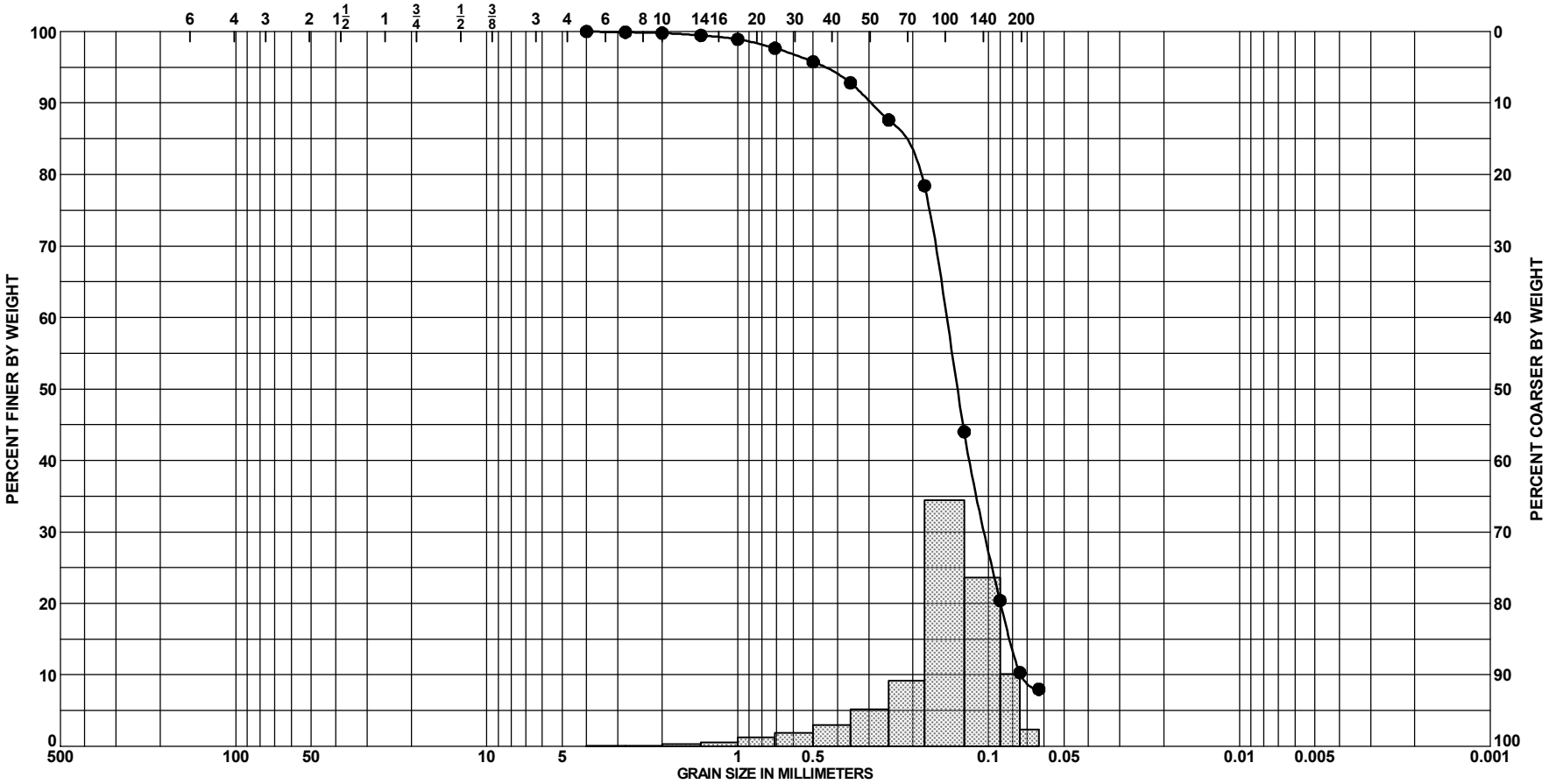


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 5	3.6 to 3.9 Ft.	SAND, poorly-graded with silt, mostly	2.5Y 5/2				4				
		fine-grained sand-sized quartz, little									
		fine-grained sand-sized shell, few silt,									
		grayish brown (SP-SM)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5A
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

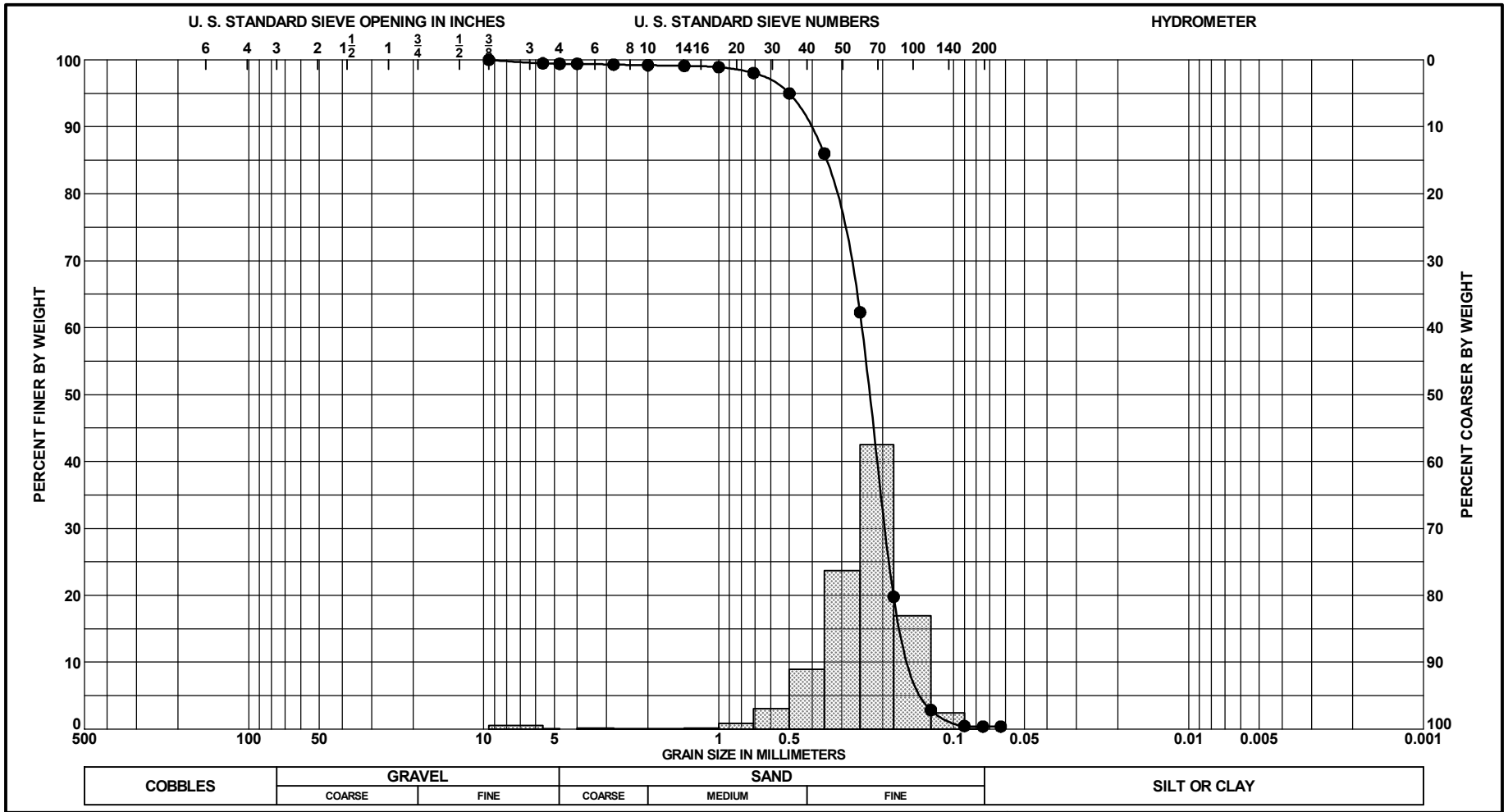


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 6	4.0 to 4.3 Ft.	SAND, poorly-graded with silt, mostly fine-grained sand-sized quartz, few silt, few fine-grained sand-sized shell, grayish brown (SP-SM)	2.5Y 5/2								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-5A
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

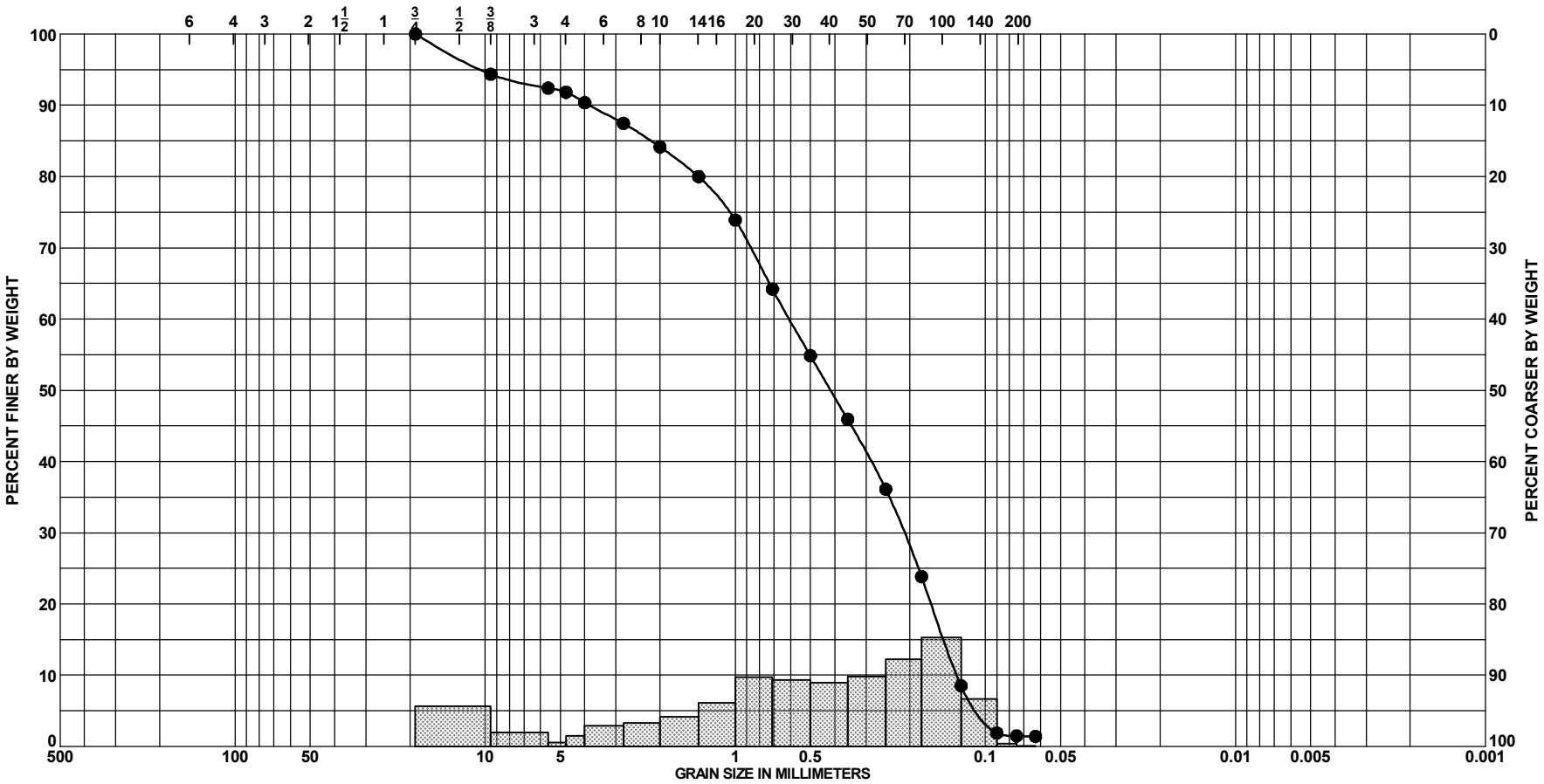


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 1.1 Ft.	SAND, poorly-graded, mostly fine-grained sand-sized quartz, few fine-grained sand-sized shell, light olive brown (SP)	2.5Y 5/3								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-6
BORING ELEV.	1.8 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

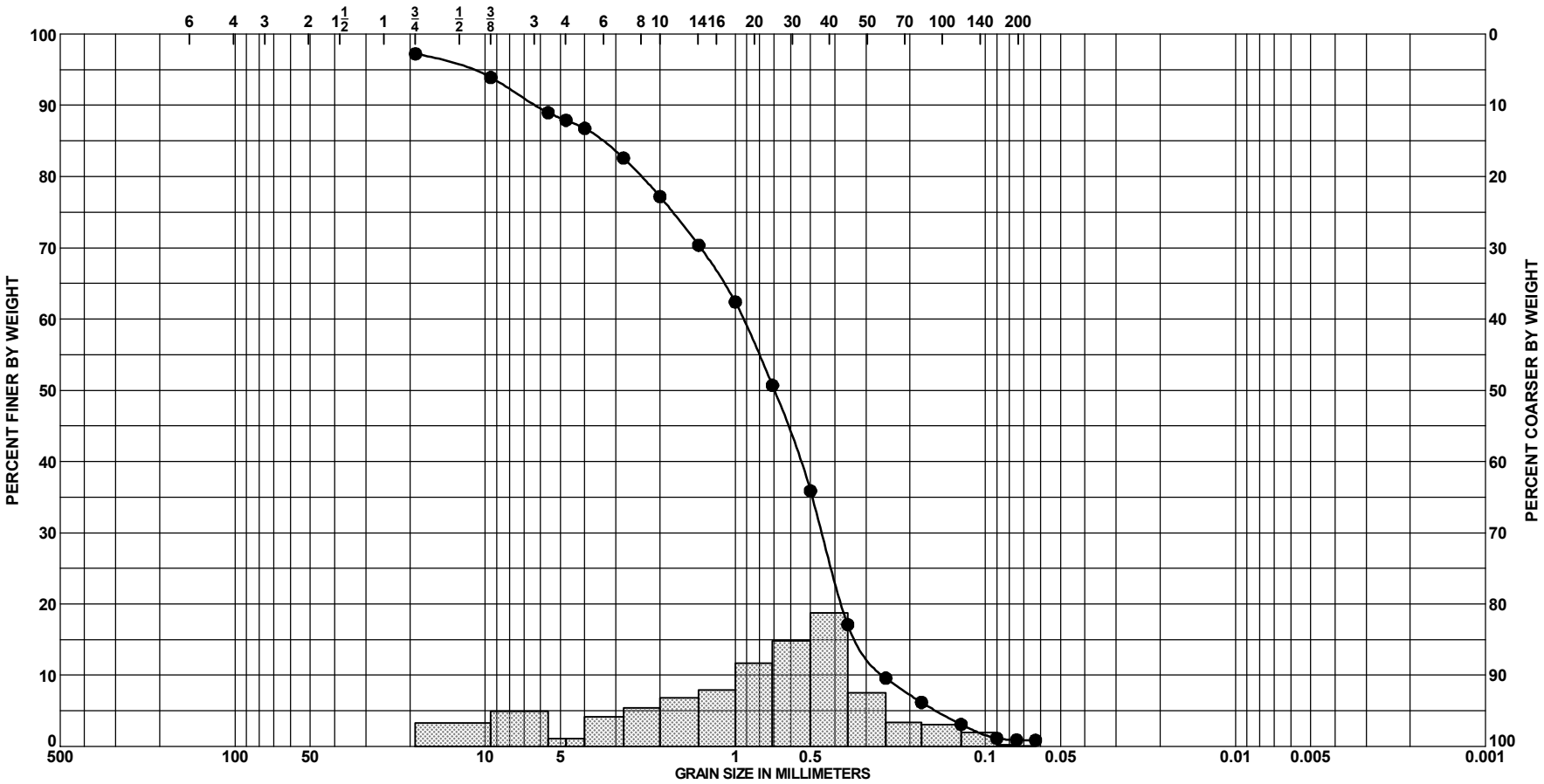


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	1.8 to 2.5 Ft.	SAND, poorly-graded, mostly fine to	10YR 5/2		77						
		med-grained sand-si limestone, some									
		sand to gravel-si shell, little									
		fine-grained sand-si quartz, trace silt,									
		grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-6
BORING ELEV.	1.8 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

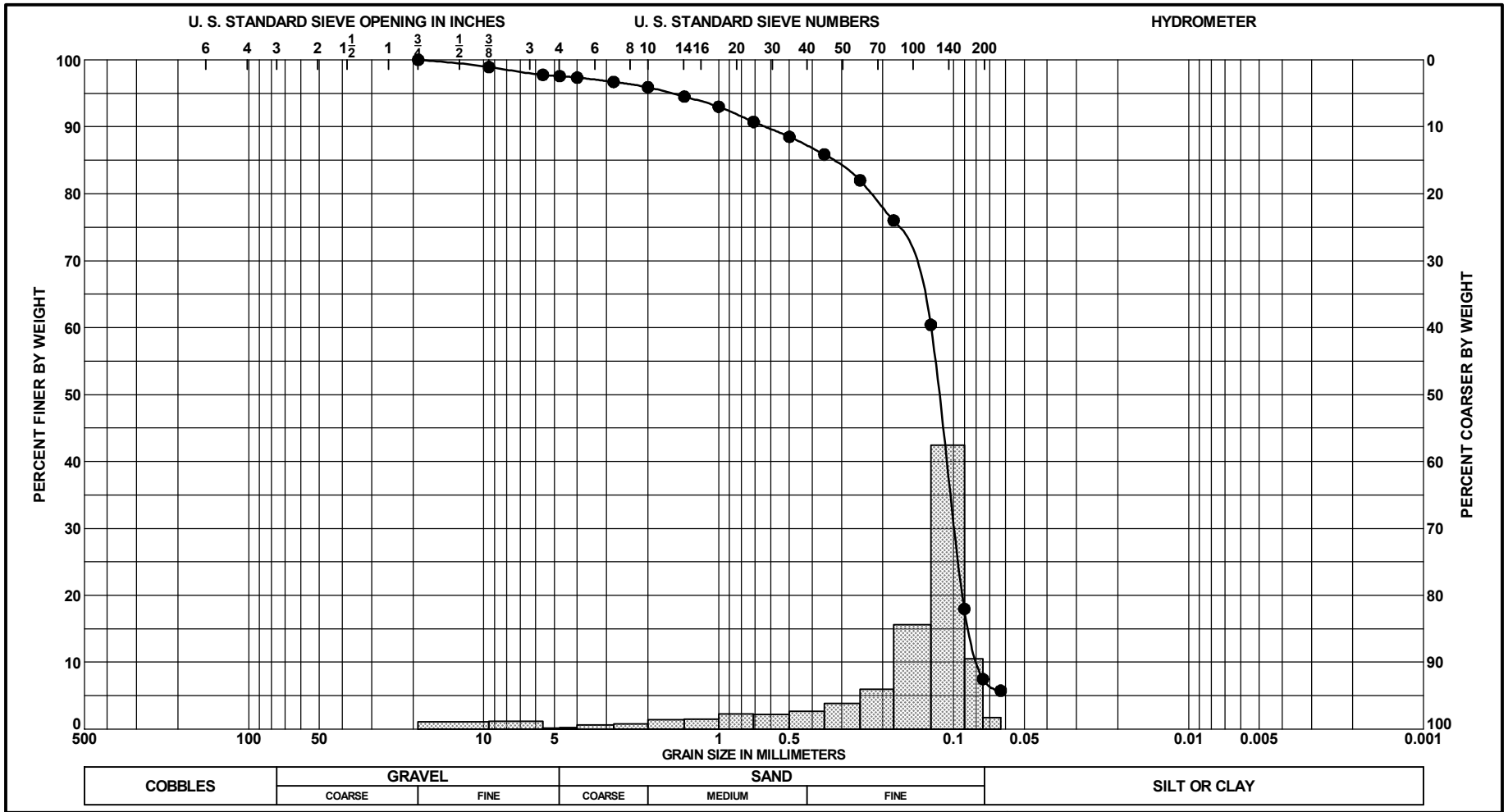


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	2.6 to 3.2 Ft.	SAND, poorly-graded, mostly sand to	2.5Y 5/3								
		gravel-sized shell, little fine-grained									
		sand-sized limestone, little									
		fine-grained sand-sized quartz, light									
		olive brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-6
BORING ELEV.	1.8 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

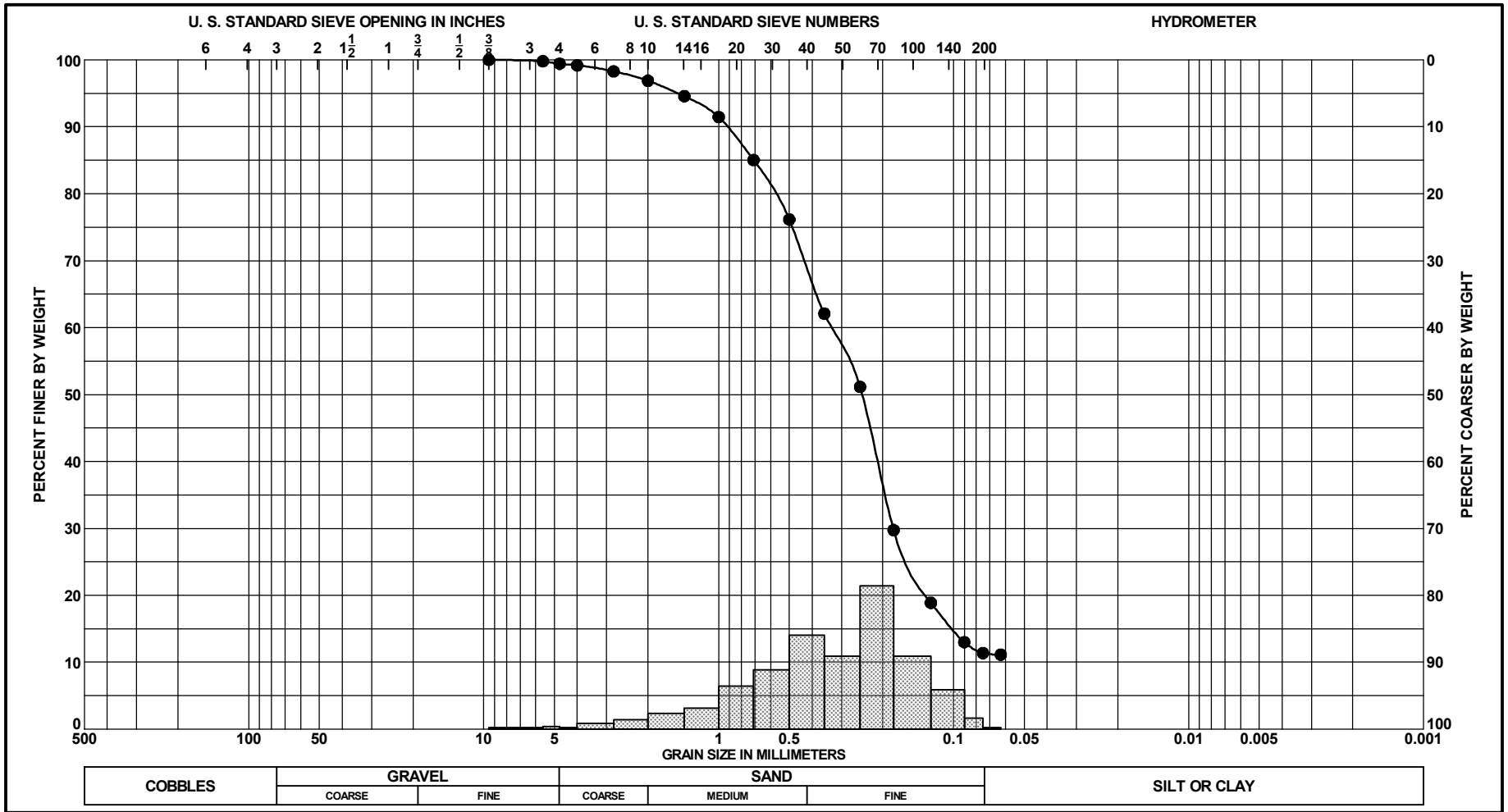


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 4	3.3 to 3.6 Ft.	SAND, poorly-graded with silt, some	2.5Y 5/2				1				
		fine-grained sa-si limestone, some									
		fine-grained sa-si quartz, few									
		medium-grained sa-si shell, few silt,									
		grayish brown (SP-SM)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-6
BORING ELEV.	1.8 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

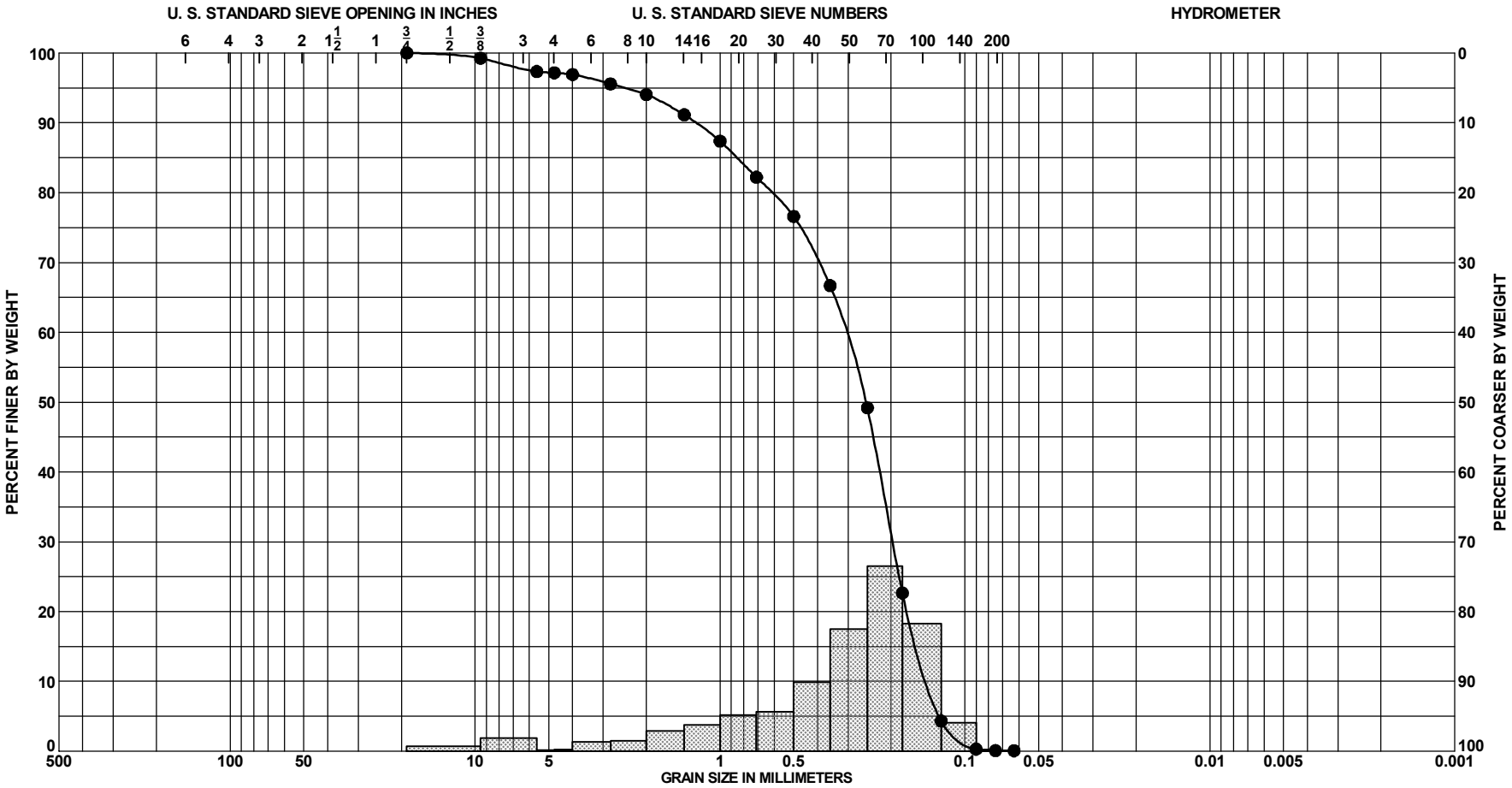


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 5	3.8 to 4.4 Ft.	SAND, poorly-graded with silt, mostly	2.5Y 5/2								
		fine-grained sand-sized limestone,									
		some fine to medium-grained									
		sand-sized shell, few silt, grayish									
		brown (SP-SM)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-6
BORING ELEV.	1.8 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

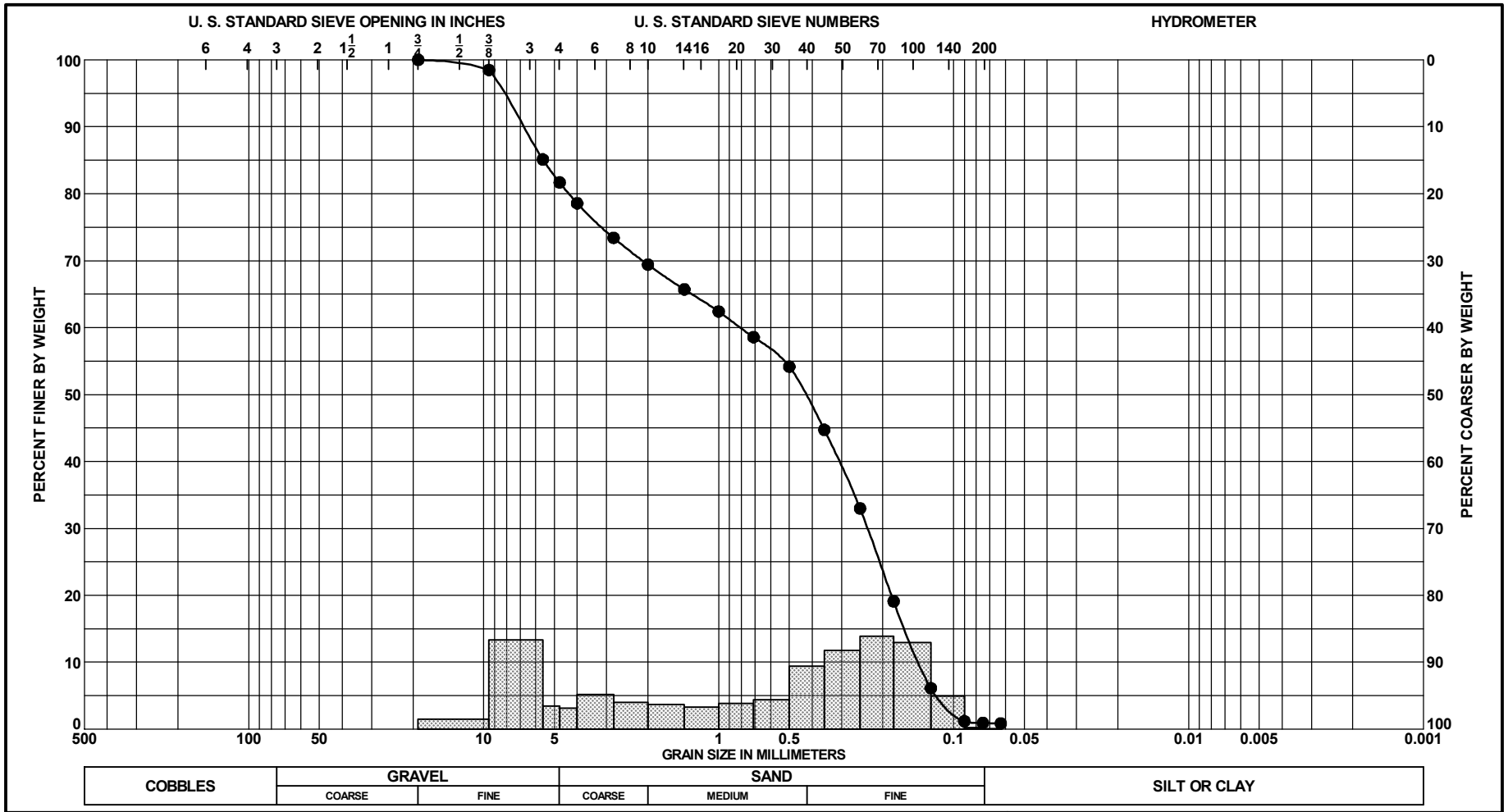


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.4 Ft.	SAND, poorly-graded, mostly	2.5Y 7/2		59						
		fine-grained sa-si quartz, little fine to									
		coarse-grained sa-si shell, few									
		medium-grained sand-sized									
		limestone, light gray (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-7
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

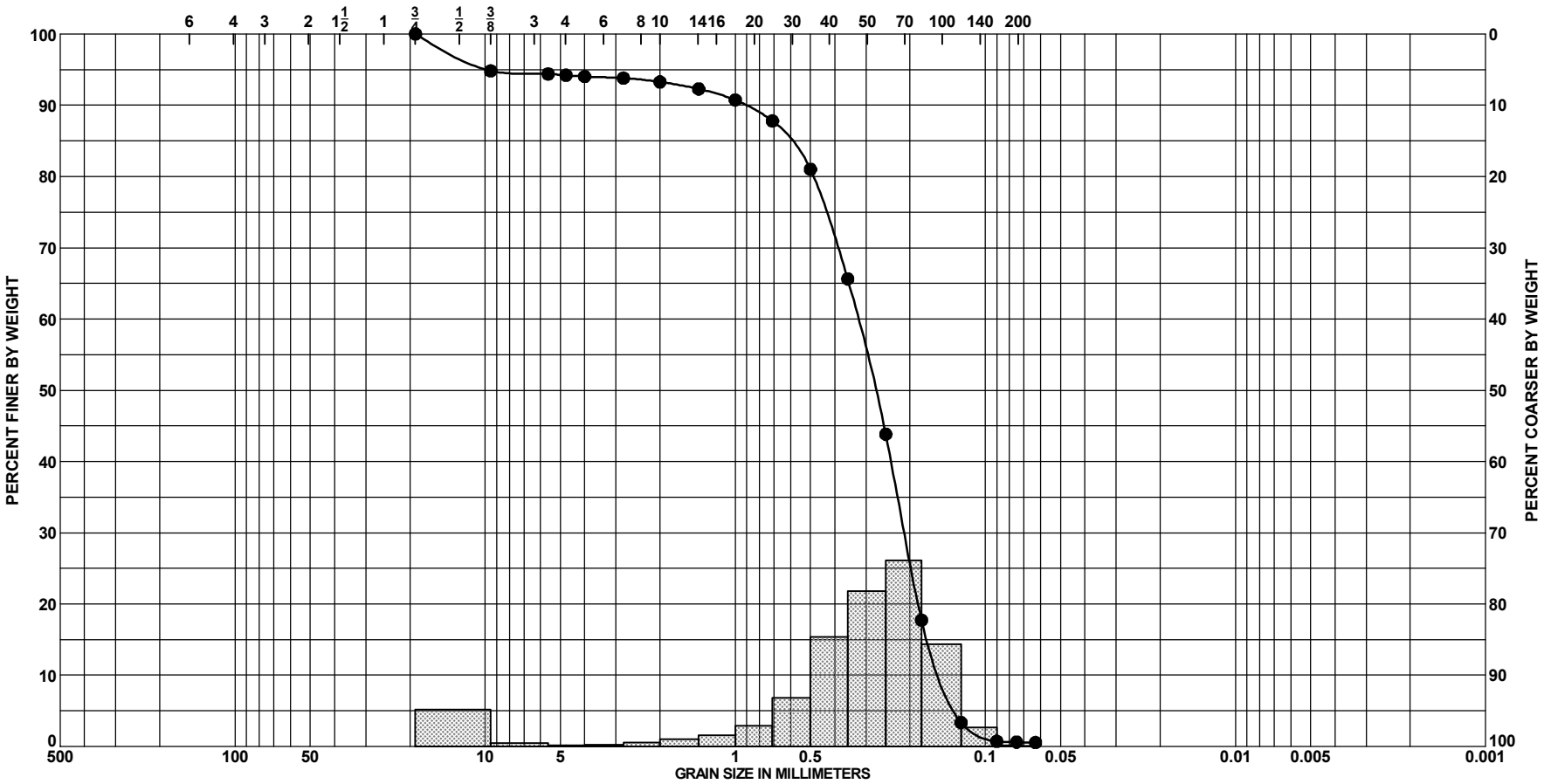


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	0.5 to 0.9 Ft.	SAND, poorly-graded, some sand to gravel-sized shell, some fine-grained sand-sized quartz, trace limestone, light yellowish brown (SP)	2.5Y 6/3								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-7
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

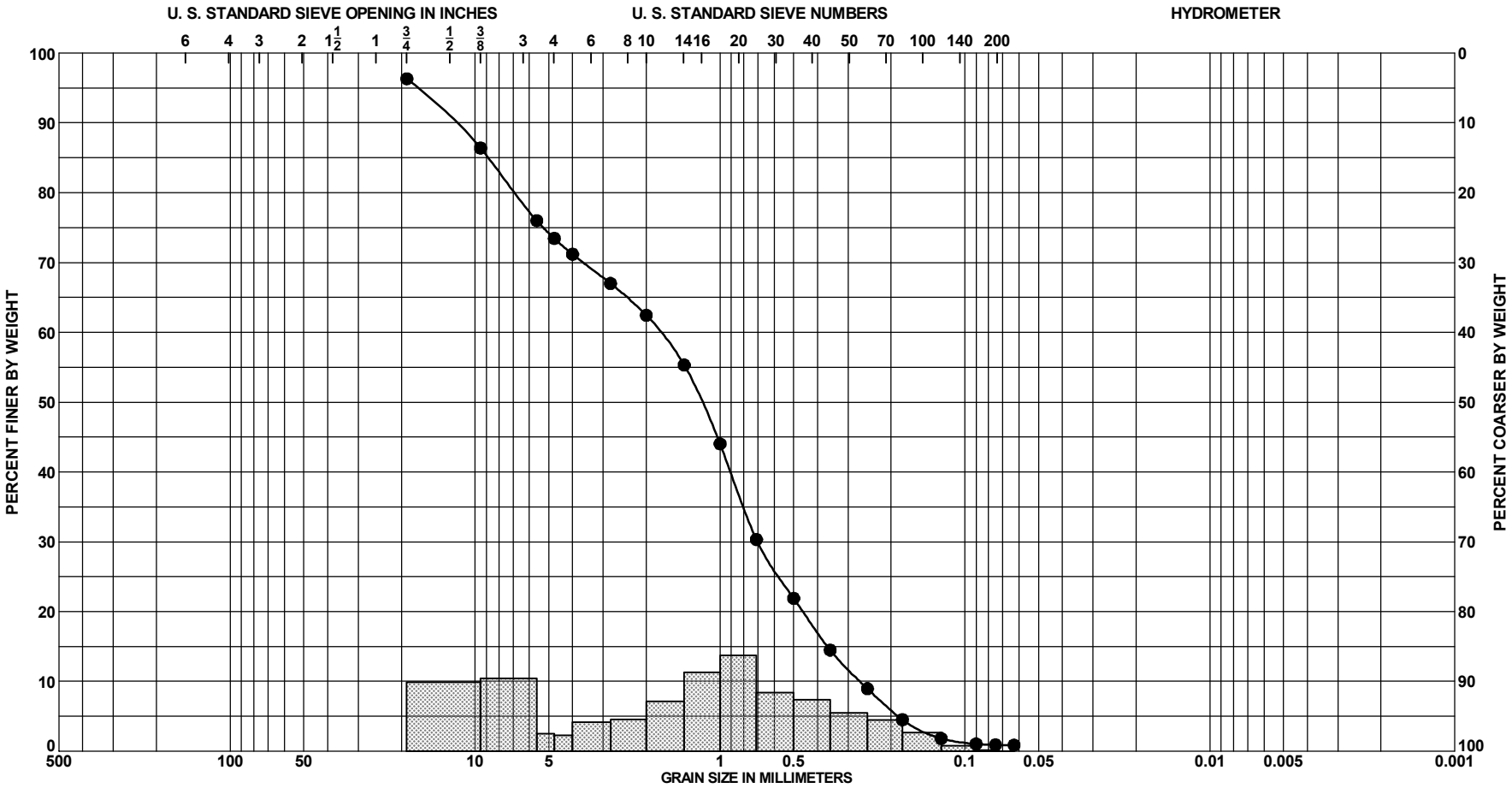


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	1.1 to 2.1 Ft.	SAND, poorly-graded, mostly sand to gravel-sized shell, some fine-grained sand-sized quartz, light olive brown (SP)	2.5Y 5/3		62						

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-7
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

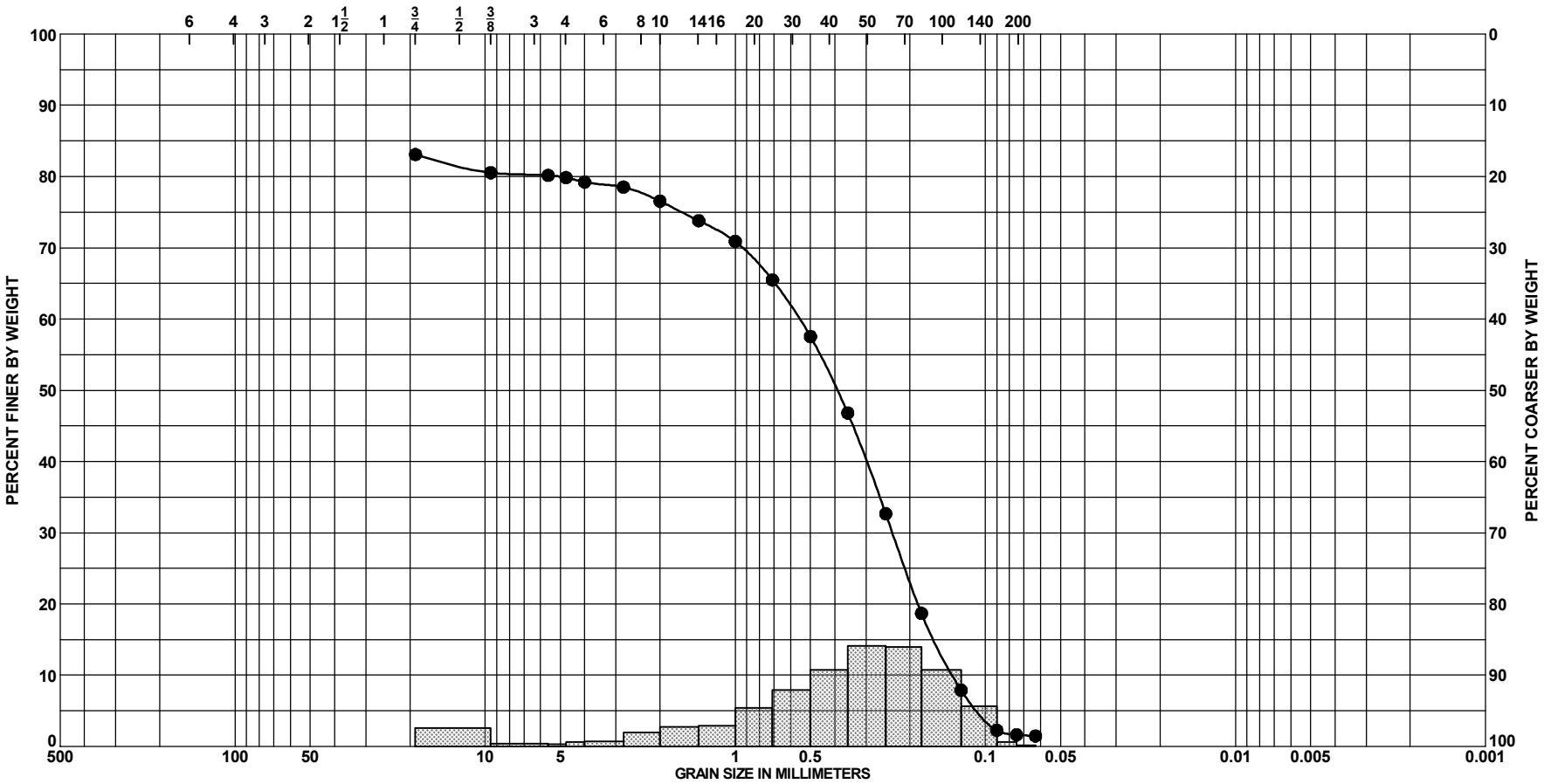


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 4	2.3 to 2.8 Ft.	SAND, well-graded, mostly sand to gravel-sized shell, little fine-grained sand-sized quartz, trace limestone, light olive brown (SW)	2.5Y 5/3								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-7
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

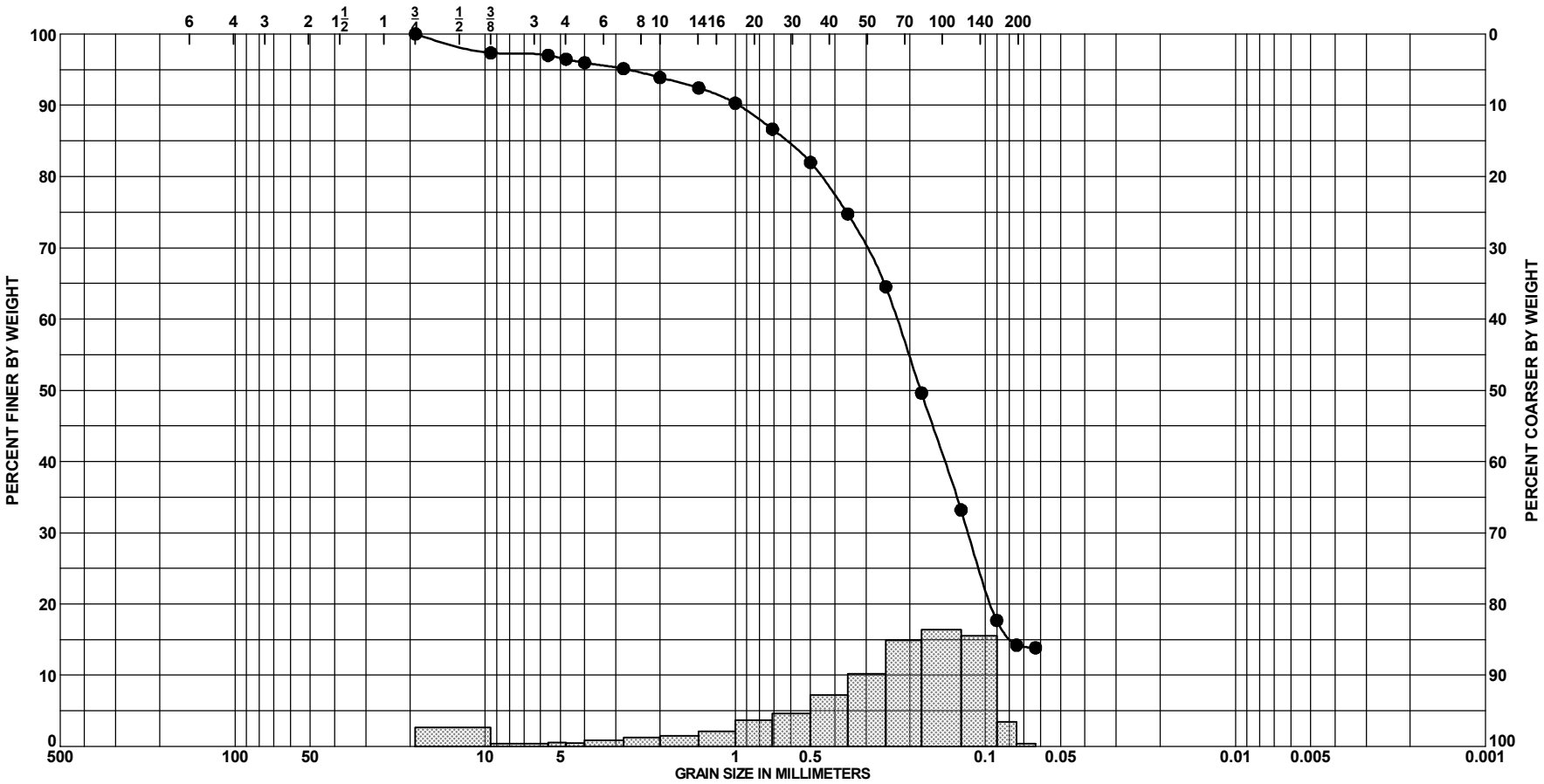


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 5	2.9 to 4.4 Ft.	SAND, poorly-graded, some fine to	2.5Y 5/2								
		medium-grained sand-sized shell,									
		some fine-grained sand-sized quartz,									
		little gravel-sized limestone, trace silt,									
		grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-7
BORING ELEV.	2.2 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

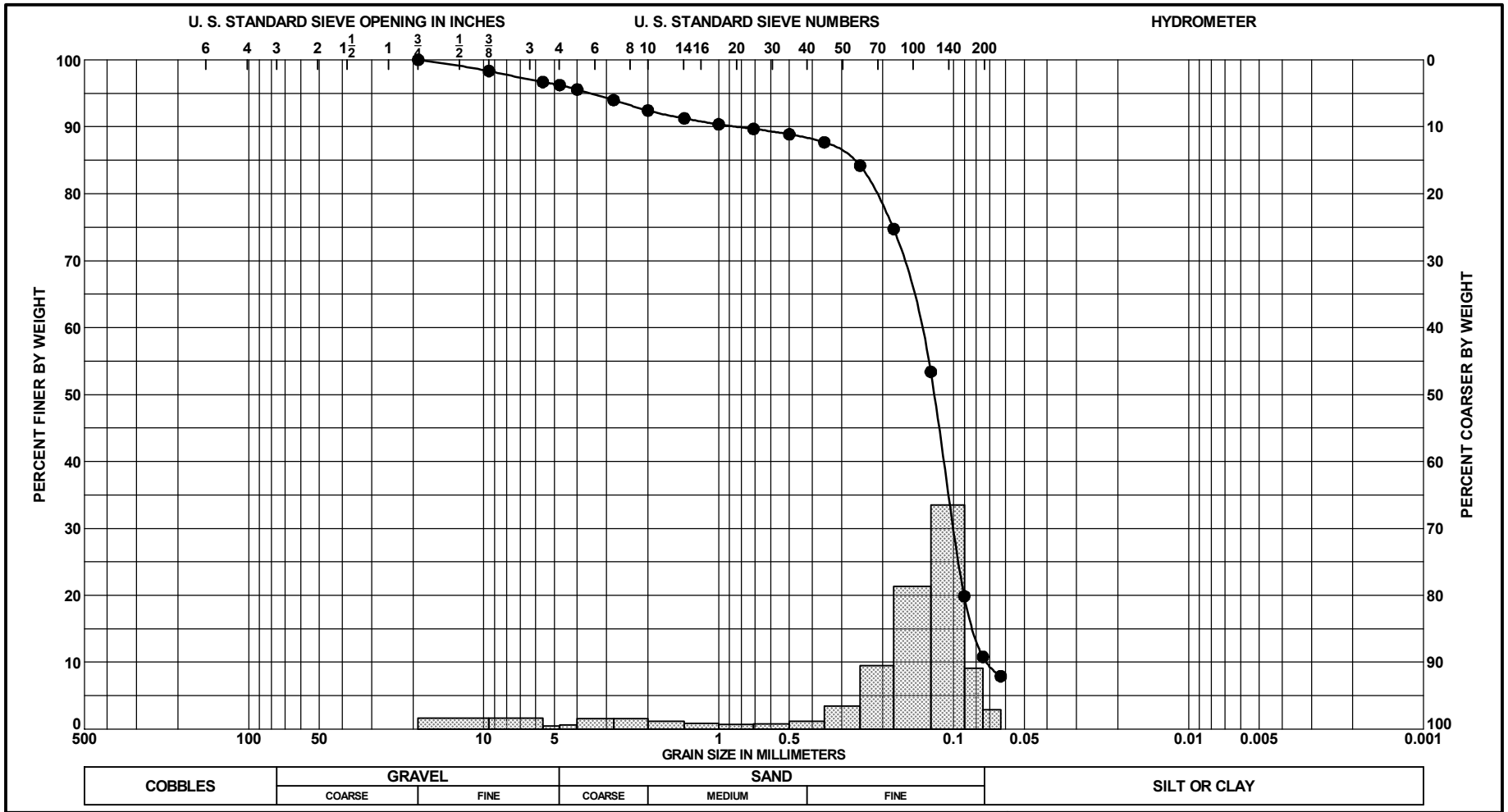


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.5 Ft.	SAND, silty, mostly fine-grained	2.5Y 4/2								
		sand-sized limestone, little fine to									
		medium-grained sand-sized shell, little									
		silt, dark grayish brown (SM)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-8A
BORING ELEV.	-1.8 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

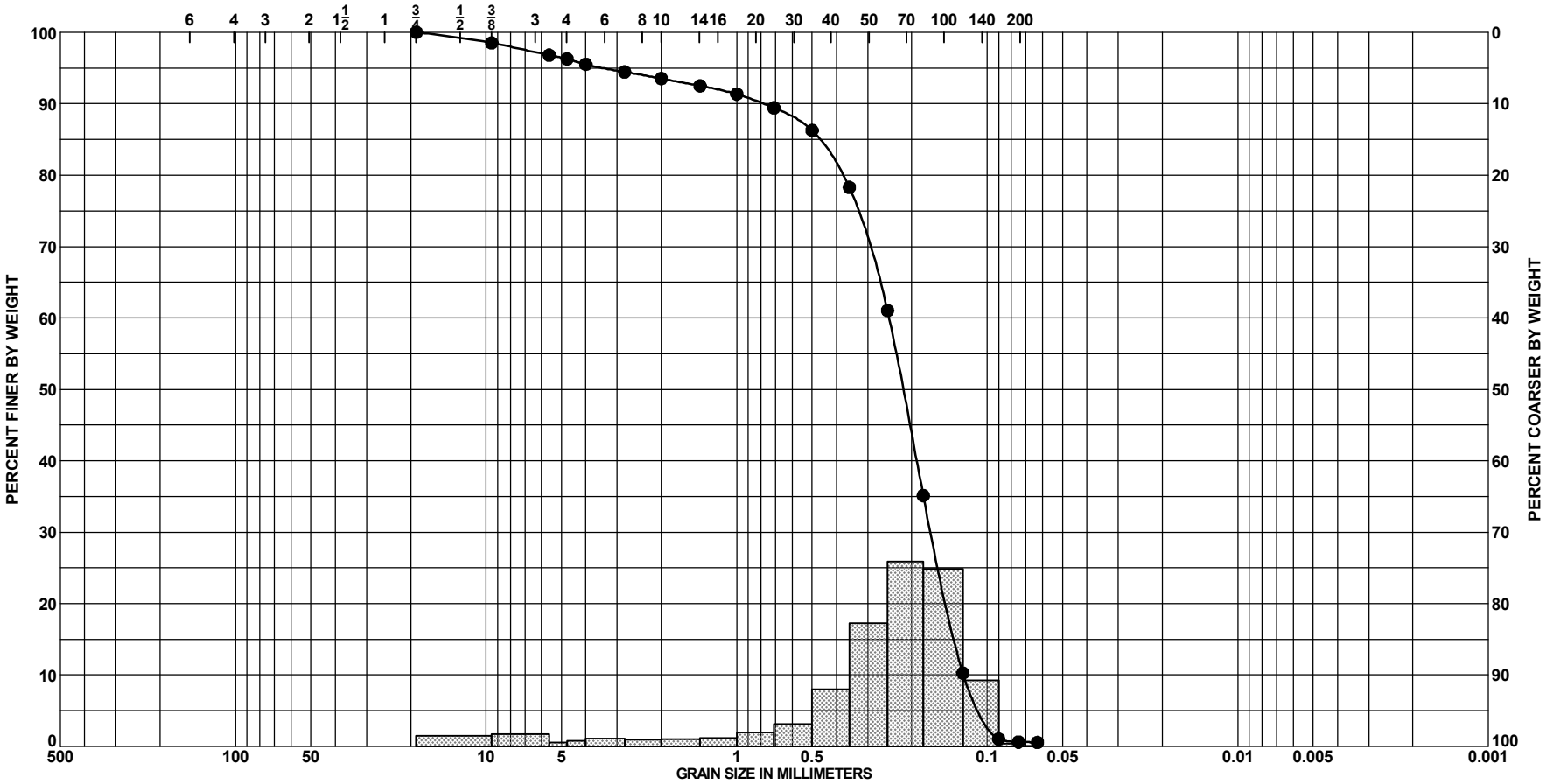


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	1.0 to 1.4 Ft.	SAND, poorly-graded with silt, mostly	2.5Y 5/2		65						
		fine-grained sand-sized limestone,									
		some fine to medium-grained									
		sand-sized shell, few silt, grayish									
		brown (SP-SM)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-8A
BORING ELEV.	-1.8 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

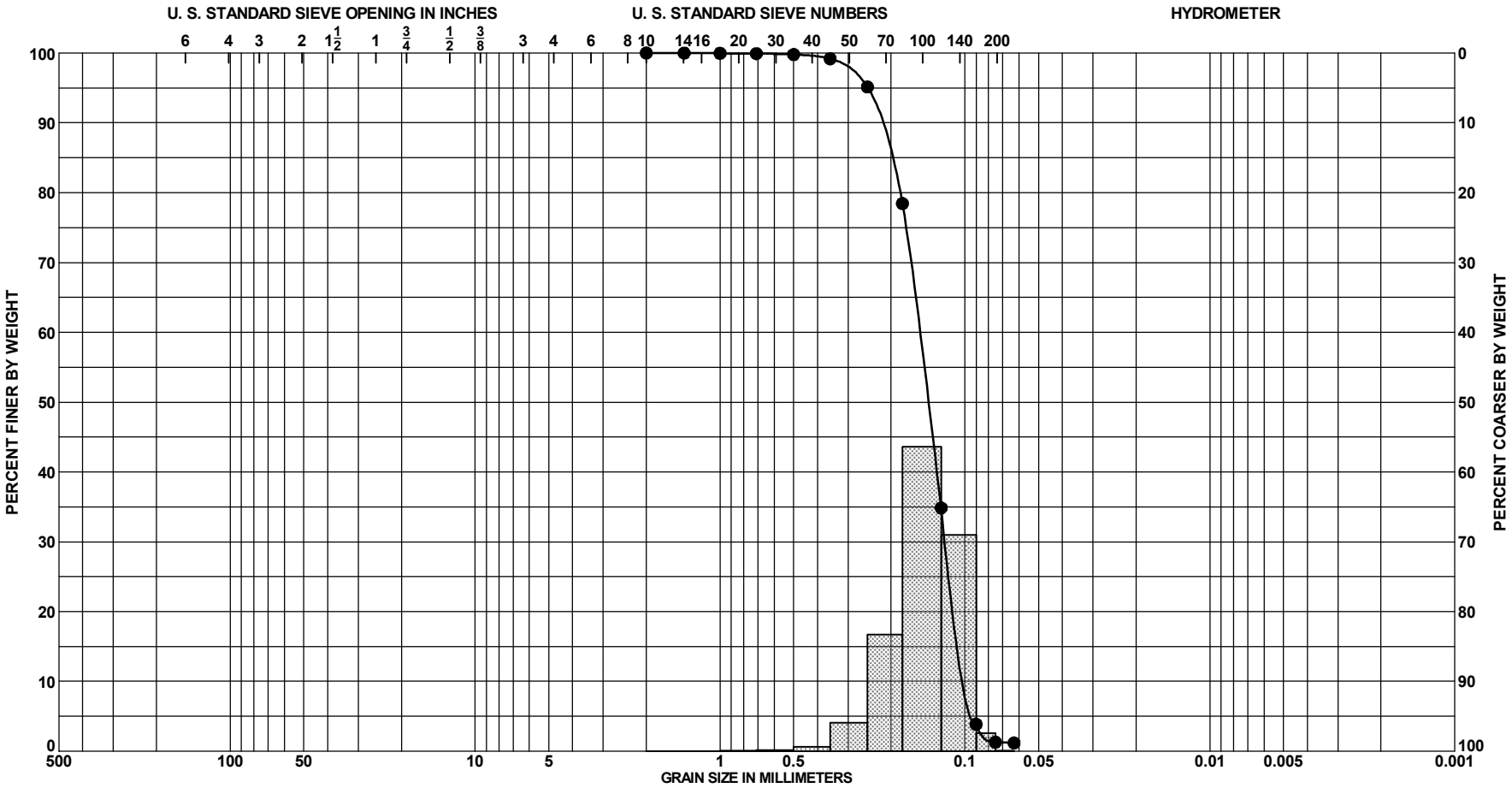


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 1.1 Ft.	SAND, poorly-graded, mostly	2.5Y 5/3								
		fine-grained sa-si quartz, little fine to									
		med-grained sand-sized shell, few									
		med-grained sand-sized limestone,									
		light olive brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-9
BORING ELEV.	1.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

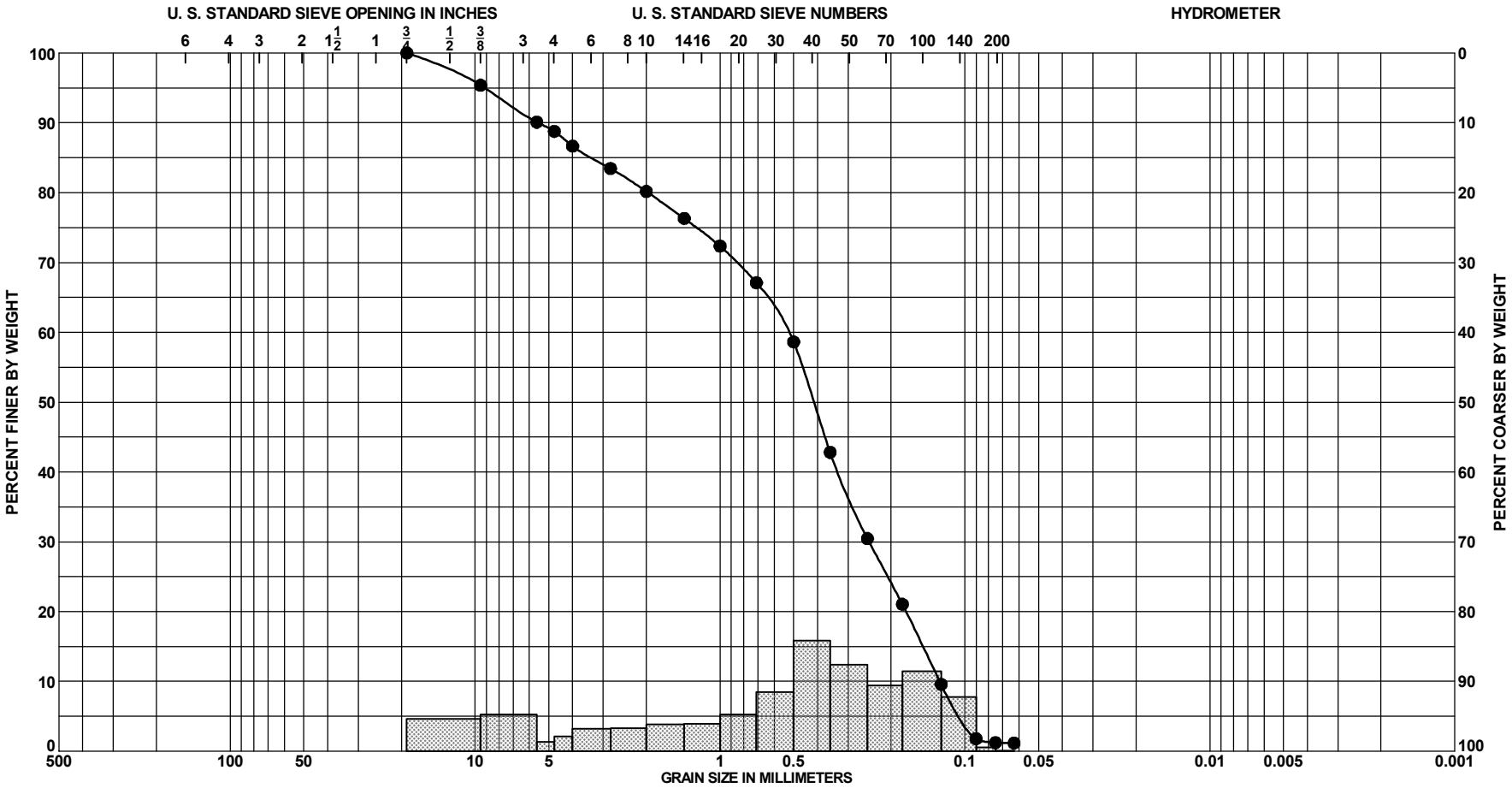


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	1.2 to 2.2 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2		68						
		fine-grained sand-sized quartz, trace									
		shell, trace silt, grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-9
BORING ELEV.	1.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

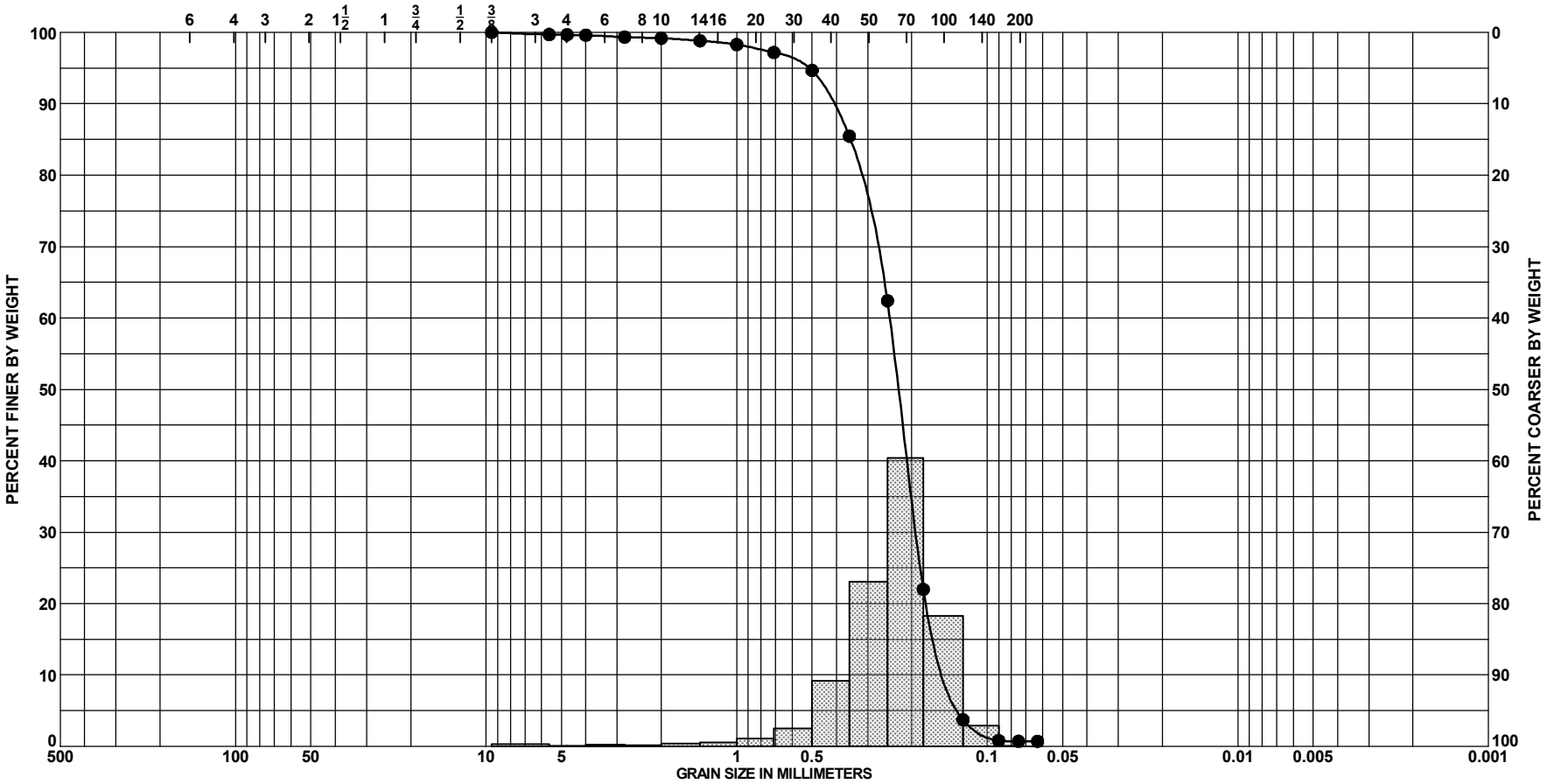


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	2.6 to 3.6 Ft.	SAND, poorly-graded, mostly sand to gravel-sized shell, some fine-grained sand-sized quartz, trace silt, light olive brown (SP)	2.5Y 5/3								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-9
BORING ELEV.	1.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

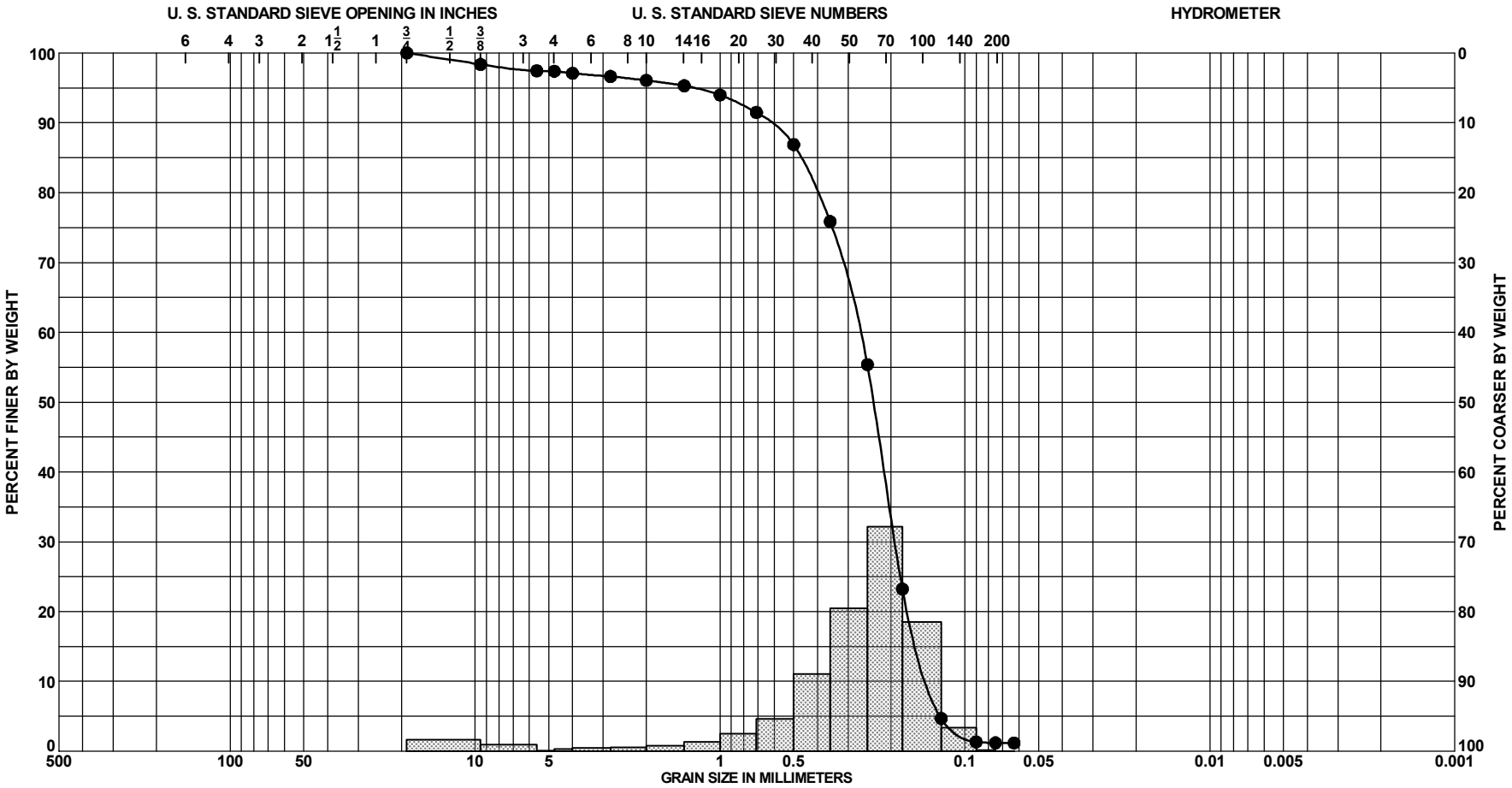


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.2 to 1.5 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2								
		fine-grained sand-sized quartz, little									
		fine to medium-grained sand-sized									
		shell, grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-10
BORING ELEV.	1.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

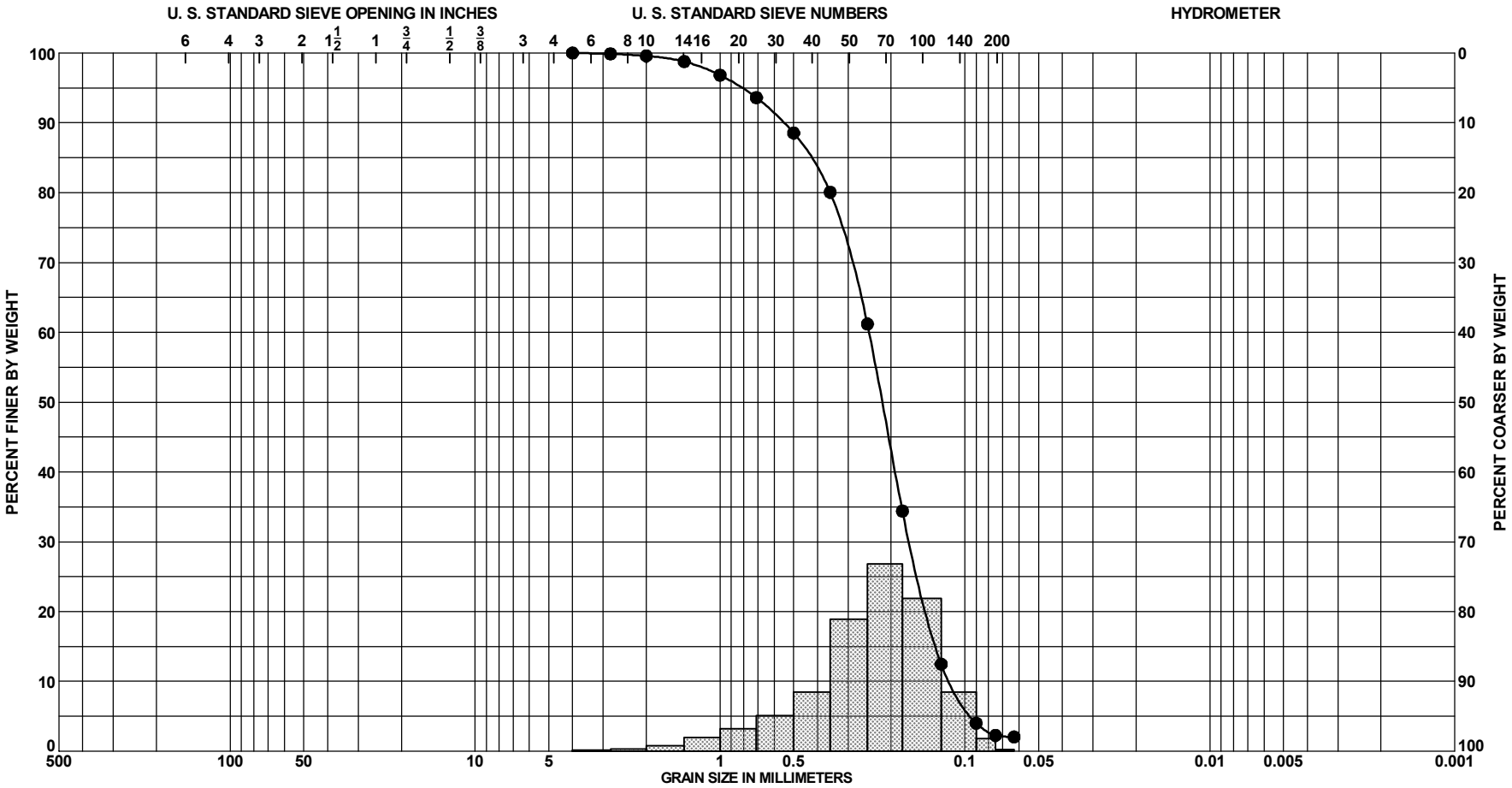


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	2.0 to 2.6 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2		60						
		fine-grained sand-sized quartz, some									
		fine to medium-grained sand-sized									
		shell, trace silt, grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-10
BORING ELEV.	1.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

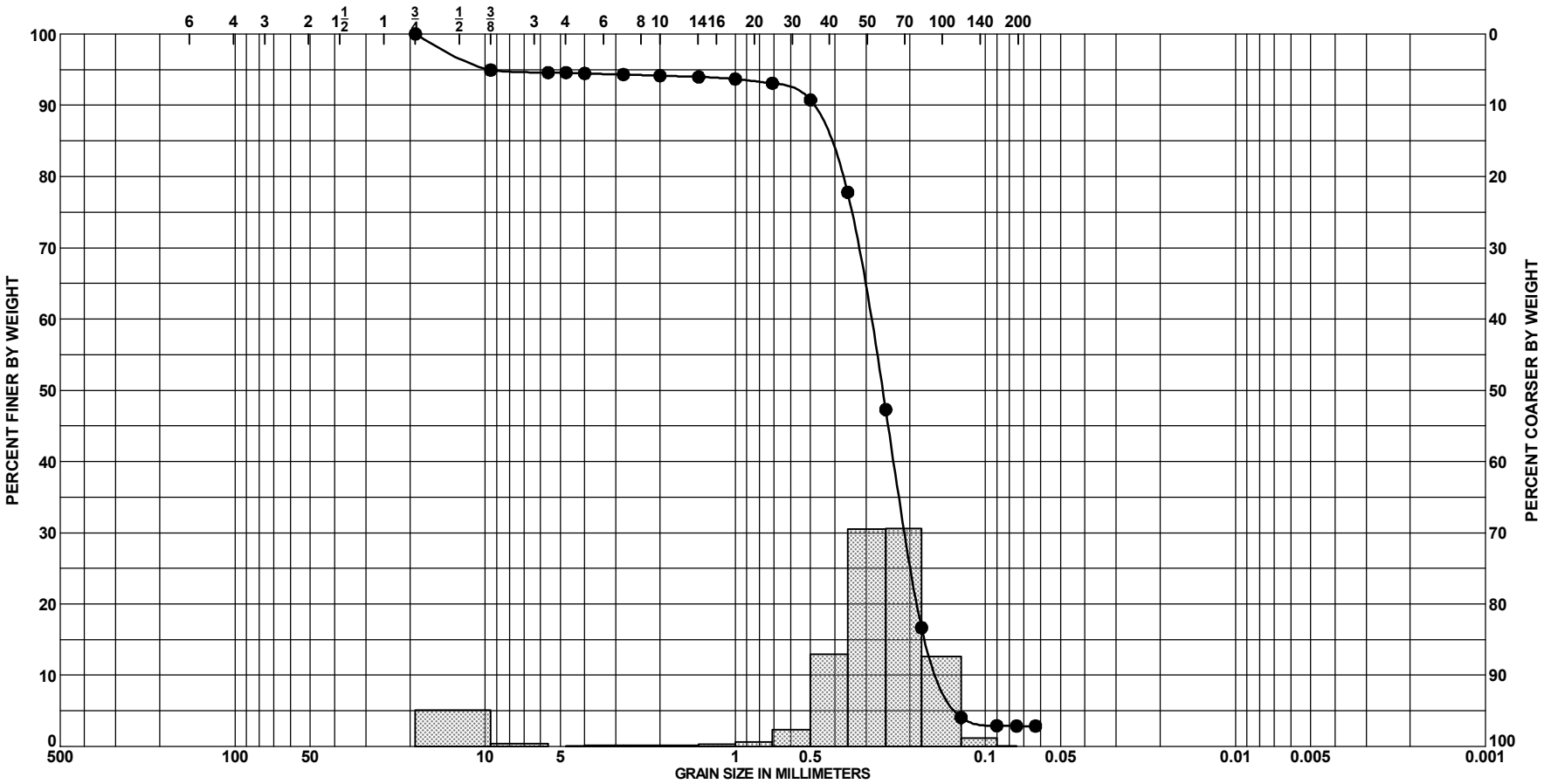


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	2.9 to 3.4 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized shell, some fine-grained sand-sized quartz, trace silt, olive brown (SP)	2.5Y 4/3								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-10
BORING ELEV.	1.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

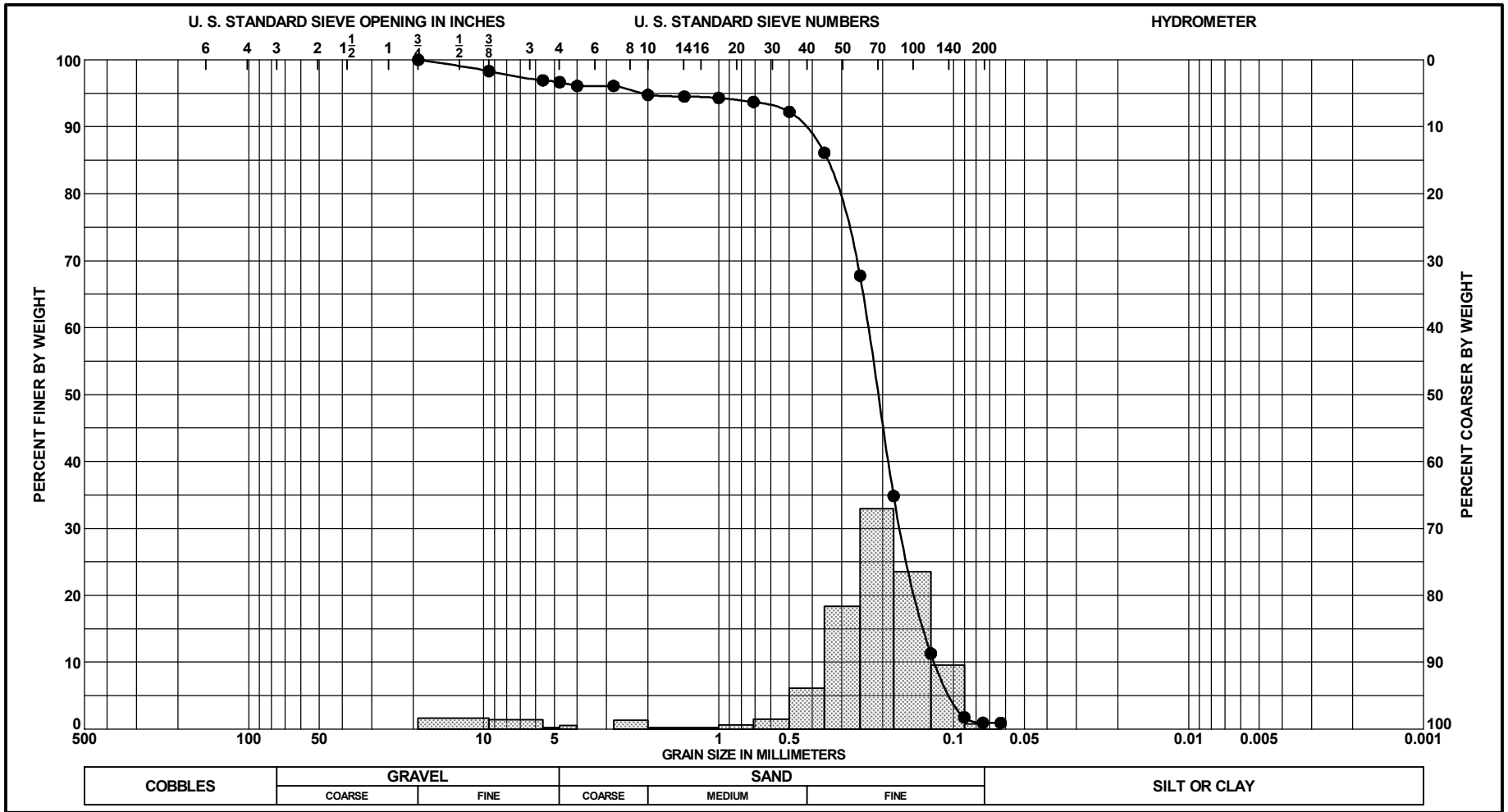


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 1.0 Ft.	SAND, poorly-graded, some sand to gravel-sized shell, some fine-grained sand-sized quartz, trace silt, grayish brown (SP)	2.5Y 5/2								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-13A
BORING ELEV.	-1.4 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

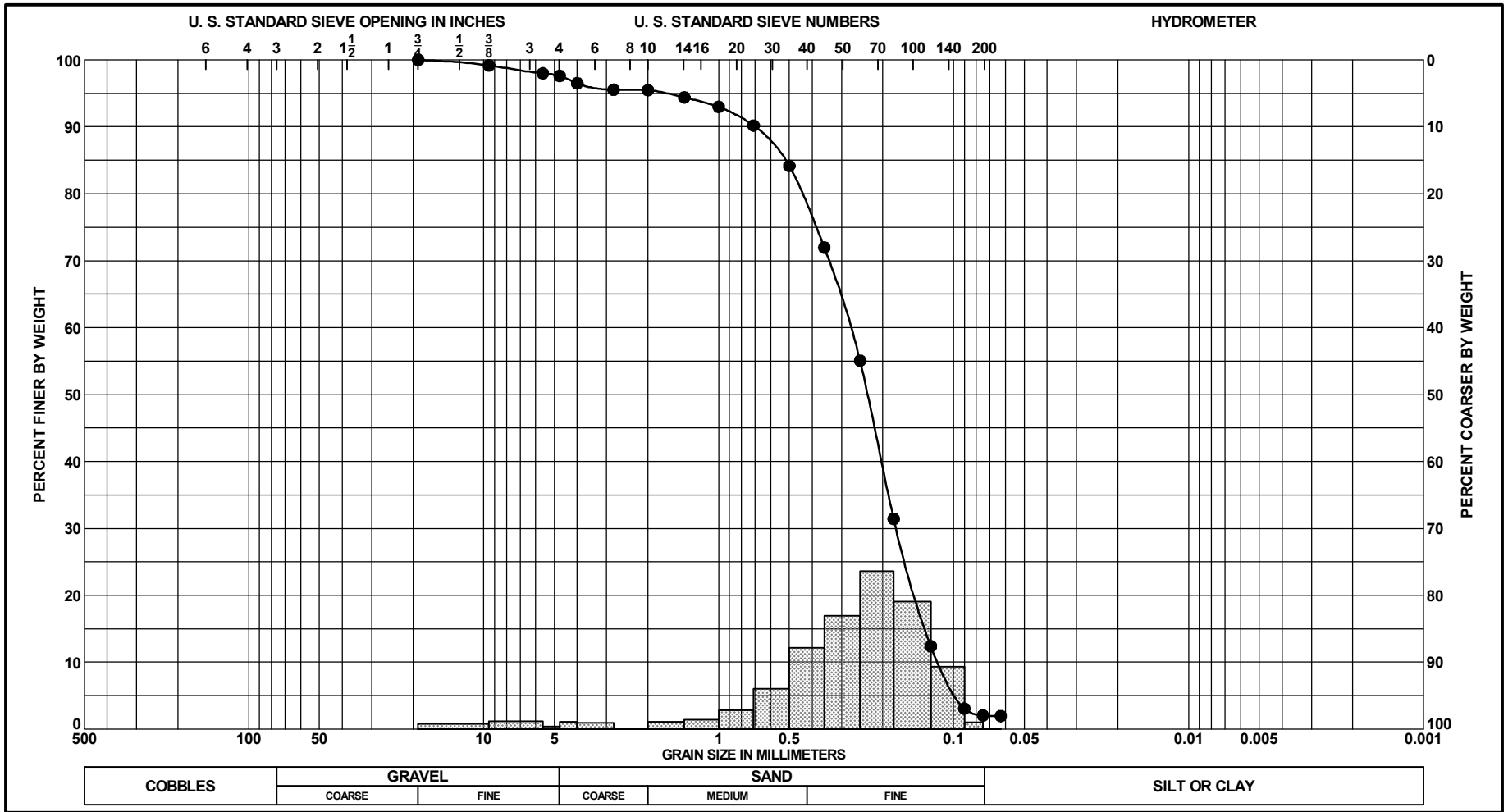


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 1.0 Ft.	SAND, poorly-graded, mostly	2.5Y 6/3								
		fine-grained sand-sized quartz, little									
		fine to medium-grained sand-sized									
		shell, light yellowish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-15A
BORING ELEV.	1.0 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

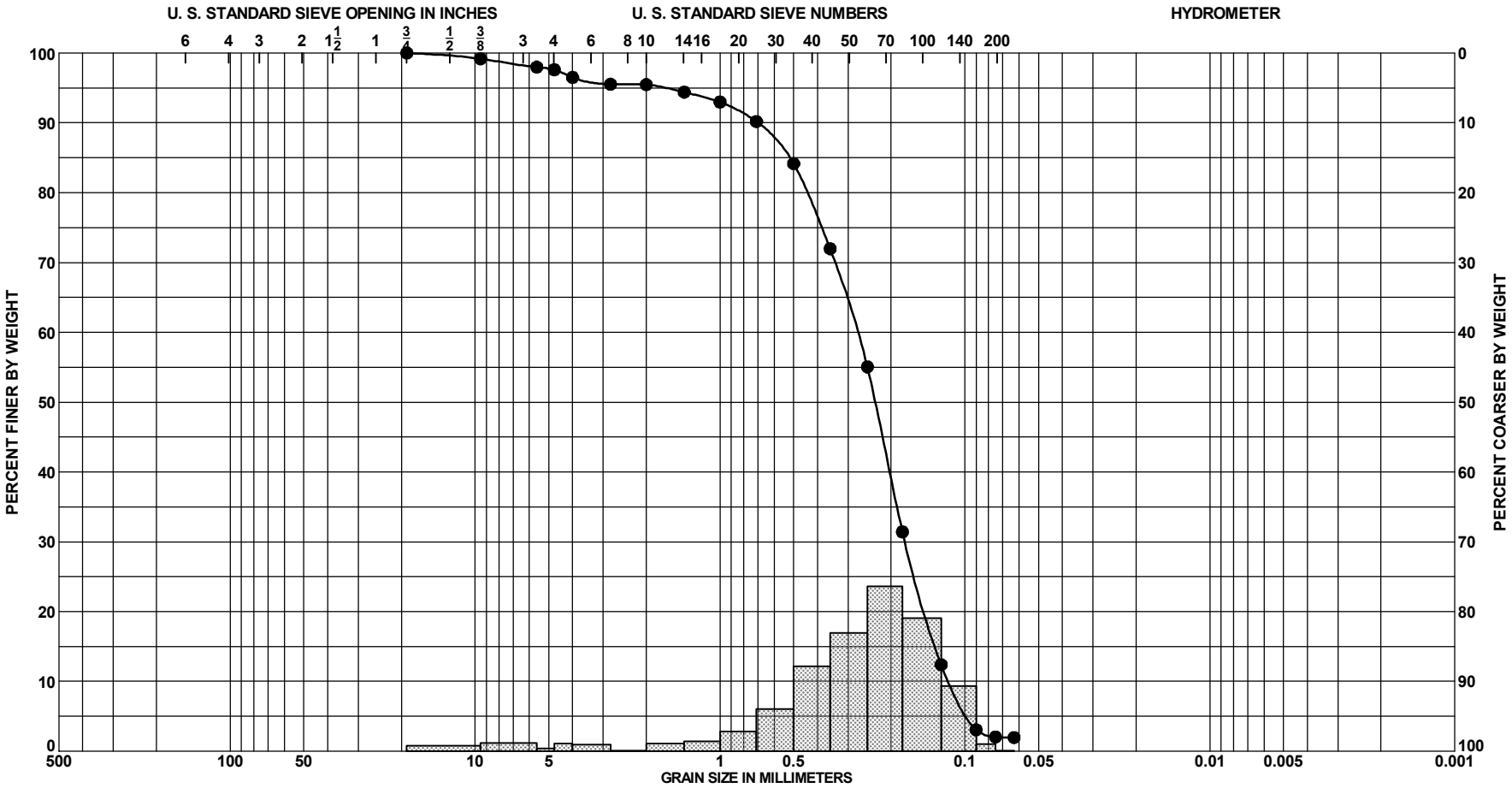


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	1.2 to 2.0 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2		69						
		fine-grained sand-sized quartz, some									
		fine to medium-grained sand-sized									
		shell, trace silt, grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-15A
BORING ELEV.	1.0 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

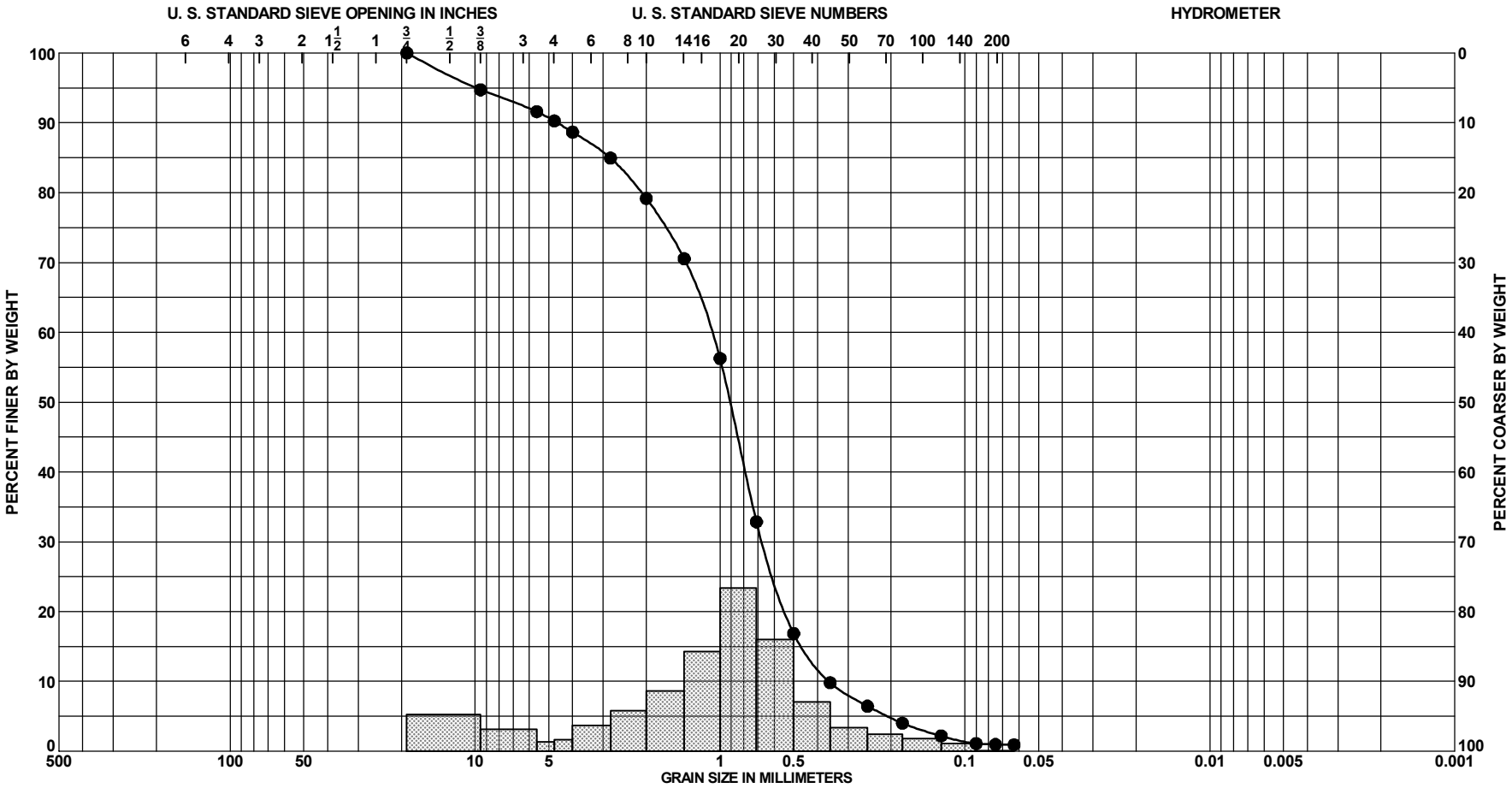


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	2.2 to 3.8 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2								
		fine-grained sand-sized quartz, some									
		fine to medium-grained sand-sized									
		shell, trace silt, grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-15A
BORING ELEV.	1.0 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

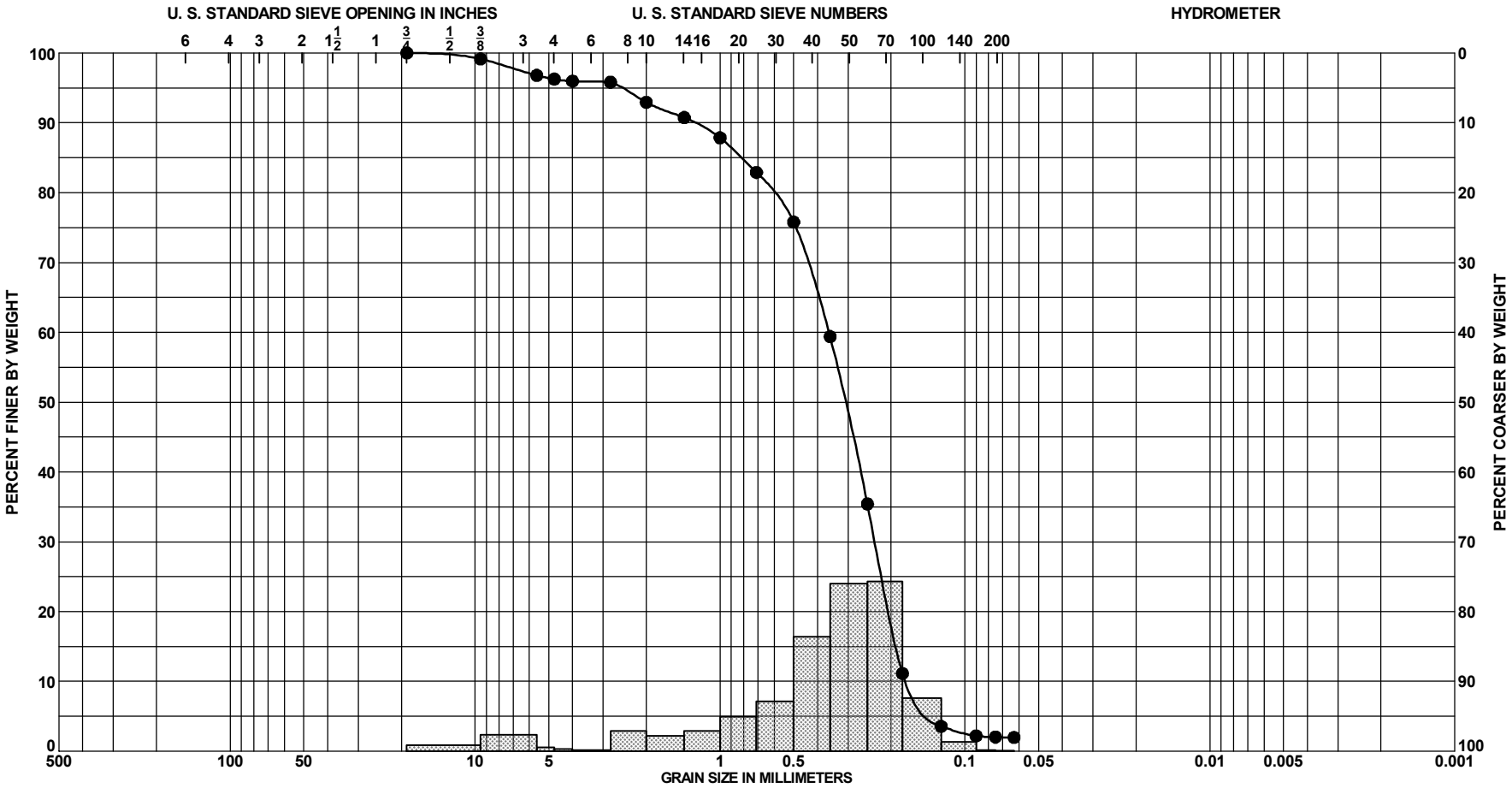


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 1.0 Ft.	SAND, poorly-graded, mostly sand to gravel-sized shell, few fine-grained sand-sized quartz, light yellowish brown (SP)	2.5Y 6/3								

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-17
BORING ELEV.	-1.3 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	1.6 to 1.8 Ft.	SAND, poorly-graded, mostly	2.5Y 5/2								
		fine-grained sand-sized quartz, some									
		fine to coarse-grained sand-sized									
		shell, trace silt, grayish brown (SP)									

PROJECT	Puerto Rico Coastal Project
	La Esperanza Peninsula Borrow Area
BORING NO.	SJH-LE-17
BORING ELEV.	-1.3 Ft., PRVD02
DATE	6/23/2014

GRADATION CURVES

SAJ FORM 2087
JUN 02

9.1.3 BOCA DE CANGREJOS NAVIGATION CHANNEL

- Boring Logs

Hole No. CB-1

DRILLING LOG

DIVISION	South Atlantic
INSTALLATION	Jacksonville District
SHEET	1 OF 1 SHEETS
1. PROJECT	Boca de Cangrejos - Navigation Project
2. LOCATION (Coordinates or Station)	Sta. 4+00 Cut 4 Rge. 25' N of centerline
3. DRILLING AGENCY	Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number)	CB-1
5. NAME OF DRILLER	C.Mason
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	6.0'
10. SIZE AND TYPE OF BIT	See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLW
12. MANUFACTURER'S DESIGNATION OF DRILL	Porter Sampler
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: ; UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	1/3
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 8/26/70; COMPLETED 8/26/70
17. ELEVATION TOP OF HOLE	-9.6
18. TOTAL CORE RECOVERY FOR BORING	15 %
19. SIGNATURE OF INSPECTOR	GEologist: J. Mindock

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-9.6	0.0					BIT OR BARREL -9.6
-12.6	3.0		SAND, silty, slightly organic, gray, quartz, very slightly shelly, fine to medium, very soft (SM)	10	1	PORTER SAMPLER -12.6
-14.6	5.0		PEAT, brown, fibrous, clayey, slightly sandy, soft (PT)	20	2	" "
-15.6	6.0		SAND, quartz, clayey, gray, fine to medium, peat pockets (SC)		3	-15.6

Hole No. CB-2

DRILLING LOG

DIVISION	South Atlantic
INSTALLATION	Jacksonville District
SHEET	1 OF 1 SHEETS
1. PROJECT	Boca de Cangrejos Navigation Project
2. LOCATION (Coordinates or Station)	0+00 Cut 2 Rge: Centerline
3. DRILLING AGENCY	Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number)	CB-2
5. NAME OF DRILLER	C. Mason
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	12.0'
10. SIZE AND TYPE OF BIT	See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLW
12. MANUFACTURER'S DESIGNATION OF DRILL	Porter Sampler
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: ; UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	1/3
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 8/26/70 ; COMPLETED 8/26/70
17. ELEVATION TOP OF HOLE	-3.0
18. TOTAL CORE RECOVERY FOR BORING	66 %
19. SIGNATURE OF INSPECTOR	Geologist: J. Mindock

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-3.0	0.0					BIT OR BARREL -3.0
-8.0	5.0		SAND, quartz, shell, coral, medium to coarse, firm, gray (SP)	27	1	PORTER SAMPLER -6.0
				66	2	" " -9.0
			PEAT, brown, firm, fibrous, soft with black silt content from -8.0 to -9.0	80	3	" " -12.0
-15.0	12.0			90	4	" " -15.0

ENG FORM 1836 1 APR 63 PREVIOUS EDITIONS MAY BE USED (EM 1110-1-1801) GPO 1963 : OF—712-275

PROJECT: BOCA DE CANGREJOS NAVIGATION PROJECT

HOLE NO. CB-2

Hole No. CB-3

DRILLING LOG

DIVISION	SOUTH ATLANTIC
INSTALLATION	Jacksonville District
SHEET	1 OF 1 SHEETS
1. PROJECT	Boca de Cangrejos Navigation Project
2. LOCATION (Coordinates or Station)	Sta. 10+00 Cut 2 Rge. Centerline
3. DRILLING AGENCY	Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number)	CB-3
5. NAME OF DRILLER	C. Mason
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	6.0'
10. SIZE AND TYPE OF BIT	See remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MLW
12. MANUFACTURER'S DESIGNATION OF DRILL	Porter Sampler
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: ; UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	1/3
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 8/28/70 ; COMPLETED 8/28/70
17. ELEVATION TOP OF HOLE	-7.0
18. TOTAL CORE RECOVERY FOR BORING	12 %
19. [redacted]	Geologist: J. Mindock

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	[redacted] SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-7.0	0.0					BIT OR BARREL -7.0
-9.5	2.5		SAND, quartz, shell, coral, fine, gray and tan (SP)	23	1	PORTER SAMPLER -10.0
-13.0	6.0		SAND, clayey, shelly, gray, very soft (SC)	0		" " -13.0
			[redacted]			

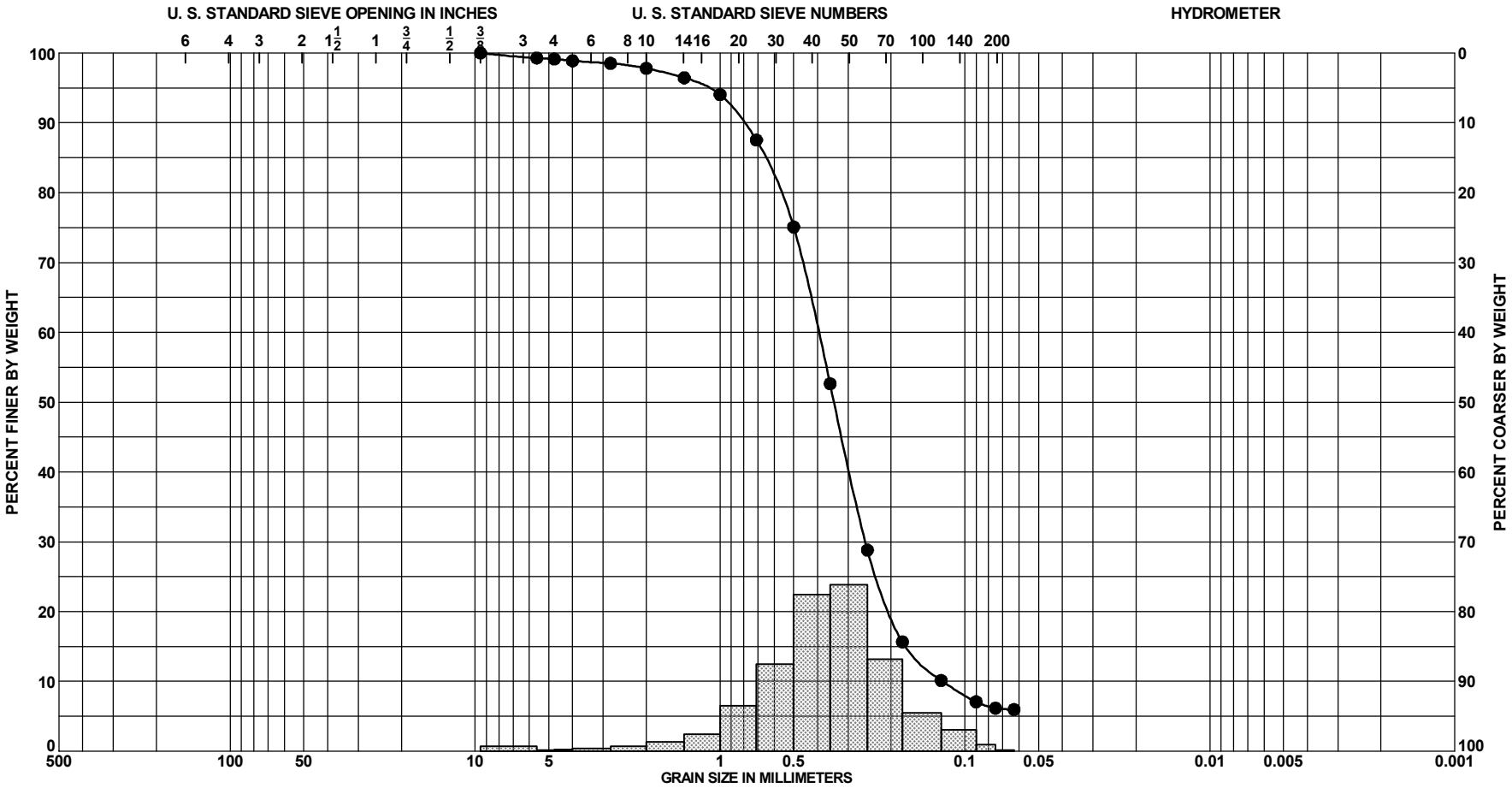
ENG FORM 1836 1 APR 63 PREVIOUS EDITIONS MAY BE USED (EM 1110-1-1801) GPO 1963 : OF-712-275

PROJECT: BOCA DE CANGREJOS NAVIGATION PROJECT

HOLE NO. CB-3

9.1.4 UPLAND SAND MINE: CONCRETOS

- Gradation Graphs
- Granularmetric Reports

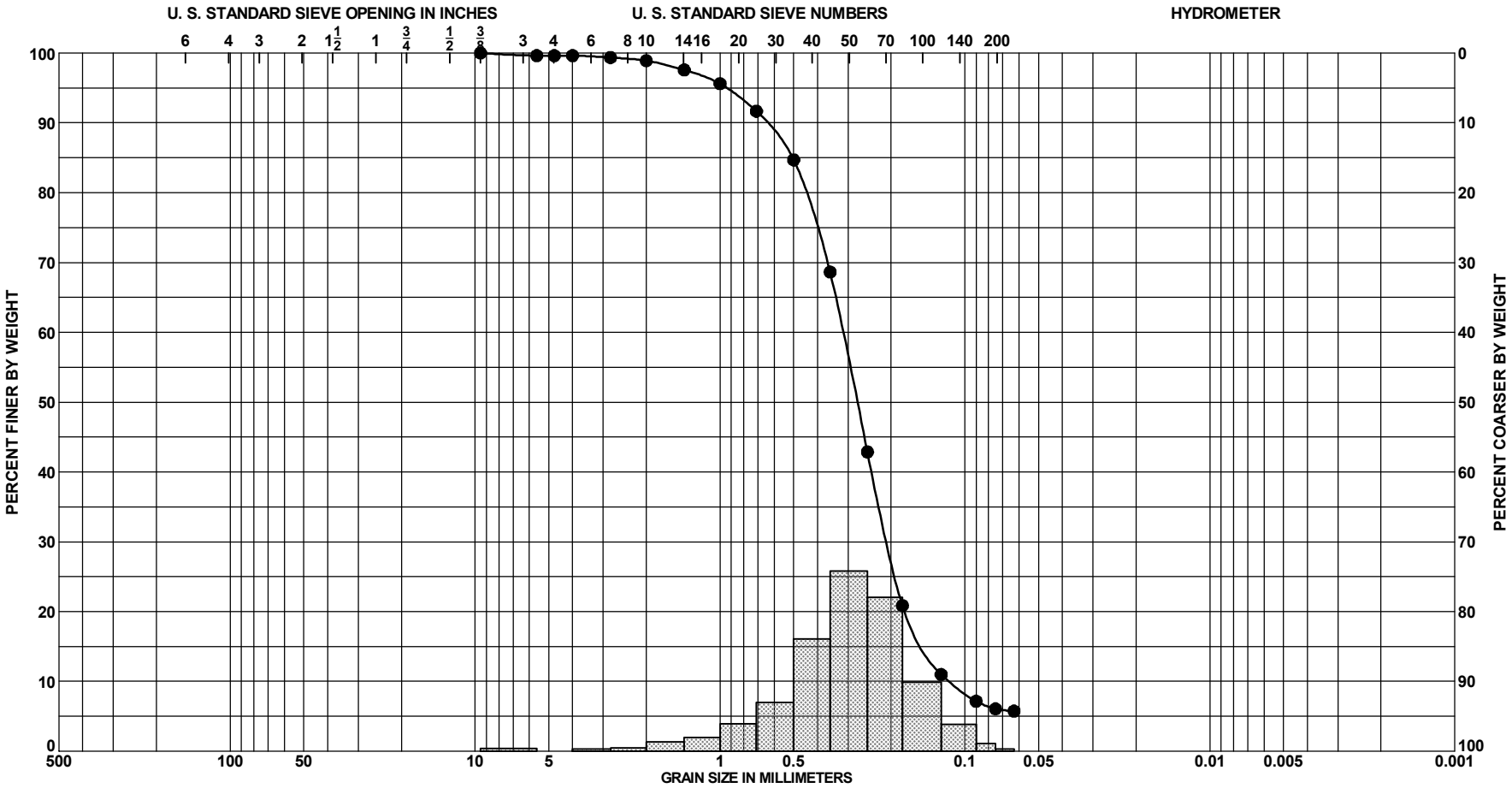


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.0 Ft.	SAND, poorly-graded with silt, mostly	10YR 4/3	0	3						
		fine to medium-grained sand-sized									
		limestone, few silt, trace quartz, brown									
		(SP-SM)									

PROJECT	Puerto Rico CSRM
	Upland Sand Mine
BORING NO.	UPLAND MINE CONCRETOS
BORING ELEV.	Not Determined
DATE	12/4/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

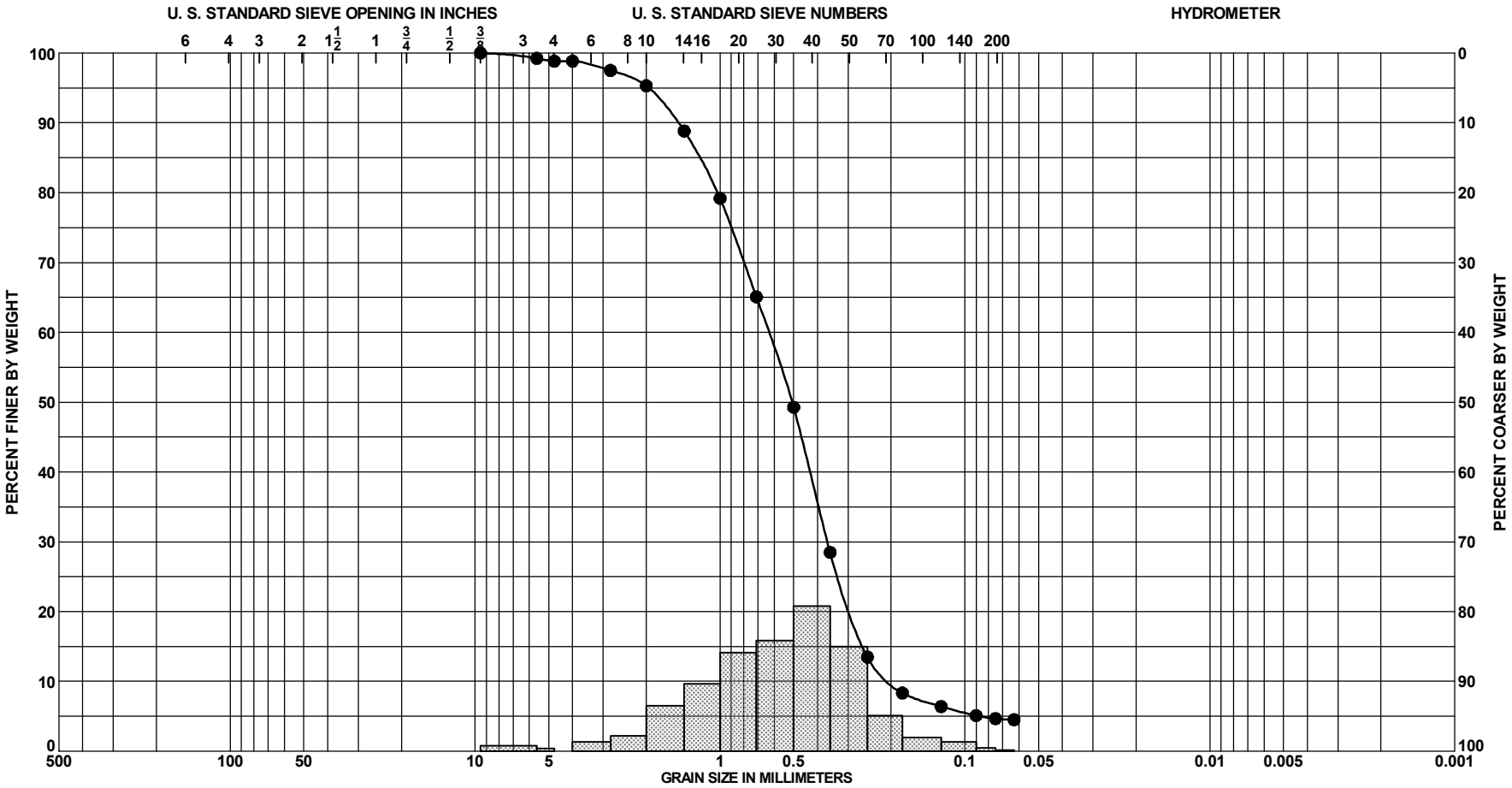


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	0.0 to 0.0 Ft.	SAND, poorly-graded with silt, mostly	10YR 5/3	0							
		fine to medium-grained sand-sized									
		limestone, few silt, few fine-grained									
		sand-sized quartz, brown (SP-SM)									

PROJECT	Puerto Rico CSRM
	Upland Sand Mine
BORING NO.	UPLAND MINE CONCRETOS
BORING ELEV.	Not Determined
DATE	12/4/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	0.0 to 0.0 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized rock, some fine-grained sand-sized quartz, trace silt, pale brown (SP)	10YR 6/3	0	2						

PROJECT	Puerto Rico CSRM
	Upland Sand Mine
BORING NO.	UPLAND MINE CONCRETOS
BORING ELEV.	Not Determined
DATE	12/4/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: Upland Sand Mine
Puerto Rico CSRM

Sample Name: Upland Mine Concretos @ 0 ft

Analysis Date: 12/4/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
	10YR 4/3	#200 - 6.16 #230 - 5.97		2.70	0

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.72	0.72
#4	-2.25	4.75	0.14	0.86
#5	-2.00	4.00	0.26	1.12
#7	-1.50	2.80	0.35	1.47
#10	-1.00	2.00	0.72	2.19
#14	-0.50	1.40	1.36	3.55
#18	0.00	1.00	2.39	5.95
#25	0.50	0.71	6.51	12.46
#35	1.00	0.50	12.45	24.91
#45	1.50	0.36	22.45	47.36
#60	2.00	0.25	23.82	71.19
#80	2.50	0.18	13.16	84.35
#120	3.00	0.13	5.52	89.87
#170	3.50	0.09	3.05	92.92
#200	3.75	0.08	0.92	93.84
#230	4.00	0.06	0.19	94.03

SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized limestone, few silt, trace quartz

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.49	2.14	1.56	1.00	0.64	-0.20

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.42	0.37	1.56	0.34	0.99	-0.95	5.87

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Upland Sand Mine
Puerto Rico CSRM

Sample Name: Upland Mine Concretos @ 0.01 ft

Analysis Date: 12/4/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
	10YR 5/3	#200 - 6.07 #230 - 5.75			0

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.37	0.37
#4	-2.25	4.75	0.00	0.37
#5	-2.00	4.00	0.00	0.37
#7	-1.50	2.80	0.28	0.65
#10	-1.00	2.00	0.46	1.11
#14	-0.50	1.40	1.31	2.41
#18	0.00	1.00	1.98	4.39
#25	0.50	0.71	3.95	8.34
#35	1.00	0.50	6.97	15.31
#45	1.50	0.36	16.06	31.37
#60	2.00	0.25	25.77	57.14
#80	2.50	0.18	22.01	79.15
#120	3.00	0.13	9.87	89.02
#170	3.50	0.09	3.82	92.84
#200	3.75	0.08	1.10	93.93
#230	4.00	0.06	0.32	94.25

SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized limestone, few silt, few fine-grained sand-sized quartz

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.75	2.41	1.86	1.30	1.02	0.08

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.72	0.30	1.86	0.28	0.92	-1.02	5.8

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Upland Sand Mine
Puerto Rico CSRM

Sample Name: Upland Mine Concretos @ 0.02 ft

Analysis Date: 12/4/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW	10YR 6/3	#200 - 4.67 #230 - 4.51		2.40	0

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.76	0.76
#4	-2.25	4.75	0.39	1.15
#5	-2.00	4.00	0.00	1.15
#7	-1.50	2.80	1.34	2.50
#10	-1.00	2.00	2.19	4.68
#14	-0.50	1.40	6.49	11.17
#18	0.00	1.00	9.64	20.81
#25	0.50	0.71	14.12	34.93
#35	1.00	0.50	15.82	50.75
#45	1.50	0.36	20.78	71.53
#60	2.00	0.25	15.00	86.53
#80	2.50	0.18	5.14	91.66
#120	3.00	0.13	1.94	93.61
#170	3.50	0.09	1.30	94.90
#200	3.75	0.08	0.43	95.33
#230	4.00	0.06	0.16	95.49

SAND, poorly-graded, mostly fine to medium-grained sand-sized rock, some fine-grained sand-sized quartz, trace silt

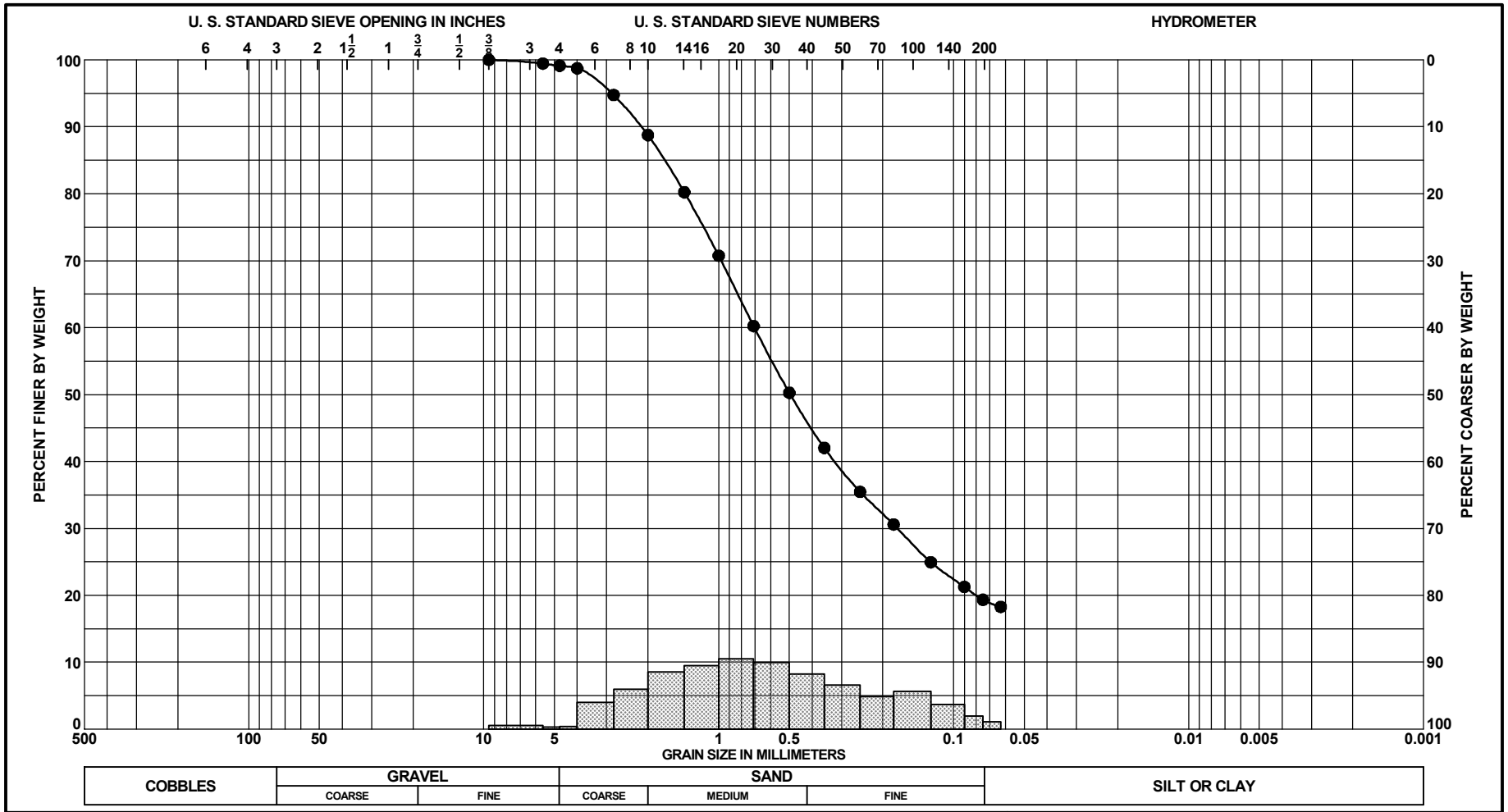
Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.56	1.92	1.62	0.98	0.15	-0.25	-0.98

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	0.79	0.58	0.98	0.51	1.08	-0.4	3.66

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

9.1.5 UPLAND SAND MINE: UTUADO

- Gradation Graphs
- Granularmetric Reports

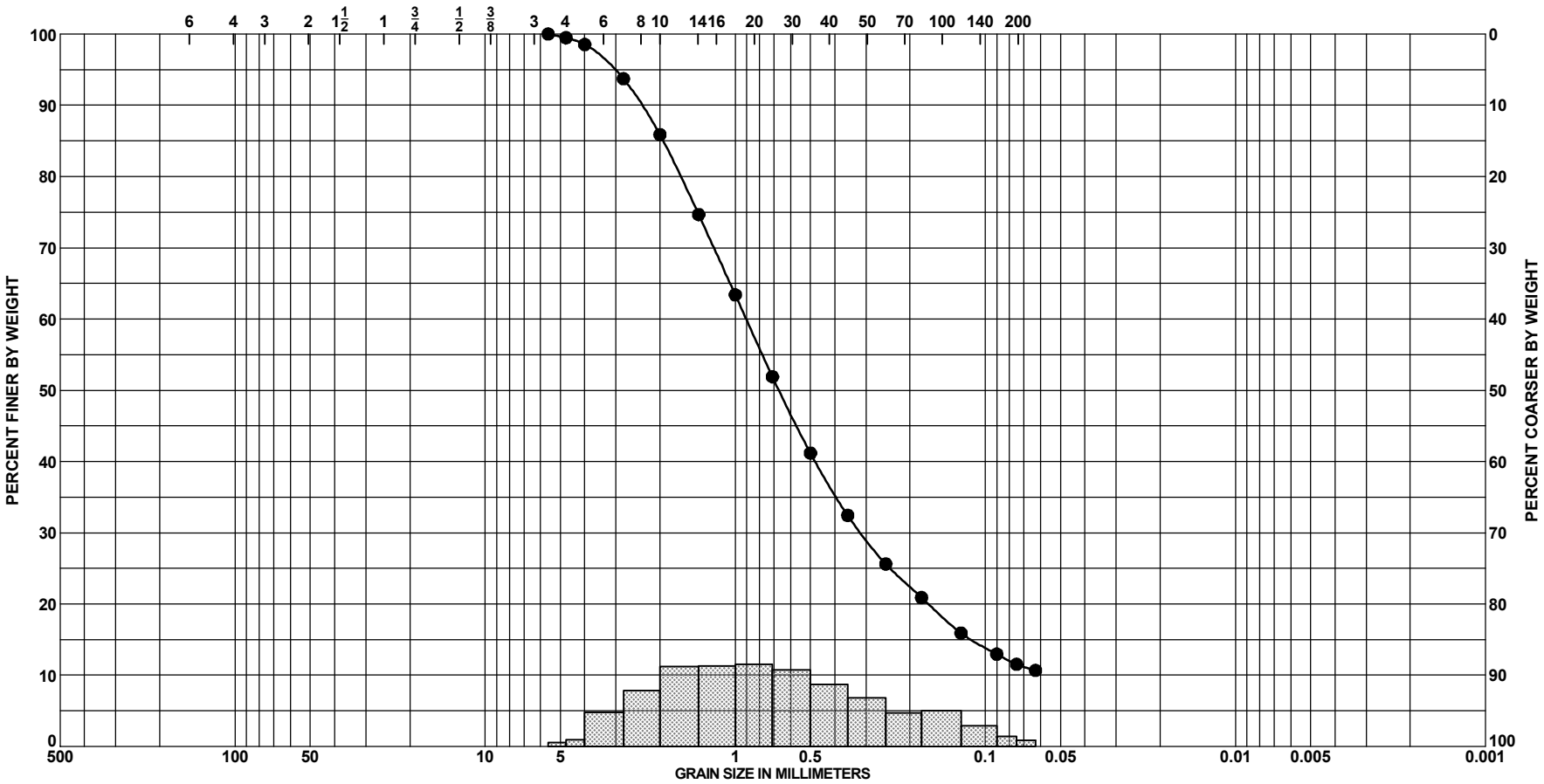


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● U-1	0.0 to 0.0 Ft.	SAND, silty, mostly fine to	10YR 7/1	0	12						
		medium-grained sand-sized quartz,									
		little silt, few sand to gravel-sized									
		limestone, light gray (SM)									

PROJECT	Puerto Rico Coastal Study
	Utuado Sand Mine Samples
BORING NO.	UTUADO 1
BORING ELEV.	Not Determined
DATE	2/19/2021

GRADATION CURVES

SAJ FORM 2087
JUN 02

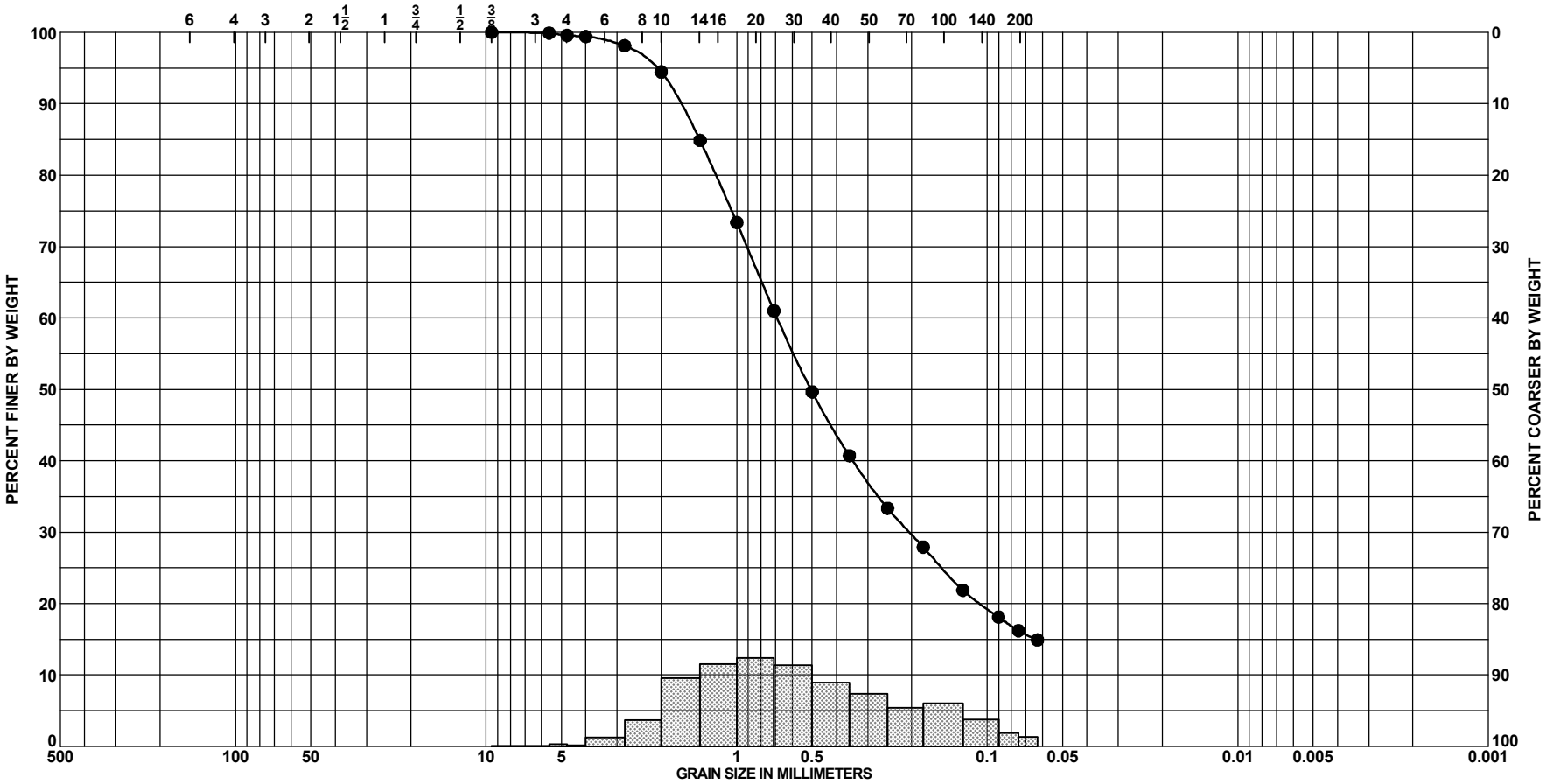


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● U-2	0.0 to 0.0 Ft.	SAND, poorly-graded with silt, mostly	10YR 6/3	0	10						
		fine to medium-grained sand-sized									
		quartz, few silt, few sand to									
		gravel-sized limestone, pale brown									
		(SP-SM)									

PROJECT	Puerto Rico Coastal Study
	Utuado Sand Mine Samples
BORING NO.	UTUADO 2
BORING ELEV.	Not Determined
DATE	2/19/2021

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● U-3	0.0 to 1.0 Ft.	SAND, silty, mostly fine to	10YR 6/3	0	9						
		medium-grained sand-sized quartz,									
		little silt, few sand to gravel-sized									
		limestone, pale brown (SM)									

PROJECT	Puerto Rico Coastal Study
	Utuado Sand Mine Samples
BORING NO.	UTUADO 3
BORING ELEV.	Not Determined
DATE	2/19/2021

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: Puerto Rico Coastal Study
Puerto Rico Coastal Study

Sample Name: Utuado 1 @ 1 ft

Analysis Date: 2/19/2021

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
568,758	812,270		

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
	10YR 7/1	#200 - 19.33 #230 - 18.27		12.28	0

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.55	0.55
#4	-2.25	4.75	0.33	0.88
#5	-2.00	4.00	0.39	1.27
#7	-1.50	2.80	3.98	5.25
#10	-1.00	2.00	6.00	11.24
#14	-0.50	1.40	8.54	19.78
#18	0.00	1.00	9.48	29.26
#25	0.50	0.71	10.51	39.78
#35	1.00	0.50	9.97	49.75
#45	1.50	0.36	8.24	57.99
#60	2.00	0.25	6.56	64.55
#80	2.50	0.18	4.88	69.42
#120	3.00	0.13	5.64	75.06
#170	3.50	0.09	3.68	78.74
#200	3.75	0.08	1.93	80.67
#230	4.00	0.06	1.06	81.73

SAND, silty, mostly fine to medium-grained sand-sized quartz, little silt, few sand to gravel-sized limestone

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
		2.99	1.02	-0.22	-0.72	-1.53

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	0.67	0.63	1.02	0.49	1.5	0.19	2.31

GRANULARMETRIC REPORT % PUERTO RICO COASTAL STUDY_UTUADO SAND MINE SAMPLES.GPJ CESAJ 20171021.GDT 3/10/21

Granularmetric Report

Project Name: Puerto Rico Coastal Study
Puerto Rico Coastal Study

Sample Name: Utuado 2 @ 1 ft

Analysis Date: 2/19/2021

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
568,854	812,270		

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
	10YR 6/3	#200 - 11.53 #230 - 10.67		10.05	0

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.60	0.00	0.00
#4	-2.25	4.75	0.51	0.51
#5	-2.00	4.00	0.95	1.46
#7	-1.50	2.80	4.81	6.27
#10	-1.00	2.00	7.85	14.12
#14	-0.50	1.40	11.23	25.34
#18	0.00	1.00	11.26	36.60
#25	0.50	0.71	11.51	48.11
#35	1.00	0.50	10.72	58.83
#45	1.50	0.36	8.74	67.57
#60	2.00	0.25	6.82	74.39
#80	2.50	0.18	4.72	79.10
#120	3.00	0.13	5.00	84.10
#170	3.50	0.09	2.94	87.04
#200	3.75	0.08	1.43	88.47
#230	4.00	0.06	0.87	89.33

SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized quartz, few silt, few sand to gravel-sized limestone

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.99	2.06	0.59	-0.52	-0.92	-1.63

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	0.49	0.71	0.59	0.66	1.44	0.34	2.38

GRANULARMETRIC REPORT % PUERTO RICO COASTAL STUDY_UTUADO SAND MINE SAMPLES.GPJ CESAJ 20171021.GDT 3/10/21

Granularmetric Report

Project Name: Puerto Rico Coastal Study
Puerto Rico Coastal Study

Sample Name: Utuado 3 @ 1 ft

Analysis Date: 2/19/2021

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
568,951	812,370		

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
	10YR 6/3	#200 - 16.20 #230 - 14.91		9.49	0

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.11	0.11
#4	-2.25	4.75	0.33	0.43
#5	-2.00	4.00	0.16	0.60
#7	-1.50	2.80	1.28	1.88
#10	-1.00	2.00	3.66	5.54
#14	-0.50	1.40	9.59	15.13
#18	0.00	1.00	11.49	26.63
#25	0.50	0.71	12.39	39.02
#35	1.00	0.50	11.35	50.37
#45	1.50	0.36	8.93	59.30
#60	2.00	0.25	7.37	66.67
#80	2.50	0.18	5.43	72.11
#120	3.00	0.13	6.04	78.15
#170	3.50	0.09	3.74	81.89
#200	3.75	0.08	1.90	83.80
#230	4.00	0.06	1.30	85.09

SAND, silty, mostly fine to medium-grained sand-sized quartz, little silt, few sand to gravel-sized limestone

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.79	2.74	0.98	-0.07	-0.46	-1.07

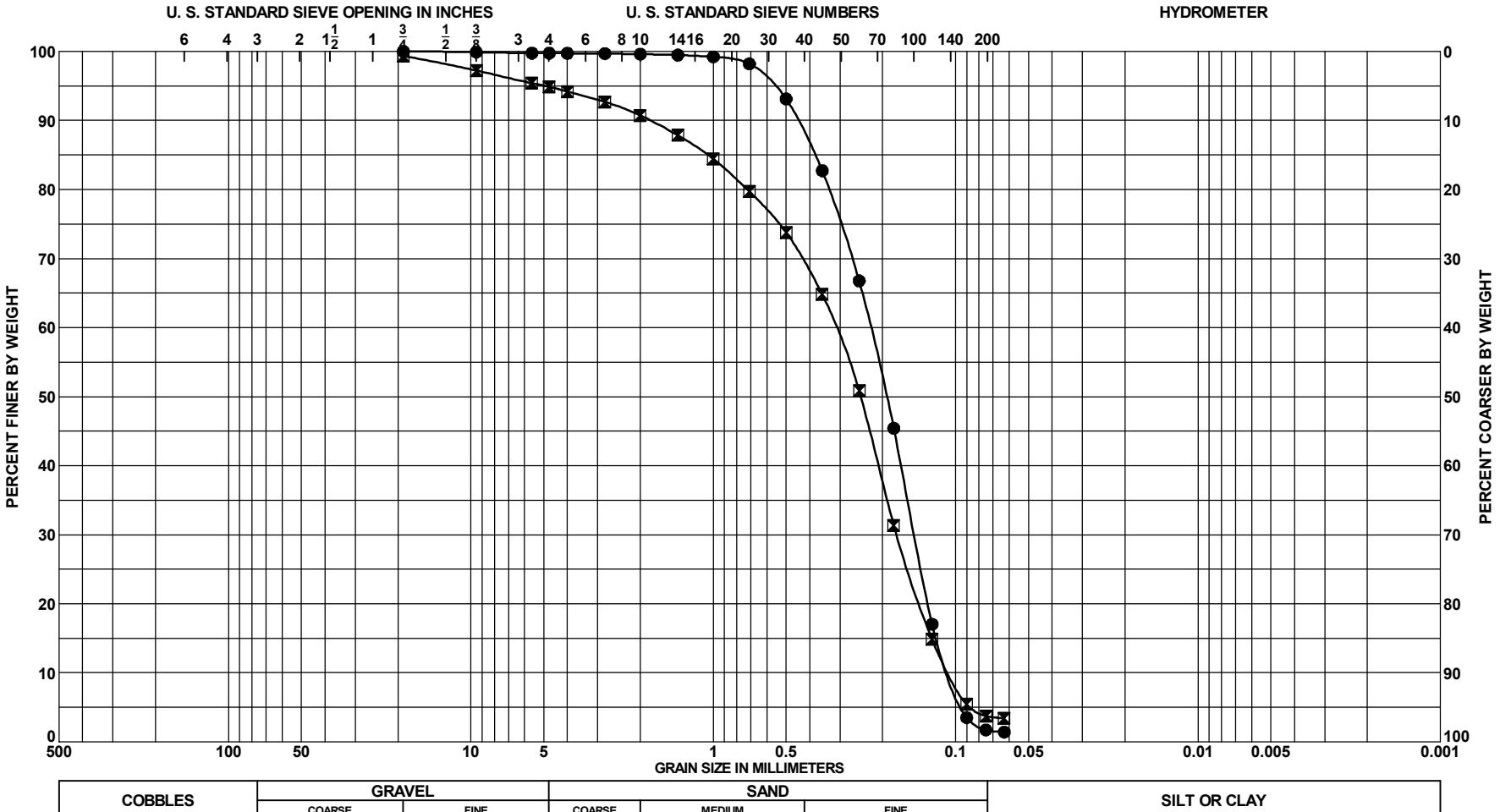
Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	0.83	0.56	0.98	0.51	1.38	0.3	2.38

GRANULARMETRIC REPORT % PUERTO RICO COASTAL STUDY_UTUADO SAND MINE SAMPLES.GPJ CESAJ 20171021.GDT 3/10/21

9.1.6 COMPOSITE SAMPLES

9.1.6.1 Beach-Source Gradation Comparison Graphs

With sand sources where sieve data are available.



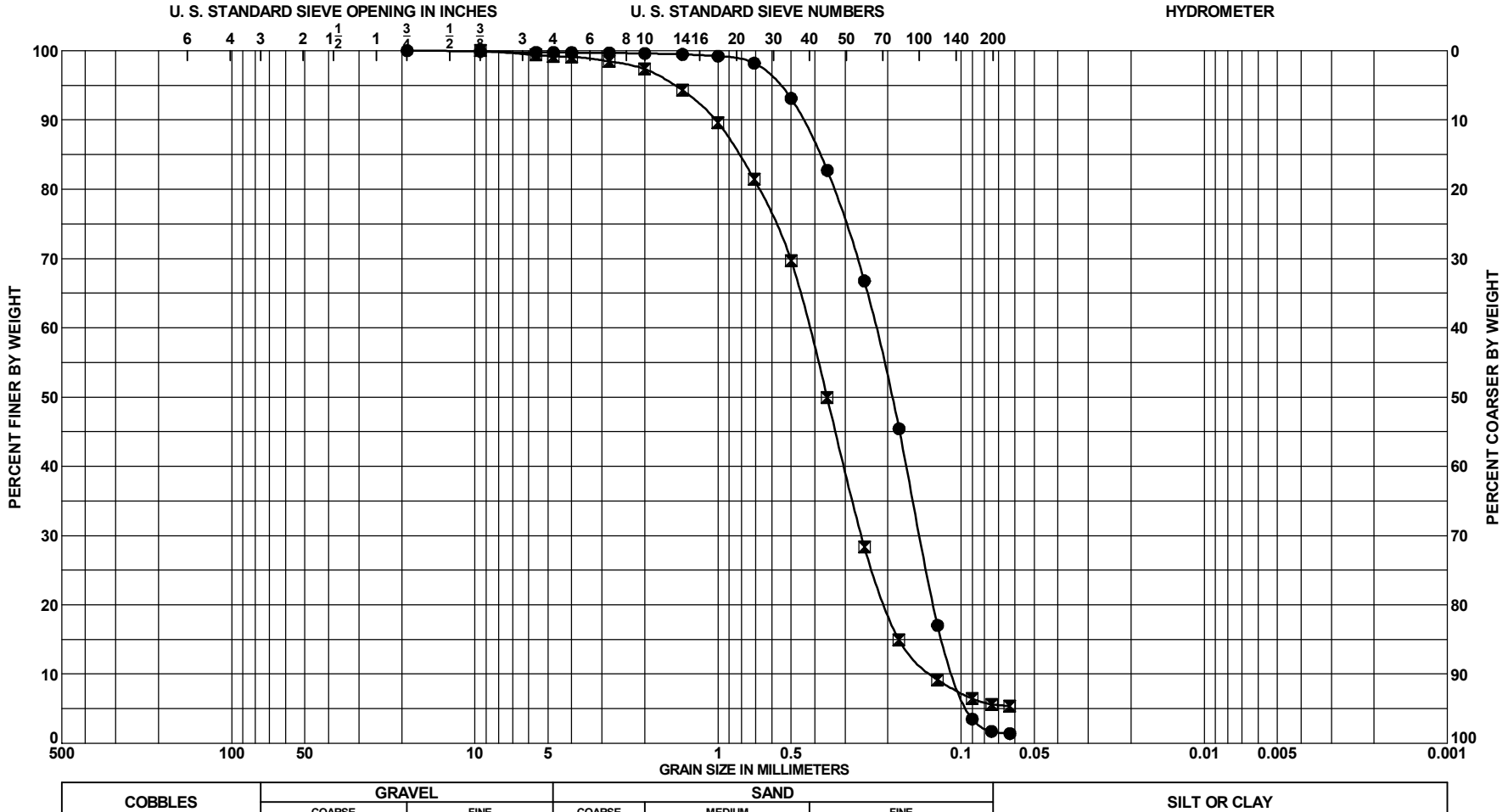
Boring No.	Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	$\%CO_3$	G_s	Org %	w_n	LL	PL	PI
● San Juan Beaches		to 0.5 Ft.	(SP)		20	41						
⊠ La Esperanza		to 0.5 Ft.	(SP)			69						

PROJECT	Puerto Rico CSRM
	Composite Samples
	San Juan Beaches and La Esperanza
DATE	10-09-20

Puerto Rico CSRM Feasibility Study
Appendix B - Geotechnical

GRADATION CURVES

SAJ FORM 2087
JUN 02



Boring No.	Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● San Juan Beaches		to 0.5 Ft.	(SP)		20	42.5						
⊠ Concretos Sand Mine		to 0.5 Ft.	()		0	3						

PROJECT Puerto Rico CSRM

San Juan Composite Samples

Puerto Rico CSRM Feasibility Study

Appendix B - Geotechnical

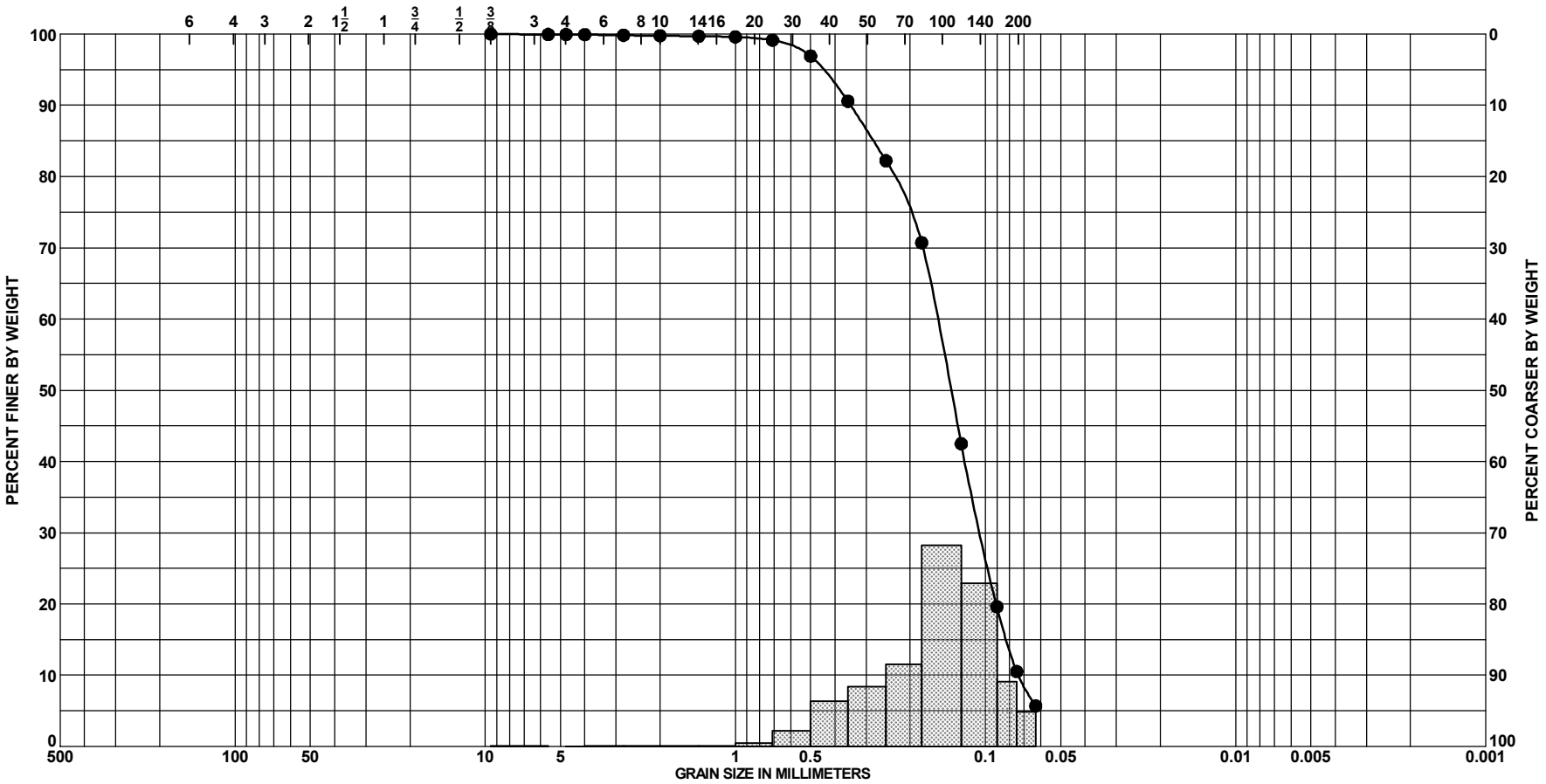
GRADATION CURVES

DATE 08-04-20

SAJ FORM 2087

9.1.6.2 San Juan Beaches Composite Samples

- Gradation Graphs
- Granularmetric Reports



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 11	San Juan - Cangrejo			17							

PROJECT Puerto Rico CSRM

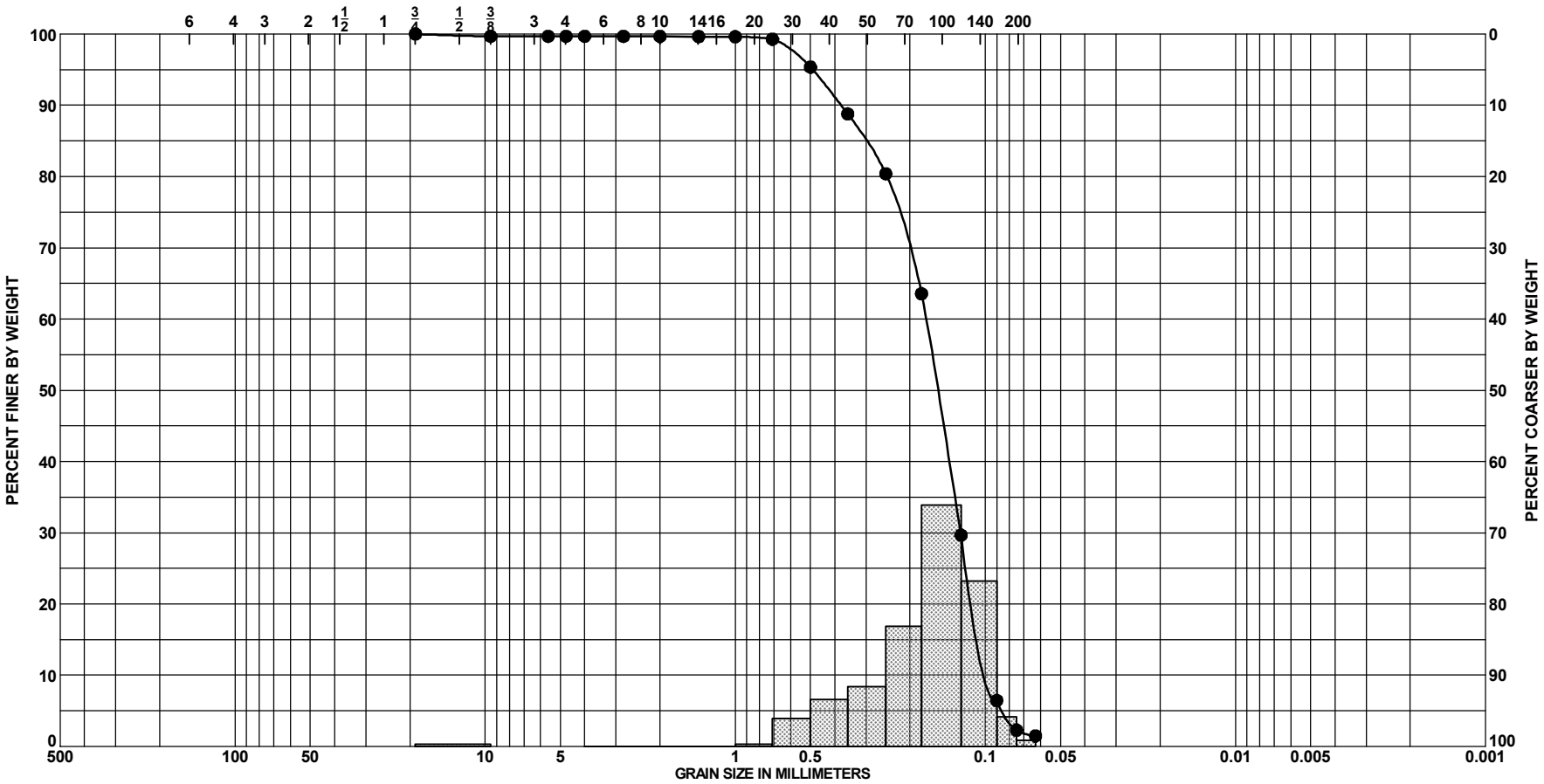
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 12	San Juan - Isla Verde	SAND, poorly-graded (SP)		16	29						

PROJECT Puerto Rico CSRM

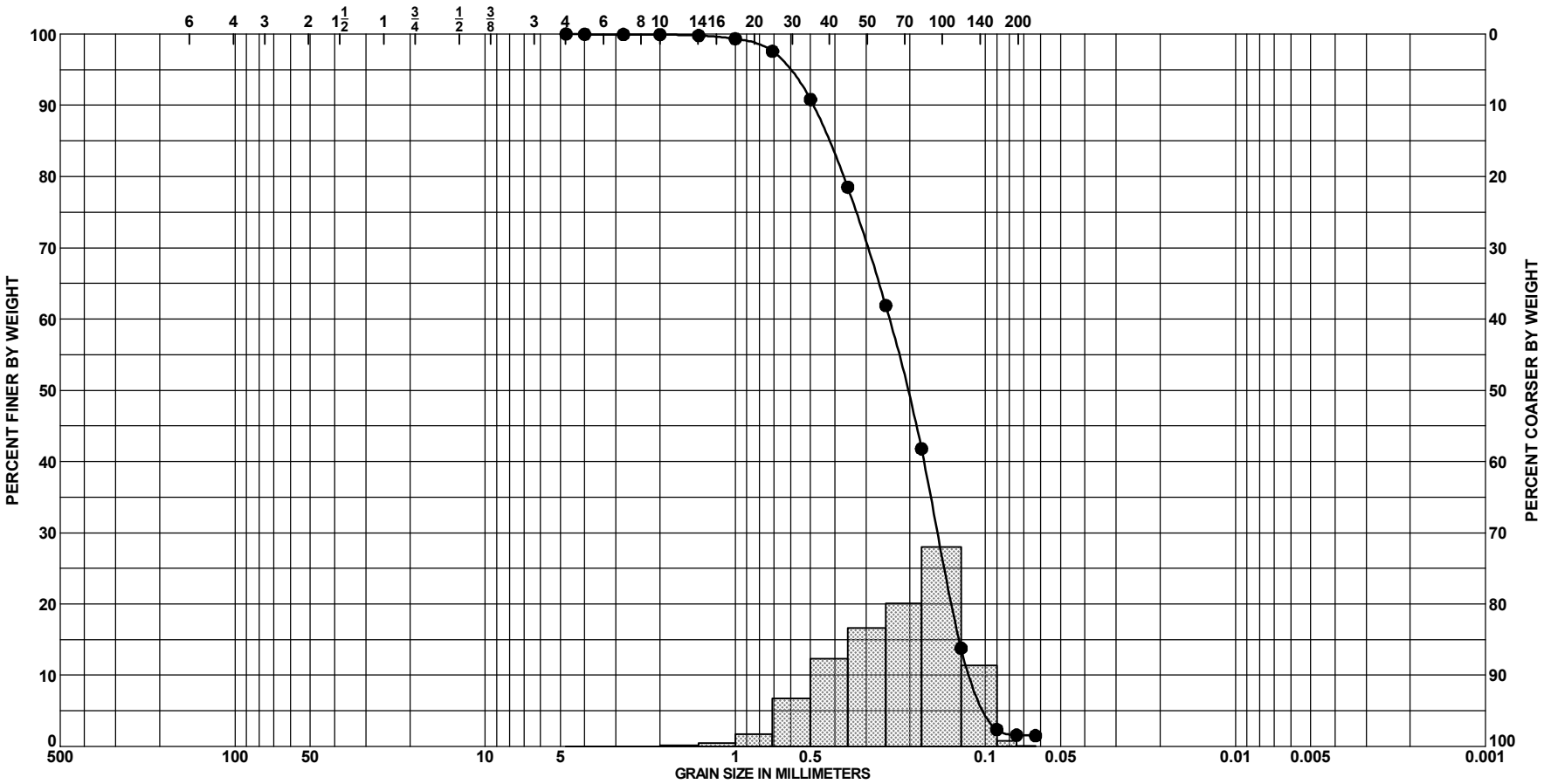
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 13	San Juan - Ocean Park	SAND, poorly-graded (SP)		20	47						

PROJECT Puerto Rico CSRM

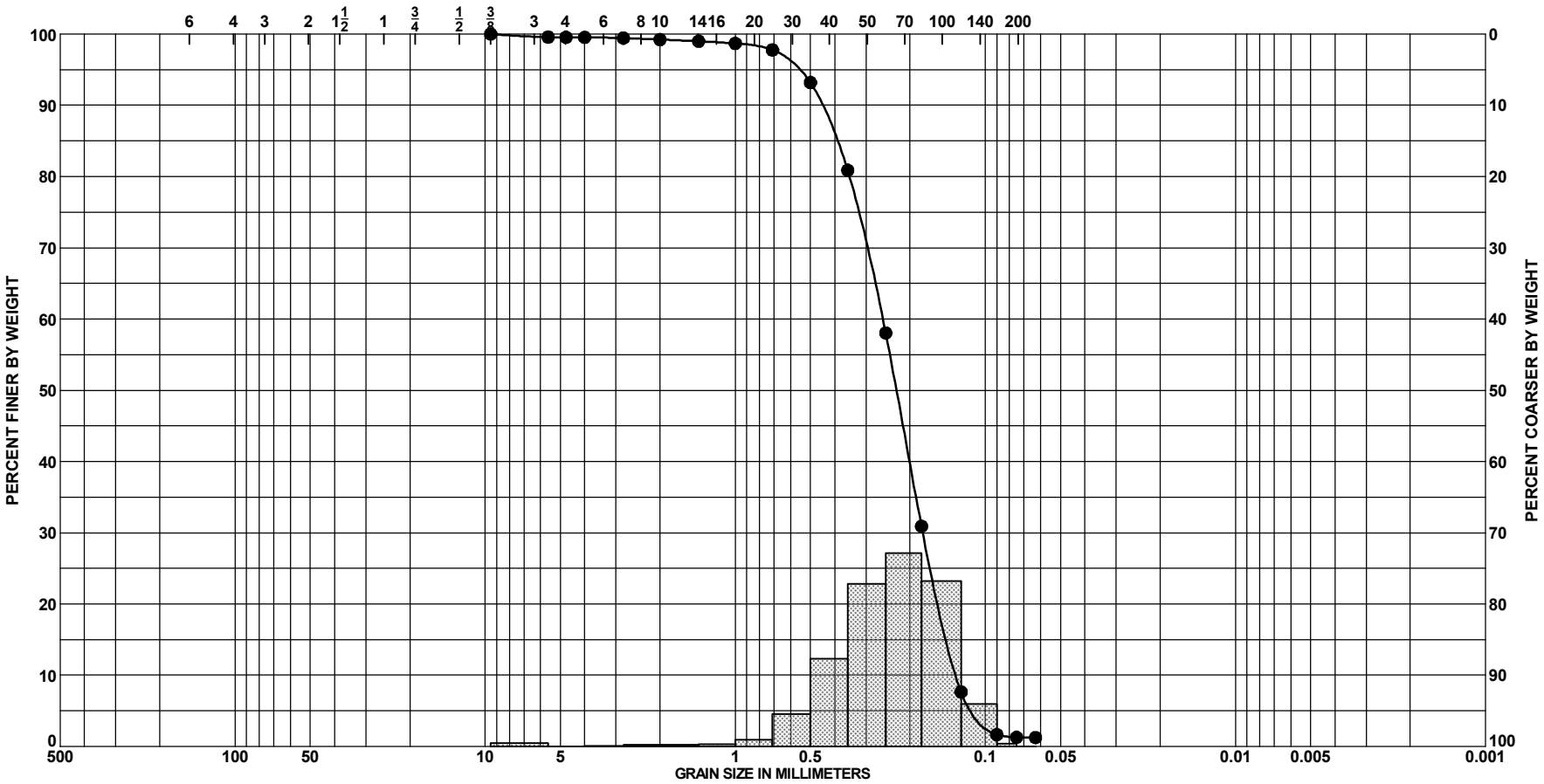
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 14	San Juan - Parque	SAND, poorly-graded (SP)		25	47						

PROJECT Puerto Rico CSRM

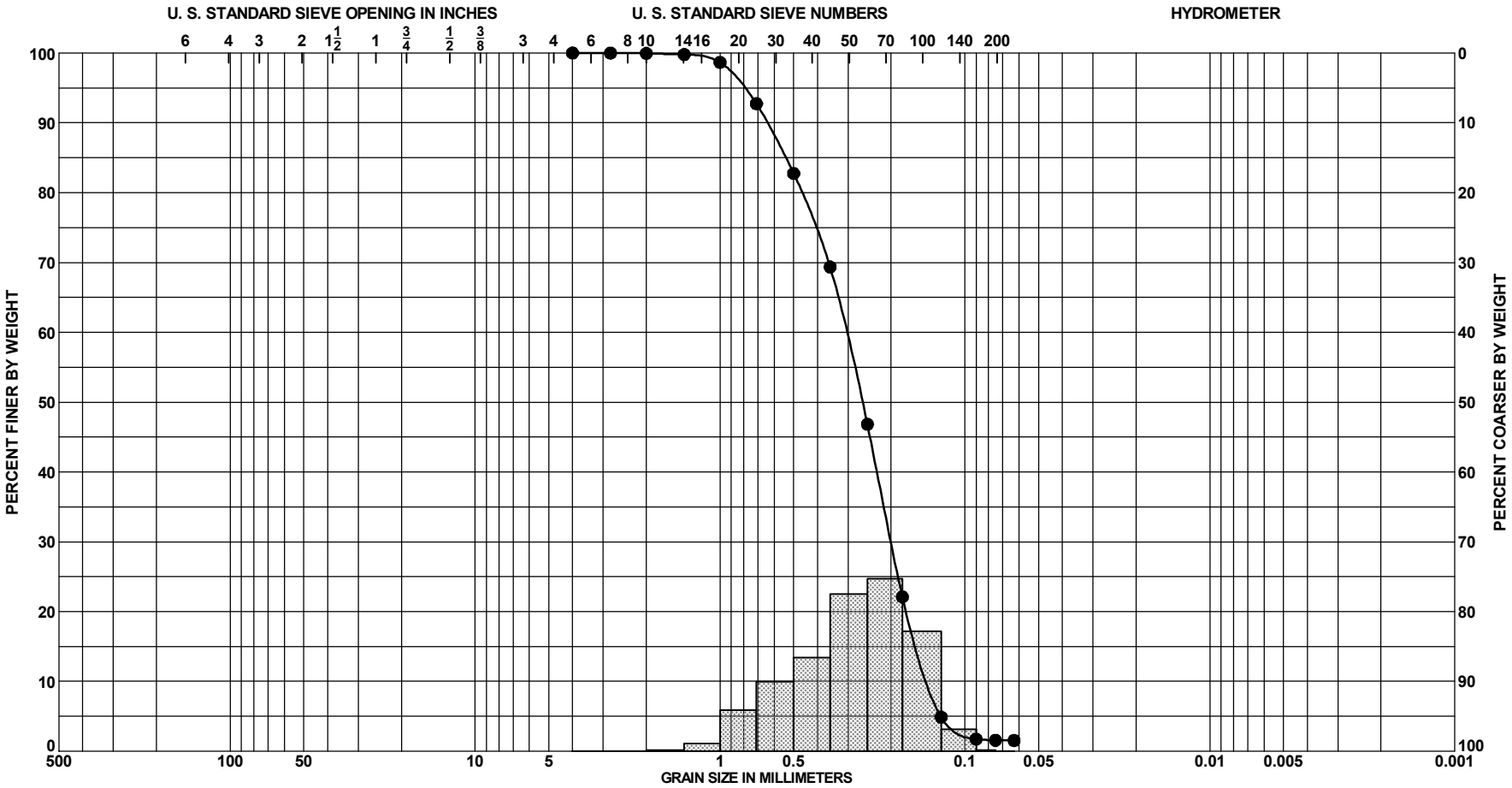
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 15	San Juan - Condado	SAND, poorly-graded (SP)		22	47						

PROJECT Puerto Rico CSRM

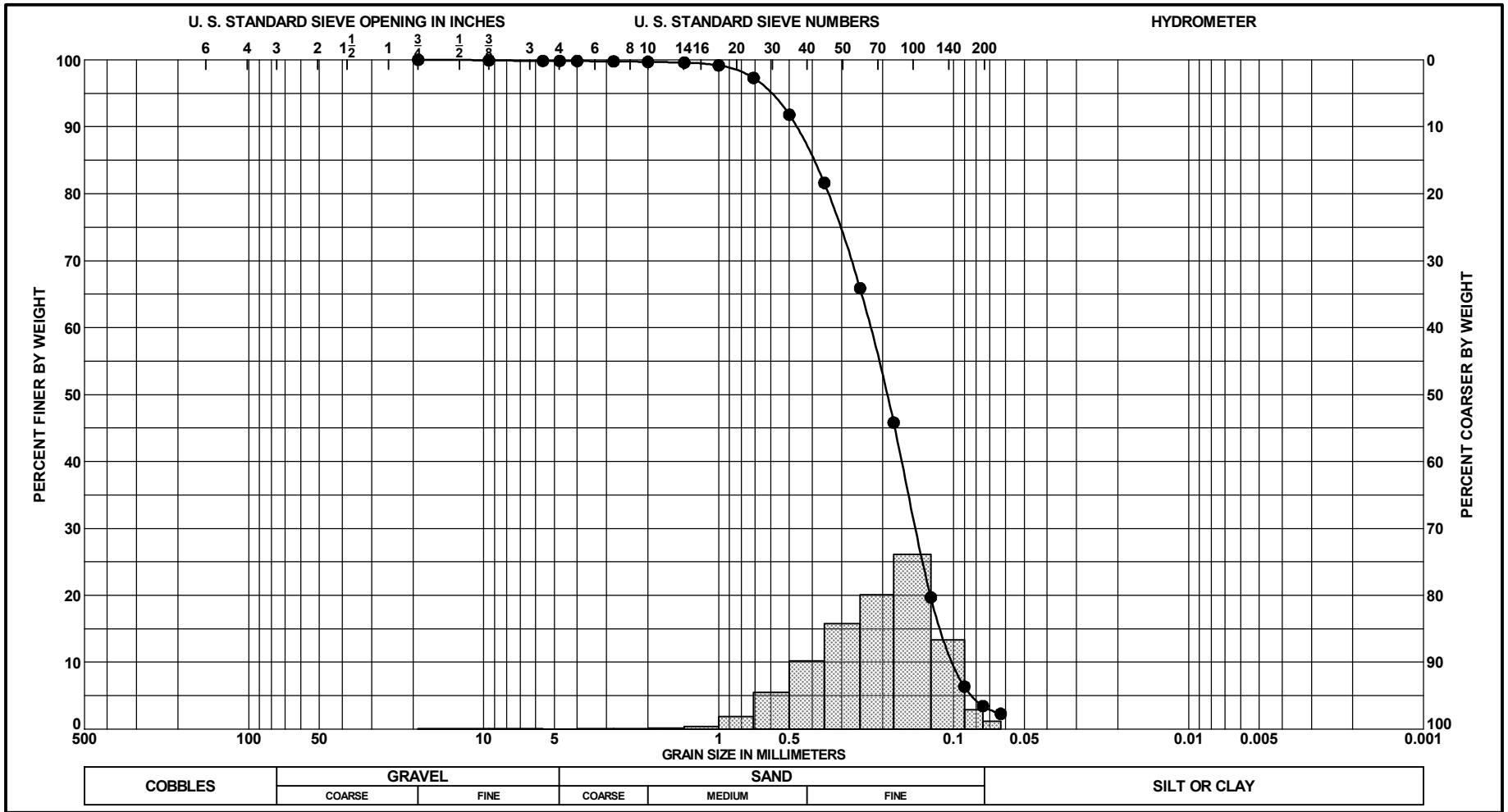
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 16	San Juan	SAND, poorly-graded (SP)		20	43						

PROJECT Puerto Rico CSRM

Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #11 San Juan - Cangrejo

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined: San Juan - Cangrejo@0, San Juan - Cangrejo@0.001, San Juan - Cangrejo@0.002, San Juan - Cangrejo@0.003

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
		#200 - 10.52 #230 - 5.68			17.43

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.05	0.05
#4	-2.25	4.75	0.00	0.05
#5	-2.00	4.00	0.03	0.09
#7	-1.50	2.80	0.08	0.17
#10	-1.00	2.00	0.07	0.25
#14	-0.50	1.40	0.06	0.30
#18	0.00	1.00	0.11	0.42
#25	0.50	0.71	0.45	0.87
#35	1.00	0.50	2.23	3.10
#45	1.50	0.36	6.33	9.43
#60	2.00	0.25	8.35	17.78
#80	2.50	0.18	11.52	29.30
#120	3.00	0.13	28.22	57.52
#170	3.50	0.09	22.88	80.40
#200	3.75	0.08	9.08	89.48
#230	4.00	0.06	4.84	94.32

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	3.60	3.38	2.87	2.31	1.89	1.15

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.69	0.15	2.87	0.14	0.82	-1.16	5.66

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #12 San Juan - Isla Verde

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined: San Juan - Isla Verde@0.004, San Juan - Isla Verde@0.005, San Juan - Isla Verde@0.006, San Juan - Isla Verde@0.007

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP		#200 - 2.30 #230 - 1.47		29.41	16.18

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4"	-4.25	19.00	0.00	0.00
3/8"	-3.25	9.50	0.32	0.32
#3.5	-2.50	5.60	0.00	0.32
#4	-2.25	4.75	0.00	0.32
#5	-2.00	4.00	0.00	0.32
#7	-1.50	2.80	0.00	0.32
#10	-1.00	2.00	0.02	0.34
#14	-0.50	1.40	0.02	0.36
#18	0.00	1.00	0.02	0.38
#25	0.50	0.71	0.34	0.72
#35	1.00	0.50	3.93	4.66
#45	1.50	0.36	6.56	11.21
#60	2.00	0.25	8.41	19.62
#80	2.50	0.18	16.83	36.44
#120	3.00	0.13	33.90	70.34
#170	3.50	0.09	23.20	93.54
#200	3.75	0.08	4.16	97.70
#230	4.00	0.06	0.82	98.53

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.59	3.29	3.10	2.70	2.16	1.78	1.03

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.53	0.17	2.70	0.15	0.81	-2.08	13.79

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #13 San Juan - Ocean Park

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined: San Juan - Ocean Park@0.008, San Juan - Ocean Park@0.009, San Juan - Ocean Park@0.01, San Juan - Ocean Park@0.011

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP		#200 - 1.59 #230 - 1.51		47.24	19.93

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#4	-2.25	4.75	0.00	0.00
#5	-2.00	4.00	0.04	0.04
#7	-1.50	2.80	0.02	0.06
#10	-1.00	2.00	0.03	0.09
#14	-0.50	1.40	0.12	0.21
#18	0.00	1.00	0.45	0.66
#25	0.50	0.71	1.76	2.42
#35	1.00	0.50	6.77	9.19
#45	1.50	0.36	12.30	21.50
#60	2.00	0.25	16.61	38.11
#80	2.50	0.18	20.12	58.22
#120	3.00	0.13	28.00	86.22
#170	3.50	0.09	11.40	97.62
#200	3.75	0.08	0.78	98.41
#230	4.00	0.06	0.09	98.49

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.38	2.96	2.80	2.30	1.61	1.28	0.69

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.15	0.23	2.30	0.20	0.8	-0.63	3.15

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #14 San Juan - Parque

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined
San Juan - Parque@0.012
San Juan - Parque@0.013
San Juan - Parque@0.014
San Juan - Parque@0.015

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP		#200 - 1.28 #230 - 1.25		46.88	24.98

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.43	0.43
#4	-2.25	4.75	0.02	0.45
#5	-2.00	4.00	0.01	0.47
#7	-1.50	2.80	0.10	0.57
#10	-1.00	2.00	0.21	0.78
#14	-0.50	1.40	0.23	1.00
#18	0.00	1.00	0.31	1.31
#25	0.50	0.71	0.92	2.23
#35	1.00	0.50	4.58	6.81
#45	1.50	0.36	12.31	19.12
#60	2.00	0.25	22.85	41.97
#80	2.50	0.18	27.12	69.09
#120	3.00	0.13	23.25	92.35
#170	3.50	0.09	5.99	98.34
#200	3.75	0.08	0.38	98.72
#230	4.00	0.06	0.04	98.75

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.22	2.82	2.63	2.15	1.63	1.37	0.80

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.06	0.24	2.15	0.23	0.79	-1.65	10.19

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #15 San Juan - Condado

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined: San Juan - Condado@0.016, San Juan - Condado@0.017, San Juan - Condado@0.018, San Juan - Condado@0.019

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP		#200 - 1.55 #230 - 1.53		46.56	22.03

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.01	0.01
#10	-1.00	2.00	0.04	0.05
#14	-0.50	1.40	0.16	0.21
#18	0.00	1.00	1.13	1.34
#25	0.50	0.71	5.91	7.25
#35	1.00	0.50	10.00	17.25
#45	1.50	0.36	13.39	30.64
#60	2.00	0.25	22.52	53.17
#80	2.50	0.18	24.74	77.91
#120	3.00	0.13	17.20	95.11
#170	3.50	0.09	3.17	98.28
#200	3.75	0.08	0.17	98.45
#230	4.00	0.06	0.02	98.47

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.00	2.68	2.44	1.93	1.29	0.94	0.31

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.81	0.29	1.93	0.26	0.8	-0.48	2.74

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Pre-fill Beach Samples 2019
Puerto Rico CSRM

Sample Name: Composite #16 San Juan

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined

San Juan - Cangrejo@0	Condado@0.017	Verde@0.006	Park@0.011
San Juan - Cangrejo@0.001	San Juan - Condado@0.018	San Juan - Isla Verde@0.007	San Juan - Parque@0.012
San Juan - Cangrejo@0.002	San Juan - Condado@0.019	San Juan - Ocean Park@0.008	San Juan - Parque@0.013
San Juan - Cangrejo@0.003	San Juan - Isla Verde@0.004	San Juan - Ocean Park@0.009	San Juan - Parque@0.014
San Juan - Condado@0.016	San Juan - Isla Verde@0.005	San Juan - Ocean Park@0.01	San Juan - Parque@0.015
San Juan -	San Juan - Isla	San Juan - Ocean	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW		#200 - 3.45 #230 - 2.29		42.52	20.11

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4"	-4.25	19.00	0.00	0.00
3/8"	-3.25	9.50	0.06	0.06
#3.5	-2.50	5.60	0.10	0.16
#4	-2.25	4.75	0.00	0.16
#5	-2.00	4.00	0.02	0.18
#7	-1.50	2.80	0.04	0.23
#10	-1.00	2.00	0.07	0.30
#14	-0.50	1.40	0.12	0.42
#18	0.00	1.00	0.41	0.82
#25	0.50	0.71	1.88	2.70
#35	1.00	0.50	5.50	8.20
#45	1.50	0.36	10.18	18.38
#60	2.00	0.25	15.75	34.13
#80	2.50	0.18	20.06	54.19
#120	3.00	0.13	26.11	80.31
#170	3.50	0.09	13.33	93.64
#200	3.75	0.08	2.91	96.55
#230	4.00	0.06	1.16	97.71

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.62	3.14	2.90	2.40	1.71	1.38	0.71

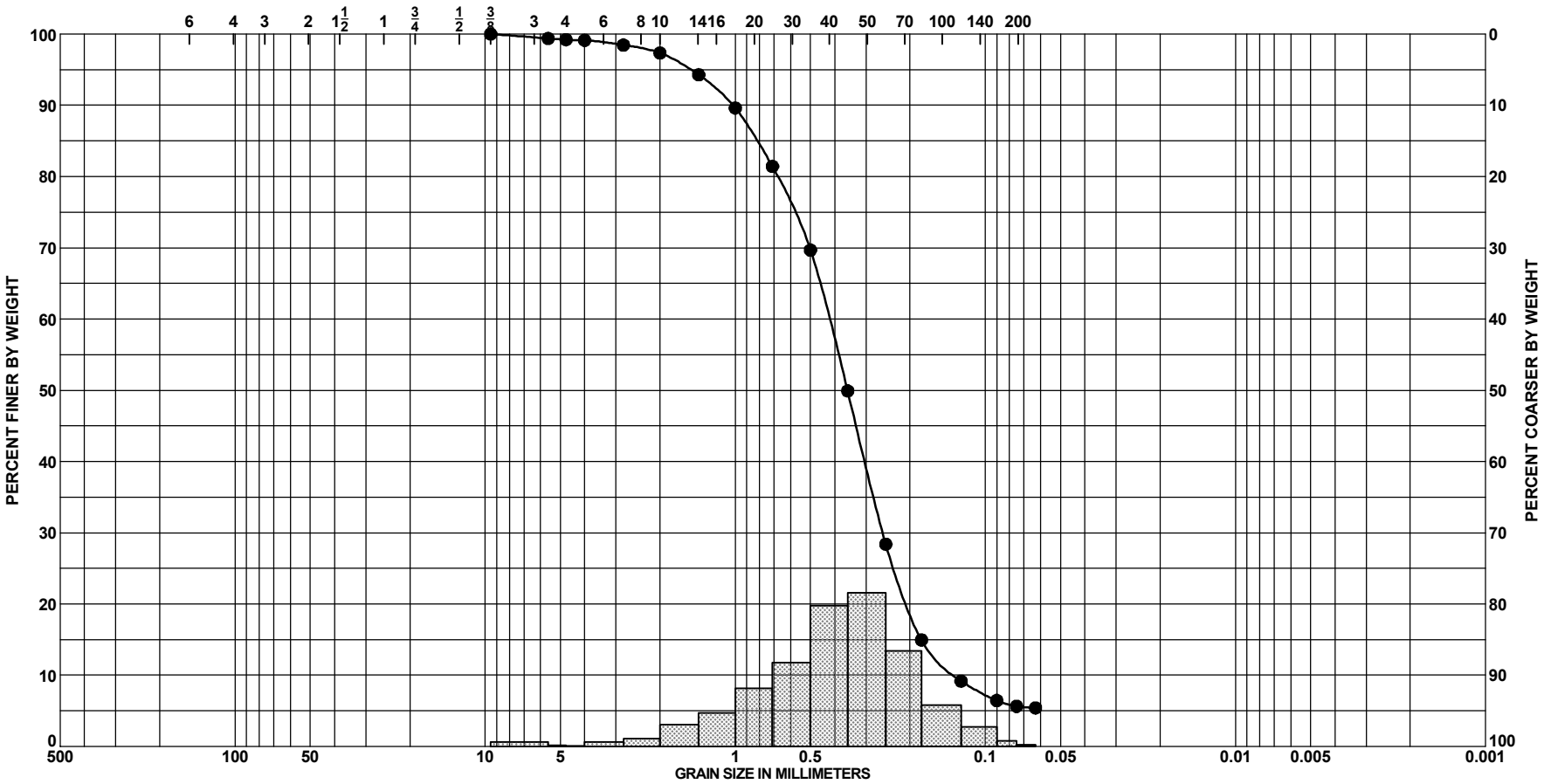
Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.24	0.21	2.40	0.19	0.86	-0.94	5.63

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BEACHES-PREFILL2019.GPJ CESAJ 20171021.GDT 8/31/20

9.1.6.3 San Juan Sand Sources Composite Samples

For sand sources where sieve data are available.

- Gradation Graphs
- Granularmetric Reports



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 19	Concretos Sand Mine			0	3						

PROJECT Puerto Rico CSRM

Concretos Sand Mine Composite

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name:
Puerto Rico CSRM

Sample Name: Composite #19 Concretos Sand Mine

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined: Upland Mine Concretos@0 Upland Mine Concretos@0.01 Upland Mine Concretos@0.02

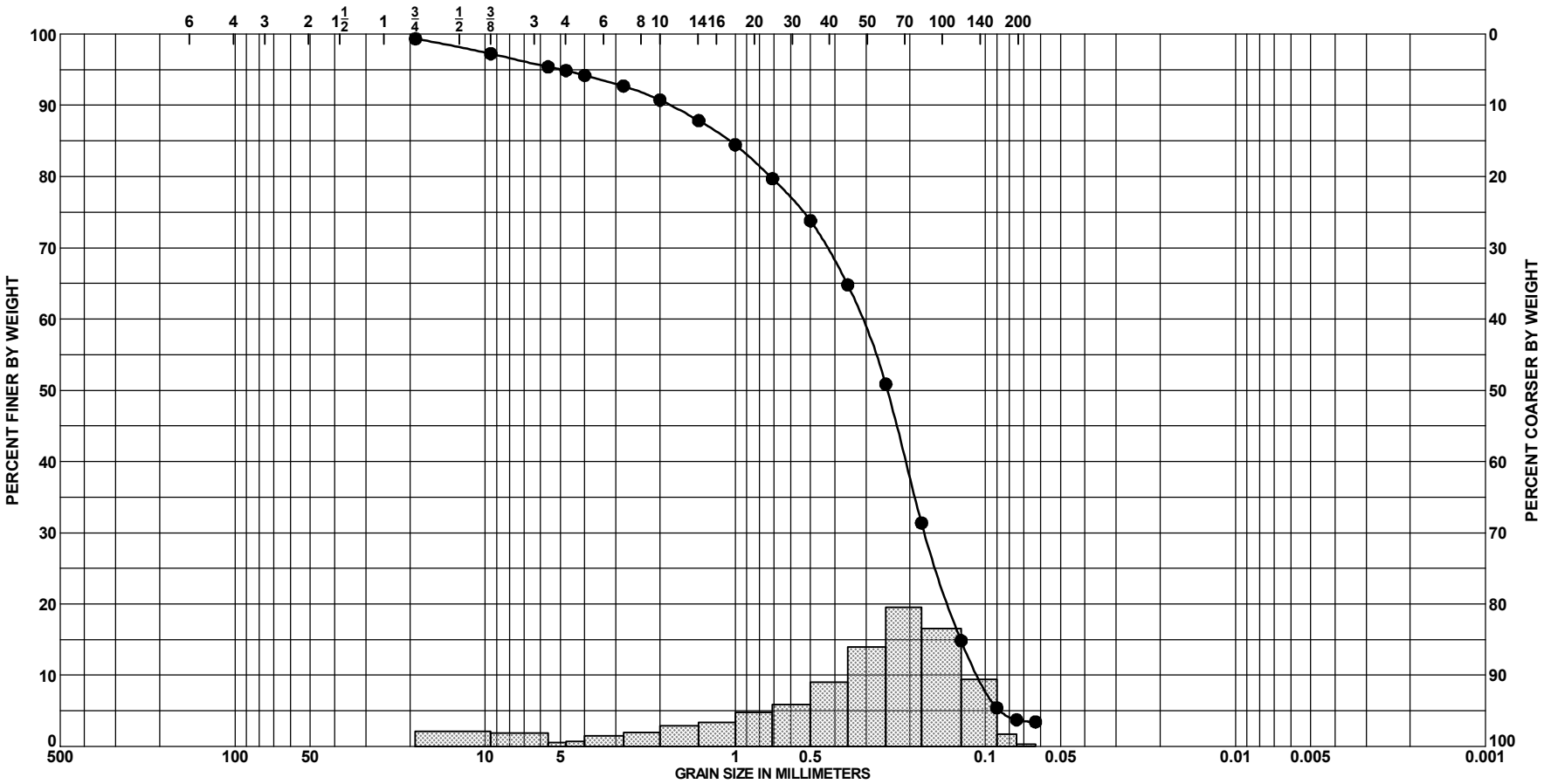
USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
		#200 - 5.63 #230 - 5.41		2.55	0

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.62	0.62
#4	-2.25	4.75	0.18	0.79
#5	-2.00	4.00	0.09	0.88
#7	-1.50	2.80	0.66	1.54
#10	-1.00	2.00	1.12	2.66
#14	-0.50	1.40	3.05	5.71
#18	0.00	1.00	4.67	10.38
#25	0.50	0.71	8.19	18.58
#35	1.00	0.50	11.75	30.32
#45	1.50	0.36	19.76	50.09
#60	2.00	0.25	21.53	71.62
#80	2.50	0.18	13.43	85.05
#120	3.00	0.13	5.78	90.83
#170	3.50	0.09	2.72	93.55
#200	3.75	0.08	0.82	94.37
#230	4.00	0.06	0.22	94.59

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
	2.46	2.13	1.50	0.77	0.34	-0.62

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.31	0.40	1.50	0.35	1.07	-0.74	4.29

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 10/27/22



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	La Esperanza	SAND, poorly-graded (SP)			69						

PROJECT Puerto Rico Coastal Project

La Esperanza Composite Sample

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: La Esperanza
Puerto Rico Coastal Project

Sample Name: Composite #1 La Esperanza

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (U.S. Ft.)	

Samples Combined

SJH-LE-1@0	SJH-LE-15A@2.2	SJH-LE-5@0	SJH-LE-6@0	SJH-LE-8A@0
SJH-LE-1@1.6	SJH-LE-17@0	SJH-LE-5@1.2	SJH-LE-6@1.8	SJH-LE-8A@1
SJH-LE-1@2.1	SJH-LE-17@1.6	SJH-LE-5@2.5	SJH-LE-6@2.6	SJH-LE-9@0
SJH-LE-1@3.1	SJH-LE-2@0	SJH-LE-5@3.2	SJH-LE-6@3.3	SJH-LE-9@1.2
SJH-LE-10@0.2	SJH-LE-2@1.3	SJH-LE-5A@0	SJH-LE-6@3.8	SJH-LE-9@2.6
SJH-LE-10@2	SJH-LE-3@0	SJH-LE-5A@0.9	SJH-LE-7@0	
SJH-LE-10@2.9	SJH-LE-3@0.8	SJH-LE-5A@2.2	SJH-LE-7@0.5	
SJH-LE-13A@0	SJH-LE-3@1.4	SJH-LE-5A@2.5	SJH-LE-7@1.1	
SJH-LE-15A@0	SJH-LE-4@0	SJH-LE-5A@3.6	SJH-LE-7@2.3	
SJH-LE-15A@1.2	SJH-LE-4@0.7	SJH-LE-5A@4	SJH-LE-7@2.9	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
		#200 - 3.73 #230 - 3.44		69.24	

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/4"	-4.25	19.00	0.66	0.66
3/8"	-3.25	9.50	2.10	2.76
#3.5	-2.50	5.60	1.84	4.61
#4	-2.25	4.75	0.52	5.13
#5	-2.00	4.00	0.68	5.81
#7	-1.50	2.80	1.49	7.29
#10	-1.00	2.00	1.98	9.27
#14	-0.50	1.40	2.88	12.15
#18	0.00	1.00	3.40	15.55
#25	0.50	0.71	4.75	20.30
#35	1.00	0.50	5.91	26.21
#45	1.50	0.36	8.99	35.20
#60	2.00	0.25	13.94	49.14
#80	2.50	0.18	19.49	68.63
#120	3.00	0.13	16.51	85.15
#170	3.50	0.09	9.43	94.58
#200	3.75	0.08	1.69	96.27
#230	4.00	0.06	0.29	96.56

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.56	2.97	2.69	2.02	0.90	0.05	-2.31

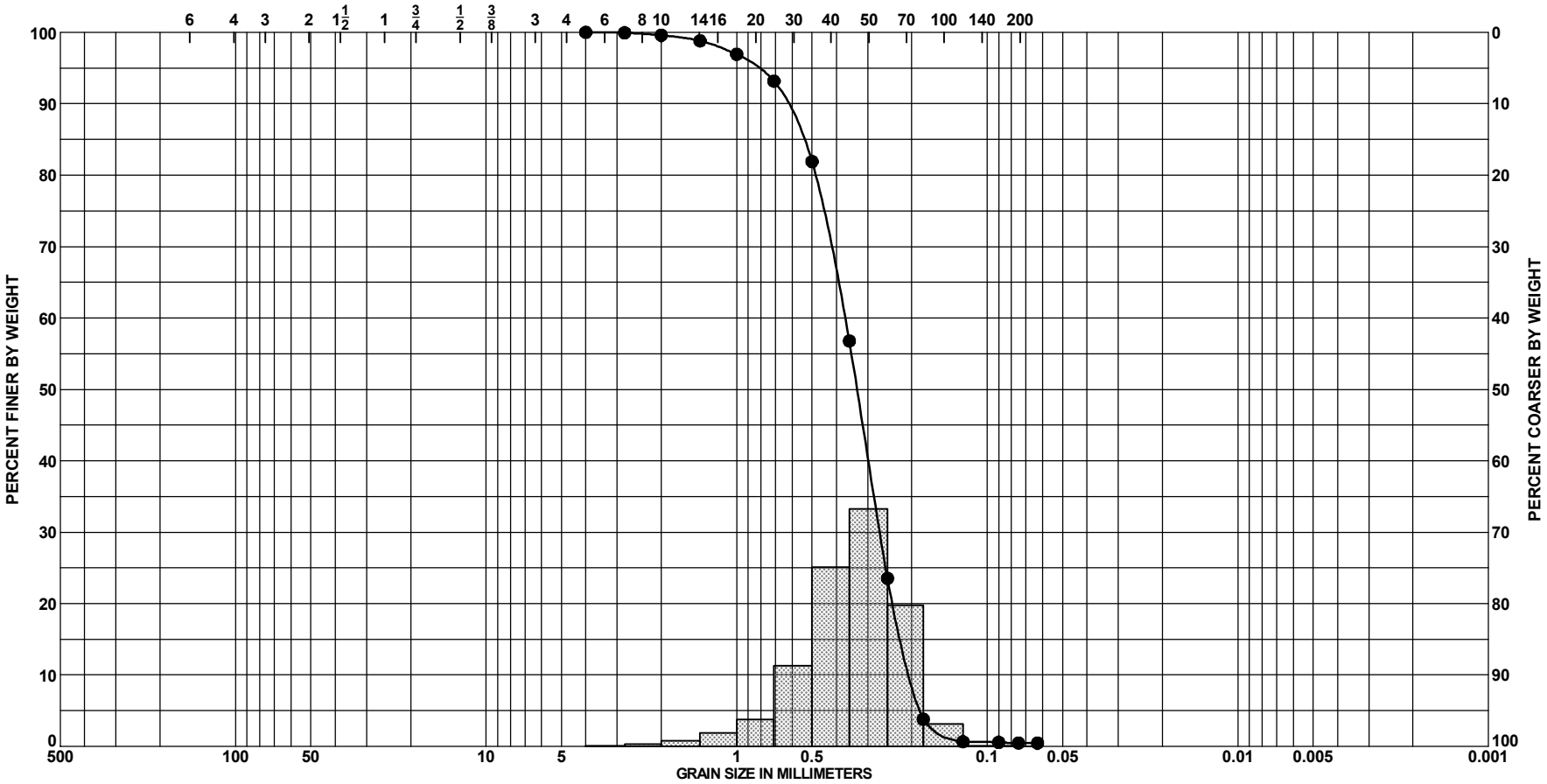
Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.46	0.36	2.02	0.25	1.62	-1.31	4.53

GRANULARMETRIC REPORT % - COMPOSITES LAESPERANZA MITIGATION_MERGED.GPJ CESAJ 20171021.GDT 10/9/20

9.2 RINCON STUDY AREA

9.2.1 RINCON BEACHES

- Gradation Graphs
- Granularmetric Reports

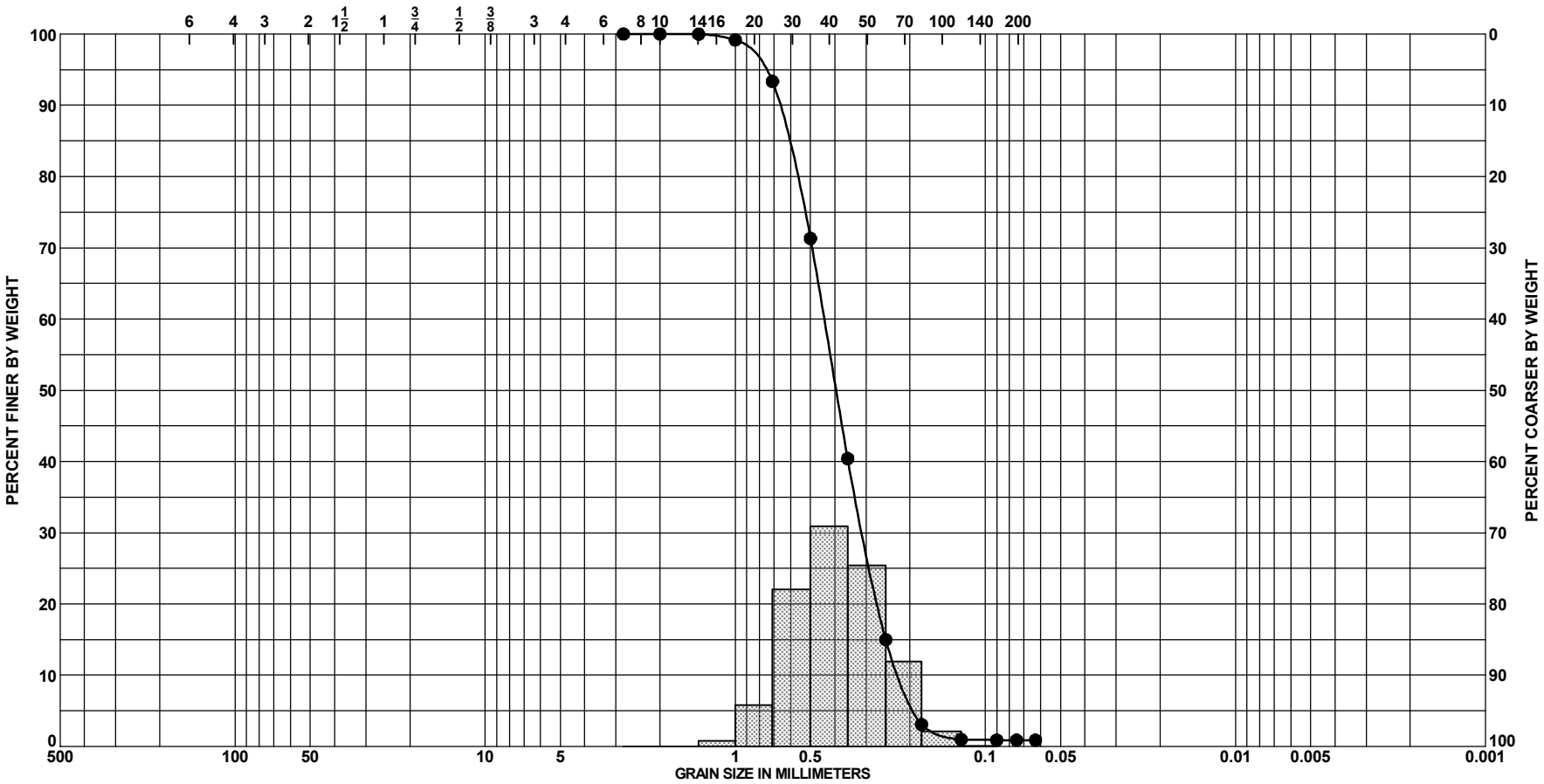


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Berm	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few fine to medium-grained sand-sized shell fragments, olive yellow (SP)	2.5Y 6/6	9							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	RINCON - CONSERGA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

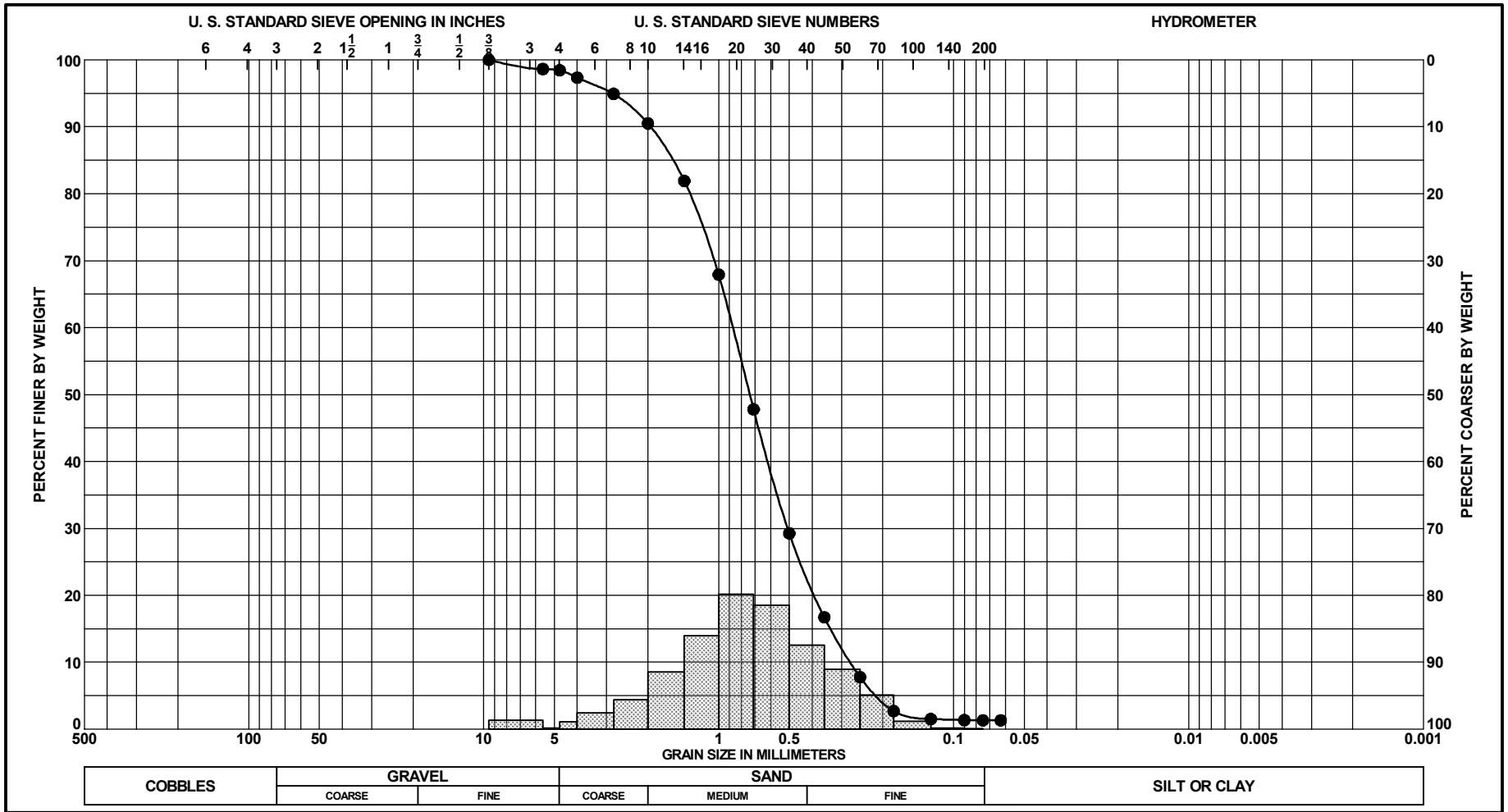


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Mid-Tide	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace rock fragments, light yellowish brown (SP)	2.5Y 6/3	18							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	RINCON - CONSERGA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

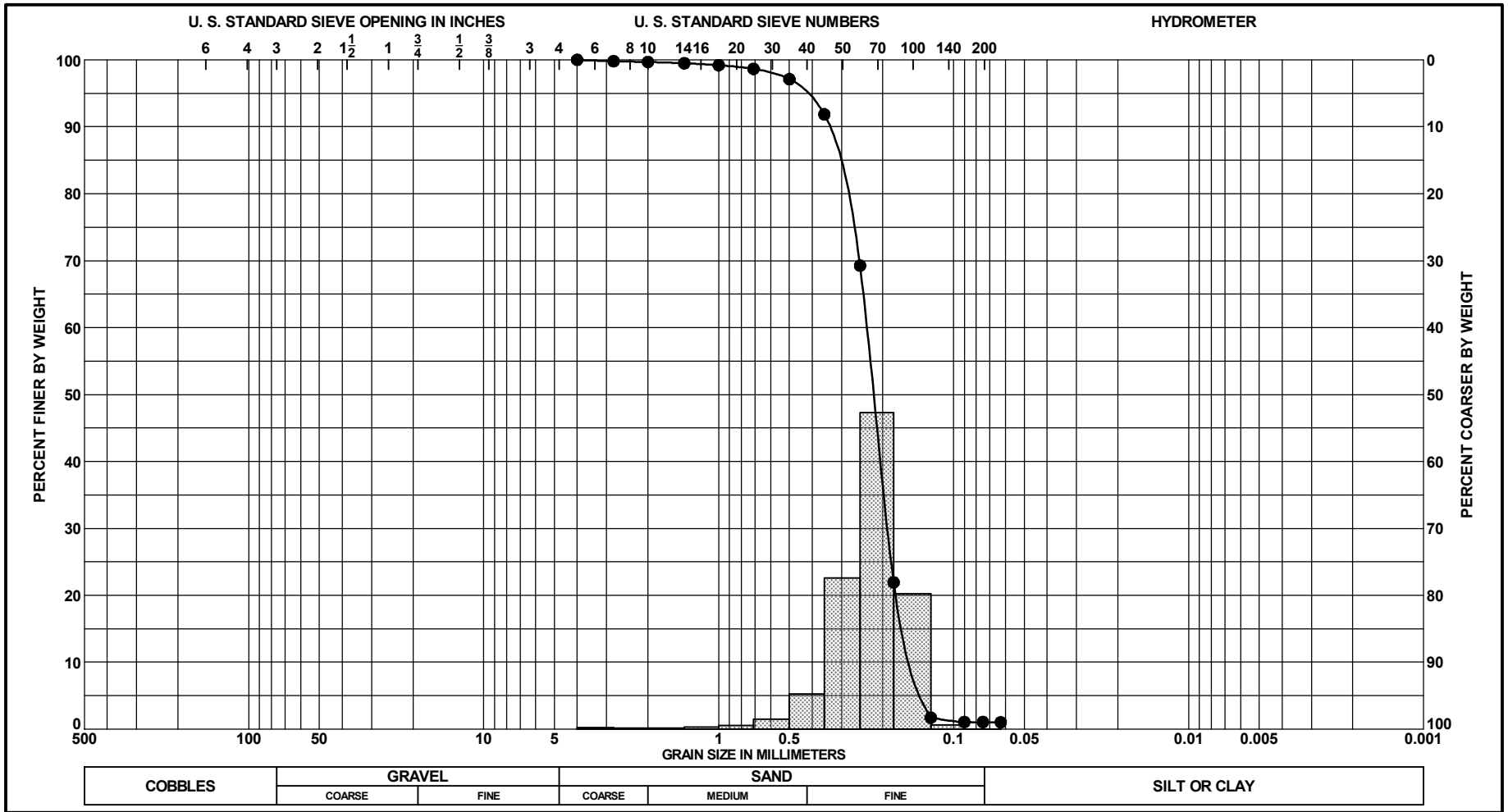


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -3	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to coarse-grained sand-sized shell fragments, few sand to gravel-sized rock fragments, trace silt, grayish brown (SP)	2.5Y 5/2	34							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	RINCON - CONSERGA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

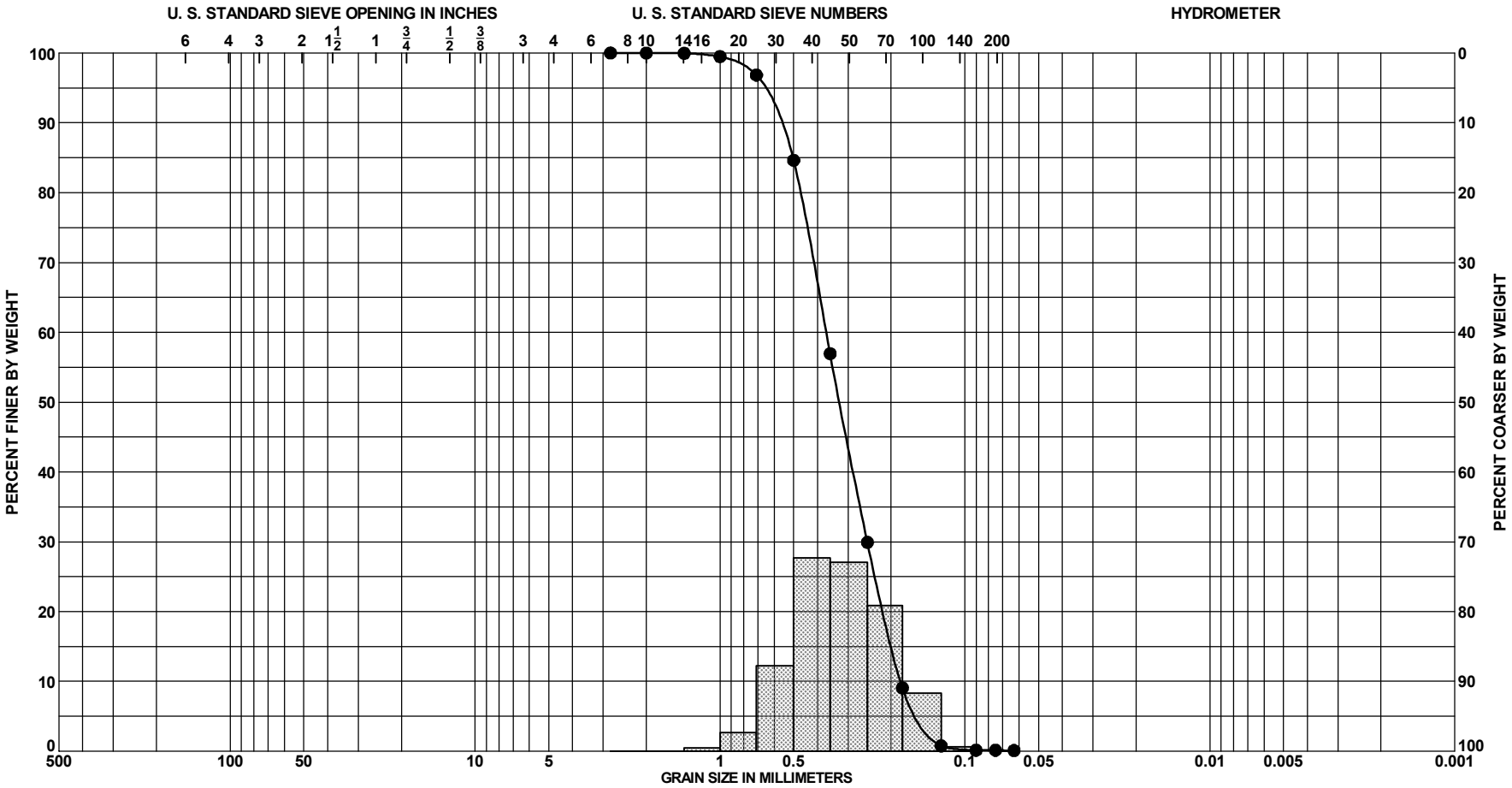


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -5	to 0.5 Ft.	SAND, poorly-graded, mostly	10YR 5/3	34	25						
		fine-grained sand-sized quartz, some									
		fine to medium-grained sand-sized									
		shell fragments, trace silt, brown (SP)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Samples 2019
BORING NO.	RINCON - CONSERGA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

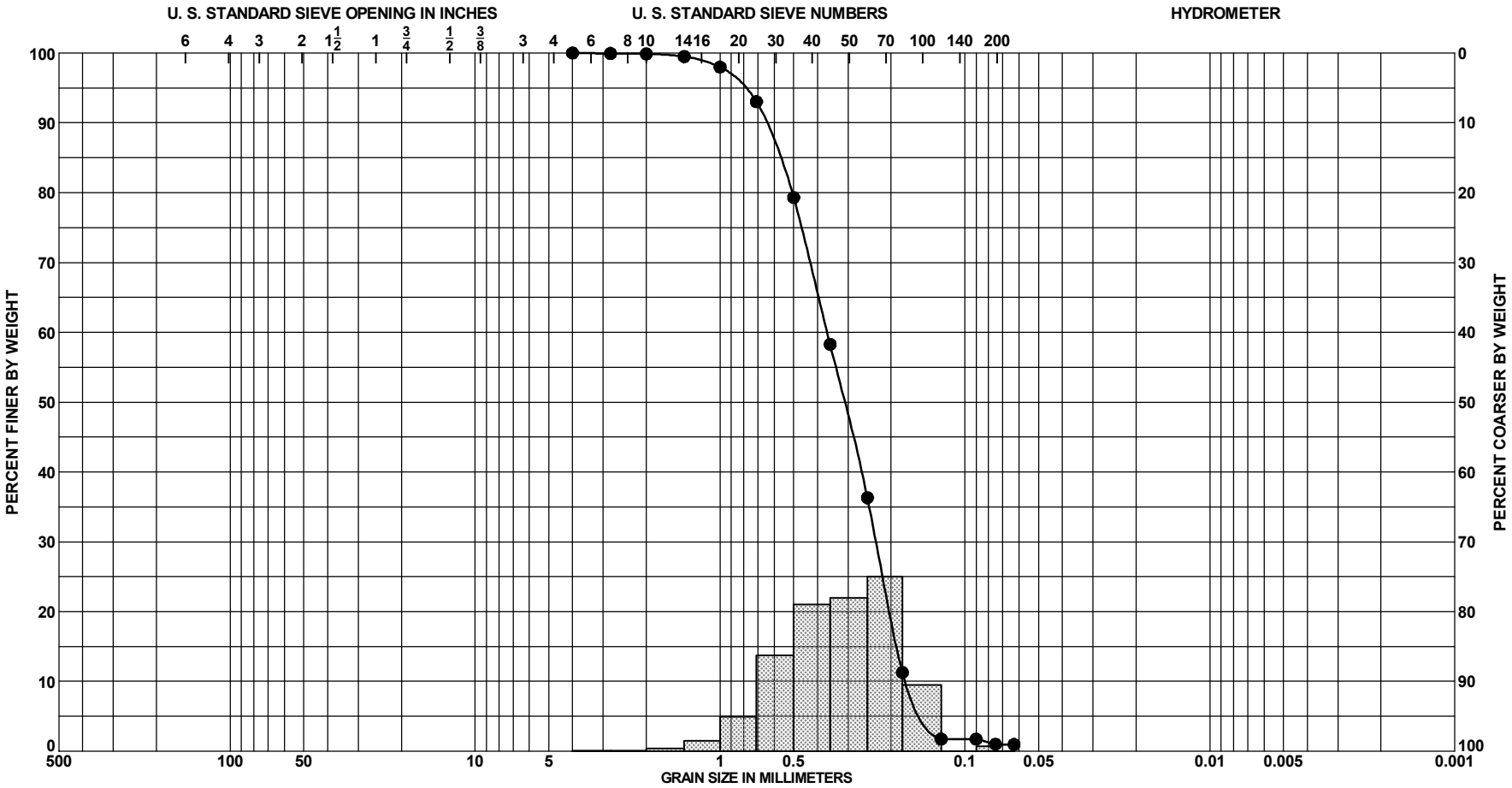


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Berm	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, light yellowish brown (SP)	2.5Y 6/3	17							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Sampling
BORING NO.	RINCON - DONA LALA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

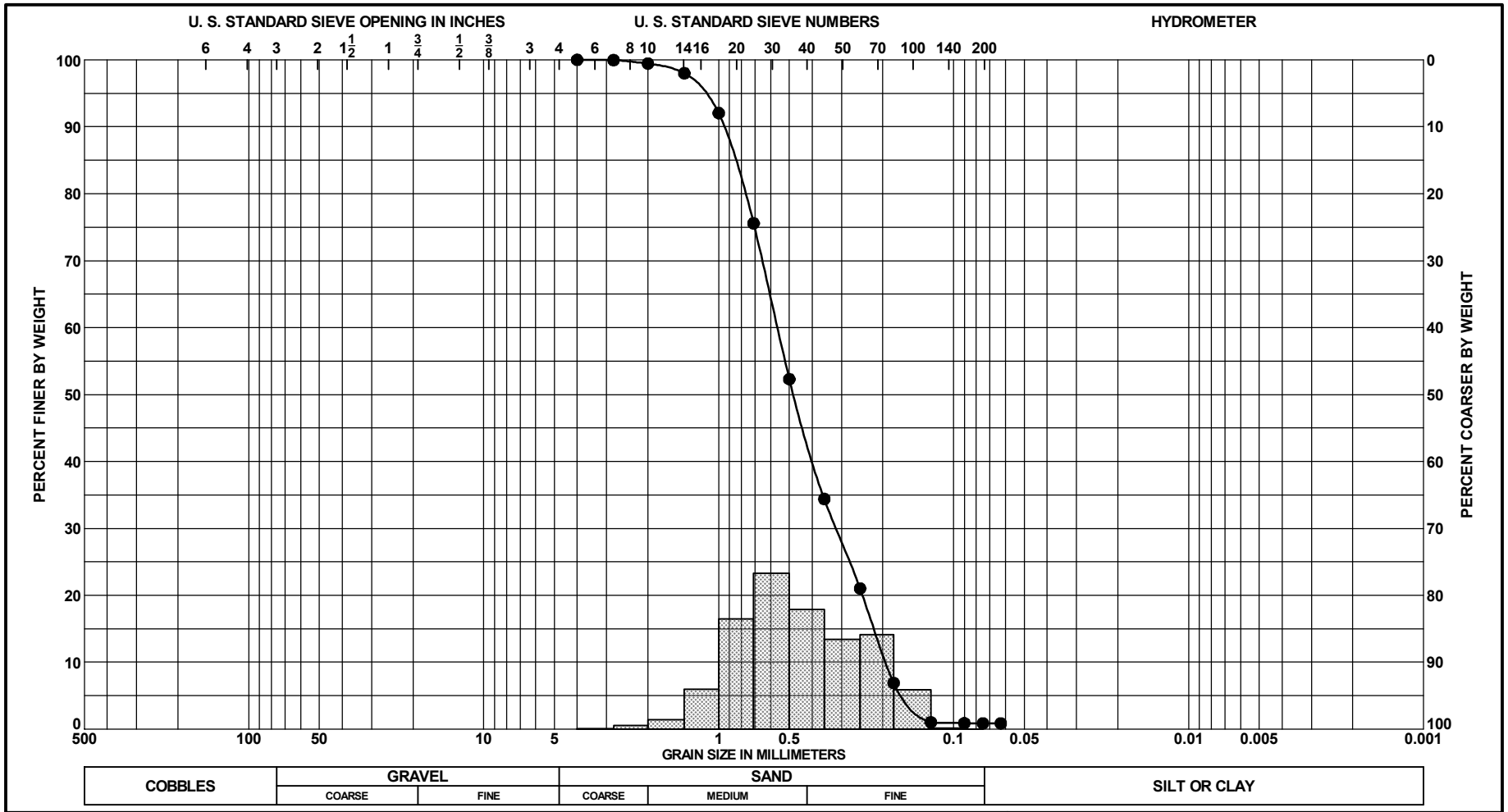


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Mid-Tide	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, brown (SP)	10YR 4/3	34	36						

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Sampling
BORING NO.	RINCON - DONA LALA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

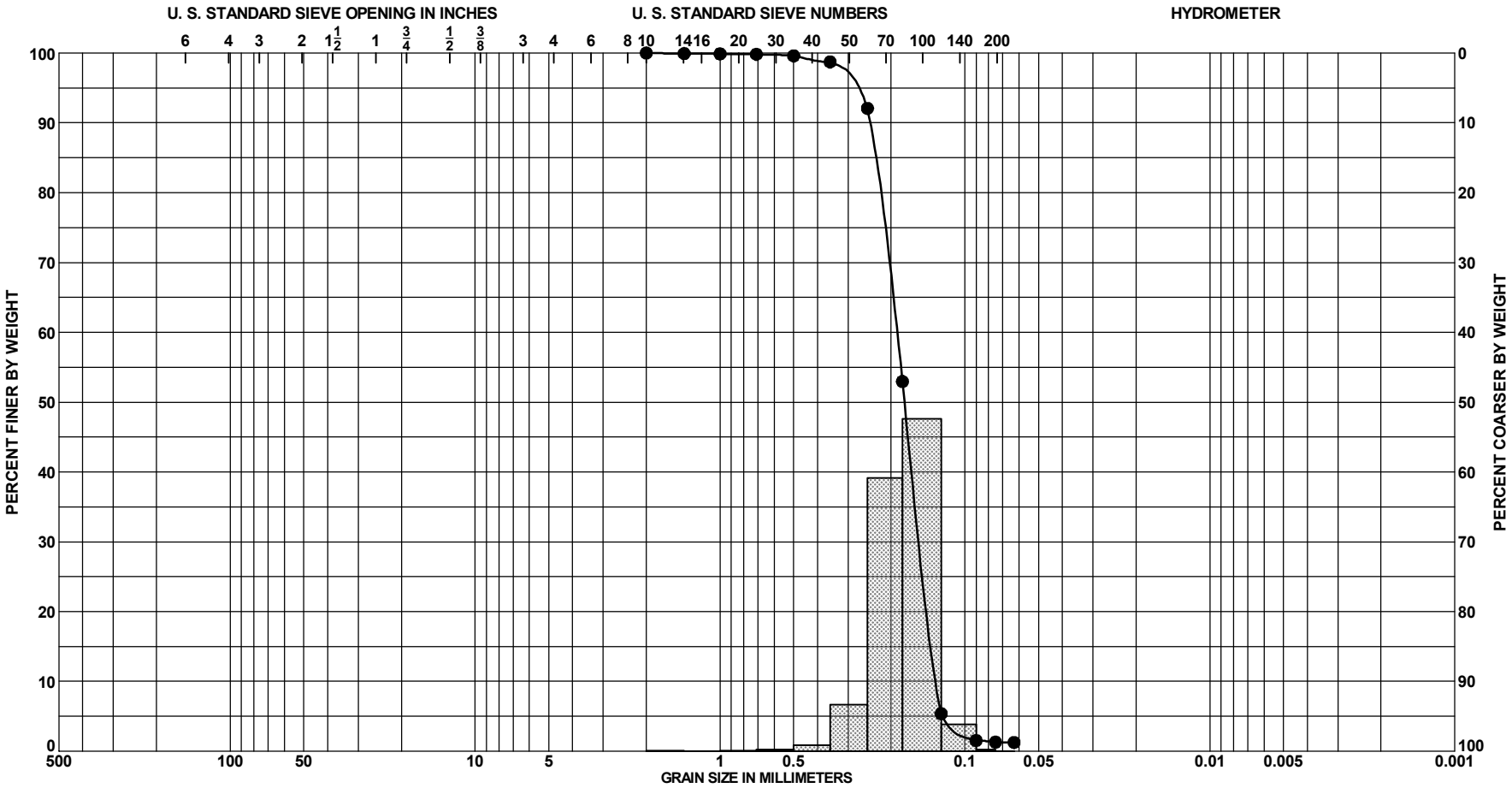


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -3	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, few fine to medium-grained sand-sized rock fragments, light [illegible]	2.5Y 5/3	38							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Sampling
BORING NO.	RINCON - DONA LALA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

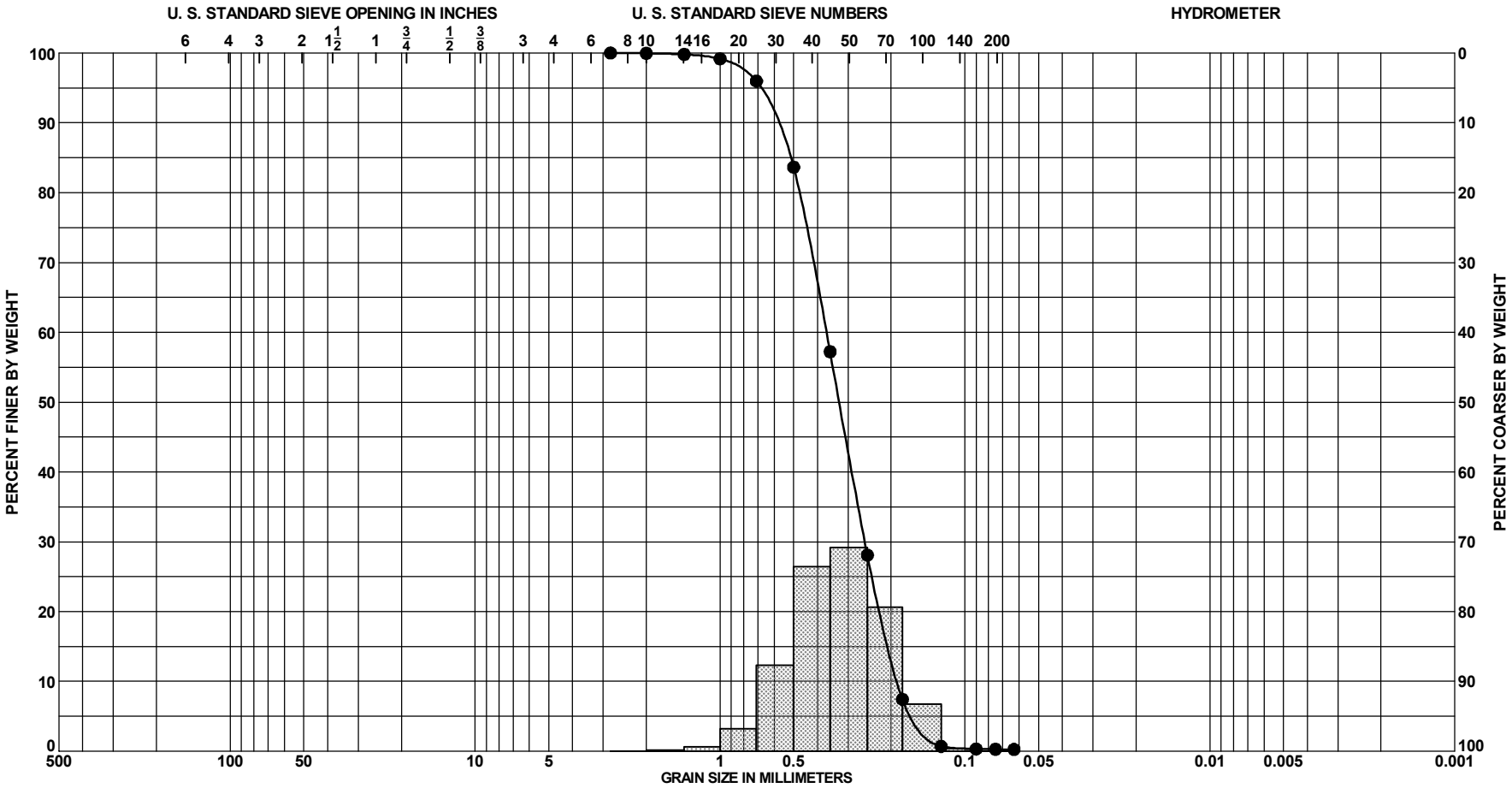


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -5	to 0.5 Ft.	SAND, poorly-graded, mostly	2.5Y 5/3	24							
		fine-grained sand-sized quartz, little									
		fine-grained sand-sized shell									
		fragments, trace silt, light olive brown									
		(SP)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Sampling
BORING NO.	RINCON - DONA LALA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

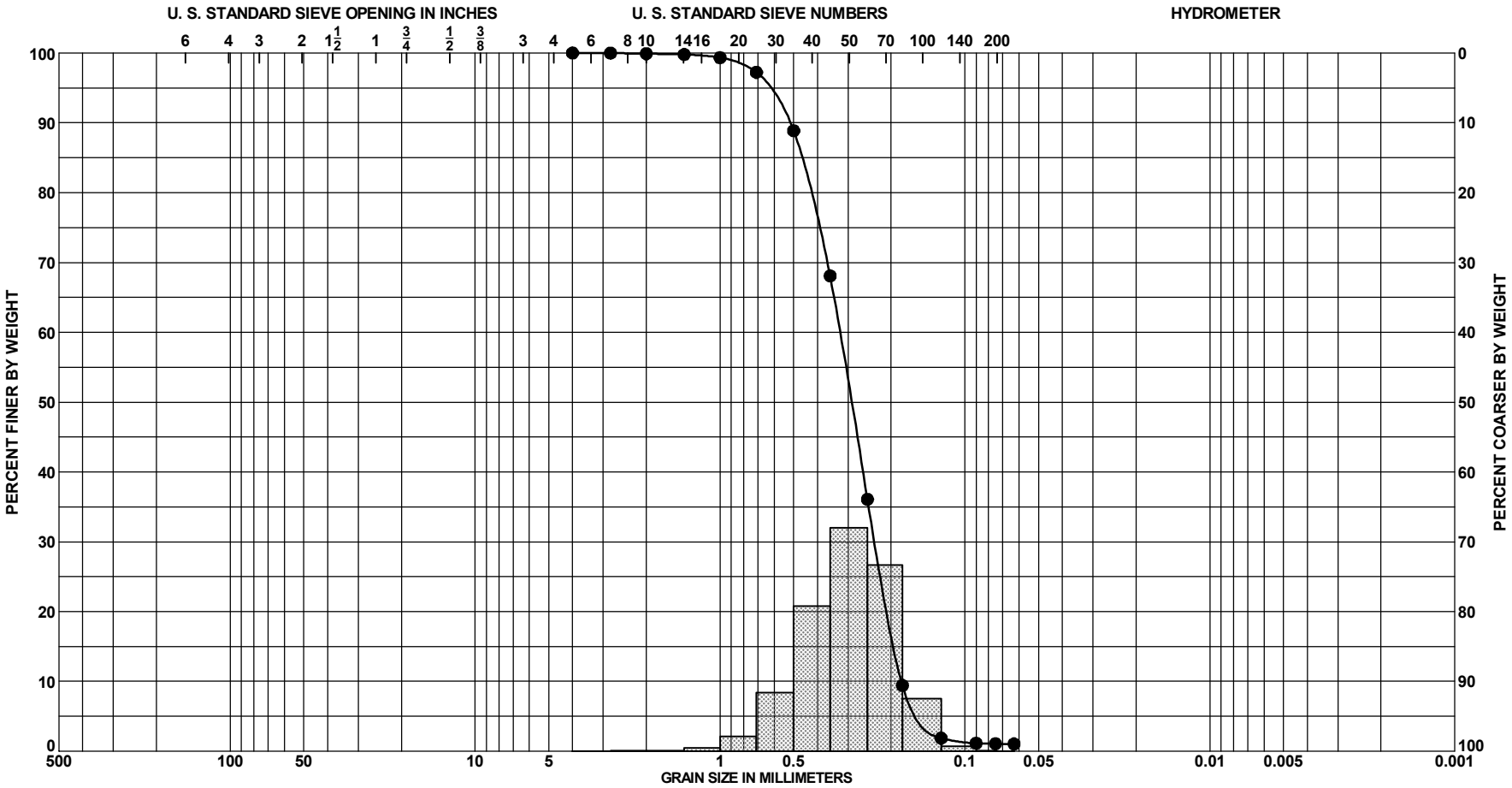


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Berm	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, brown (SP)	10YR 5/3	33							

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Sampling
BORING NO.	RINCON - STELLA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

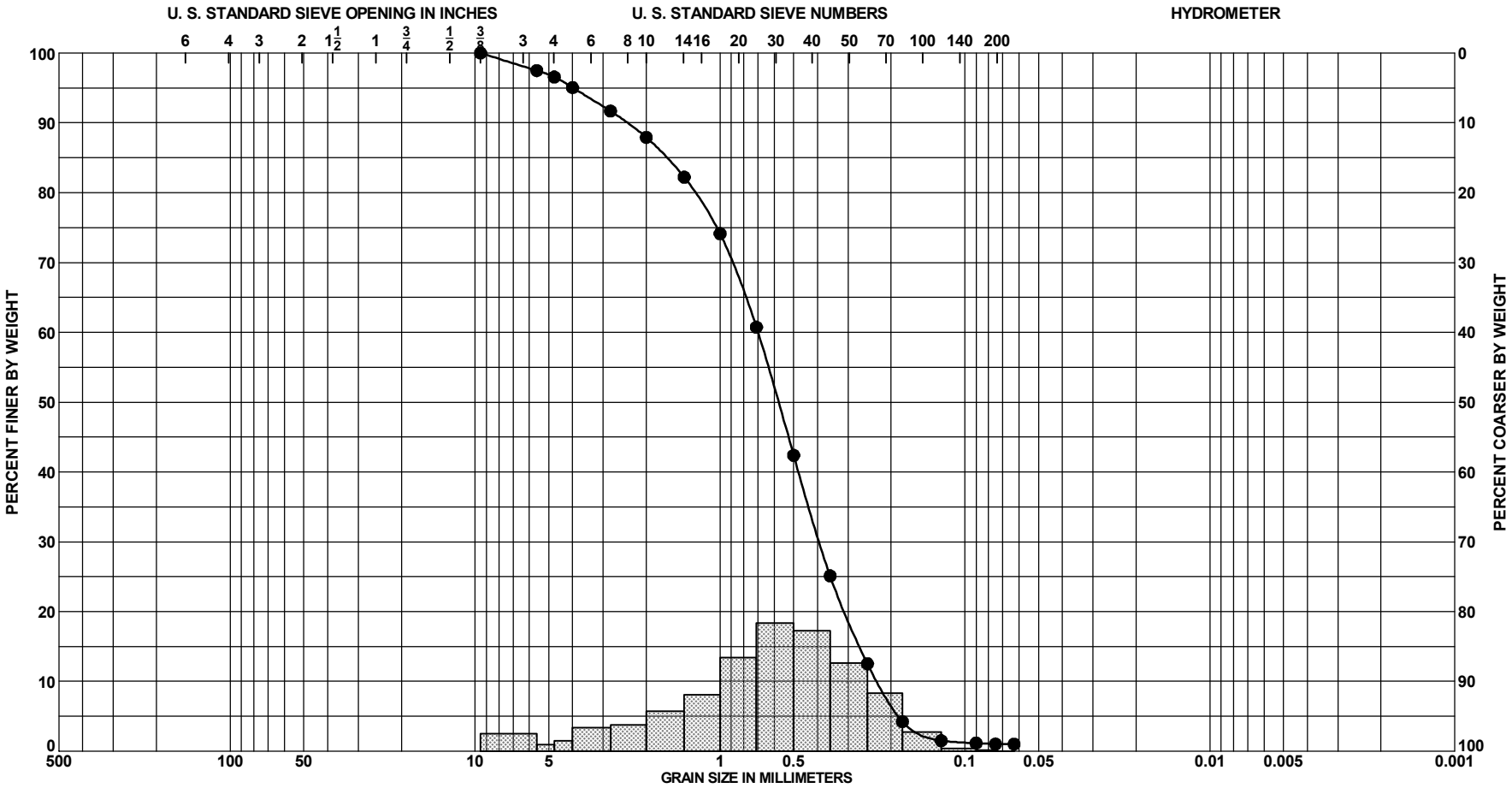


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Mid-Tide	to 0.5 Ft.	SAND, poorly-graded, mostly fine to	10YR 5/2	36							
		medium-grained sand-sized quartz,									
		some fine to medium-grained									
		sand-sized shell fragments, trace rock									
		fragments, trace silt, grayish brown									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Sampling
BORING NO.	RINCON - STELLA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

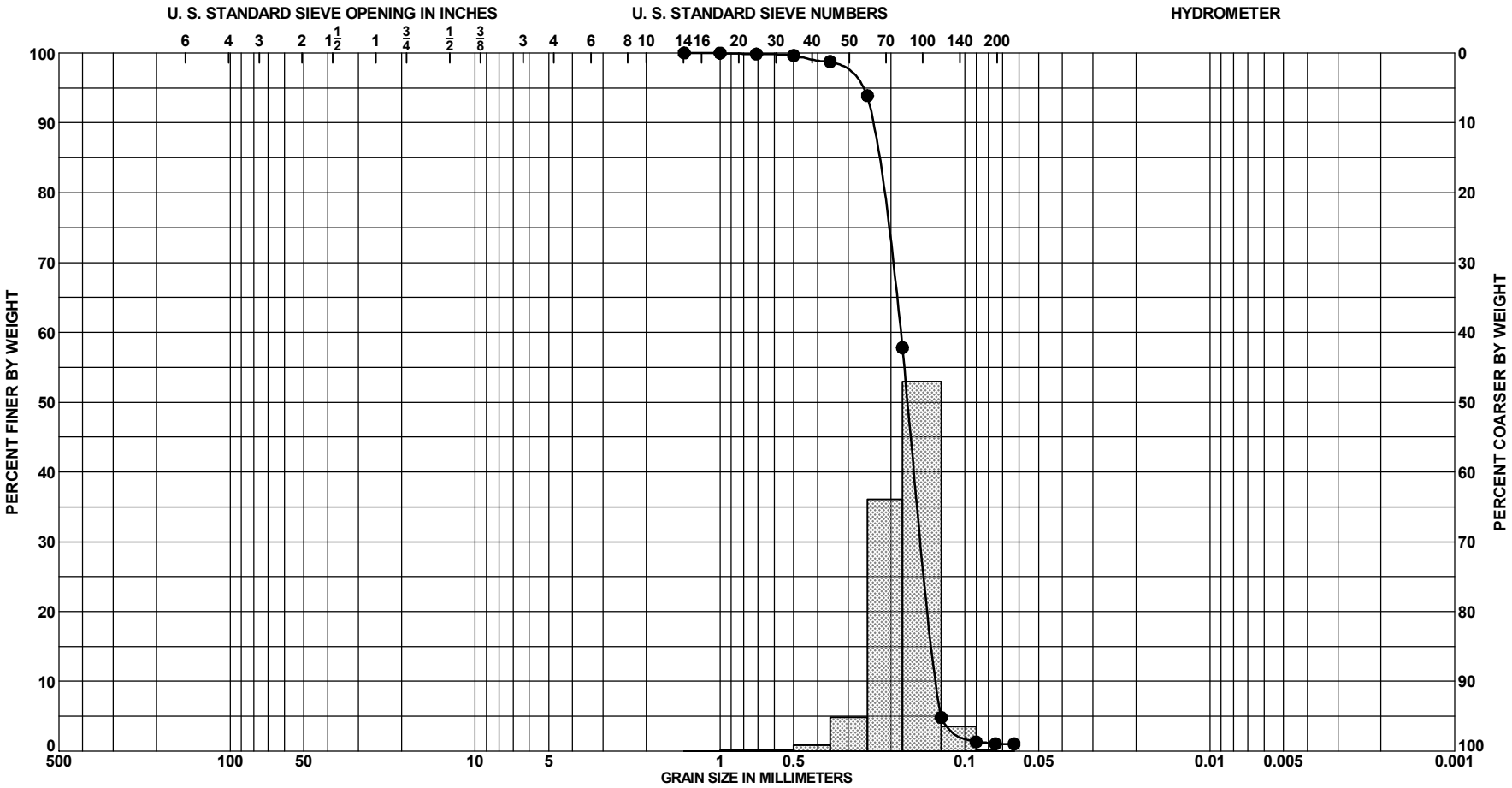


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -3	to 0.5 Ft.	SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to coarse-grained sand-sized shell-fragments, few sand to gravel-sized rock fragments, trace silt, br[illegible]	10YR 4/3	36	34						

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Sampling
BORING NO.	RINCON - STELLA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● -5	to 0.5 Ft.	SAND, poorly-graded, mostly	2.5Y 5/3	19							
		fine-grained sand-sized quartz, little									
		fine-grained sand-sized shell									
		fragments, trace silt, light olive brown									
		(SP)									

PROJECT	Puerto Rico CSRM
	Pre-fill Beach Sampling
BORING NO.	RINCON - STELLA
BORING ELEV.	Not Determined
DATE	4/24/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Conserga @ 0.012 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
374,611	834,611	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 6/6	#200 - 0.46 #230 - 0.45			8.7

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.06	0.06
#10	-1.00	2.00	0.35	0.41
#14	-0.50	1.40	0.78	1.19
#18	0.00	1.00	1.89	3.07
#25	0.50	0.71	3.75	6.83
#35	1.00	0.50	11.27	18.10
#45	1.50	0.36	25.13	43.22
#60	2.00	0.25	33.24	76.47
#80	2.50	0.18	19.74	96.20
#120	3.00	0.13	3.14	99.34
#170	3.50	0.09	0.09	99.44
#200	3.75	0.08	0.10	99.54
#230	4.00	0.06	0.01	99.55

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, few fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.47	2.19	1.98	1.60	1.14	0.91	0.26

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.52	0.35	1.60	0.33	0.68	-0.86	4.59

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Conserga @ 0.013 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
374,611	834,611	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 6/3	#200 - 0.89 #230 - 0.89			18.1

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.80	0.00	0.00
#10	-1.00	2.00	0.01	0.01
#14	-0.50	1.40	0.02	0.03
#18	0.00	1.00	0.80	0.83
#25	0.50	0.71	5.81	6.65
#35	1.00	0.50	22.04	28.69
#45	1.50	0.36	30.89	59.58
#60	2.00	0.25	25.43	85.02
#80	2.50	0.18	11.90	96.92
#120	3.00	0.13	2.11	99.02
#170	3.50	0.09	0.09	99.11
#200	3.75	0.08	0.00	99.11
#230	4.00	0.06	0.00	99.11

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments, trace rock fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.42	1.98	1.80	1.34	0.92	0.71	0.36

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.35	0.39	1.34	0.40	0.6	0.03	2.74

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Conserga @ 0.014 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
374,611	834,611	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW	2.5Y 5/2	#200 - 1.30 #230 - 1.30			33.9

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	1.37	1.37
#4	-2.25	4.75	0.17	1.54
#5	-2.00	4.00	1.12	2.66
#7	-1.50	2.80	2.43	5.08
#10	-1.00	2.00	4.43	9.51
#14	-0.50	1.40	8.58	18.09
#18	0.00	1.00	14.00	32.09
#25	0.50	0.71	20.13	52.22
#35	1.00	0.50	18.54	70.76
#45	1.50	0.36	12.52	83.28
#60	2.00	0.25	8.95	92.23
#80	2.50	0.18	5.07	97.30
#120	3.00	0.13	1.19	98.49
#170	3.50	0.09	0.16	98.65
#200	3.75	0.08	0.05	98.70
#230	4.00	0.06	0.00	98.70

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to coarse-grained sand-sized shell fragments, few sand to gravel-sized rock fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.27	1.54	1.17	0.44	-0.25	-0.62	-1.52

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	0.40	0.76	0.44	0.74	1.09	-0.36	3.31

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Conserga @ 0.015 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
374,611	834,611	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 5/3	#200 - 1.06 #230 - 1.03		24.55	34.2

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.20	0.20
#10	-1.00	2.00	0.12	0.32
#14	-0.50	1.40	0.19	0.51
#18	0.00	1.00	0.29	0.80
#25	0.50	0.71	0.55	1.35
#35	1.00	0.50	1.53	2.88
#45	1.50	0.36	5.26	8.14
#60	2.00	0.25	22.60	30.74
#80	2.50	0.18	47.33	78.07
#120	3.00	0.13	20.22	98.29
#170	3.50	0.09	0.65	98.94
#200	3.75	0.08	0.01	98.94
#230	4.00	0.06	0.03	98.97

SAND, poorly-graded, mostly fine-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.65	2.47	2.20	1.87	1.67	1.20

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.13	0.23	2.20	0.22	0.54	-1.99	12.1

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Dona Lala @ 0.004 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
371,461	839,810	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 6/3	#200 - 0.13 #230 - 0.10			16.7

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.80	0.00	0.00
#10	-1.00	2.00	0.01	0.01
#14	-0.50	1.40	0.04	0.05
#18	0.00	1.00	0.47	0.52
#25	0.50	0.71	2.65	3.16
#35	1.00	0.50	12.22	15.38
#45	1.50	0.36	27.69	43.06
#60	2.00	0.25	27.02	70.08
#80	2.50	0.18	20.85	90.94
#120	3.00	0.13	8.31	99.24
#170	3.50	0.09	0.63	99.87
#200	3.75	0.08	0.00	99.87
#230	4.00	0.06	0.03	99.90

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.74	2.33	2.12	1.63	1.17	1.01	0.58

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.64	0.32	1.63	0.32	0.64	-0.07	2.75

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Dona Lala @ 0.005 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
371,461	839,810	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 4/3	#200 - 0.99 #230 - 0.97		36.11	33.6

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.06	0.06
#10	-1.00	2.00	0.06	0.12
#14	-0.50	1.40	0.38	0.50
#18	0.00	1.00	1.50	2.01
#25	0.50	0.71	4.95	6.96
#35	1.00	0.50	13.73	20.69
#45	1.50	0.36	21.03	41.73
#60	2.00	0.25	21.97	63.70
#80	2.50	0.18	25.03	88.73
#120	3.00	0.13	9.53	98.26
#170	3.50	0.09	0.01	98.27
#200	3.75	0.08	0.74	99.01
#230	4.00	0.06	0.02	99.03

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.83	2.41	2.23	1.69	1.10	0.83	0.30

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.62	0.33	1.69	0.31	0.76	-0.37	3.09

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Dona Lala @ 0.006 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
371,461	839,810	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW	2.5Y 5/3	#200 - 0.86 #230 - 0.86			38

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.04	0.04
#10	-1.00	2.00	0.51	0.56
#14	-0.50	1.40	1.44	2.00
#18	0.00	1.00	5.95	7.95
#25	0.50	0.71	16.48	24.43
#35	1.00	0.50	23.29	47.72
#45	1.50	0.36	17.90	65.61
#60	2.00	0.25	13.38	78.99
#80	2.50	0.18	14.11	93.10
#120	3.00	0.13	5.87	98.97
#170	3.50	0.09	0.13	99.11
#200	3.75	0.08	0.03	99.14
#230	4.00	0.06	0.00	99.14

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, few fine to medium-grained sand-sized rock fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.66	2.18	1.85	1.06	0.51	0.24	-0.25

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.14	0.45	1.06	0.48	0.87	0.05	2.42

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Dona Lala @ 0.007 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
371,461	839,810	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 5/3	#200 - 1.29 #230 - 1.25			23.9

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#10	-1.00	2.00	0.00	0.00
#14	-0.50	1.40	0.08	0.08
#18	0.00	1.00	0.04	0.12
#25	0.50	0.71	0.07	0.19
#35	1.00	0.50	0.23	0.41
#45	1.50	0.36	0.87	1.28
#60	2.00	0.25	6.64	7.93
#80	2.50	0.18	39.11	47.04
#120	3.00	0.13	47.59	94.63
#170	3.50	0.09	3.84	98.47
#200	3.75	0.08	0.24	98.71
#230	4.00	0.06	0.04	98.75

SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.05	2.89	2.79	2.53	2.22	2.10	1.78

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.48	0.18	2.53	0.17	0.39	-1.18	8.85

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Stella @ 0.008 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
373,482	834,560	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 5/3	#200 - 0.27 #230 - 0.26			33.1

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#7	-1.50	2.80	0.00	0.00
#10	-1.00	2.00	0.04	0.04
#14	-0.50	1.40	0.16	0.20
#18	0.00	1.00	0.62	0.82
#25	0.50	0.71	3.20	4.02
#35	1.00	0.50	12.33	16.36
#45	1.50	0.36	26.43	42.78
#60	2.00	0.25	29.14	71.93
#80	2.50	0.18	20.65	92.58
#120	3.00	0.13	6.74	99.32
#170	3.50	0.09	0.37	99.69
#200	3.75	0.08	0.04	99.73
#230	4.00	0.06	0.02	99.74

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.68	2.29	2.07	1.62	1.16	0.99	0.54

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.61	0.33	1.62	0.33	0.64	-0.23	3.09

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Stella @ 0.009 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
373,482	834,560	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 5/2	#200 - 1.07 #230 - 1.04			35.6

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.01	0.01
#10	-1.00	2.00	0.09	0.10
#14	-0.50	1.40	0.11	0.20
#18	0.00	1.00	0.46	0.67
#25	0.50	0.71	2.10	2.77
#35	1.00	0.50	8.36	11.13
#45	1.50	0.36	20.79	31.92
#60	2.00	0.25	32.01	63.93
#80	2.50	0.18	26.64	90.57
#120	3.00	0.13	7.57	98.14
#170	3.50	0.09	0.73	98.87
#200	3.75	0.08	0.06	98.93
#230	4.00	0.06	0.02	98.96

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to medium-grained sand-sized shell fragments, trace rock fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.79	2.38	2.21	1.78	1.33	1.12	0.63

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.74	0.30	1.78	0.29	0.62	-0.46	3.73

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Stella @ 0.01 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
373,482	834,560	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW	10YR 4/3	#200 - 1.02 #230 - 1.00		33.62	36.1

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	2.51	2.51
#4	-2.25	4.75	0.91	3.43
#5	-2.00	4.00	1.53	4.95
#7	-1.50	2.80	3.36	8.31
#10	-1.00	2.00	3.77	12.09
#14	-0.50	1.40	5.69	17.78
#18	0.00	1.00	8.09	25.86
#25	0.50	0.71	13.40	39.27
#35	1.00	0.50	18.35	57.62
#45	1.50	0.36	17.27	74.89
#60	2.00	0.25	12.59	87.47
#80	2.50	0.18	8.29	95.76
#120	3.00	0.13	2.73	98.49
#170	3.50	0.09	0.36	98.85
#200	3.75	0.08	0.13	98.98
#230	4.00	0.06	0.02	99.00

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, some fine to coarse-grained sand-sized shell-fragments, few sand to gravel-sized rock fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.45	1.86	1.50	0.79	-0.05	-0.66	-1.99

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	0.60	0.66	0.79	0.58	1.28	-0.7	3.24

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Beach Samples
Puerto Rico CSRM

Sample Name: Rincon - Stella @ 0.011 ft

Analysis Date: 4/24/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
373,482	834,560	State Plane, PR/VI (M)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	2.5Y 5/3	#200 - 1.05 #230 - 1.05			18.6

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#14	-0.50	1.40	0.00	0.00
#18	0.00	1.00	0.02	0.02
#25	0.50	0.71	0.13	0.15
#35	1.00	0.50	0.21	0.36
#45	1.50	0.36	0.87	1.23
#60	2.00	0.25	4.89	6.11
#80	2.50	0.18	36.10	42.21
#120	3.00	0.13	52.96	95.17
#170	3.50	0.09	3.51	98.68
#200	3.75	0.08	0.27	98.95
#230	4.00	0.06	0.01	98.95

SAND, poorly-graded, mostly fine-grained sand-sized quartz, little fine-grained sand-sized shell fragments, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.00	2.89	2.81	2.57	2.26	2.14	1.89

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	2.52	0.17	2.57	0.17	0.37	-1.07	6.72

GRANULARMETRIC REPORT % PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

9.2.2 RINCON – RIO GRANDE DE ARECIBO SHOAL

- Boring Logs
- Gradation Graphs

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 5 SHEETS
	South Atlantic	St. Louis District	

1. PROJECT FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL Contract 3		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, PR/VI (U.S. Ft.)	HORIZONTAL: NAD83 / VERTICAL: PRVD02
2. BORING DESIGNATION: CB-RGA-20-61A	LOCATION COORDINATES: X = 170,643 Y = 270,704	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-75 (land-based)	☒ AUTO HAMMER ☐ MANUAL HAMMER
3. DRILLING AGENCY: Challenge Engineering & Testing, Inc.	CONTRACTOR FILE NO.: 2020D01	12. TOTAL SAMPLES	DISTURBED: 40 / UNDISTURBED (UD): 0
4. NAME OF DRILLER: Nicolas Andino - SUELOS, Inc.		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL / BEARING	14. ELEVATION GROUND WATER: 0.5 Ft. measured after 24 hrs.	
		15. DATE BORING	STARTED: 03-04-20 / COMPLETED: 03-05-20
6. THICKNESS OF OVERBURDEN: N/A		16. ELEVATION TOP OF BORING: 4.5 Ft.	
7. DEPTH DRILLED INTO ROCK: N/A		17. TOTAL RECOVERY FOR BORING: 74 %	
8. TOTAL DEPTH OF BORING: 78.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: V.J. Thompson III, P.E., Civil Engineer	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
4.5	0.0						4.5		
			SAND, poorly-graded, firm, mostly fine to medium-grained sand-sized sand, few gravel up to 3/4", trace shell up to 1/4", wet, 2.5Y 3/2 very dark grayish brown (SP)	75	1		SPT Sampler	0 1 2 4	3
			At El. 2.5 Ft., few gravel up to 1-1/4", 2.5Y 5/3 light olive brown				2.5		
				55	2		SPT Sampler	4 5 6 6	11
							0.5		
				60	3		SPT Sampler	4 6 5 3	11
			At El. -1.5 Ft., few gravel up to 1/2", wet, 2.5Y 4/3 olive brown				-1.5		
				60	4		SPT Sampler	3 3 2 2	5
							-3.5		
				60	5		SPT Sampler	6 3 2 4	5
							-5.5		
				70	6		SPT Sampler	1 2 3 2	5
			At El. -7.5 Ft., trace gravel up to 1/4", 2.5Y 4/2 dark grayish brown				-7.5		
				60	7		SPT Sampler	0 1 1 1	2
							-9.5		
				85	8		SPT Sampler	1 2	

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 2 OF 5 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,643 Y = 270,704	4.5 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				85	8		SPT Sampler -11.5	2 1	4
				80	9		SPT Sampler -13.5	2 2 1 1	3
				90	10		SPT Sampler -15.5	5 2 2 1	4
				70	11		SPT Sampler -17.5	4 1 1 1	2
-19.0	23.5			80	12A		SPT Sampler -19.0	1 0 0	0
			SILT, inorganic-L, low plasticity, soft, mostly silt, trace fine-grained sand-sized quartz, trace organic matter, trace clay, wet, 5Y 2.5/1 black (ML)	60	12B		SPT Sampler -19.5	0	
-21.5	26.0			45	13		SPT Sampler -21.5	1 0 0 1	0
			CLAY, lean, medium plasticity, soft, mostly clay, few silt, trace fine-grained sand-sized quartz, trace organic matter, wet, 2.5Y 3/1 very dark gray (CL)	80	14		SPT Sampler -23.5	1 0 0 1	0
			At El. -23.5 Ft., few fine-grained sand-sized quartz, trace shell up to 1/8"	75	15		SPT Sampler -25.5	0 0 2 3	2
-27.5	32.0		At El. -25.5 Ft., low plasticity, hard, few limestone up to 1-1/4", moist, cemented clay balls < 1", 10GY 5/1 greenish gray	35	16		SPT Sampler -27.5	1 2 10 15	12
			SAND, clayey, nonplastic, hard, mostly fine to medium-grained sand-sized sand, some clay, few limestone up to 5/8", few sand, moist, 5G 5/1 greenish gray (SC)	45	17		SPT Sampler -29.5	4 14 28 30	42
				76	18		SPT Sampler	15 14	

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 3 OF 5 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,643 Y = 270,704	4.5 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			At El. -30.5 Ft., 5Y 6/4 pale olive	76	18		SPT Sampler (-31.2)	40 / 50/0.2'	54
							-31.5 Advanced Boring		
			At El. -31.5 Ft., low plasticity, very hard, 5Y 5/4 olive	94	19		SPT Sampler (-33.3)	16 / 32 / 45 / 50/0.3'	77
							-33.5 Advanced Boring		
			At El. -33.5 Ft., few limestone up to 1-1/2"	90	20		SPT Sampler (-34.5)	28 / 50	
							Advanced Boring (-35.5)		
			At El. -35.5 Ft., trace limestone up to 1/2", moist	80	21		SPT Sampler (-37.5)	22 / 32 / 36 / 18	68
			At El. -37.5 Ft., very hard, few limestone up to 3/4"	75	22		SPT Sampler (-39.5)	11 / 30 / 32 / 28	62
			At El. -39.5 Ft., 5Y 6/4 pale olive	90	23		SPT Sampler (-41.5)	12 / 22 / 28 / 38	50
			At El. -41.5 Ft., hard, trace limestone up to 1/4"	94	24		SPT Sampler (-43.3)	20 / 28 / 43 / 50/0.3'	71
							-43.5 Advanced Boring		
-45.5	50.0			84	25		SPT Sampler (-45.4)	14 / 23 / 30 / 50/0.4'	53
			SILT, inorganic-L, nonplastic, hard, mostly silt, some fine-grained sand-sized sand, few clay, few limestone up to 3/4", trace shell up to 1/4", wet, 5Y 7/1 light gray (ML)				-45.5 Advanced Boring		
				75	26		SPT Sampler (-47.5)	22 / 22 / 30 / 38	52
			At El. -48.5 Ft., moist, 5Y 7/6 yellow	75	27		SPT Sampler (-49.5)	12 / 14 / 21 / 28	35
			At El. -49.5 Ft., low plasticity, trace limestone up to 3/4", discontinue clay, discontinue shell, dry	83	28		SPT Sampler	9 / 12	

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 4 OF 5 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,643 Y = 270,704	4.5 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				83	28		SPT Sampler	36 / 50/0.3'	48
-51.5	56.0						-51.3 / -51.5 Advanced Boring		
			SAND, silty, hard, mostly fine-grained sand-sized sand, some silt, trace limestone up to 1/2", moist, 5Y 7/6 yellow (SM)	85	29		SPT Sampler	12 / 12 / 18 / 16	30
-53.5	58.0						-53.5		
			SILT, inorganic-L, nonplastic, hard, mostly silt, some fine-grained sand-sized sand, trace clay, trace limestone up to 1/2", moist, 5Y 7/4 pale yellow (ML)	80	30		SPT Sampler	13 / 23 / 34 / 34	57
							-55.5		
				60	31		SPT Sampler	4 / 7 / 7 / 24	14
							-57.5		
				55	32		SPT Sampler	6 / 18 / 18 / 28	36
							-59.5		
			At El. -59.5 Ft., low plasticity, 5Y 8/3 pale yellow	90	33		SPT Sampler	20 / 14 / 22 / 32	36
							-61.5		
				90	34		SPT Sampler	10 / 17 / 18 / 26	35
							-63.5		
				80	35		SPT Sampler	12 / 19 / 26 / 20	45
							-65.5		
			At El. -65.5 Ft., nonplastic, few limestone up to 1/2", 2.5Y 8/2 pale yellow	85	36		SPT Sampler	4 / 17 / 28 / 26	45
							-67.5		
				80	37		SPT Sampler	21 / 18 / 20 / 18	38
							-69.5		
				80	38		SPT Sampler	18 / 24	

55 60 65 70 75

SAJ FORM 1836-A
JUN 02

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 5 OF 5 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,643 Y = 270,704	4.5 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
-71.5	76.0			80	38		SPT Sampler -71.5	20 23	44
-73.5	78.0	Highly Weathered	LIMESTONE, non-fossiliferous, hard, highly weathered, fine grained, 2.5Y 8/4 pale yellow	75	39		SPT Sampler -73.5	12 18 26 42	44

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. HSA Siezed In Borehole & Broke Off Bottom 25 Ft.

4. Calibrated Auto Hammer

5. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
3	4.0/6.0	SP*
6	10.0/12.0	SP*
9	16.0/18.0	SP*
12A	22.0/23.5	SM*
19	36.0/38.0	SC*
23	44.0/46.0	SC*
30	58.0/60.0	CL*

*Lab visual classification based on gradation curve

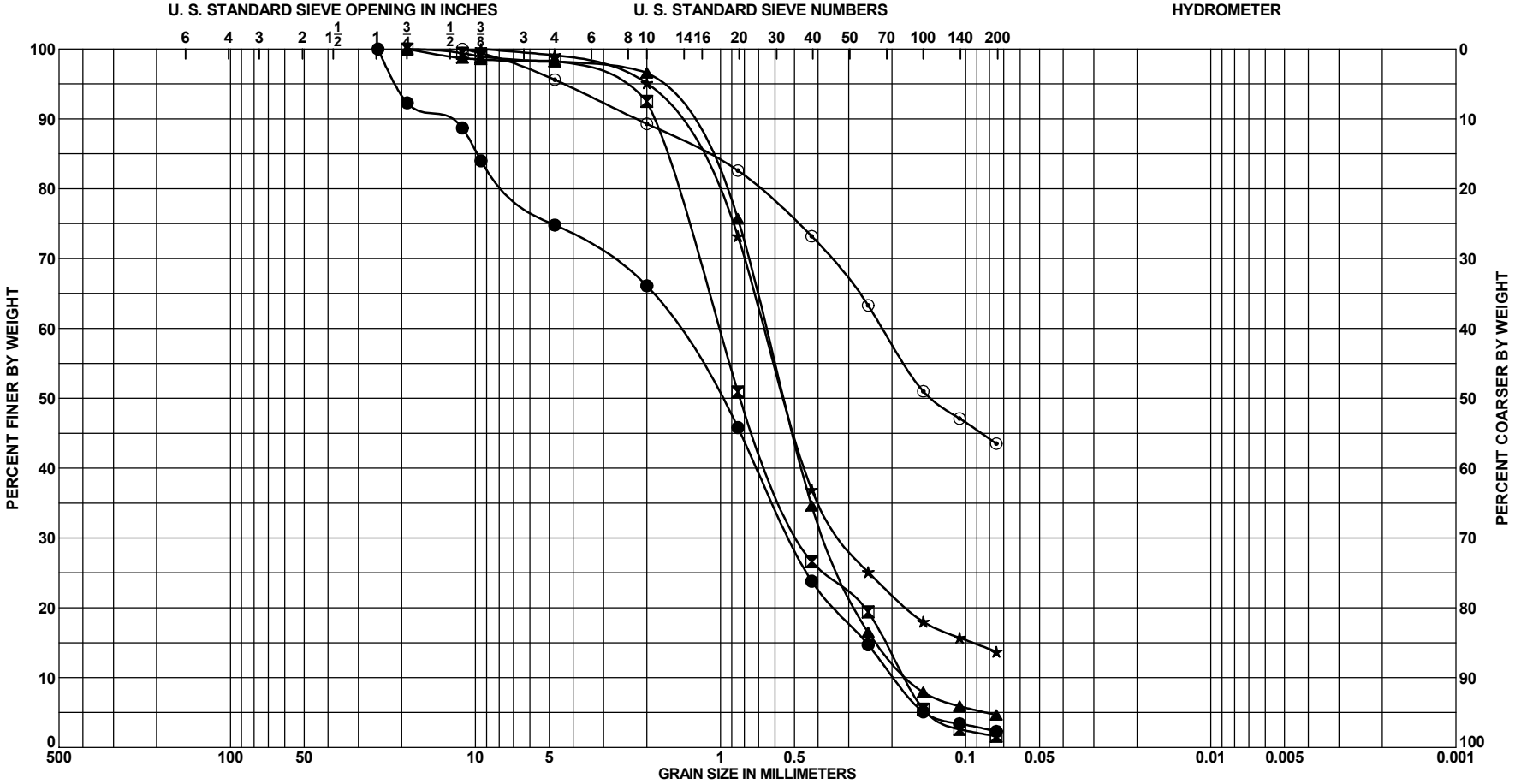
6. Additional Laboratory Testing

15 Atterberg
17 Atterberg
27 Atterberg
32 Atterberg
36 Atterberg

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

75 80 85 90 95

SAJ FORM 1836-A
JUN 02

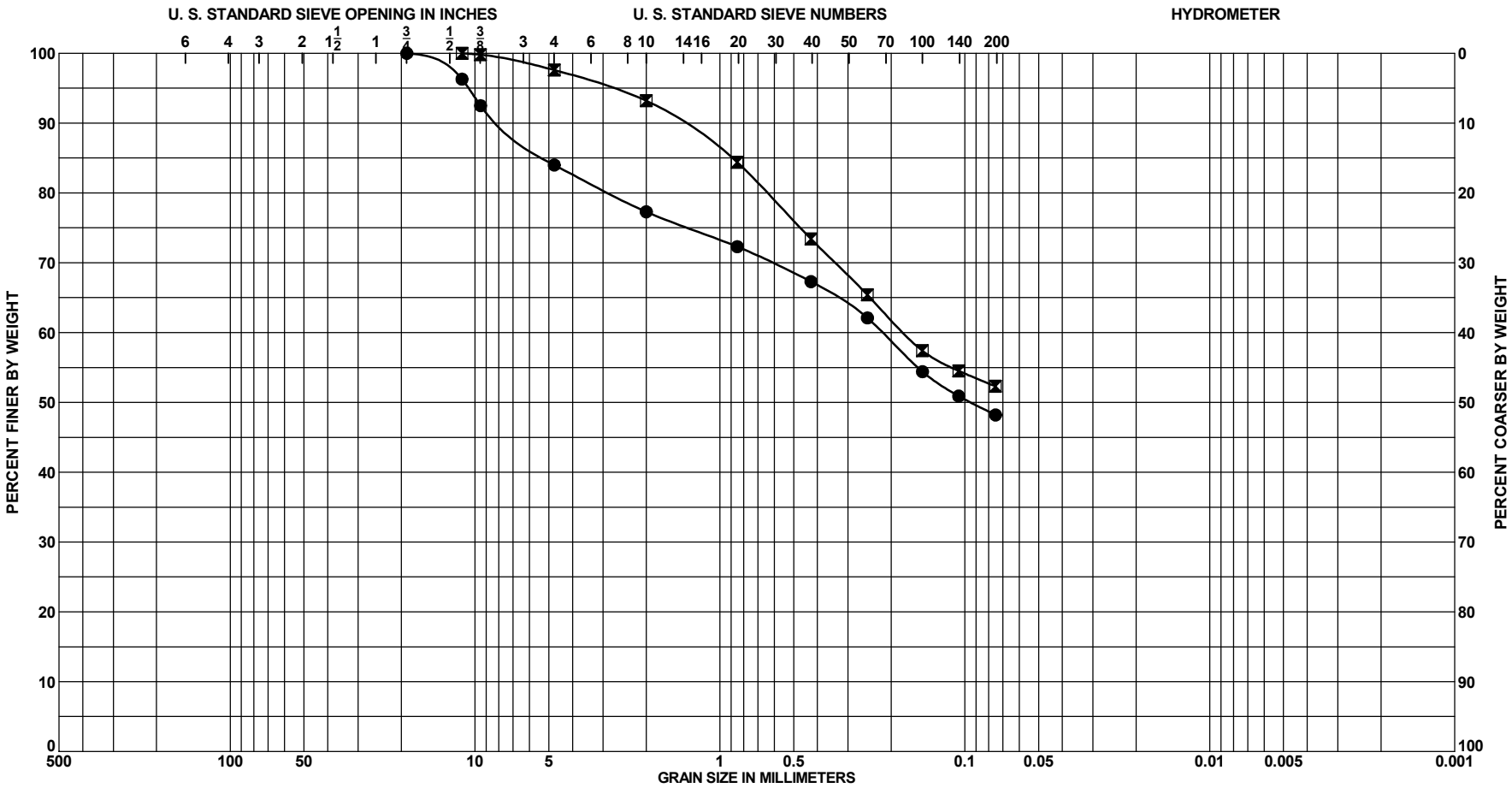


Sample No.		Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
●	3	4.0 to 6.0 Ft.	(SP)									
⊠	6	10.0 to 12.0 Ft.	(SP)									
▲	9	16.0 to 18.0 Ft.	(SP)									
★	12A	22.0 to 23.5 Ft.	(SM)									
⊙	19	36.0 to 38.0 Ft.	(SC)									

GRADATION CURVES

PROJECT	FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL
	Contract 3
BORING NO.	CB-RGA-20-61A
BORING ELEV.	4.5 Ft., PRVD02
DATE	5/29/2020

SAJ FORM 2087
JUN 02



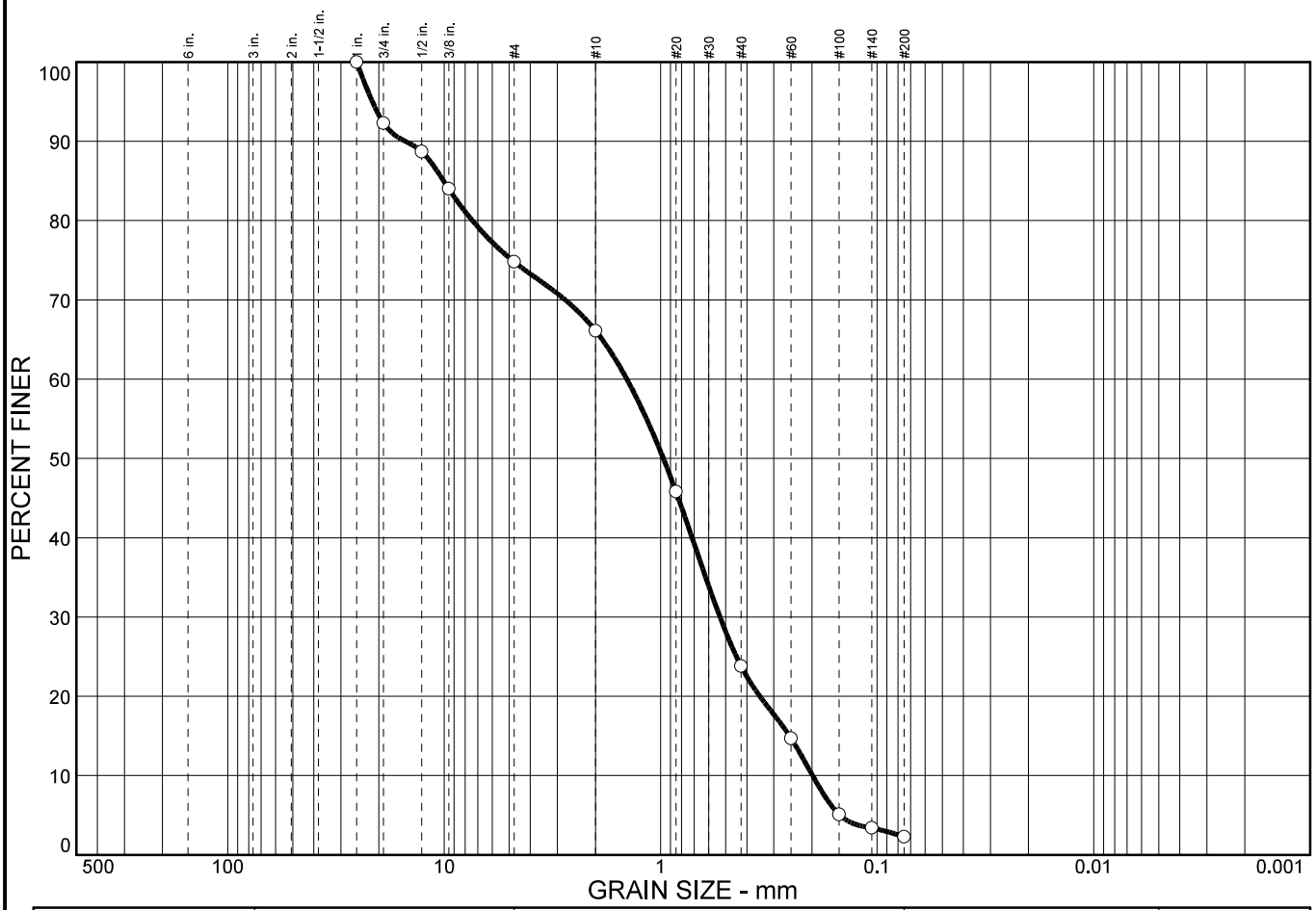
Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 23	44.0 to 46.0 Ft.	(SC)									
⊠ 30	58.0 to 60.0 Ft.	(CL)									

PROJECT	FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL
	Contract 3
BORING NO.	CB-RGA-20-61A
BORING ELEV.	4.5 Ft., PRVD02
DATE	5/29/2020

GRADATION CURVES

SAJ FORM 2087
JUN 02

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	25.2	72.5	2.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
.75 in.	92.3		
.5 in.	88.7		
.375 in.	84.0		
#4	74.8		
#10	66.1		
#20	45.8		
#40	23.8		
#60	14.7		
#100	5.1		
#140	3.4		
#200	2.3		

* (no specification provided)

Material Description

Poorly grade sand with gravel

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 10.1 D_{60}= 1.43 D_{50}= 0.973
D_{30}= 0.532 D_{15}= 0.254 D_{10}= 0.199
C_u= 7.21 C_c= 0.99

Classification

USCS= AASHTO=

Remarks

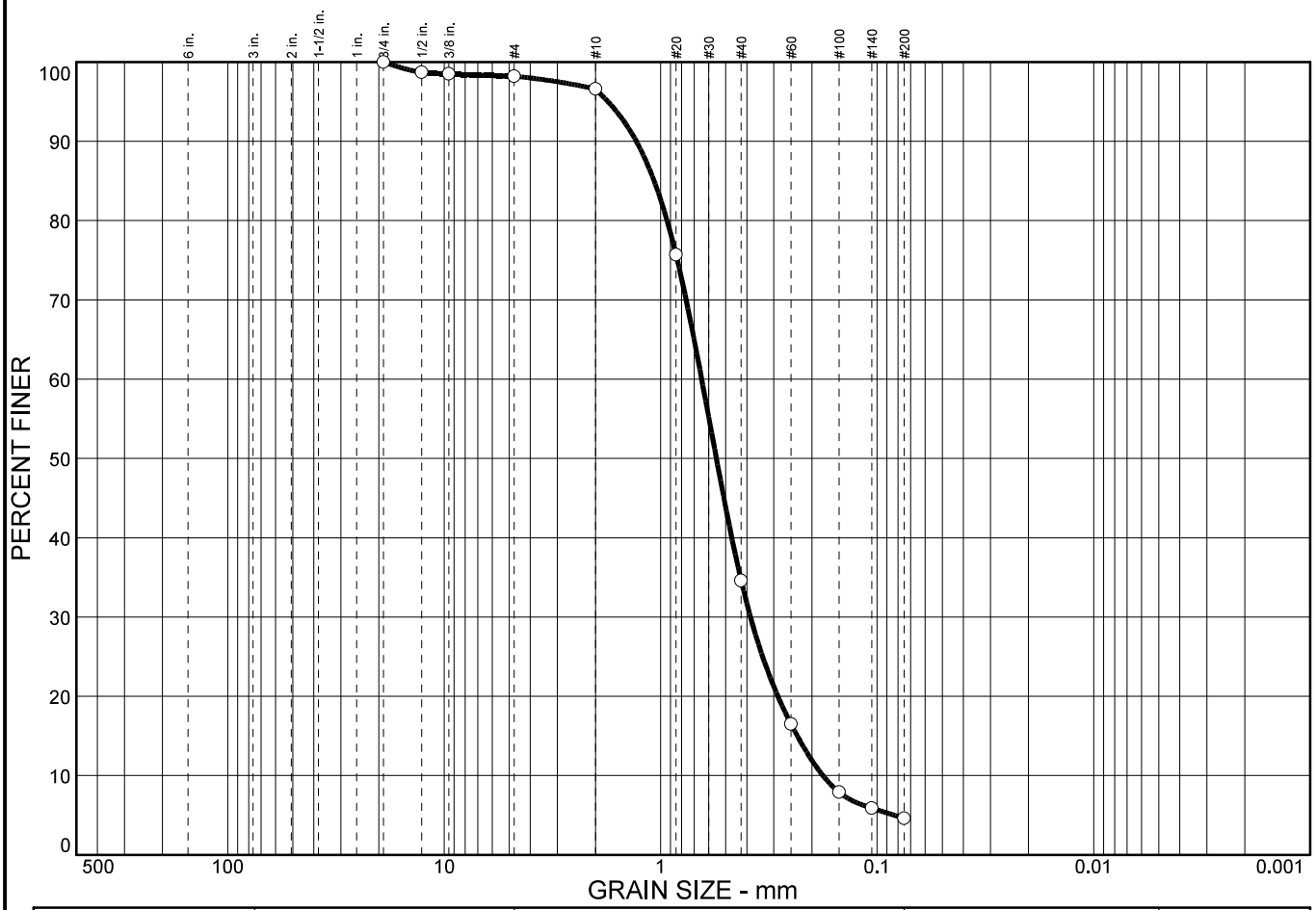
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=1.44

Sample No.: Sample 3 **Source of Sample:** CB-RGA-20-61 **Date:** 5/28/20
Location: Arecibo, PR **Elev./Depth:** 4-6'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.8	93.6	4.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	98.7		
.375 in.	98.5		
#4	98.2		
#10	96.6		
#20	75.7		
#40	34.6		
#60	16.5		
#100	7.9		
#140	5.9		
#200	4.6		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 1.07 D_{60}= 0.647 D_{50}= 0.553
D_{30}= 0.385 D_{15}= 0.234 D_{10}= 0.178
C_u= 3.63 C_c= 1.29

Classification

USCS= AASHTO=

Remarks

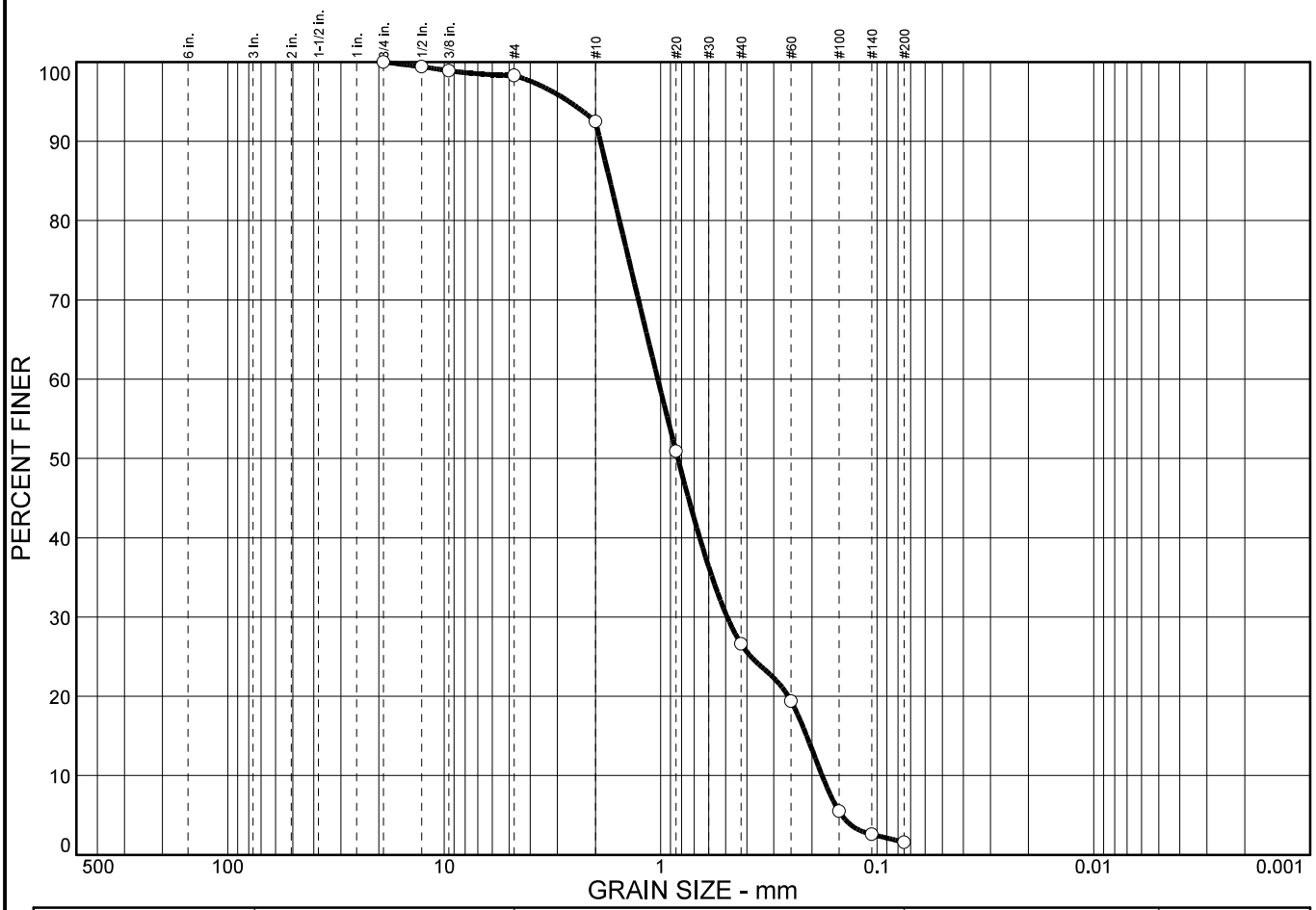
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.95

Sample No.: Sample 9 **Source of Sample:** CB-RGA-20-61 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 16-18'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.7	96.7	1.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	99.4		
.375 in.	98.9		
#4	98.3		
#10	92.5		
#20	50.9		
#40	26.6		
#60	19.4		
#100	5.5		
#140	2.6		
#200	1.6		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 1.72 D_{60}= 1.03 D_{50}= 0.833
D_{30}= 0.493 D_{15}= 0.212 D_{10}= 0.180
C_u= 5.74 C_c= 1.31

Classification

USCS= AASHTO=

Remarks

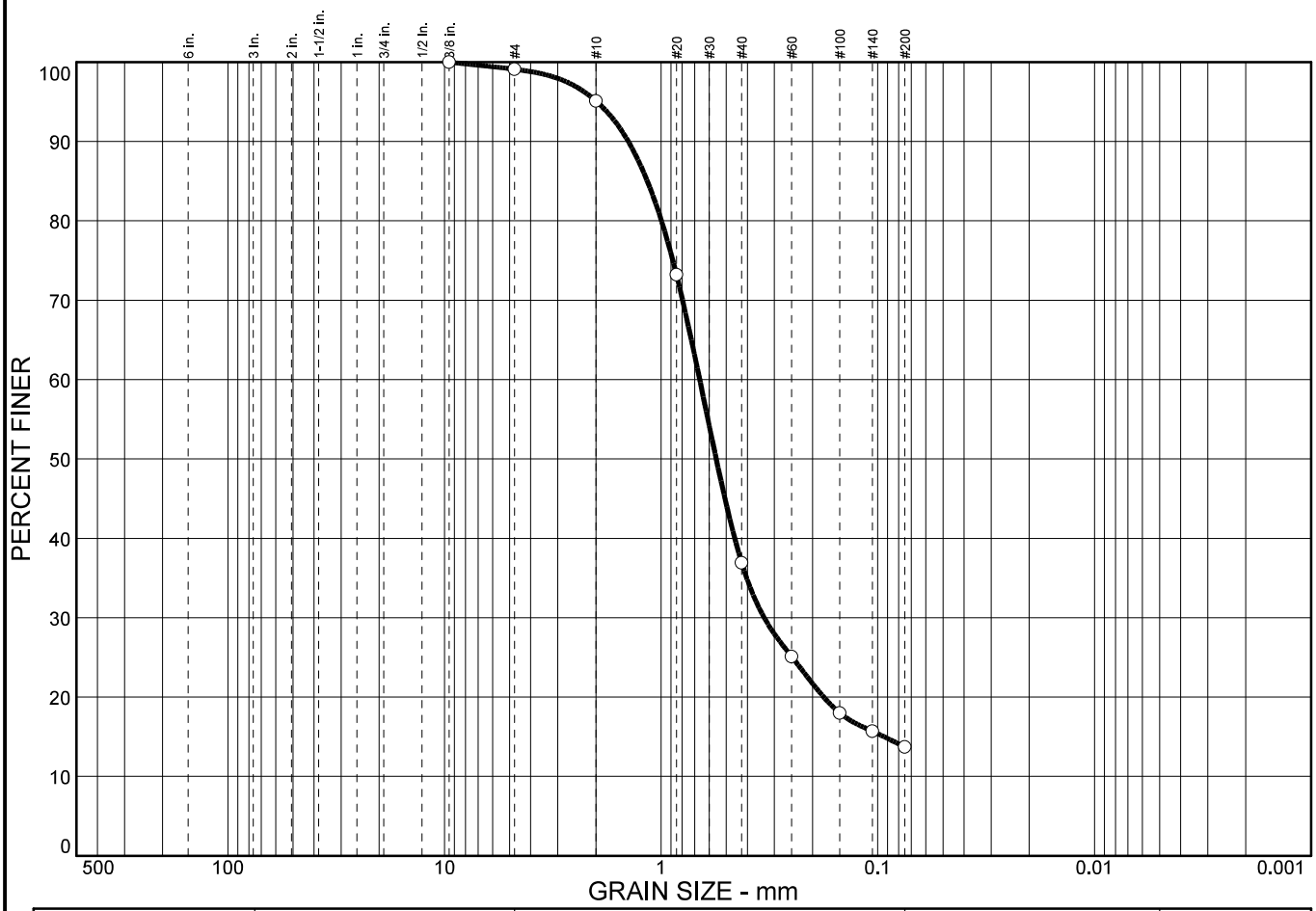
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.97

Sample No.: Sample 6 **Source of Sample:** CB-RGA-20-61 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 10-12'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.9	85.4	13.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.1		
#10	95.1		
#20	73.2		
#40	36.9		
#60	25.1		
#100	18.0		
#140	15.7		
#200	13.7		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 1.16 D_{60}= 0.665 D_{50}= 0.557
D_{30}= 0.335 D_{15}= 0.0935 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

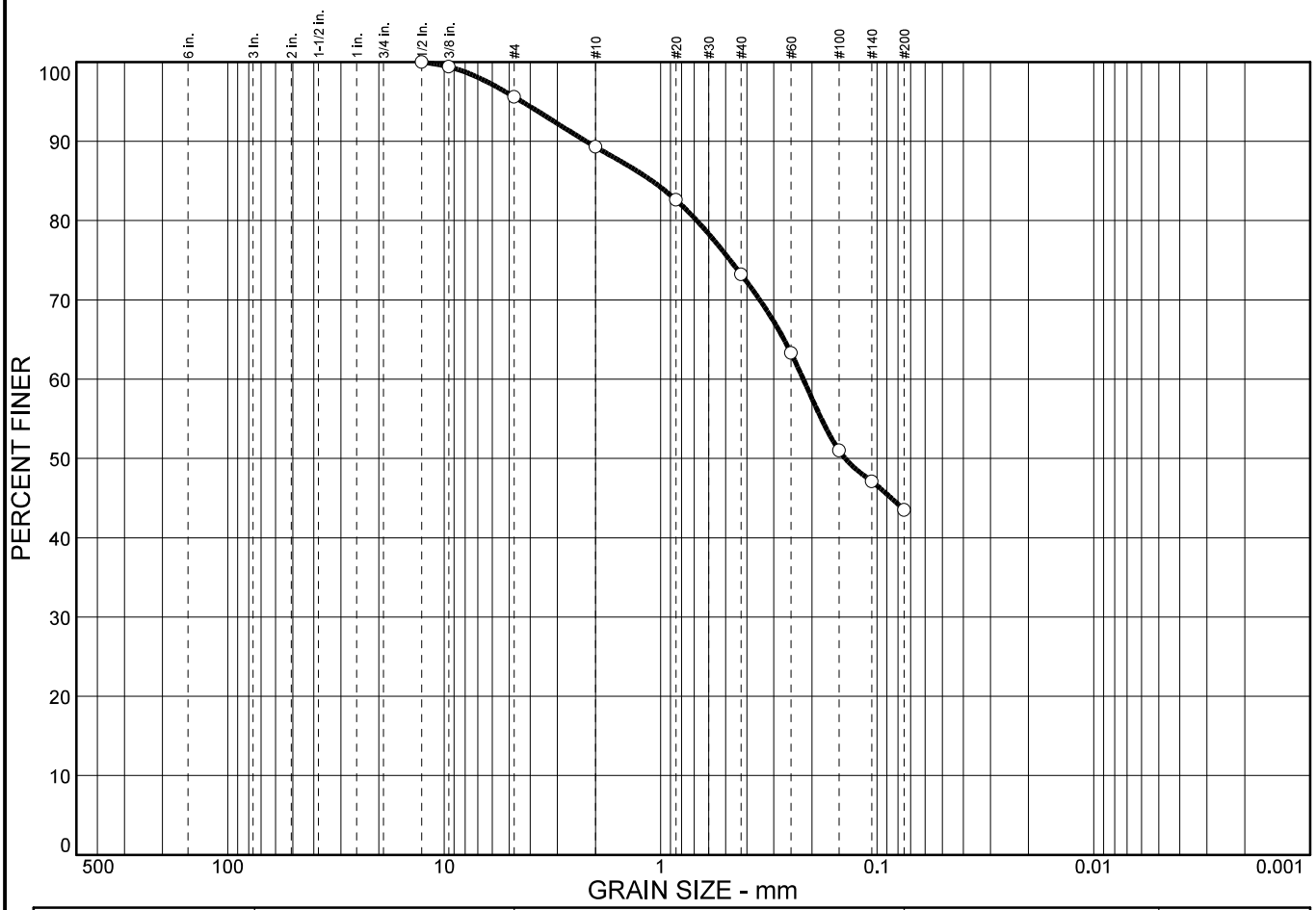
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.83

Sample No.: Sample 12A **Source of Sample:** CB-RGA-20-61 **Date:** 5/28/20
Location: Arecibo, PR **Elev./Depth:** 22-24'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.4	52.1	43.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5 in.	100.0		
.375 in.	99.4		
#4	95.6		
#10	89.3		
#20	82.6		
#40	73.2		
#60	63.3		
#100	51.0		
#140	47.1		
#200	43.5		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 1.10 D_{60}= 0.219 D_{50}= 0.141
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

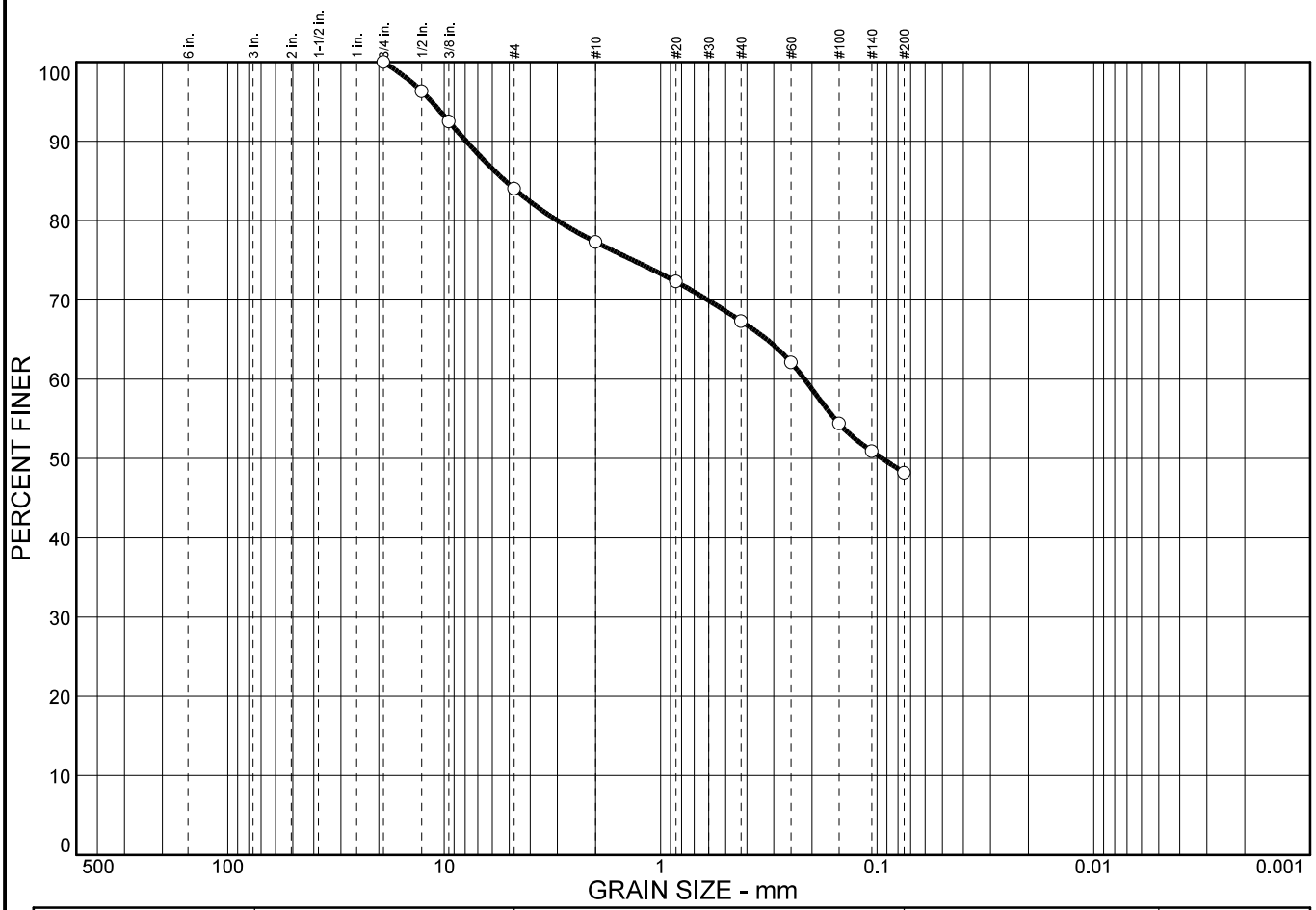
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.54

Sample No.: Sample 19 **Source of Sample:** CB-RGA-20-61 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 36-38'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	16.0	35.8	48.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	96.3		
.375 in.	92.5		
#4	84.0		
#10	77.3		
#20	72.3		
#40	67.3		
#60	62.1		
#100	54.4		
#140	50.9		
#200	48.2		

* (no specification provided)

Material Description

Silty sand with gravel

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 5.22 D_{60}= 0.217 D_{50}= 0.0948
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

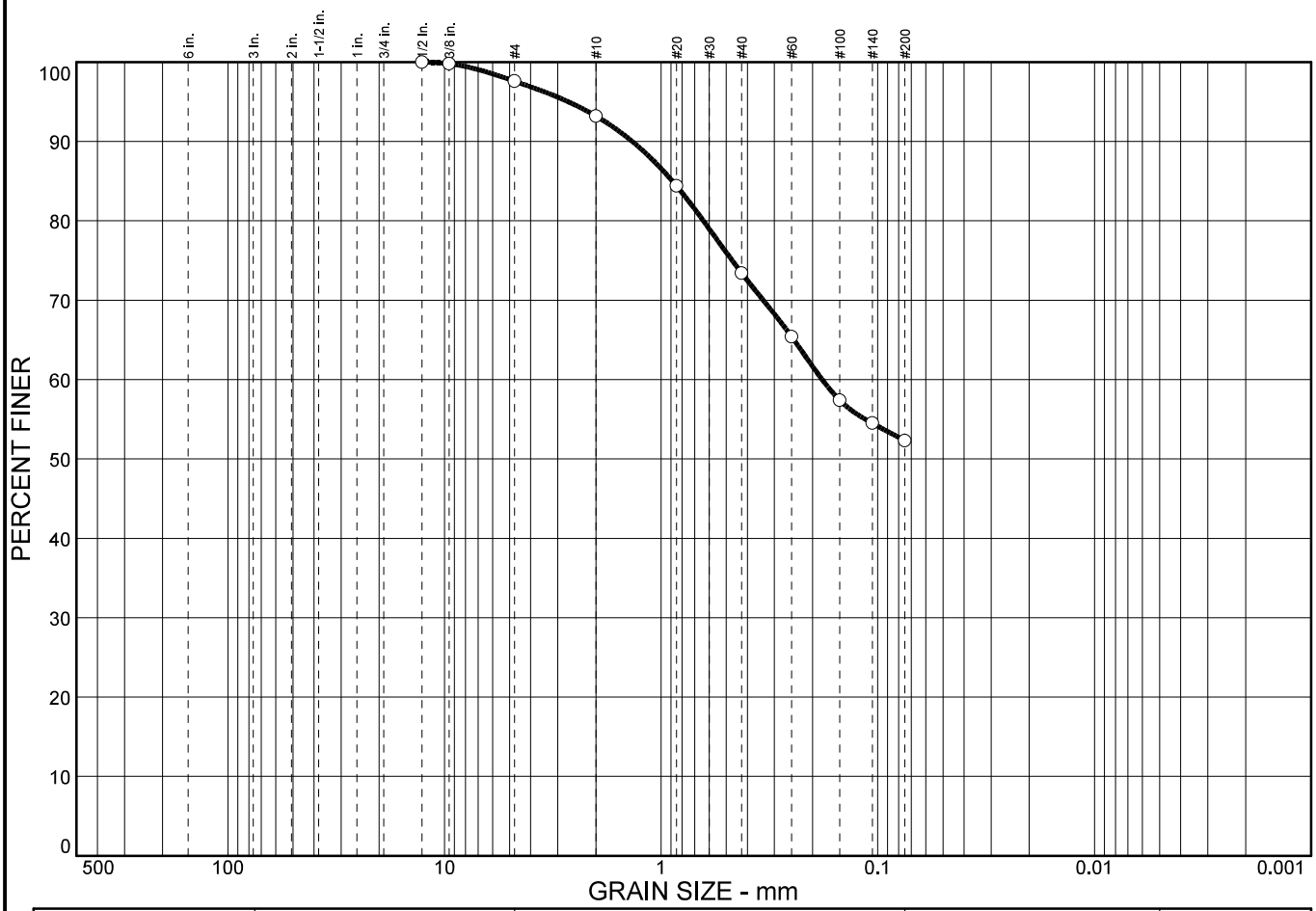
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.69

Sample No.: Sample 23 **Source of Sample:** CB-RGA-20-61 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 44-46'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	2.4	45.3	52.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5 in.	100.0		
.375 in.	99.8		
#4	97.6		
#10	93.2		
#20	84.4		
#40	73.4		
#60	65.4		
#100	57.4		
#140	54.5		
#200	52.3		

* (no specification provided)

Material Description

Sandy silt

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 0.887 D_{60}= 0.181 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.45

Sample No.: Sample 30 **Source of Sample:** CB-RGA-20-61 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 58-60'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 3 SHEETS
	South Atlantic	St. Louis District	

1. PROJECT	FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL Sand Bar Exploration
2. BORING DESIGNATION	CB-RGA-20-01
LOCATION COORDINATES	X = 170,654 Y = 270,617
3. DRILLING AGENCY	Challenge Engineering & Testing, Inc.
CONTRACTOR FILE NO.	2020D04
4. NAME OF DRILLER	Nicolas Andino - SUELOS, Inc.
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	40.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	CME-75 (land-based)
	☒ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 23 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	0.7 Ft. measured after 24 hrs.
15. DATE BORING	STARTED 06-08-20 / COMPLETED 06-08-20
16. ELEVATION TOP OF BORING	4.7 Ft.
17. TOTAL RECOVERY FOR BORING	82 %
18. SIGNATURE AND TITLE OF INSPECTOR	V.J. Thompson III, P.E., Civil Engineer

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
4.7	0.0						4.7		
			SAND, poorly-graded, soft, mostly subrounded fine to medium-grained sand-sized sand, trace organic matter, trace gravel up to 1/8", trace subangular shell up to 1/4", dry, 5Y 5/3 olive (SP)	85	1		SPT Sampler	1 3 5 7	8
			At El. 2.7 Ft., 5Y 5/2 olive gray				2.7		
				60	2		SPT Sampler	4 5 3 3	8
							0.7		
			At El. 0.7 Ft., firm, mostly subrounded fine to medium-grained sand-sized sand, trace gravel up to 1/8", trace subangular shell up to 1/8", wet, 5Y 5/2 olive gray	60	3		SPT Sampler	3 4 3 3	7
							-1.3		
				70	4		SPT Sampler	6 3 2 2	5
			At El. -3.3 Ft., 5Y 5/1 gray				-3.3		
				85	5		SPT Sampler	10 10 7 5	17
			At El. -4.8 Ft., 2" gray clay ball				-5.3		
			At El. -5.3 Ft., trace gravel up to 5/8"	85	6		SPT Sampler	2 2 3 5	5
							-7.3		
				90	7		SPT Sampler	9 9 9 7	18
							-9.3		
				90	8		SPT Sampler	10 8	

0 5 10 15

SAJ FORM 1836
JUN 02

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 2 OF 3 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,654 Y = 270,617	4.7 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			At El. -10.3 Ft., trace clay, trace gravel up to 1/2"	90	8		SPT Sampler -11.3	9, 10	17
				90	9		SPT Sampler -13.3	7, 7, 8, 7	15
			At El. -13.3 Ft., trace gravel up to 5/8"	90	10		SPT Sampler -15.3	5, 7, 11, 11	18
				95	11		SPT Sampler -17.3	7, 9, 9, 4	18
			At El. -17.3 Ft., few gravel up to 3/4", 10GY 4/1 dark greenish gray	100	12A		SPT Sampler -18.8	5, 3, 4	7
-18.7	23.4								
-19.3	24.0		SAND, silty, firm, mostly subrounded fine-grained sand-sized sand, trace clay, wet, 5G 4/1 dark greenish gray (SM)	80	12B		-19.3 SPT Sampler	3	
			CLAY, lean, medium plasticity, soft, mostly clay, trace fine-grained sand-sized sand, wet, 10GY 4/1 dark greenish gray (CL)	45	13		SPT Sampler -21.3	1, 1, 1, 1	2
				55	14		SPT Sampler -23.3	2, 1, 1, 2	2
-23.3	28.0								
-24.3	29.0		SILT, inorganic-L, medium plasticity, soft, mostly silt, some clay, wet, 10GY 4/1 dark greenish gray (ML)	100	15A		SPT Sampler -24.3	3, 3	
			SAND, silty, firm, mostly subrounded fine to medium-grained sand-sized sand, some clay, few gravel up to 3/4", wet, 5GY 5/1 greenish gray (SM)	90	15B		SPT Sampler -25.3	3, 2	
-25.8	30.5								
-26.8	31.5		SILT, inorganic-H, medium plasticity, soft, mostly silt, few clay, trace sand, wet, 5GY 5/1 greenish gray (MH)	100	16A		SPT Sampler -26.8	9, 5, 4	9
			SAND, poorly-graded, firm, mostly fine to medium-grained sand-sized sand, few gravel up to 5/8", trace clay, wet, 5GY 4/1 dark greenish gray (SP)	60	16B		-27.3 SPT Sampler	5	
			At El. -27.3 Ft., trace gravel up to 1/2"	90	17		SPT Sampler -29.3	4, 6, 6, 9	12
-29.3	34.0								
			SAND, well-graded with silt, firm, mostly fine to medium-grained sand-sized sand, moist, 5Y 4/1 dark gray (SW-SM)	90	18		SPT Sampler	2, 2	

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 3 OF 3 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,654 Y = 270,617	4.7 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				90	18		SPT Sampler	2, 2	4
			At El. -31.3 Ft., some subangular shell up to 1/2", trace clay, trace gravel up to 1/2"				-31.3		
				90	19		SPT Sampler	3, 8, 14, 11	22
			At El. -33.3 Ft., trace gravel up to 1-1/4"				-33.3		
				95	20		SPT Sampler	12, 13, 16, 18	29
-35.3	40.0						-35.3		

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
1	0.0/2.0	SP*
3	4.0/6.0	SP*
5	8.0/10.0	SP*
7	12.0/14.0	SP*
9	16.0/18.0	SP*
11	20.0/22.0	SP*
12B	23.5/24.0	SM*
15B	29.0/30.0	SM*
17	32.0/34.0	SP*
18	34.0/36.0	SW-SM*

*Lab visual classification based on gradation curve

4. Additional Laboratory Testing

13 Moisture Content
13 Atterberg
15A Moisture Content
15A Atterberg
16A Moisture Content
16A Atterberg

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

35 40 45 50 55

SAJ FORM 1836-A
JUN 02

DRILLING LOG	DIVISION South Atlantic	INSTALLATION St. Louis District	SHEET 1 OF 6 SHEETS

1. PROJECT	FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL Contract 3
2. BORING DESIGNATION	CB-RGA-20-62A
LOCATION COORDINATES	X = 170,635 Y = 270,638
3. DRILLING AGENCY	Challenge Engineering & Testing, Inc.
CONTRACTOR FILE NO.	2020D01
4. NAME OF DRILLER	Nicolas Andino - SUELOS, Inc.
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	100.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	CME-75 (land-based)
	☒ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 51 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	0.4 Ft. measured after 24 hrs.
15. DATE BORING	STARTED 03-02-20 / COMPLETED 03-03-20
16. ELEVATION TOP OF BORING	4.4 Ft.
17. TOTAL RECOVERY FOR BORING	72 %
18. SIGNATURE AND TITLE OF INSPECTOR	V.J. Thompson III, P.E., Civil Engineer

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
4.4	0.0						4.4		
			SAND, poorly-graded with silt, firm, mostly subrounded to rounded fine to medium-grained sand-sized sand, trace subangular to rounded shell up to 1/4", trace silt, trace gravel up to 1/2", trace limestone up to 3/8", moist, 10YR 5/3 brown (SP-SM)	85	1		SPT Sampler	2 4 6 8	10
							2.4		
				80	2		SPT Sampler	5 7 7 9	14
			At El. 0.4 Ft., wet, 10YR 5/1 gray				0.4		
				80	3		SPT Sampler	5 5 4 4	9
							-1.6		
				80	4		SPT Sampler	3 3 3 4	6
-3.6	8.0						-3.6		
			SAND, poorly-graded, firm, mostly subrounded to rounded fine to medium-grained sand-sized sand, trace subangular shell up to 1/4", trace silt, trace gravel up to 1/2", trace limestone up to 3/8", wet, 2.5Y 5/1 gray (SP)	75	5		SPT Sampler	3 4 5 2	9
							-5.6		
			At El. -5.6 Ft., few silt, 2.5Y 4/1 dark gray	90	6		SPT Sampler	2 5 6 3	11
							-7.6		
			At El. -7.6 Ft., few gravel up to 5/8", 5Y 5/1 gray	90	7		SPT Sampler	6 5 4 3	9
							-9.6		
			At El. -9.6 Ft., few subangular to rounded gravel up to 1/4"	55	8		SPT Sampler	1 1	

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION St. Louis District		SHEET 2 OF 6 SHEETS
PROJECT FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	COORDINATE SYSTEM/DATUM State Plane, PR/VI (U.S. Ft.)	HORIZONTAL NAD83	VERTICAL PRVD02
LOCATION COORDINATES X = 170,635 Y = 270,638	ELEVATION TOP OF BORING 4.4 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				55	8		SPT Sampler -11.6	1 1	2
			At El. -11.6 Ft., few subangular to rounded gravel up to 1/2", 5Y 4/1 dark gray	100	9		SPT Sampler -13.6	6 4 3 2	7
				100	10		SPT Sampler -15.6	5 4 5 4	9
			At El. -15.6 Ft., few coarse-grained sand-sized sand, trace subangular to rounded gravel up to 1/4", 5Y 5/1 gray	90	11		SPT Sampler -17.6	2 2 3 5	5
			At El. -17.6 Ft., few silt, few subangular to rounded gravel up to 1-1/4"	90	12		SPT Sampler -19.6	8 6 10 9	16
				70	13		SPT Sampler -21.6	6 7 9 10	16
			At El. -21.6 Ft., few shell up to 1-1/4"	85	14		SPT Sampler -23.6	3 3 4 6	7
				85	15		SPT Sampler -25.6	5 5 7 12	12
			At El. -25.4 Ft., 5Y 3/1 very dark gray	85	16		SPT Sampler -27.6	5 4 5 8	9
-27.6	32.0		SAND, poorly-graded with silt, firm, mostly fine to medium-grained sand-sized sand, few shell up to 1-1/2", wet, 5Y 3/1 very dark gray (SP-SM)	90	17		SPT Sampler -29.6	4 6 7 9	13
				80	18		SPT Sampler	10 18	

15 20 25 30 35

SAJ FORM 1836-A
JUN 02

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 3 OF 6 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,635 Y = 270,638	4.4 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			At El. -30.6 Ft., few subangular to rounded gravel up to 1-1/2"	80	18		SPT Sampler -31.6	18 20	36
			At El. -31.6 Ft., few limestone up to 1-1/4"	100	19A		SPT Sampler -32.6	12 4	
-32.6	37.0		CLAY, lean, high plasticity, firm, mostly clay, some gravel up to 1", trace limestone up to 1/2", 5Y 5/2 olive gray (CL)	50	19B		SPT Sampler -33.6	5 6	
			At El. -33.6 Ft., few gravel up to 1", trace fine-grained sand-sized sand	80	20		SPT Sampler -35.6	3 5 6 8	11
-35.6	40.0		SAND, clayey, low plasticity, firm, mostly fine to medium-grained sand-sized sand, some clay, trace gravel up to 1/4", moist, 5Y 5/2 olive gray (SC)	75	21		SPT Sampler -37.6	3 4 5 6	9
-37.6	42.0		SILT, inorganic-L, low plasticity, firm, mostly silt, some sand, trace clay, moist, 5Y 5/1 gray (ML)	80	22		SPT Sampler -39.6	2 3 4 5	7
-39.6	44.0		CLAY, lean, medium plasticity, firm, mostly clay, trace sand, trace silt, moist, 5Y 5/1 gray (CL)	45	23		SPT Sampler -41.6	2 4 7 11	11
				60	24		SPT Sampler -43.6	3 5 8 11	13
				45	25		SPT Sampler -45.6	5 7 3 8	10
			At El. -45.6 Ft., few fine to medium-grained sand-sized sand, 10YR 3/3 dark brown	40	26		SPT Sampler -47.6	3 6 11 17	17
			At El. -47.6 Ft., 10YR 4/1 dark gray	50	27		SPT Sampler -49.6	3 6 8 18	14
-49.6	54.0		SAND, silty, firm, mostly fine to medium-grained sand-sized quartz, few clay, few shell up to 1/4", moist, 5Y 4/1 dark gray	50	28		SPT Sampler	6 10	

35 40 45 50 55

SAJ FORM 1836-A
JUN 02

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 4 OF 6 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,635 Y = 270,638	4.4 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			(SM)	50	28		SPT Sampler -51.6	12 13	22
				45	29		SPT Sampler -53.6	5 9 14 14	23
-53.6	58.0		CLAY, lean, high plasticity, firm, mostly clay, moist, 5Y 5/2 olive gray (CL)	75	30		SPT Sampler -55.6	5 6 7 7	13
			At El. -55.6 Ft., trace gravel up to 1/4", 5Y 6/6 olive yellow	35	31		SPT Sampler -57.6	2 3 4 5	7
			At El. -58.6 Ft., discontinue gravel, 10YR 5/6 yellowish brown	65	32		SPT Sampler -59.6	3 3 5 6	8
				90	33		SPT Sampler -61.6	4 6 7 10	13
			At El. -61.6 Ft., 10YR 6/2 light brownish gray	90	34		SPT Sampler -63.6	4 5 7 9	12
			At El. -63.6 Ft., trace gravel up to 1/4", trace fine-grained sand-sized sand, 2.5Y 4/1 dark gray	75	35		SPT Sampler -65.6	6 7 10 13	17
			At El. -65.6 Ft., 10YR 4/1 dark gray	80	36		SPT Sampler -67.6	6 6 8 7	14
-67.6	72.0	Highly Weathered	LIMESTONE, non-fossiliferous, soft, highly weathered, broken due to drill action, 5Y 7/2 light gray	60	37		SPT Sampler -69.6	6 6 11 11	17
-69.6	74.0		SILT, inorganic-L, low plasticity, soft, mostly silt, some limestone up to 3/4", few sand, moist, 5Y 7/2 light gray (ML)	85	38		SPT Sampler	7 13	

55 60 65 70 75

SAJ FORM 1836-A
JUN 02

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 5 OF 6 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,635 Y = 270,638	4.4 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				85	38		SPT Sampler -71.6	21 29	34
				70	39		SPT Sampler -73.6	10 13 25 20	38
-73.6	78.0	Highly Weathered	LIMESTONE, non-fossiliferous, highly weathered, broken due to drill action, few sand, few silt, 5Y 7/1 light gray	65	40		SPT Sampler -75.6	14 28 14 23	42
-75.6	80.0		SILT, inorganic-L, low plasticity, hard, mostly silt, some limestone up to 1", few sand, moist, 5Y 7/1 light gray (ML)	65	41		SPT Sampler -77.6	12 10 10 20	20
			At El. -77.6 Ft., 10GY 6/1 greenish gray	70	42		SPT Sampler -79.6	7 13 13 8	26
-79.6	84.0		CLAY, lean, medium plasticity, hard, mostly clay, some limestone up to 1-1/4", few sand, moist, 10Y 4/1 dark greenish gray (CL)	60	43		SPT Sampler -81.6	6 9 13 15	22
-82.6	87.0	Highly Weathered	LIMESTONE, non-fossiliferous, highly weathered, broken due to drill action, few clay, 2.5Y 7/2 light gray	65	44		SPT Sampler -83.6	7 11 50 16	61
-85.6	90.0		CLAY, lean, low plasticity, hard, mostly clay, few limestone up to 1", few fine-grained sand-sized sand, moist, 2.5Y 7/3 pale yellow (CL)	65	45		SPT Sampler -85.6	12 13 28 32	41
			At El. -87.6 Ft., 2.5Y 7/2 light gray	65	46		SPT Sampler -87.6	11 7 14 17	21
			At El. -89.4 Ft., 2.5Y 6/1 gray	70	47		SPT Sampler -89.6	6 6 11 16	17
-90.6	95.0			78	48		SPT Sampler	14 10	

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 6 OF 6 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,635 Y = 270,638	4.4 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
		Highly Weathered	LIMESTONE, non-fossiliferous, highly weathered, broken due to drill action, 5Y 7/1 light gray	78	48		SPT Sampler	11	21
							-91.4	50/0.3'	
							-91.6 Advanced Boring		
				75	49		-92.0 SPT Sampler	50/0.4'	
							Advanced Boring		
							-93.6		
				65	50		SPT Sampler	11	38
								16	
								22	
-95.6	100.0						-95.6	16	

NOTES:

1. USACE Jacksonville is the custodian for these original files.

2. Soils are field visually classified in accordance with the Unified Soils Classification System.

3. Calibrated Auto Hammer

4. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
2	2.0/4.0	SP-SM*
5	8.0/10.0	SP*
8	14.0/16.0	SP*
11	20.0/22.0	SP*
14	26.0/28.0	SP*
17	32.0/34.0	SP-SM*
28	54.0/56.0	SM*

*Lab visual classification based on gradation curve

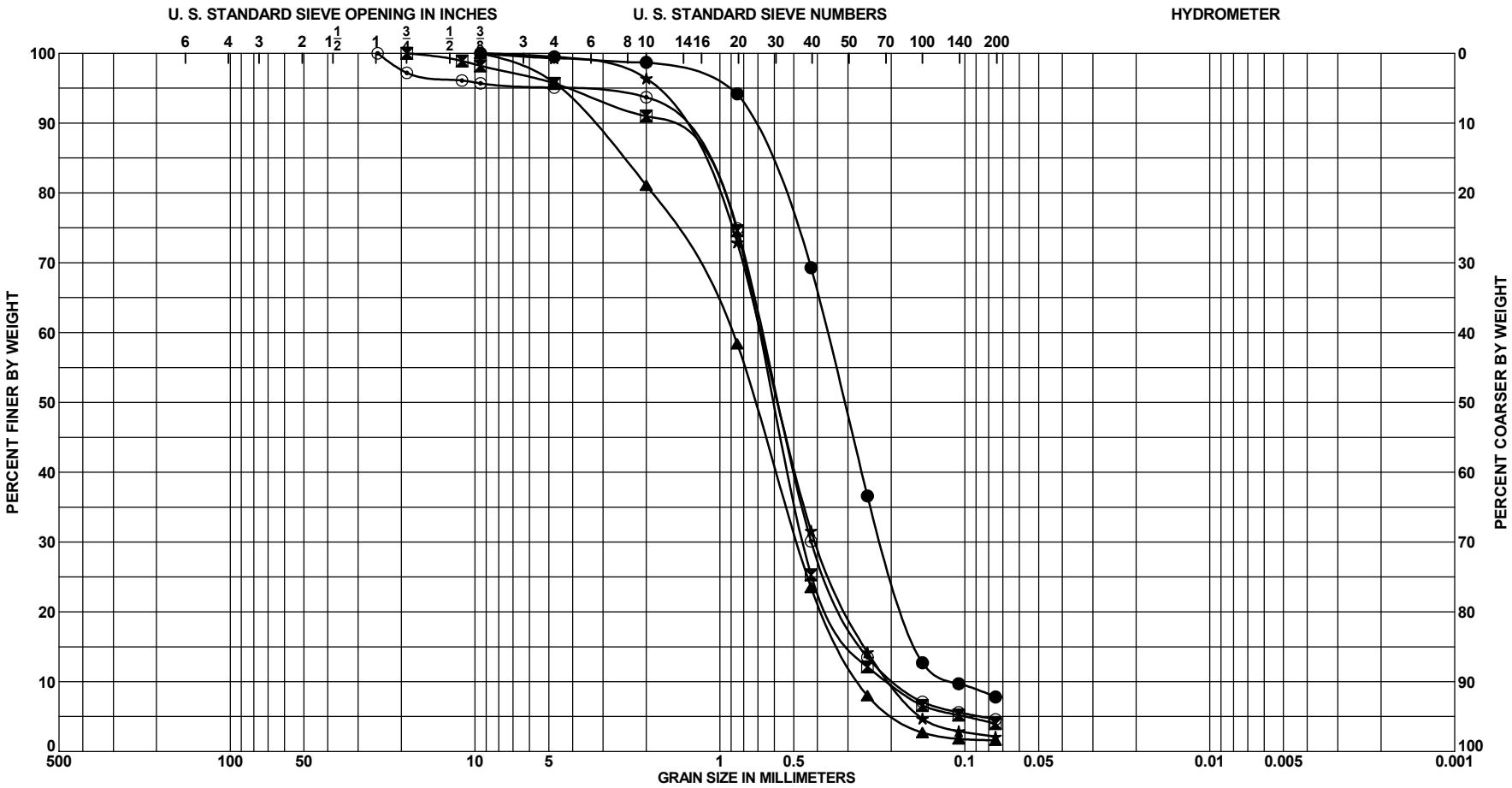
5. Additional Laboratory Testing

19B Atterberg
24 Atterberg
26 Atterberg
31 Atterberg
33 Atterberg
35 Atterberg
44A Atterberg
46 Atterberg

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

95
100
105
110
115

SAJ FORM 1836-A
JUN 02

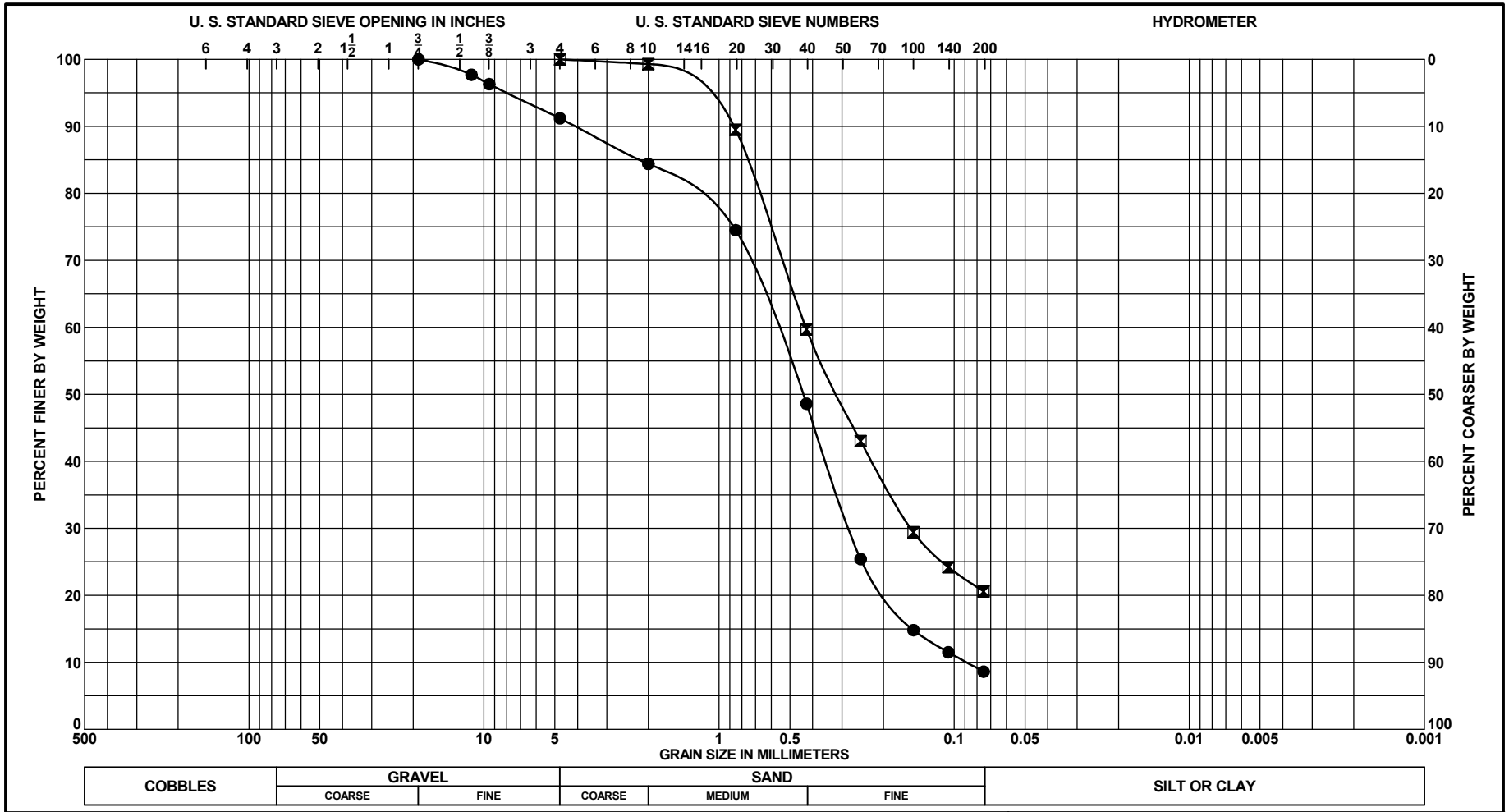


Sample No.		Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
●	2	2.0 to 4.0 Ft.	(SP-SM)									
⊠	5	8.0 to 10.0 Ft.	(SP)									
▲	8	14.0 to 16.0 Ft.	(SP)									
★	11	20.0 to 22.0 Ft.	(SP)									
⊙	14	26.0 to 28.0 Ft.	(SP)									

GRADATION CURVES

PROJECT	FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL
	Contract 3
BORING NO.	CB-RGA-20-62A
BORING ELEV.	4.4 Ft., PRVD02
DATE	5/29/2020

SAJ FORM 2087
JUN 02



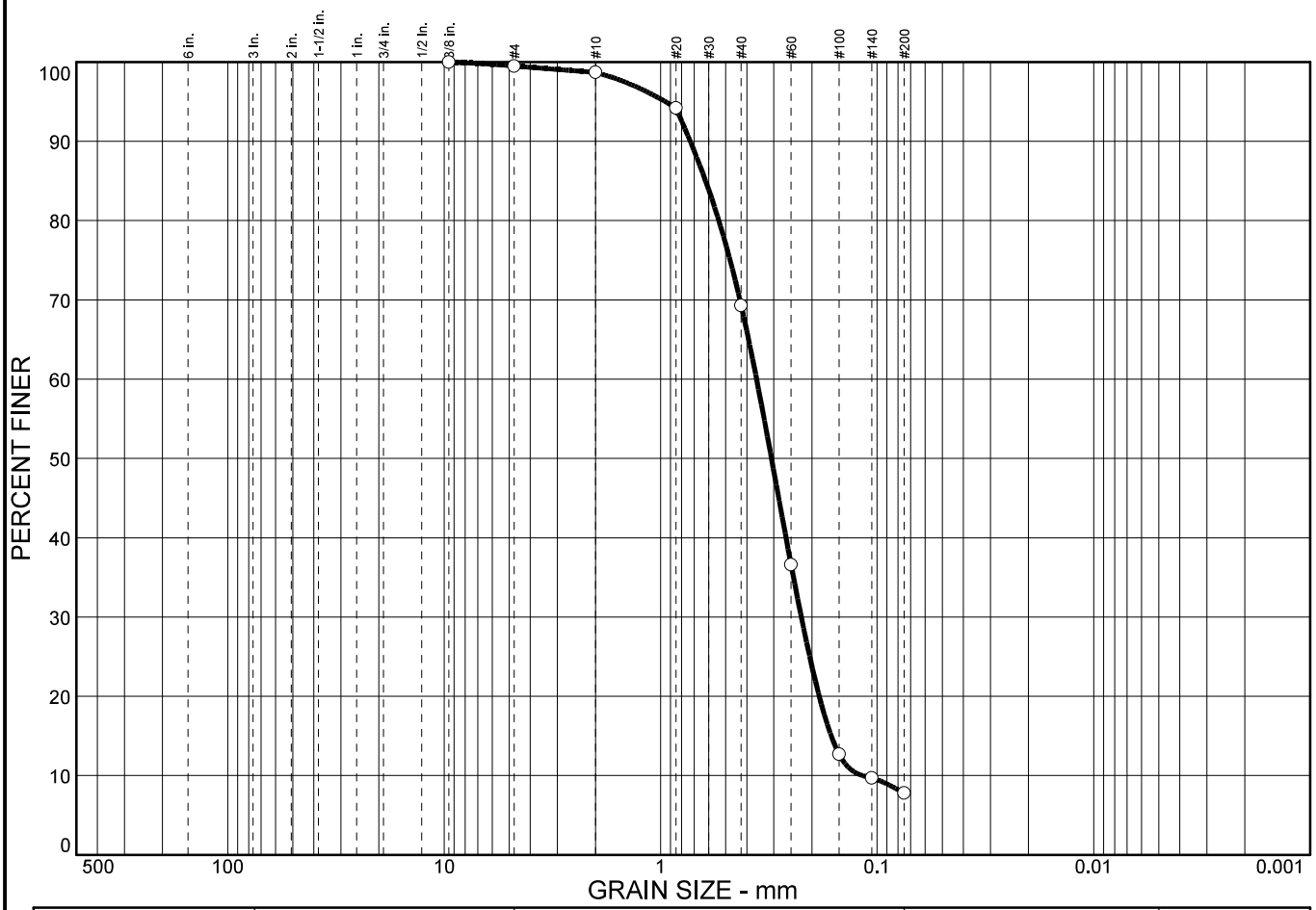
Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 17	32.0 to 34.0 Ft.	(SP-SM)									
⊠ 28	54.0 to 56.0 Ft.	(SM)									

PROJECT	FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL
	Contract 3
BORING NO.	CB-RGA-20-62A
BORING ELEV.	4.4 Ft., PRVD02
DATE	5/29/2020

GRADATION CURVES

SAJ FORM 2087
JUN 02

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.5	91.7	7.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.5		
#10	98.7		
#20	94.2		
#40	69.3		
#60	36.6		
#100	12.7		
#140	9.7		
#200	7.8		

* (no specification provided)

Material Description

Poorly graded sand with silt

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 0.620 D_{60}= 0.361 D_{50}= 0.308
D_{30}= 0.224 D_{15}= 0.163 D_{10}= 0.117
C_u= 3.09 C_c= 1.19

Classification

USCS= AASHTO=

Remarks

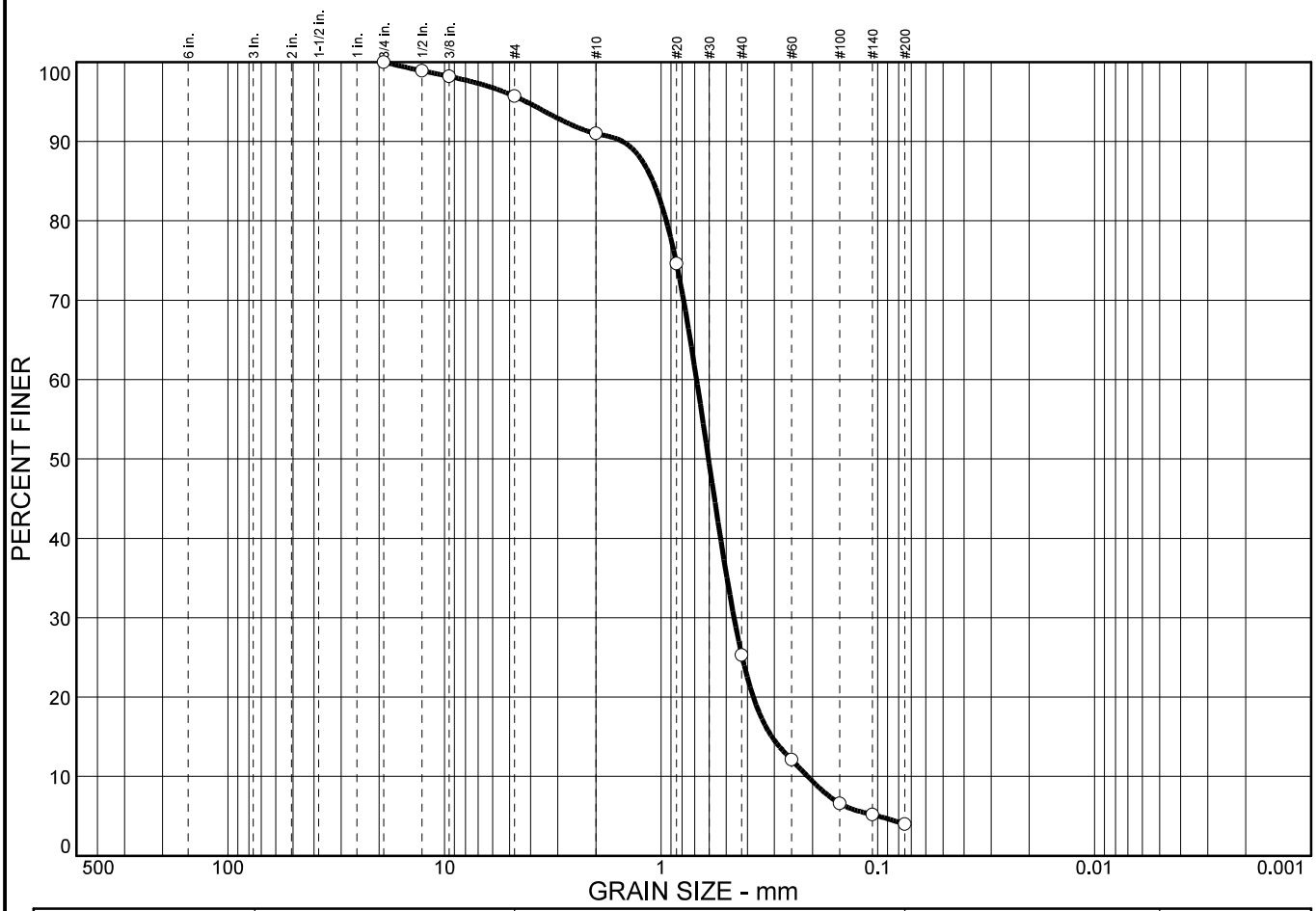
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.88

Sample No.: Sample 2 **Source of Sample:** CB-RGA-20-62 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 2-4'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.3	91.7	4.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	98.9		
.375 in.	98.2		
#4	95.7		
#10	91.0		
#20	74.6		
#40	25.3		
#60	12.1		
#100	6.6		
#140	5.2		
#200	4.0		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 1.09 D_{60}= 0.687 D_{50}= 0.605
D_{30}= 0.461 D_{15}= 0.308 D_{10}= 0.211
C_u= 3.26 C_c= 1.47

Classification

USCS= AASHTO=

Remarks

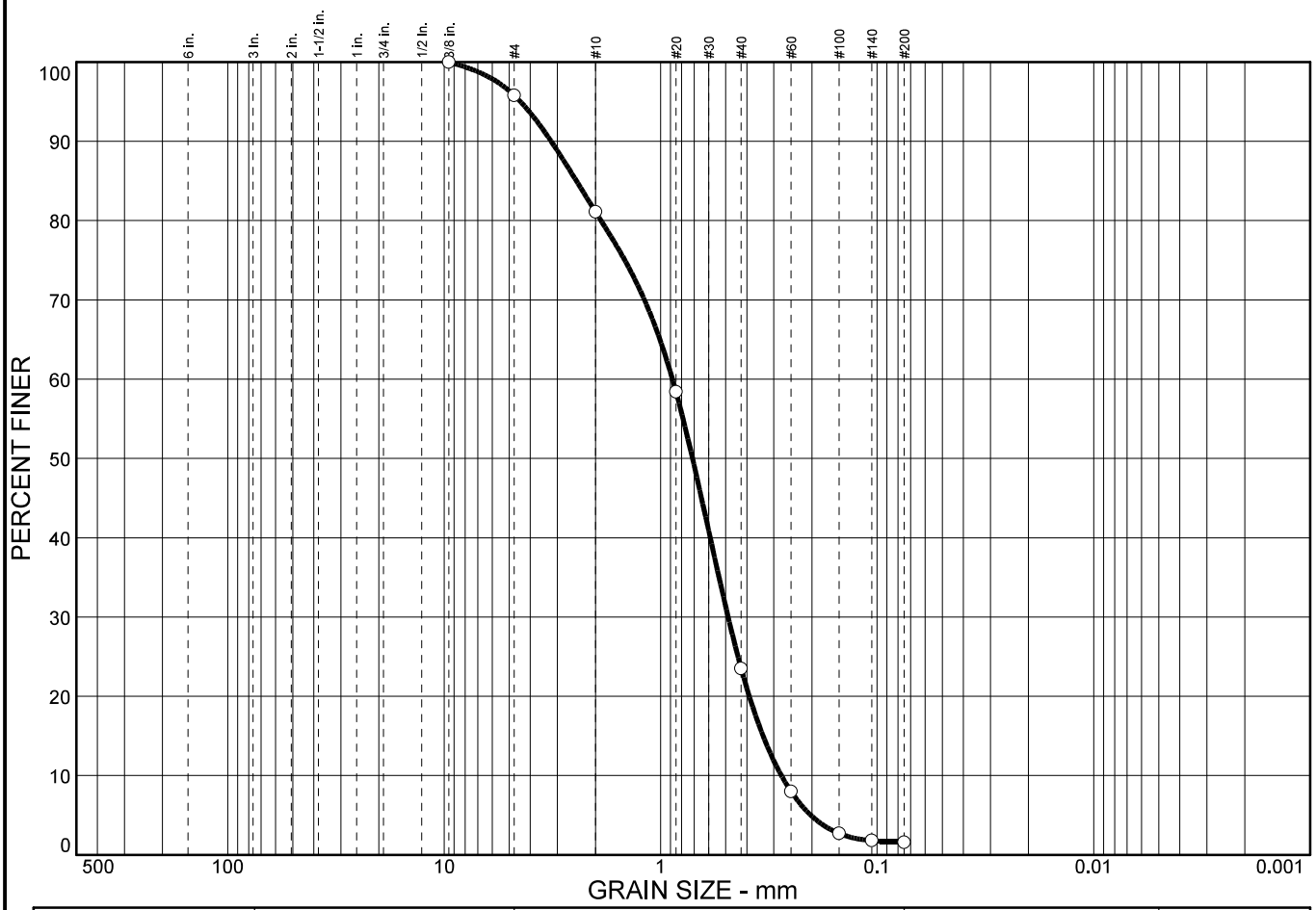
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=1.00

Sample No.: Sample 5 **Source of Sample:** CB-RGA-20-62 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 8-10'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.2	94.2	1.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	95.8		
#10	81.1		
#20	58.4		
#40	23.5		
#60	8.0		
#100	2.7		
#140	1.8		
#200	1.6		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 2.45 D_{60}= 0.883 D_{50}= 0.713
D_{30}= 0.488 D_{15}= 0.337 D_{10}= 0.277
C_u= 3.19 C_c= 0.97

Classification

USCS= AASHTO=

Remarks

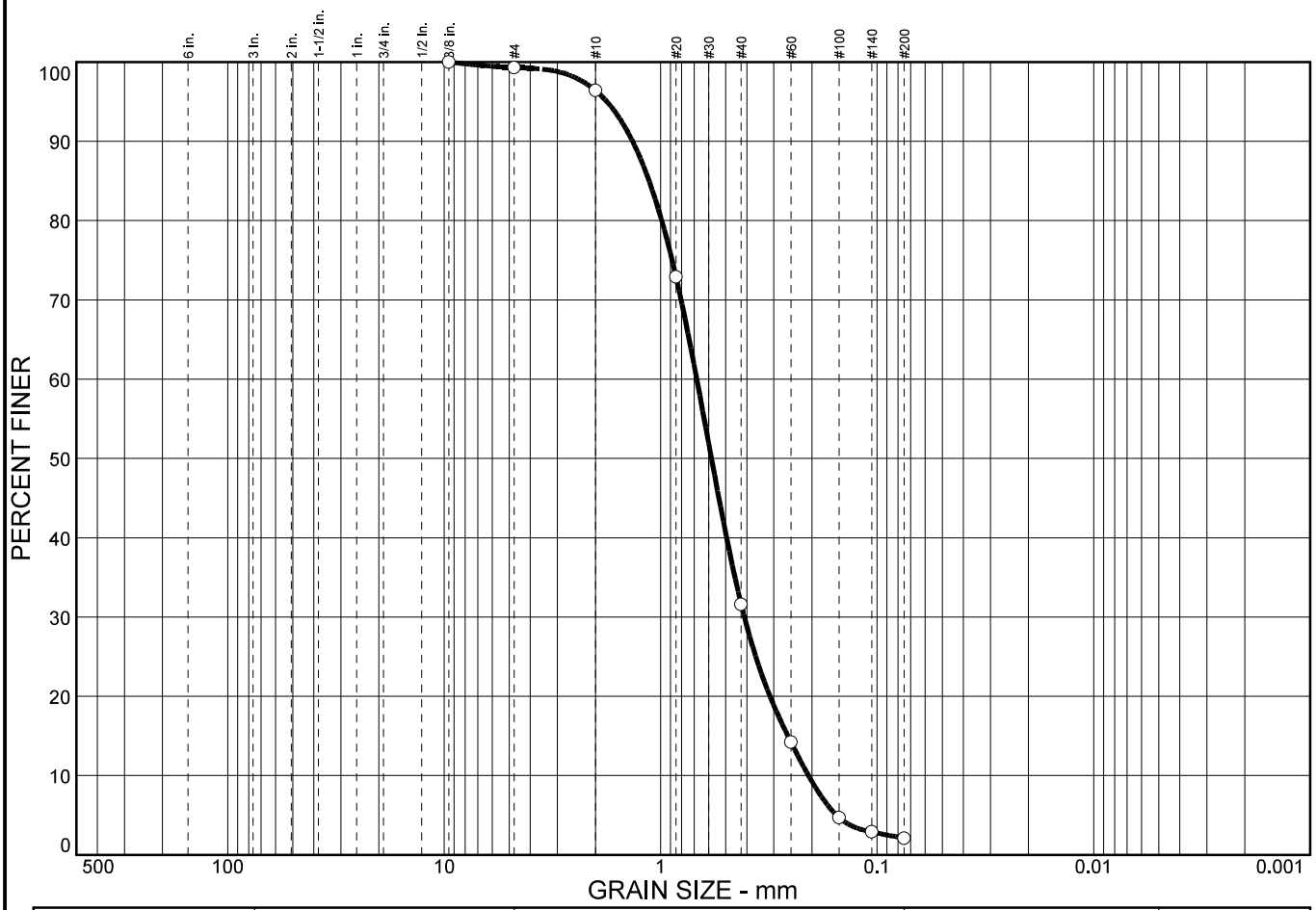
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=1.01

Sample No.: Sample 8 **Source of Sample:** CB-RGA-20-62 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 14-16'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.7	97.2	2.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.3		
#10	96.4		
#20	72.9		
#40	31.6		
#60	14.2		
#100	4.7		
#140	2.9		
#200	2.1		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 1.13 D_{60}= 0.682 D_{50}= 0.583
D_{30}= 0.411 D_{15}= 0.258 D_{10}= 0.208
C_u= 3.28 C_c= 1.19

Classification

USCS= AASHTO=

Remarks

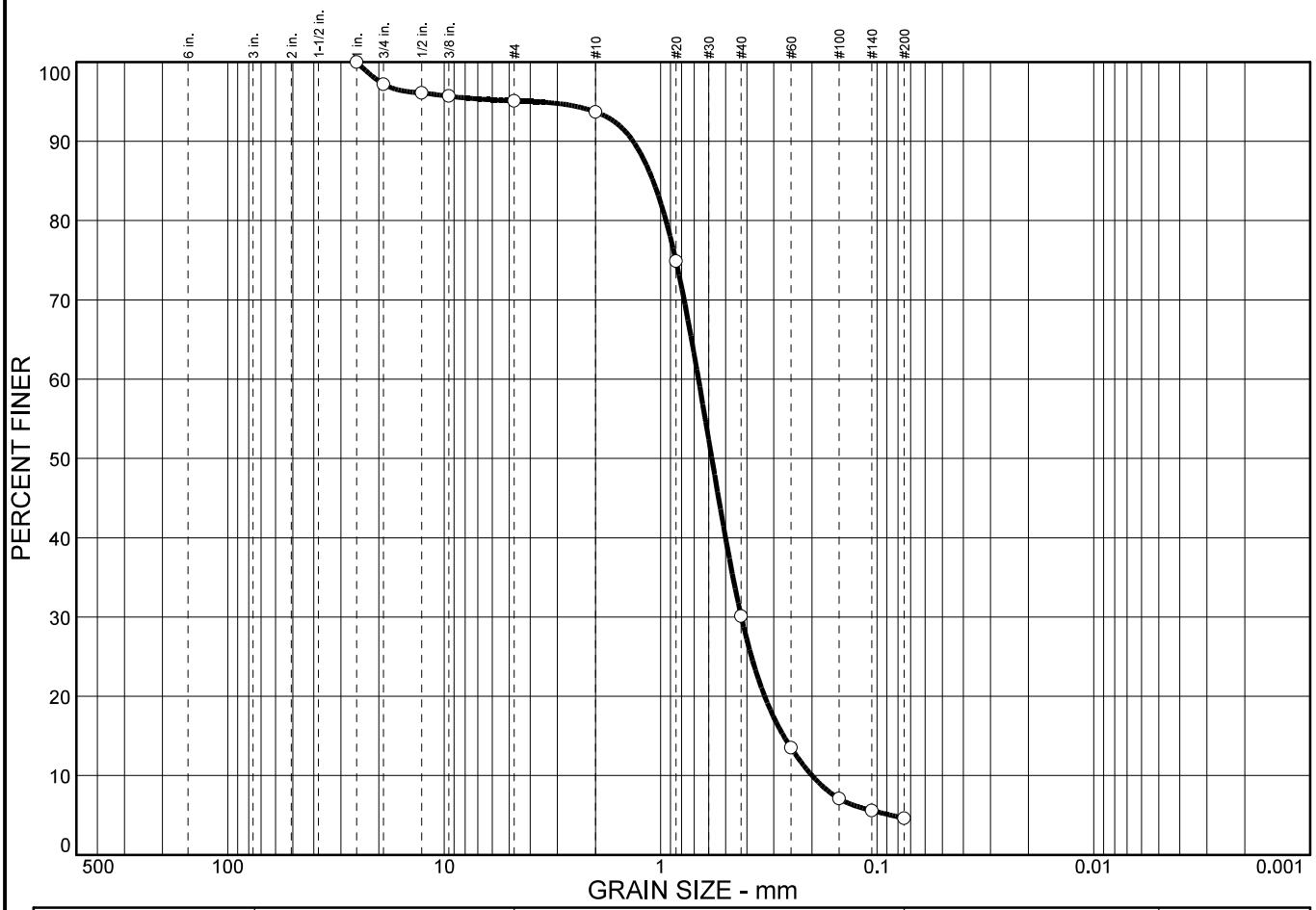
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.96

Sample No.: Sample 11 **Source of Sample:** CB-RGA-20-62 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 20-22'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.9	90.5	4.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
.75 in.	97.2		
.5 in.	96.1		
.375 in.	95.7		
#4	95.1		
#10	93.7		
#20	74.9		
#40	30.1		
#60	13.5		
#100	7.1		
#140	5.6		
#200	4.6		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 1.08 D_{60}= 0.670 D_{50}= 0.581
D_{30}= 0.424 D_{15}= 0.270 D_{10}= 0.200
C_u= 3.35 C_c= 1.34

Classification

USCS= AASHTO=

Remarks

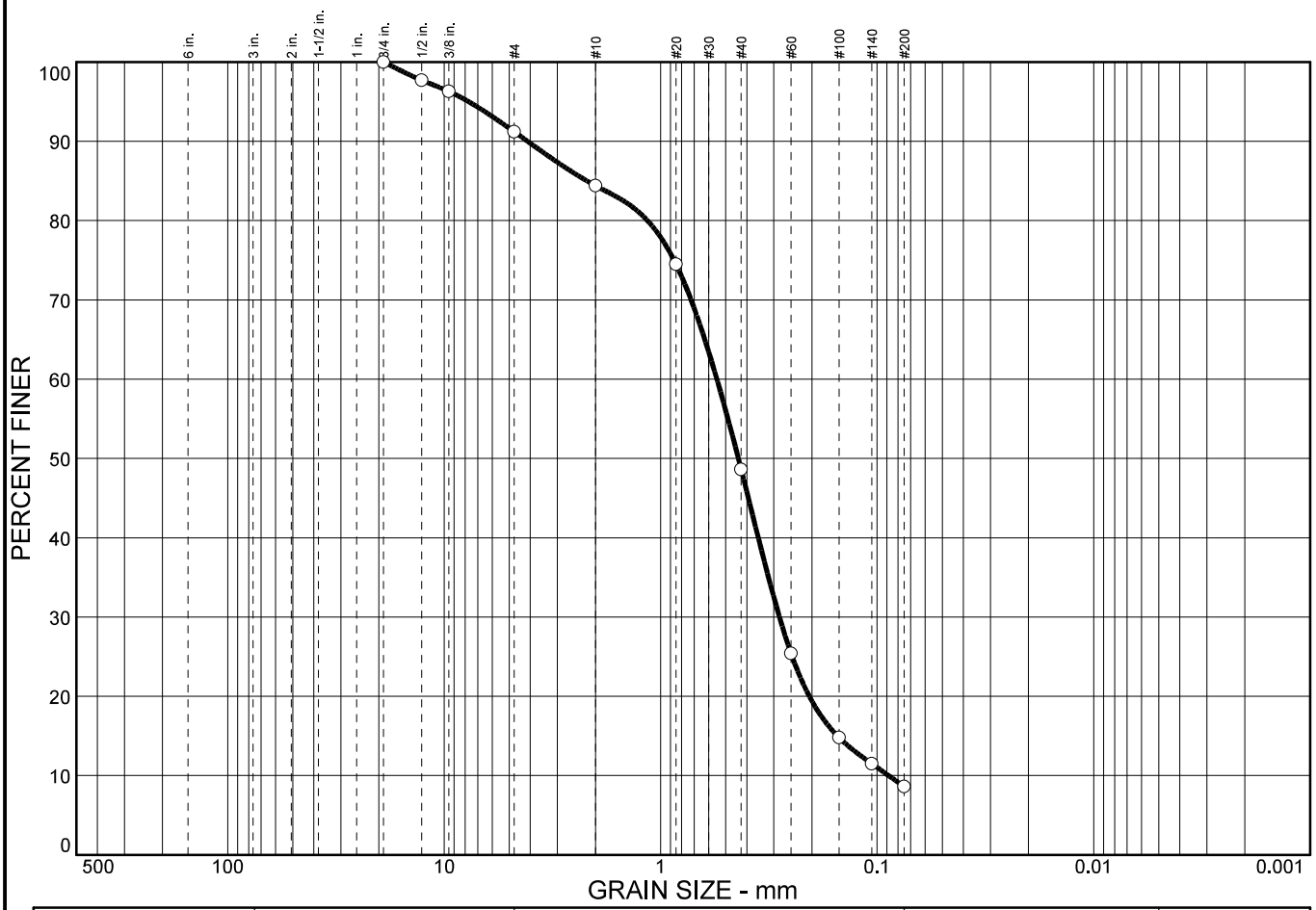
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=1.05

Sample No.: Sample 14 **Source of Sample:** CB-RGA-20-62 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 26-28'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	8.8	82.6	8.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.5 in.	97.7		
.375 in.	96.3		
#4	91.2		
#10	84.4		
#20	74.5		
#40	48.6		
#60	25.4		
#100	14.8		
#140	11.5		
#200	8.6		

* (no specification provided)

Material Description

Well-graded sand with silt

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 2.19 D_{60}= 0.551 D_{50}= 0.438
D_{30}= 0.283 D_{15}= 0.153 D_{10}= 0.0886
C_u= 6.21 C_c= 1.64

Classification

USCS= AASHTO=

Remarks

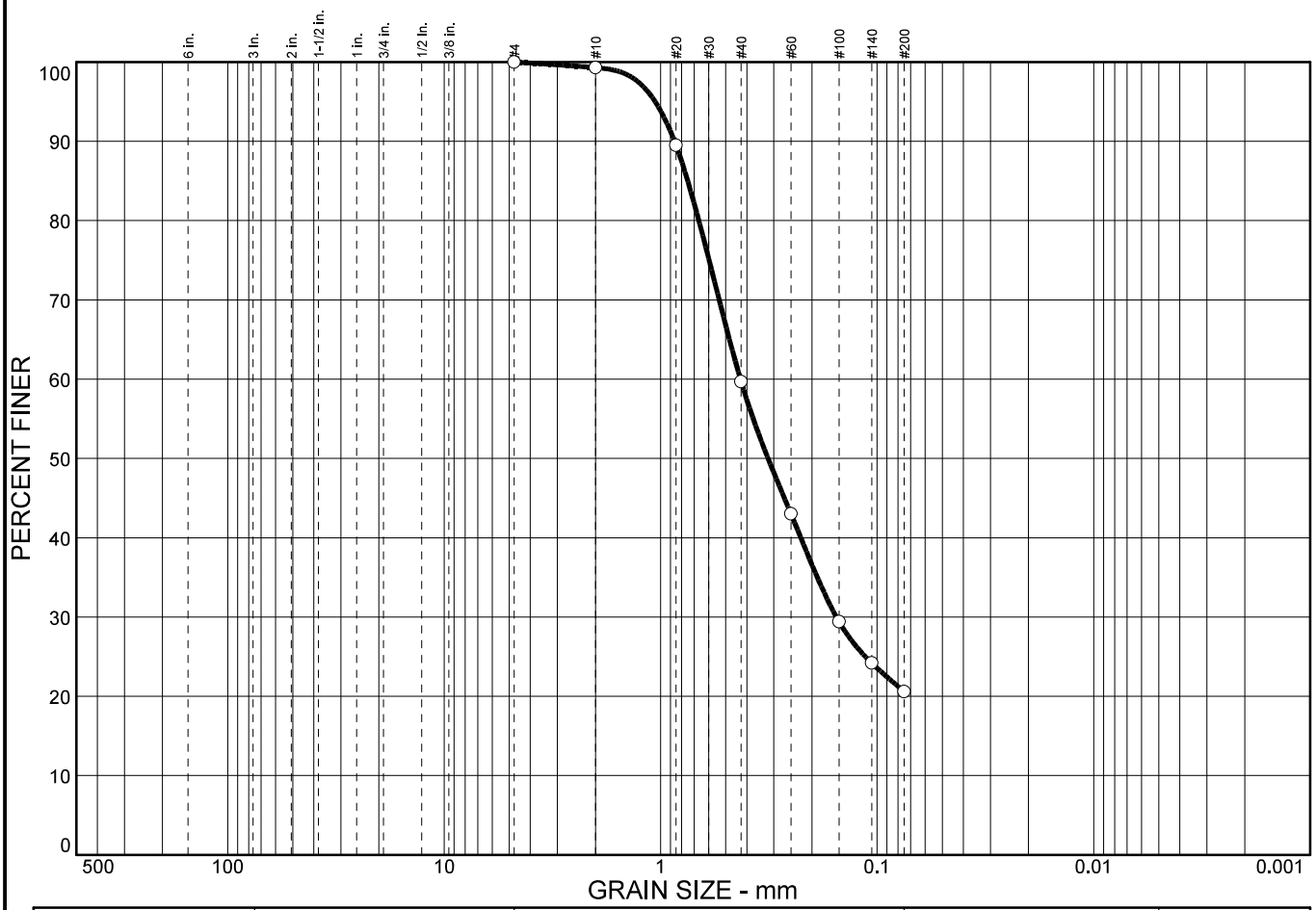
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.98

Sample No.: Sample 17 **Source of Sample:** CB-RGA-20-62 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 32-34'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	79.4	20.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.3		
#20	89.5		
#40	59.7		
#60	43.0		
#100	29.4		
#140	24.2		
#200	20.6		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 0.751 D_{60}= 0.428 D_{50}= 0.319
D_{30}= 0.154 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.71

Sample No.: Sample 28 **Source of Sample:** CB-RGA-20-62 **Date:** 5/29/20
Location: Arecibo, PR **Elev./Depth:** 54-56'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

DRILLING LOG	DIVISION South Atlantic	INSTALLATION St. Louis District	SHEET 1 OF 4 SHEETS

1. PROJECT	FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL Contract 3
2. BORING DESIGNATION	CB-RGA-20-63A
LOCATION COORDINATES	X = 170,682 Y = 270,731
3. DRILLING AGENCY	Challenge Engineering & Testing, Inc.
CONTRACTOR FILE NO.	2020D01
4. NAME OF DRILLER	Nicolas Andino - SUELOS, Inc.
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	N/A
7. DEPTH DRILLED INTO ROCK	N/A
8. TOTAL DEPTH OF BORING	54.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, PR/VI (U.S. Ft.)
HORIZONTAL	NAD83
VERTICAL	PRVD02
11. MANUFACTURER'S DESIGNATION OF DRILL	CME-75 (land-based)
	☒ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 28 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	0.4 Ft. measured after 24 hrs.
15. DATE BORING	STARTED 03-05-20 / COMPLETED 03-06-20
16. ELEVATION TOP OF BORING	7.4 Ft.
17. TOTAL RECOVERY FOR BORING	75 %
18. SIGNATURE AND TITLE OF INSPECTOR	V.J. Thompson III, P.E., Civil Engineer

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
7.4	0.0						7.4		
			SAND, poorly-graded, firm, mostly fine to medium-grained sand-sized sand, few shell up to 1/4", trace silt, dry, 5Y 6/3 pale olive (SP)	65	1		SPT Sampler	0 0 0 1	0
							5.4		
				90	2		SPT Sampler	2 3 4 4	7
							3.4		
				90	3		SPT Sampler	3 2 3 6	5
							1.4		
			At El. 1.4 Ft., few gravel up to 1-1/4", wet, 5Y 5/3 olive	80	4		SPT Sampler	3 5 7 9	12
							-0.6		
				75	5		SPT Sampler	2 6 5 7	11
-2.6	10.0						-2.6		
			SAND, poorly-graded with silt, firm, mostly fine to medium-grained sand-sized sand, few gravel up to 2", wet, 5Y 5/3 olive (SP-SM)	45	6		SPT Sampler	4 5 6 7	11
							-4.6		
				25	7		SPT Sampler	6 5 3 2	8
							-6.6		
				65	8		SPT Sampler	3 3	

0 5 10 15

(Continued)

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 2 OF 4 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,682 Y = 270,731	7.4 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				65	8		SPT Sampler -8.6	6 3	9
				80	9		SPT Sampler -10.6	2 2 3 3	5
			At El. -10.6 Ft., few gravel up to 3/4", few shell up to 1/4", wet	75	10		SPT Sampler -12.6	4 3 6 17	9
-13.6	21.0			100	11A		SPT Sampler -13.6	8 5	
-14.6	22.0	Moderately Weathered	LIMESTONE, non-fossiliferous, soft, moderately weathered, fine grained, 2.5Y 8/1 white	50	11B		SPT Sampler -14.6	6 12	
			LIMESTONE, hard	89	12		SPT Sampler -16.5	13 26 45 50/0.4'	71
							-16.6 Advanced Boring		
				90	13		SPT Sampler -18.6	38 28 30 50	58
			At El. -18.6 Ft., highly weathered, broken due to drill action, trace sand, clay	121	14		SPT Sampler -20.0	21 50 50/0.4'	100+
							-20.6 Advanced Boring		
			At El. -20.6 Ft., very hard	100	15		SPT Sampler -21.3	32 50/0.2'	
		Highly Weathered					Advanced Boring -22.6		
				100	16		SPT Sampler -23.1	50	
							Advanced Boring -24.6		
				100	17		SPT Sampler -25.0	50/0.4'	
							Advanced Boring -26.6		
				90	18		SPT Sampler -27.6	18 50	

SAJ FORM 1836-A
JUN 02

DRILLING LOG (Cont. Sheet)	INSTALLATION: St. Louis District	SHEET 3 OF 4 SHEETS

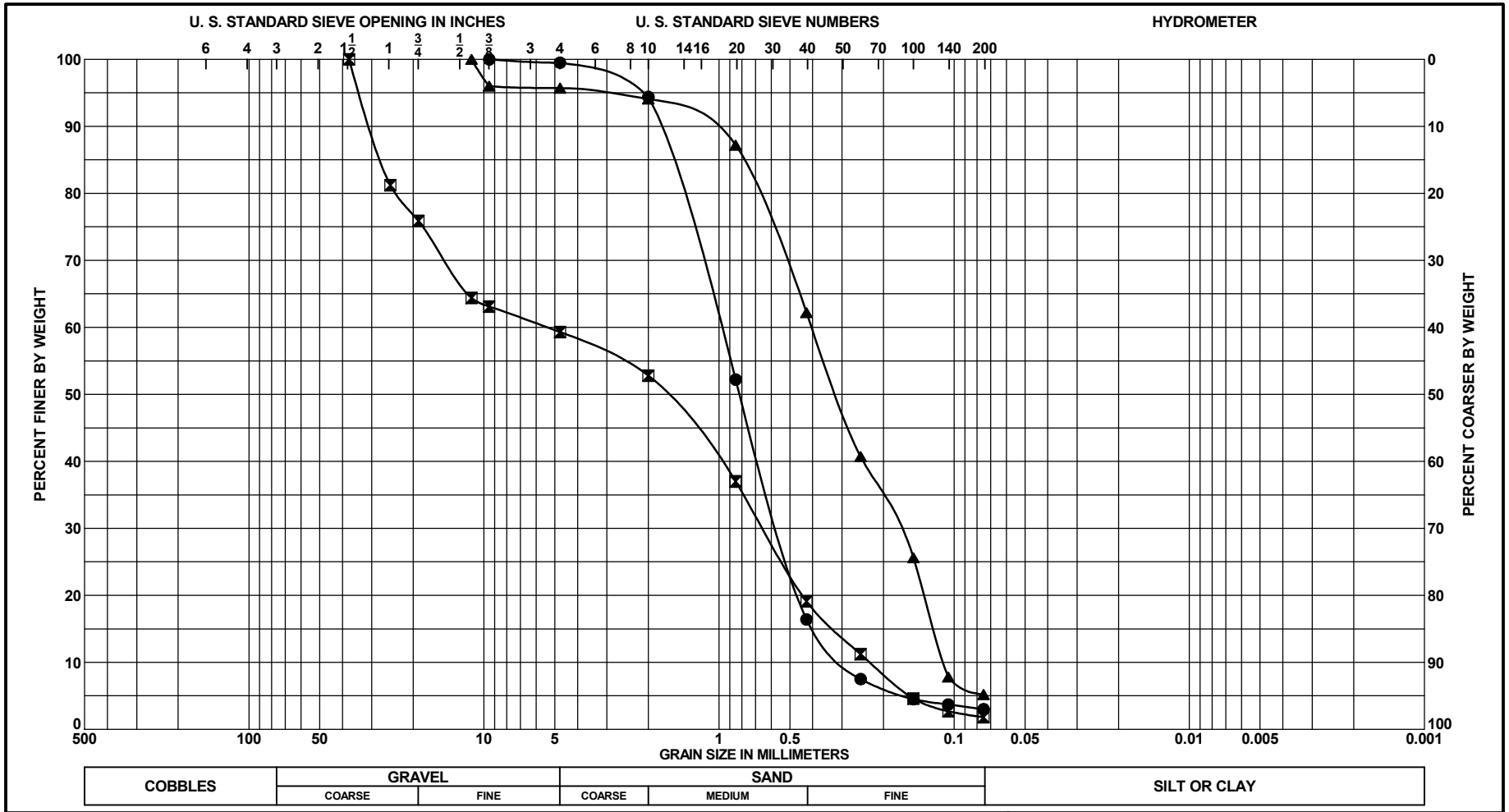
PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL	State Plane, PR/VI (U.S. Ft.)	NAD83	PRVD02

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 170,682 Y = 270,731	7.4 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			At El. -27.6 Ft., some fine sand		18		Advanced Boring -28.6		
				100	19		-29.0 SPT Sampler	50/0.4'	
							Advanced Boring -30.6		
				100	20		-31.4 SPT Sampler	48 50/0.3'	
							Advanced Boring -32.6		
				100	21		-32.8 SPT Sampler	50/0.2'	
							Advanced Boring -34.6		
				88	22		-36.3 SPT Sampler	15 24 32 50/0.2'	56
							-36.6 Advanced Boring		
		Highly Weathered		65	23		-38.6 SPT Sampler	42 40 22 23	62
				100	24		-39.4 SPT Sampler	44 50/0.3'	
							Advanced Boring -40.6		
				100	25		-41.1 SPT Sampler	50	
							Advanced Boring -42.6		
				100	26		-42.7 SPT Sampler	50/0.1'	
							Advanced Boring -44.6		
-46.6	54.0			10	27		SPT Sampler -46.6	50	
			NOTES:				140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).		

35 40 45 50 55

SAJ FORM 1836-A
JUN 02



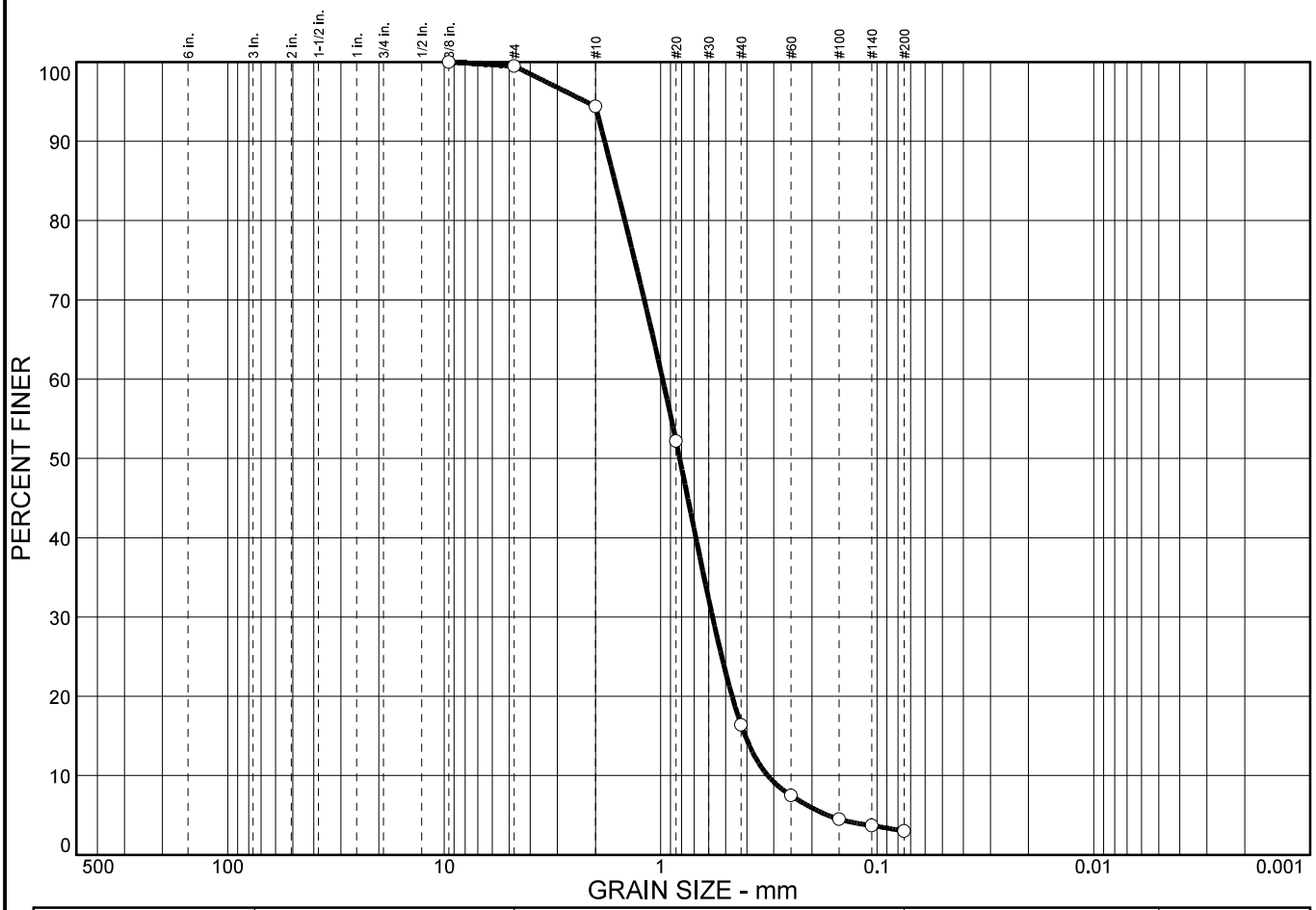
Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 4	6.0 to 8.0 Ft.	(SP)									
⊠ 7	12.0 to 14.0 Ft.	(SP)									
▲ 10	18.0 to 20.0 Ft.	(SP-SM)									

PROJECT	FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL
	Contract 3
BORING NO.	CB-RGA-20-63A
BORING ELEV.	7.4 Ft., PRVD02
DATE	5/25/2020

GRADATION CURVES

SAJ FORM 2087
JUN 02

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.5	96.5	3.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	99.5		
#10	94.4		
#20	52.2		
#40	16.4		
#60	7.5		
#100	4.5		
#140	3.7		
#200	3.0		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 1.63 D_{60}= 0.980 D_{50}= 0.818
D_{30}= 0.576 D_{15}= 0.406 D_{10}= 0.320
C_u= 3.06 C_c= 1.06

Classification

USCS= AASHTO=

Remarks

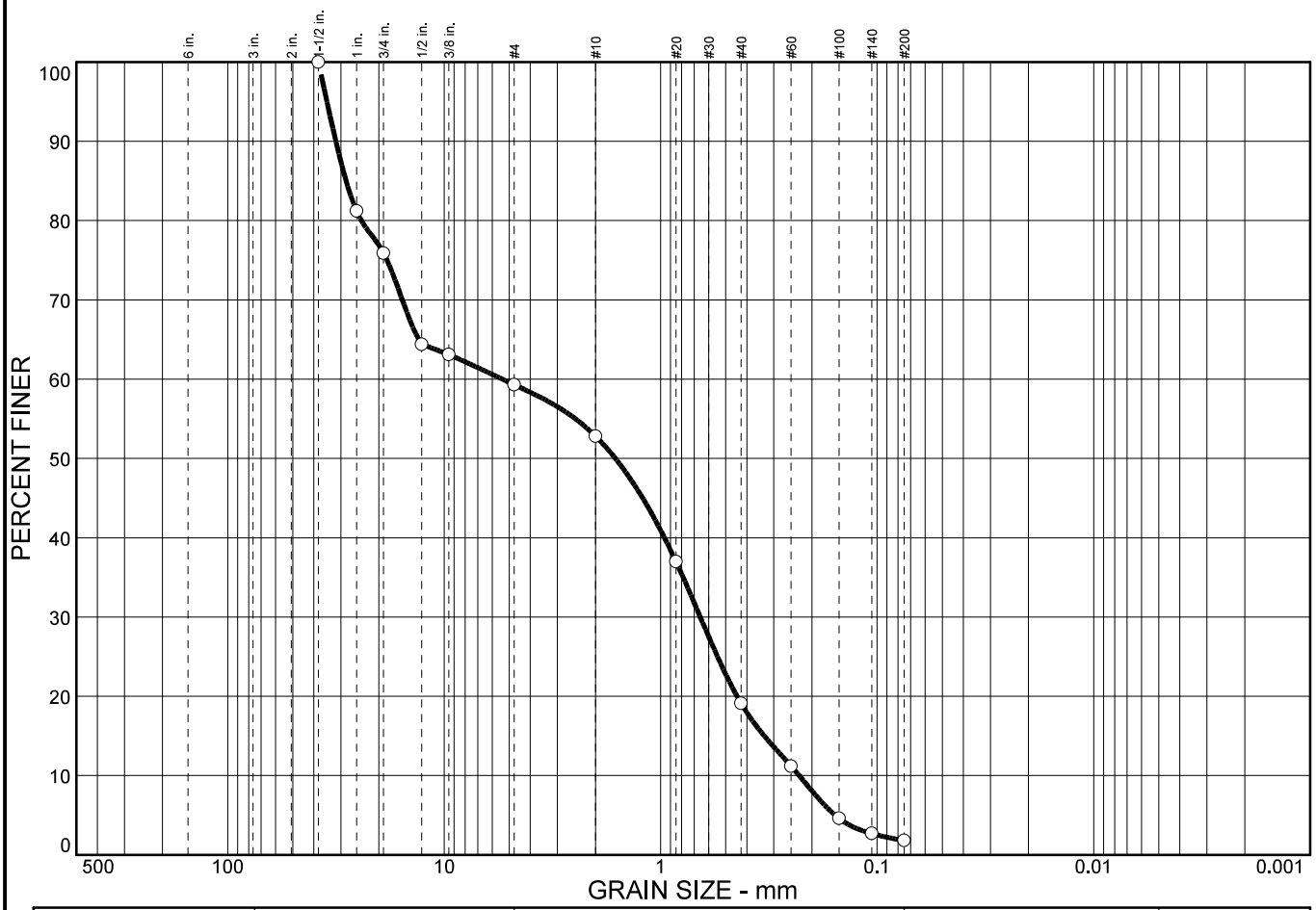
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.96

Sample No.: Sample 4 **Source of Sample:** CB-RGA-20-63 **Date:** 5/25/20
Location: Arecibo, PR **Elev./Depth:** 6-8'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	40.7	57.5	1.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	81.2		
.75 in.	75.9		
.5 in.	64.4		
.375 in.	63.1		
#4	59.3		
#10	52.8		
#20	37.0		
#40	19.1		
#60	11.2		
#100	4.6		
#140	2.7		
#200	1.8		

* (no specification provided)

Material Description

Poorly graded sand with gravel

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 28.4 D_{60}= 5.39 D_{50}= 1.62
D_{30}= 0.657 D_{15}= 0.332 D_{10}= 0.229
C_u= 23.48 C_c= 0.35

Classification

USCS= AASHTO=

Remarks

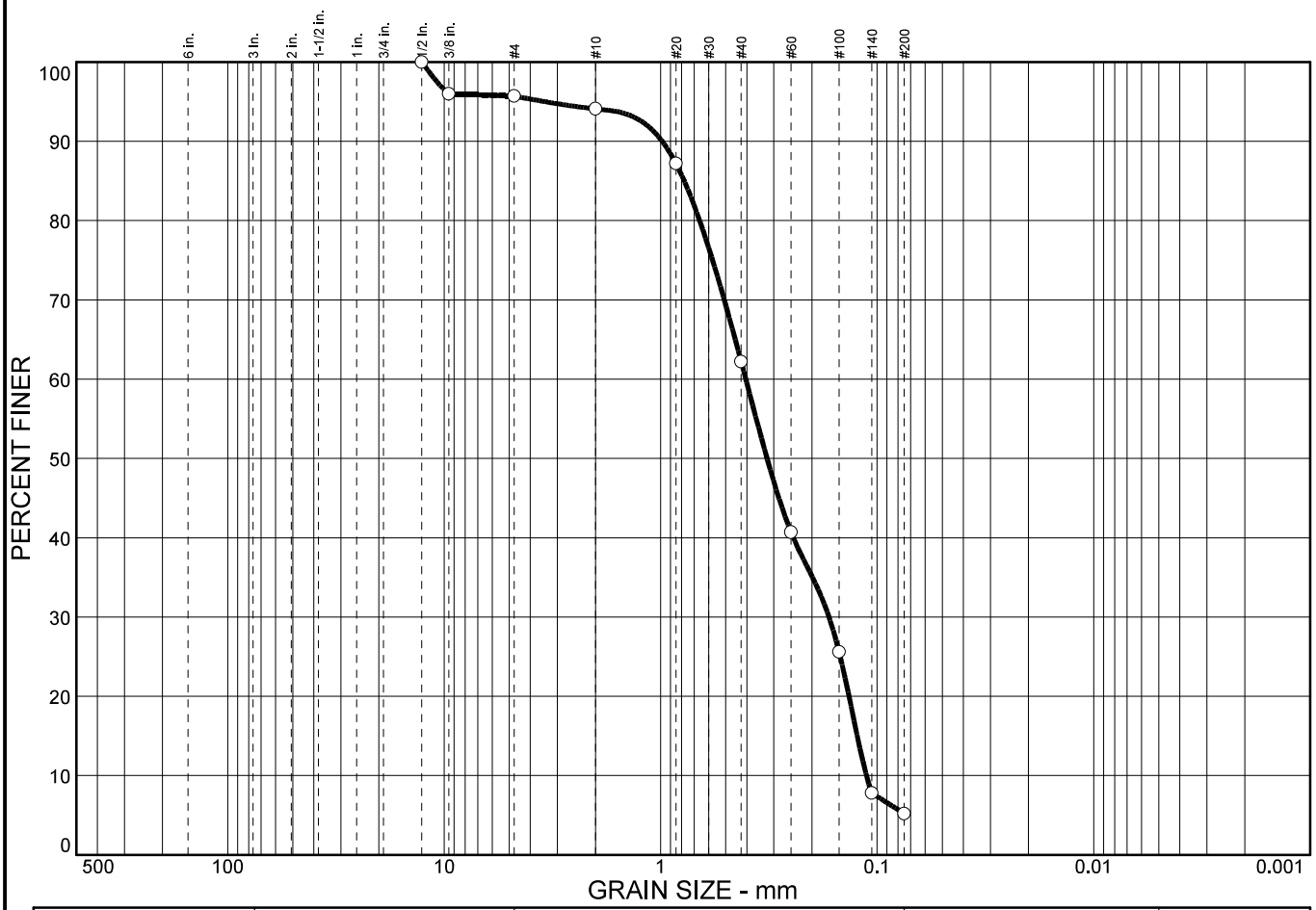
Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=1.97

Sample No.: Sample 7 **Source of Sample:** CB-RGA-20-63 **Date:** 5/25/20
Location: Arecibo, PR **Elev./Depth:** 12-14'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

Particle Size Distribution Report



% +75 MM	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.3	90.5	5.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5 in.	100.0		
.375 in.	96.0		
#4	95.7		
#10	94.1		
#20	87.2		
#40	62.2		
#60	40.7		
#100	25.6		
#140	7.8		
#200	5.2		

* (no specification provided)

Material Description

Poorly graded sand with silt

Atterberg Limits

PL= - LL= - PI= -

Coefficients

D_{85}= 0.778 D_{60}= 0.405 D_{50}= 0.323
D_{30}= 0.167 D_{15}= 0.124 D_{10}= 0.112
C_u= 3.61 C_c= 0.61

Classification

USCS= AASHTO=

Remarks

Tested by: T. Melendez
Checked by: Javier E. Osorio, MECE, PE
F.M.=0.83

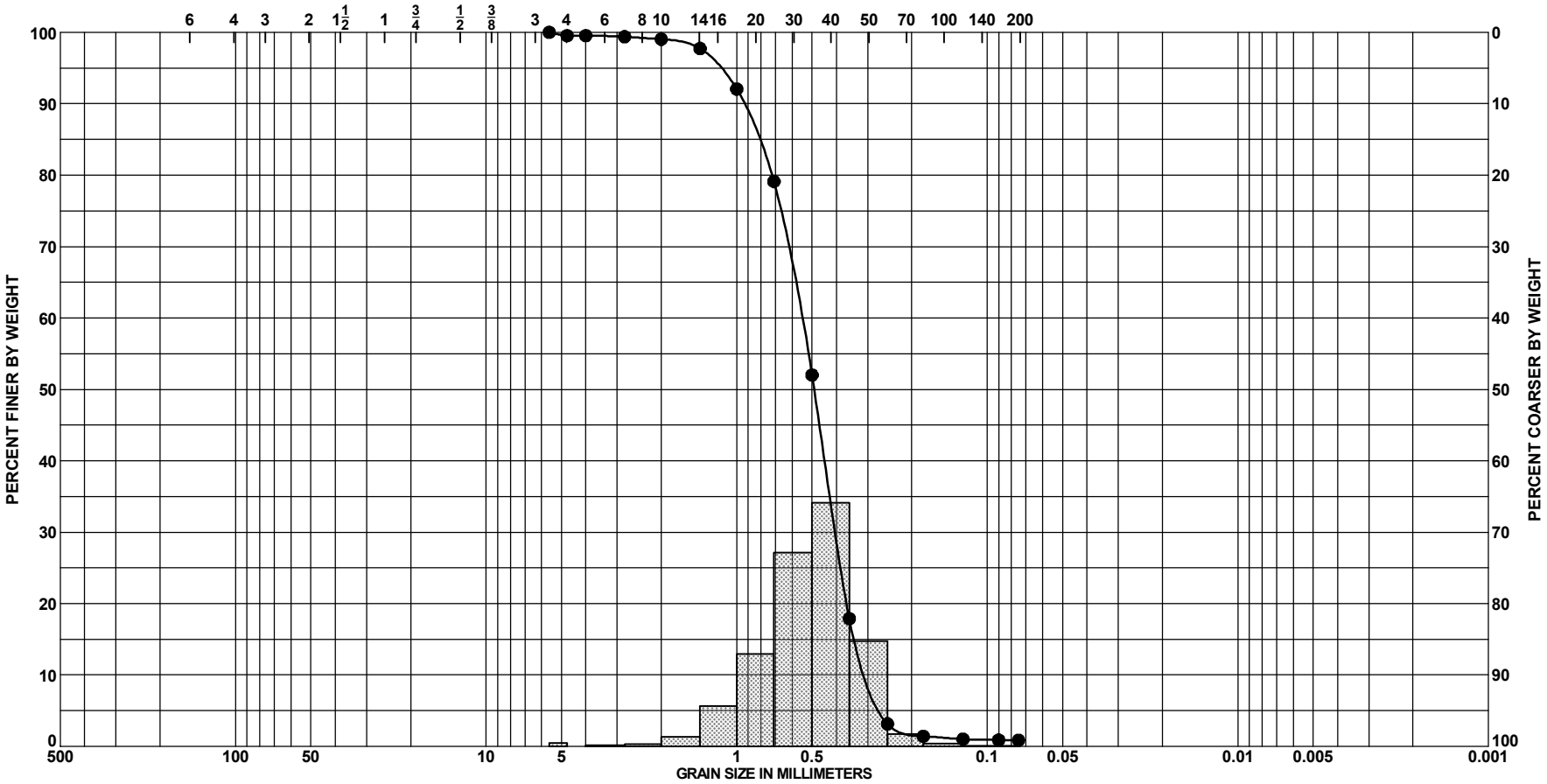
Sample No.: Sample 10 **Source of Sample:** CB-RGA-20-63 **Date:** 5/25/20
Location: Arecibo, PR **Elev./Depth:** 18-20'

JACA & SIERRA TESTING LABORATORIES
San Juan, Puerto Rico

Client: Challenge Engineering and Testing, Inc.
Project: Rio Grande de Arecibo Flood Control Project-Arecibo, PR
Project No: **Figure**

9.2.3 RINCON - UPLAND SAND MINE

- Gradation Graphs
- Granularmetric Reports

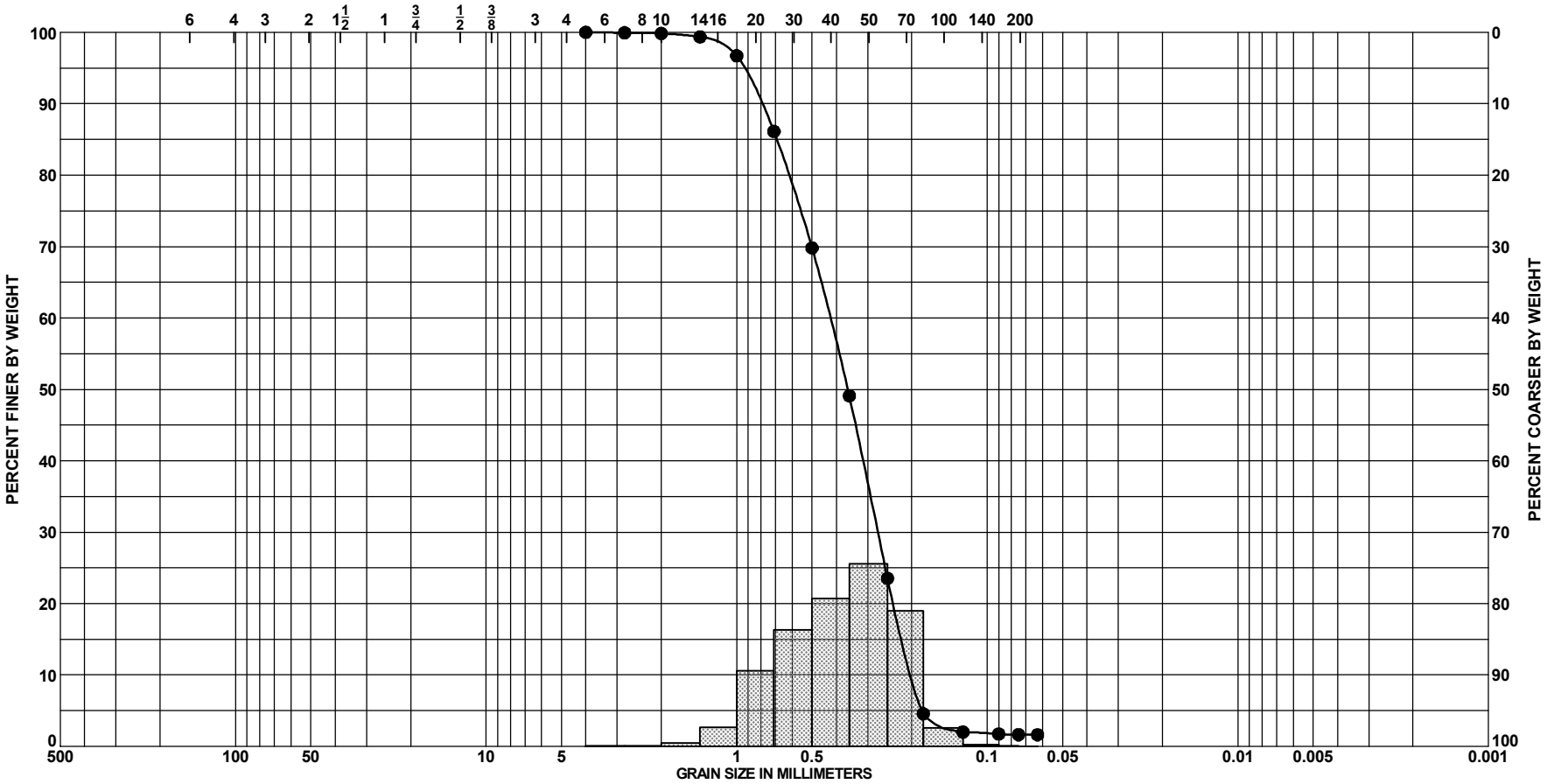


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● M-1	0.0 to 0.0 Ft.	SAND, poorly-graded, mostly fine to	10YR 4/2	25	19						
		medium-grained sand-sized quartz,									
		little medium-grained sand-sized shell,									
		little medium-grained sand-sized									
		limestone, trace silt, dark grayish									
		brown (SS)									

PROJECT	Puerto Rico CSRM Study
	Upland Sand Mine
BORING NO.	RINCON M-1
BORING ELEV.	Not Determined
DATE	1/13/2020

GRADATION CURVES

SAJ FORM 2087
JUN 02

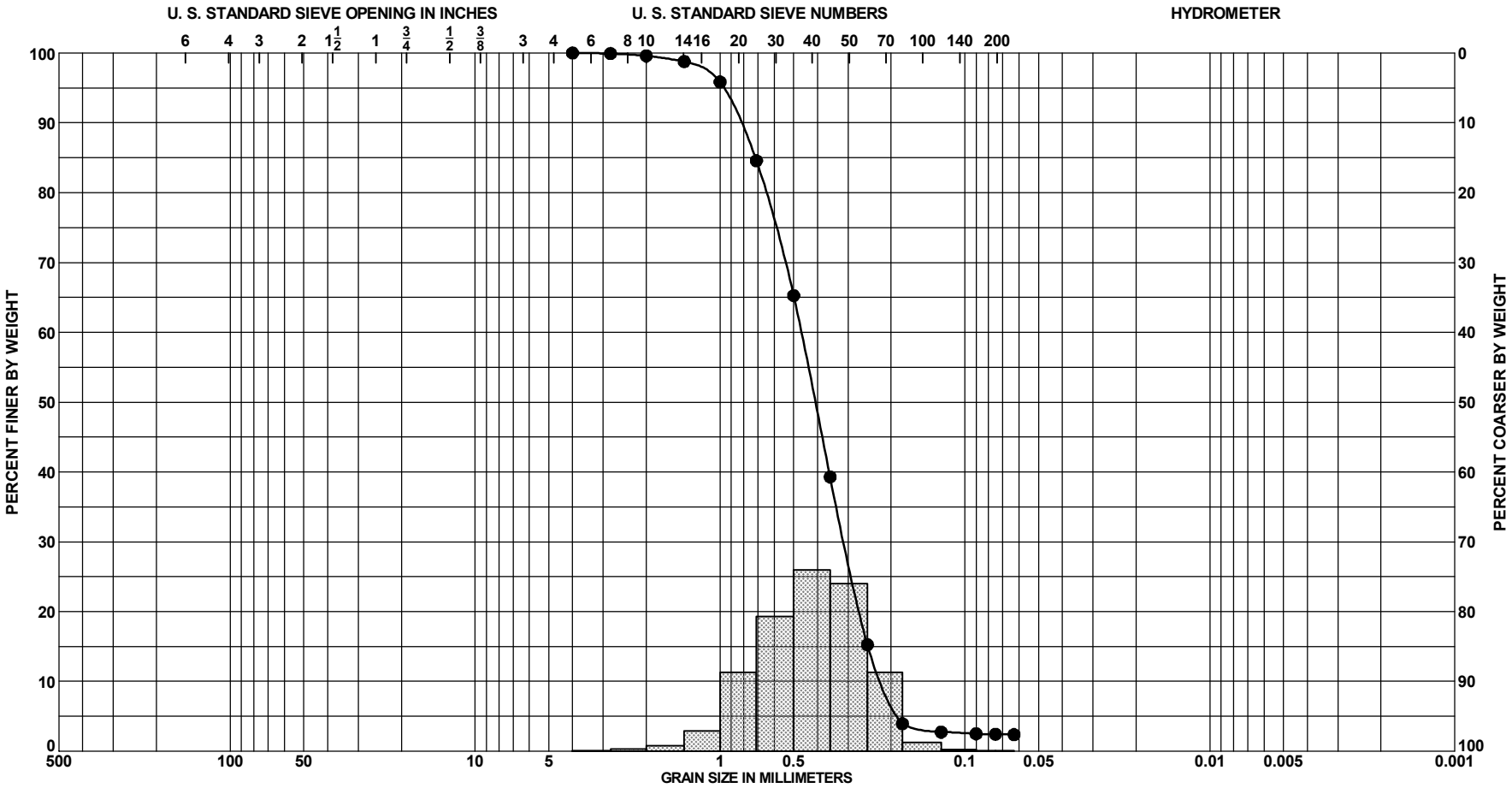


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● M-2	0.0 to 0.0 Ft.	SAND, poorly-graded, mostly	10YR 5/1	15							
		fine-grained sand-sized quartz, little									
		medium-grained sand-sized shell, little									
		medium-grained sand-sized									
		limestone, trace silt, gray (SP)									

PROJECT	Puerto Rico CSRM Study
	Upland Sand Mine
BORING NO.	RINCON M-2
BORING ELEV.	Not Determined
DATE	1/13/2020

GRADATION CURVES

SAJ FORM 2087
JUN 02

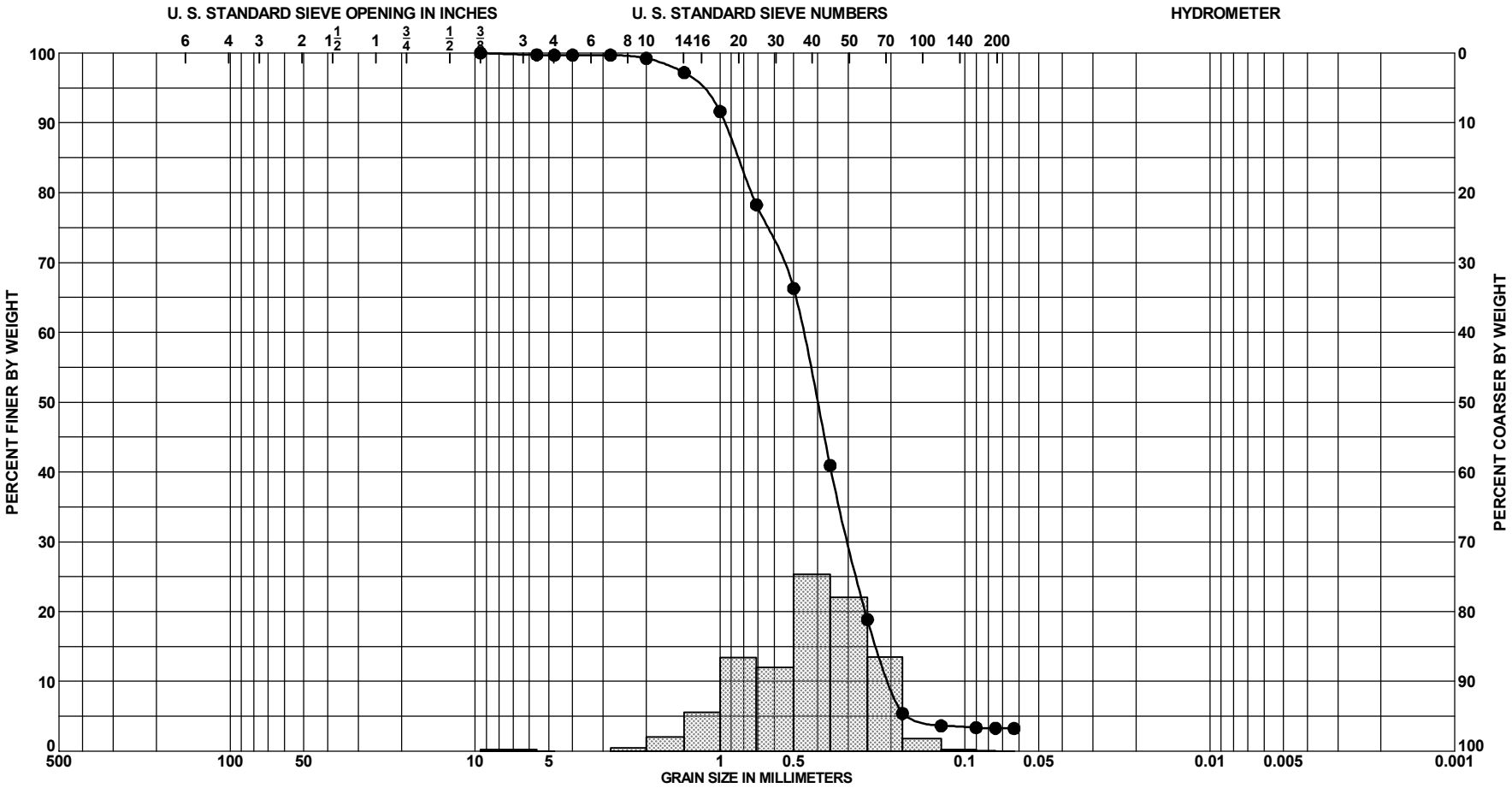


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	0.0 to 0.0 Ft.	SAND, poorly-graded, mostly fine to	10YR 5/6	2	21						
		medium-grained sand-sized rock, few									
		fine-grained sand-sized quartz, trace									
		silt, trace shell, yellowish brown (SP)									

PROJECT	Puerto Rico CSRM Study
	Private Property
BORING NO.	RINCON 1
BORING ELEV.	Not Determined
DATE	12/4/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

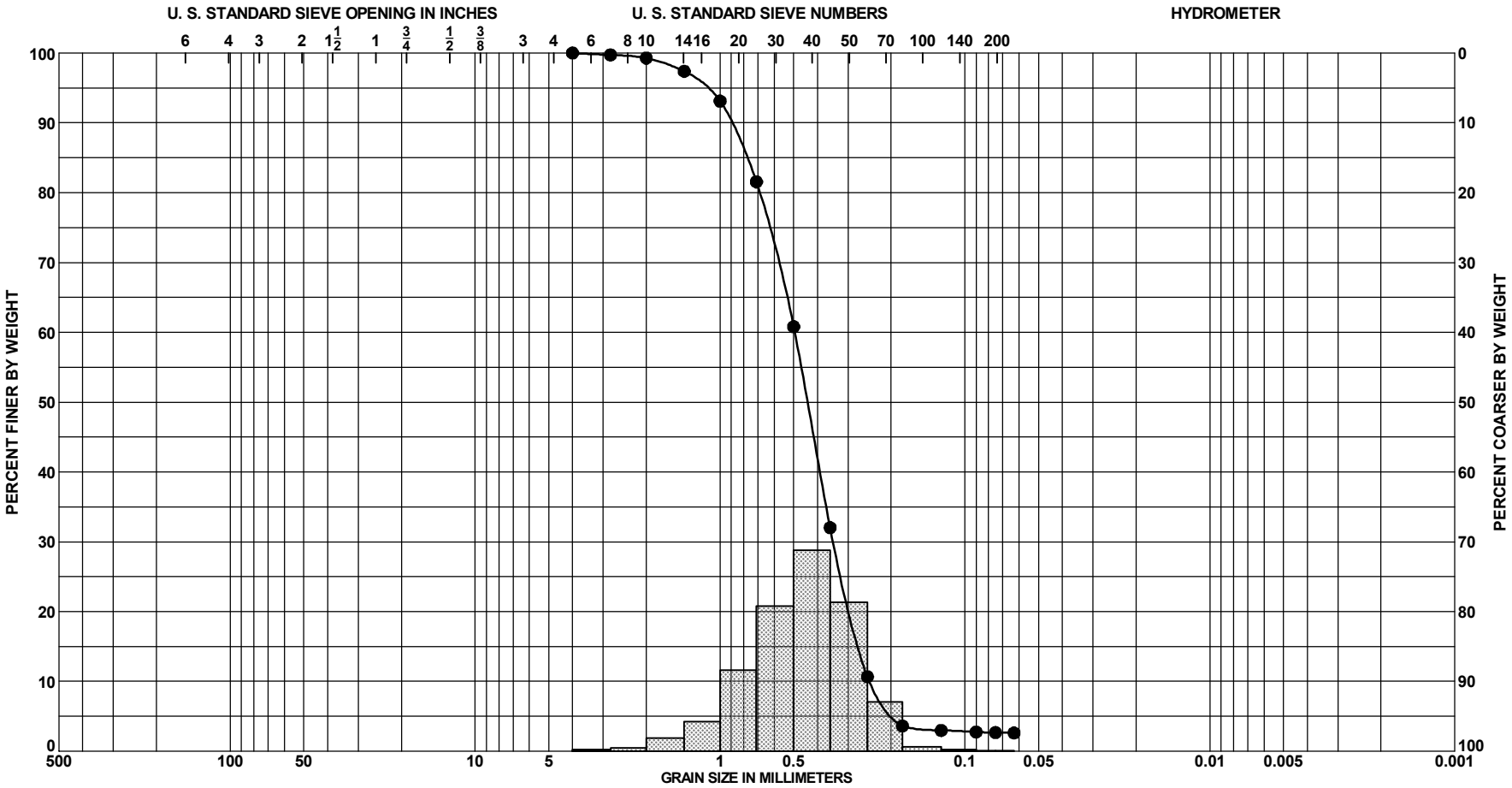


Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	0.0 to 0.0 Ft.	SAND, poorly-graded, mostly fine to	10YR 6/3	12							
		medium-grained sand-sized rock, few									
		medium-grained sand-sized shell, few									
		fine-grained sand-sized quartz, trace									
		silt, pale brown (SP)									

PROJECT	Puerto Rico CSRM Study
	Private Property
BORING NO.	RINCON 2
BORING ELEV.	Not Determined
DATE	12/4/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	0.0 to 0.0 Ft.	SAND, poorly-graded, mostly fine to	10YR 5/4	9	31						
		medium-grained sand-sized limerock,									
		few medium-grained sand-sized shell,									
		few fine-grained sand-sized quartz,									
		trace silt, yellowish brown (SP)									

PROJECT	Puerto Rico CSRM Study
	Private Property
BORING NO.	RINCON 3
BORING ELEV.	Not Determined
DATE	12/4/2019

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: Upland Sand Mine Samples
Puerto Rico CSRM Study

Sample Name: Rincon M-1 @ 0.01 ft

Analysis Date: 1/13/2020

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
376,711	830,547	State Plane, PR/VI (U.S. Ft.)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 4/2	#200 - 0.85		19.20	25.3

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#3.5	-2.50	5.60	0.00	0.00
#4	-2.25	4.75	0.46	0.46
#5	-2.00	4.00	0.00	0.46
#7	-1.50	2.80	0.15	0.61
#10	-1.00	2.00	0.35	0.96
#14	-0.50	1.40	1.30	2.26
#18	0.00	1.00	5.68	7.93
#25	0.50	0.71	12.95	20.89
#35	1.00	0.50	27.11	47.99
#45	1.50	0.36	34.12	82.11
#60	2.00	0.25	14.74	96.85
#80	2.50	0.18	1.74	98.59
#120	3.00	0.13	0.40	99.00
#170	3.50	0.09	0.11	99.11
#200	3.75	0.08	0.05	99.15

SAND, poorly-graded, mostly fine to medium-grained sand-sized quartz, little medium-grained sand-sized shell, little medium-grained sand-sized limestone, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
1.94	1.56	1.40	1.03	0.58	0.31	-0.26

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	0.94	0.52	1.03	0.49	0.67	-0.87	5.81

GRANULARMETRIC REPORT % PUERTO RICO RINCON_CONCRETOS-MINE-COMBINED.GPJ CESAJ 20171021.GDT 8/31/20

Granularmetric Report

Project Name: Upland Sand Mine Samples
Puerto Rico CSRM Study

Sample Name: Rincon M-2 @ 0.02 ft

Analysis Date: 1/13/2020

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
377,560	830,856	State Plane, PR/VI (U.S. Ft.)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 5/1	#200 - 1.63 #230 - 1.62			14.7

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.05	0.05
#10	-1.00	2.00	0.10	0.15
#14	-0.50	1.40	0.48	0.64
#18	0.00	1.00	2.64	3.28
#25	0.50	0.71	10.60	13.88
#35	1.00	0.50	16.32	30.20
#45	1.50	0.36	20.71	50.91
#60	2.00	0.25	25.56	76.47
#80	2.50	0.18	18.96	95.43
#120	3.00	0.13	2.57	98.00
#170	3.50	0.09	0.27	98.27
#200	3.75	0.08	0.10	98.37
#230	4.00	0.06	0.02	98.38

SAND, poorly-graded, mostly fine-grained sand-sized quartz, little medium-grained sand-sized shell, little medium-grained sand-sized limestone, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.49	2.20	1.97	1.48	0.84	0.57	0.08

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.38	0.38	1.48	0.36	0.75	-0.36	2.76

GRANULARMETRIC REPORT % PUERTO RICO RINCON_CONCRETOS-MINE-COMBINED.GPJ CESAJ 20171021.GDT 8/31/20

Granularmetric Report

Project Name: Upland Sand Mine Samples
Puerto Rico CSRM Study

Sample Name: Rincon 1 @ 1 ft

Analysis Date: 12/4/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
376,195	831,387	State Plane, PR/VI (U.S. Ft.)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 5/6	#200 - 2.43 #230 - 2.38		20.80	1.8

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.08	0.08
#10	-1.00	2.00	0.33	0.41
#14	-0.50	1.40	0.81	1.22
#18	0.00	1.00	2.92	4.14
#25	0.50	0.71	11.28	15.42
#35	1.00	0.50	19.32	34.75
#45	1.50	0.36	25.97	60.72
#60	2.00	0.25	24.03	84.75
#80	2.50	0.18	11.30	96.05
#120	3.00	0.13	1.22	97.27
#170	3.50	0.09	0.24	97.51
#200	3.75	0.08	0.06	97.57
#230	4.00	0.06	0.05	97.62

SAND, poorly-graded, mostly fine to medium-grained sand-sized rock, few fine-grained sand-sized quartz, trace silt, trace shell

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.45	1.98	1.80	1.29	0.75	0.51	0.04

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.23	0.43	1.29	0.41	0.72	-0.33	3.29

GRANULARMETRIC REPORT % PUERTO RICO RINCON_CONCRETOS-MINE-COMBINED.GPJ CESAJ 20171021.GDT 8/31/20

Granularmetric Report

Project Name: Upland Sand Mine Samples
Puerto Rico CSRM Study

Sample Name: Rincon 2 @ 1 ft

Analysis Date: 12/4/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
376,194	831,185	State Plane, PR/VI (U.S. Ft.)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 6/3	#200 - 3.28 #230 - 3.25			11.9

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.26	0.26
#4	-2.25	4.75	0.03	0.29
#5	-2.00	4.00	0.00	0.29
#7	-1.50	2.80	0.00	0.29
#10	-1.00	2.00	0.47	0.77
#14	-0.50	1.40	2.04	2.81
#18	0.00	1.00	5.56	8.37
#25	0.50	0.71	13.38	21.75
#35	1.00	0.50	11.97	33.72
#45	1.50	0.36	25.36	59.09
#60	2.00	0.25	22.06	81.14
#80	2.50	0.18	13.46	94.60
#120	3.00	0.13	1.77	96.37
#170	3.50	0.09	0.26	96.63
#200	3.75	0.08	0.09	96.72
#230	4.00	0.06	0.03	96.75

SAND, poorly-graded, mostly fine to medium-grained sand-sized rock, few medium-grained sand-sized shell, few fine-grained sand-sized quartz, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.61	2.11	1.86	1.32	0.64	0.29	-0.30

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.19	0.44	1.32	0.40	0.85	-0.65	3.96

GRANULARMETRIC REPORT % PUERTO RICO RINCON_CONCRETOS-MINE-COMBINED.GPJ CESAJ 20171021.GDT 8/31/20

Granularmetric Report

Project Name: Upland Sand Mine Samples
Puerto Rico CSRM Study

Sample Name: Rincon 3 @ 1 ft

Analysis Date: 12/4/2019

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
376,193	830,983	State Plane, PR/VI (U.S. Ft.)	

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP	10YR 5/4	#200 - 2.67 #230 - 2.62		31.00	8.5

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.27	0.27
#10	-1.00	2.00	0.46	0.72
#14	-0.50	1.40	1.90	2.62
#18	0.00	1.00	4.26	6.88
#25	0.50	0.71	11.57	18.45
#35	1.00	0.50	20.75	39.20
#45	1.50	0.36	28.77	67.97
#60	2.00	0.25	21.37	89.34
#80	2.50	0.18	7.05	96.39
#120	3.00	0.13	0.64	97.03
#170	3.50	0.09	0.22	97.26
#200	3.75	0.08	0.07	97.33
#230	4.00	0.06	0.05	97.38

SAND, poorly-graded, mostly fine to medium-grained sand-sized limerock, few medium-grained sand-sized shell, few fine-grained sand-sized quartz, trace silt

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.40	1.88	1.66	1.19	0.66	0.39	-0.22

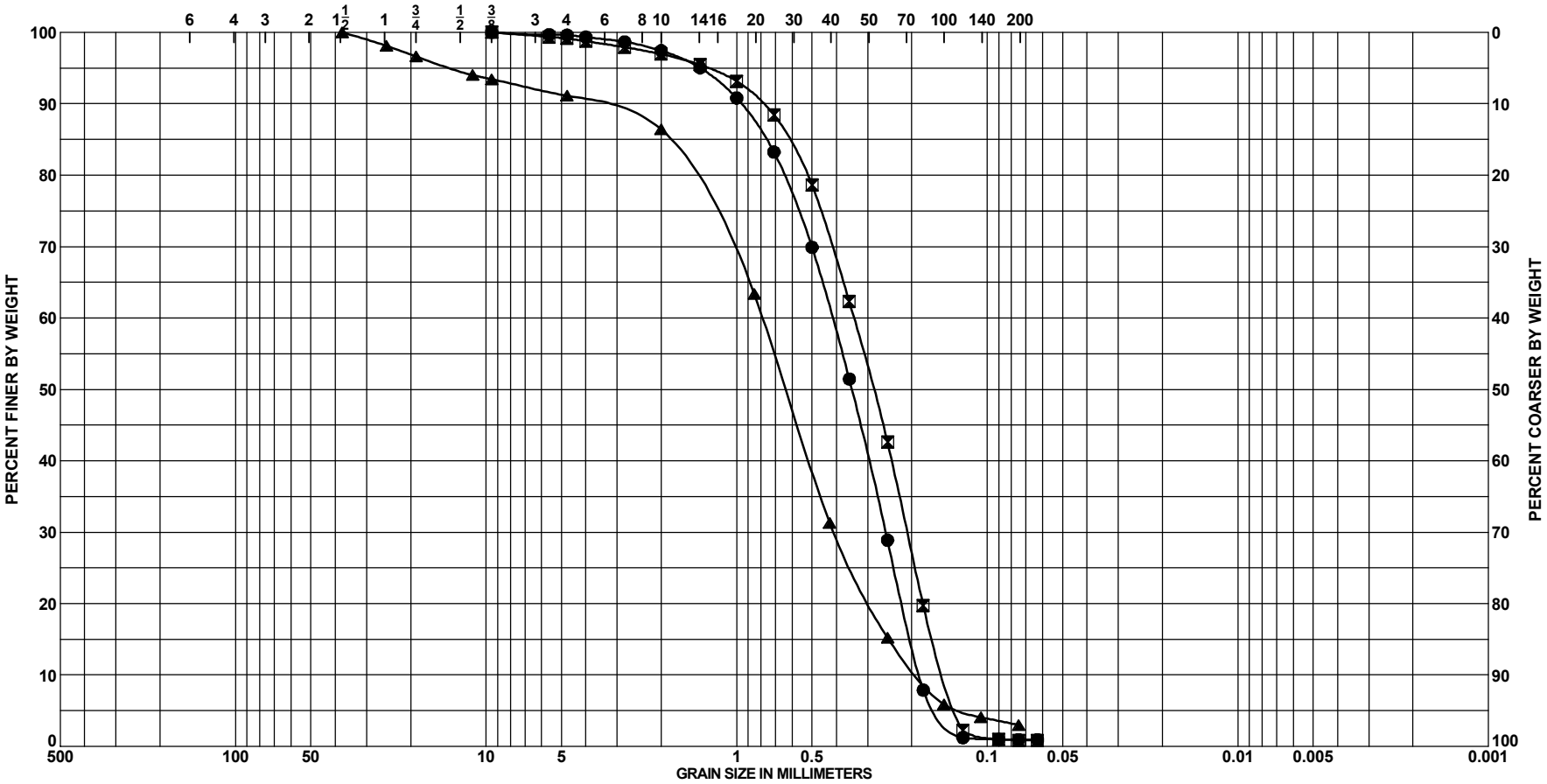
Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.10	0.47	1.19	0.44	0.73	-0.48	3.75

GRANULARMETRIC REPORT % PUERTO RICO RINCON_CONCRETOS-MINE-COMBINED.GPJ CESAJ 20171021.GDT 8/31/20

9.2.4 RINCON - COMPOSITE SAMPLES

9.2.4.1 Beach-Source Gradation Comparison Graphs

With sand sources where sieve data are available.



Boring No.	Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● ZZ-COMPOSITES	Rinncon - Conserga		(SP)		24	25						
⊠ ZZ-COMPOSITES	Rincon - Stella		(SP)		31	34						
▲ ZZ-COMPOSITES	Arecibo Flood Shoal		(SP)									

PROJECT Puerto Rico CSRM

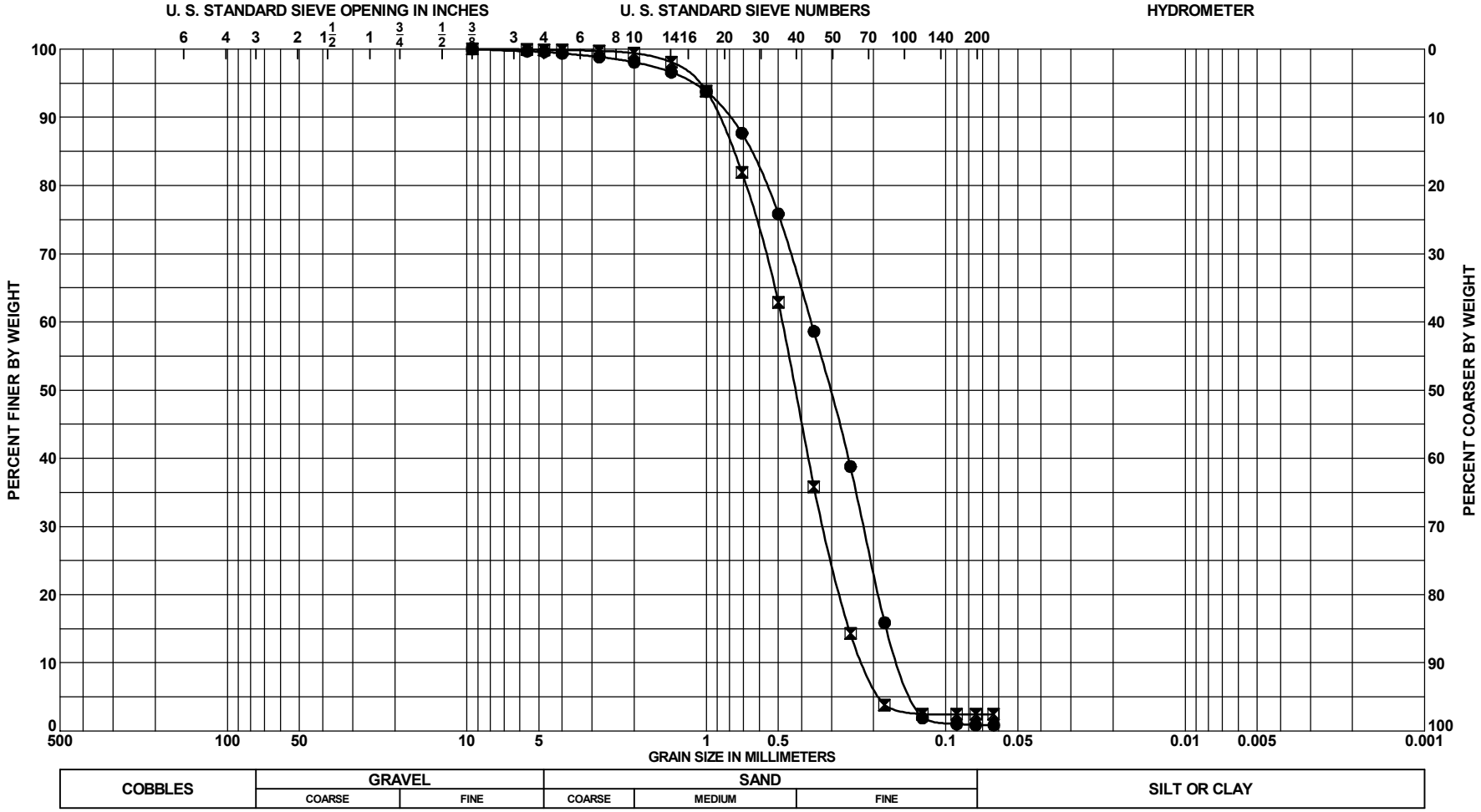
Compatibility Rincon Beaches

with Arecibo Flood Shoal

GRADATION CURVES

DATE 08-16-22

SAJ FORM 2087
JUN 02



Boring No.	Sample No.	Depth	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● Rincon - Beaches		to 0.5 Ft.	(SP)		28	31						
⊠ Rincon Sand Mine		to 1.0 Ft.	(SP)		12	24						

PROJECT Puerto Rico CSRM

Composite Samples Rincon

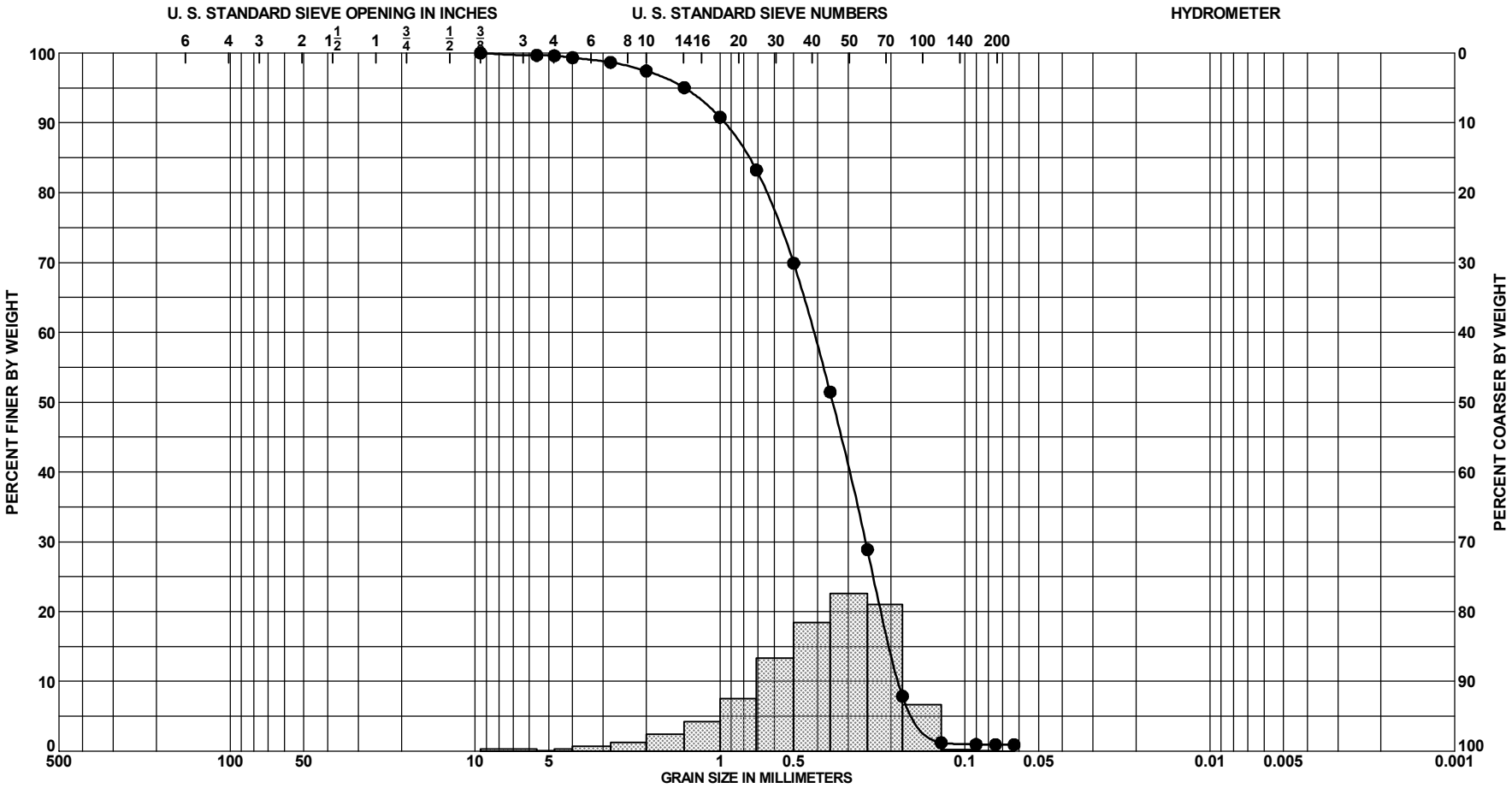
DATE 08-04-20

GRADATION CURVES

SAJ FORM 2087

9.2.4.2 Rincon Beaches Composite Samples

- Gradation Graphs
- Granularmetric Reports



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 2	Rincon - Conserga	SAND, poorly-graded (SP)		24	25						

PROJECT Puerto Rico CSRM

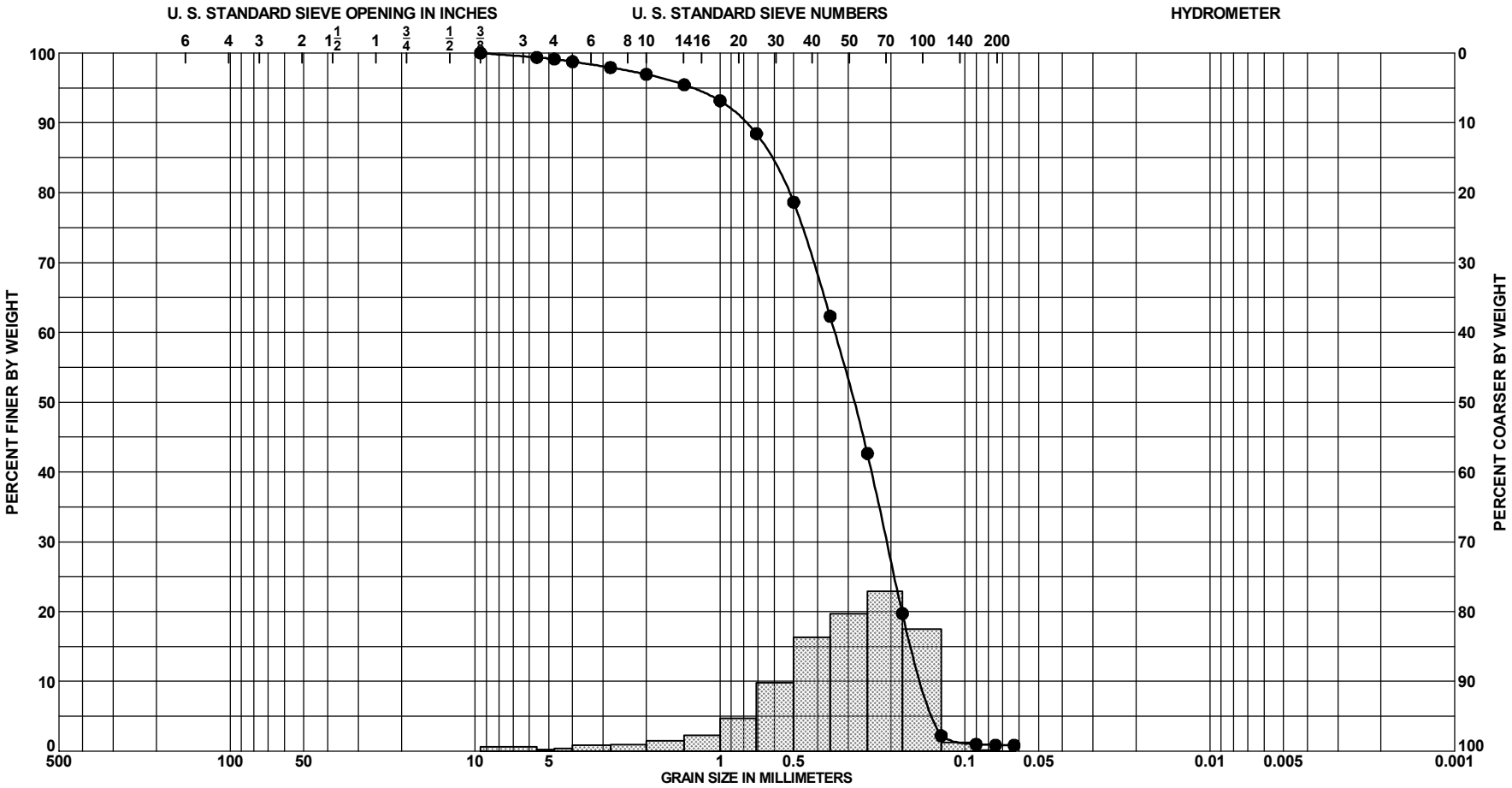
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 3	Rincon - Stella	SAND, poorly-graded (SP)		31	34						

PROJECT Puerto Rico CSRM

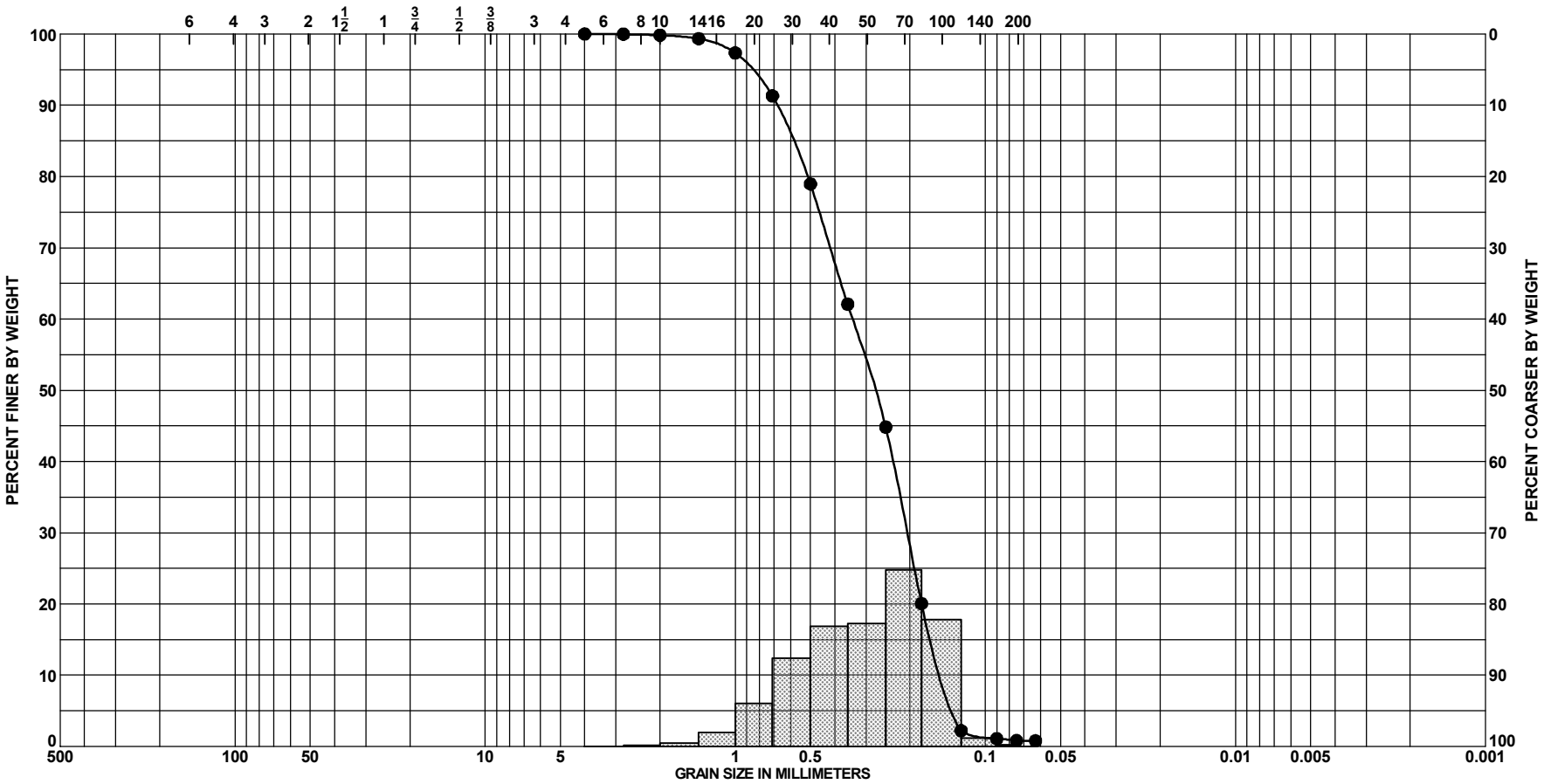
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 4	Rincon - Dona Lala	SAND, poorly-graded (SP)		28	36						

PROJECT Puerto Rico CSRM

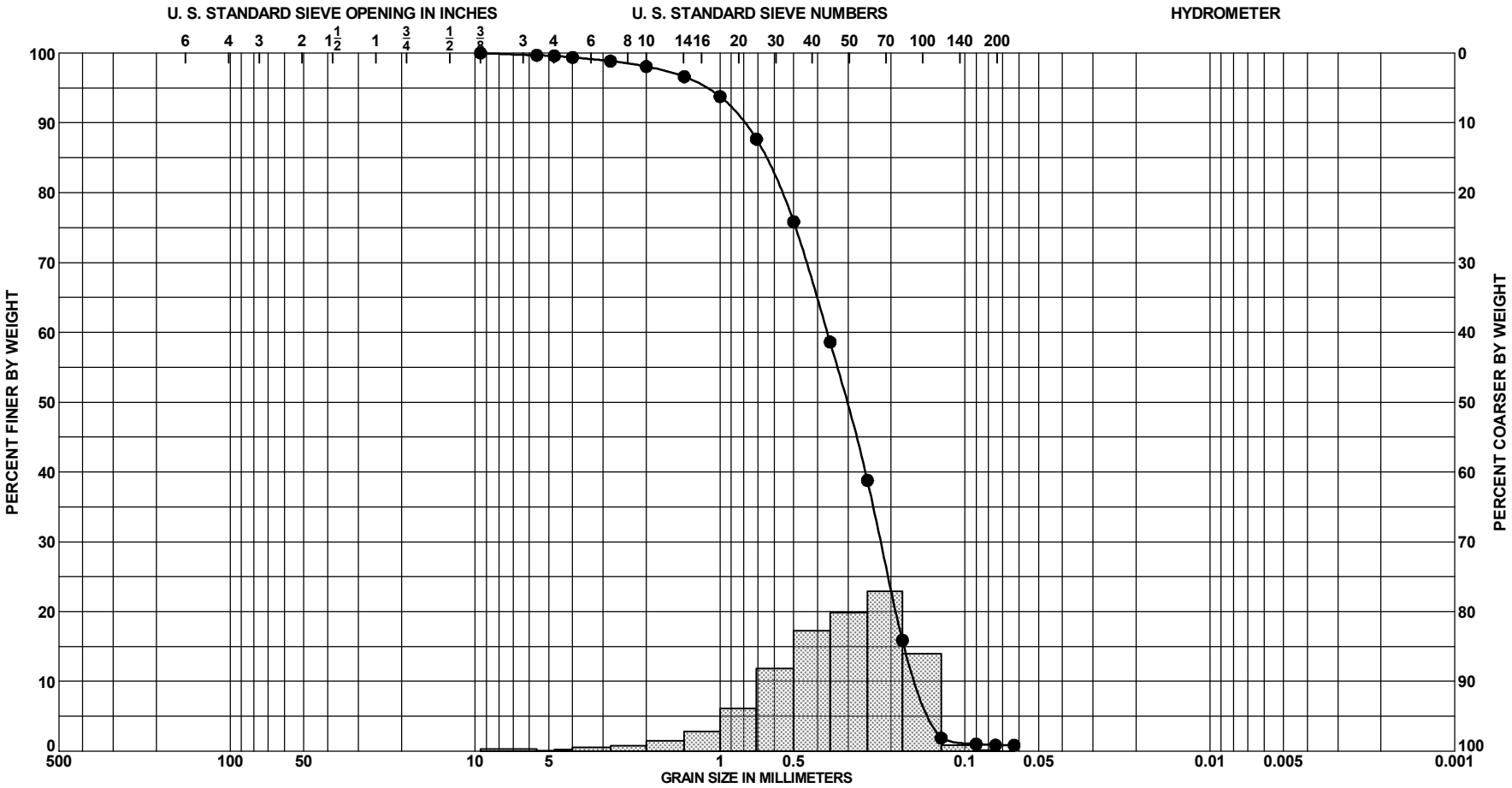
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 16	Rincon - Beaches	SAND, poorly-graded (SP)		28	31						

PROJECT Puerto Rico CSRM

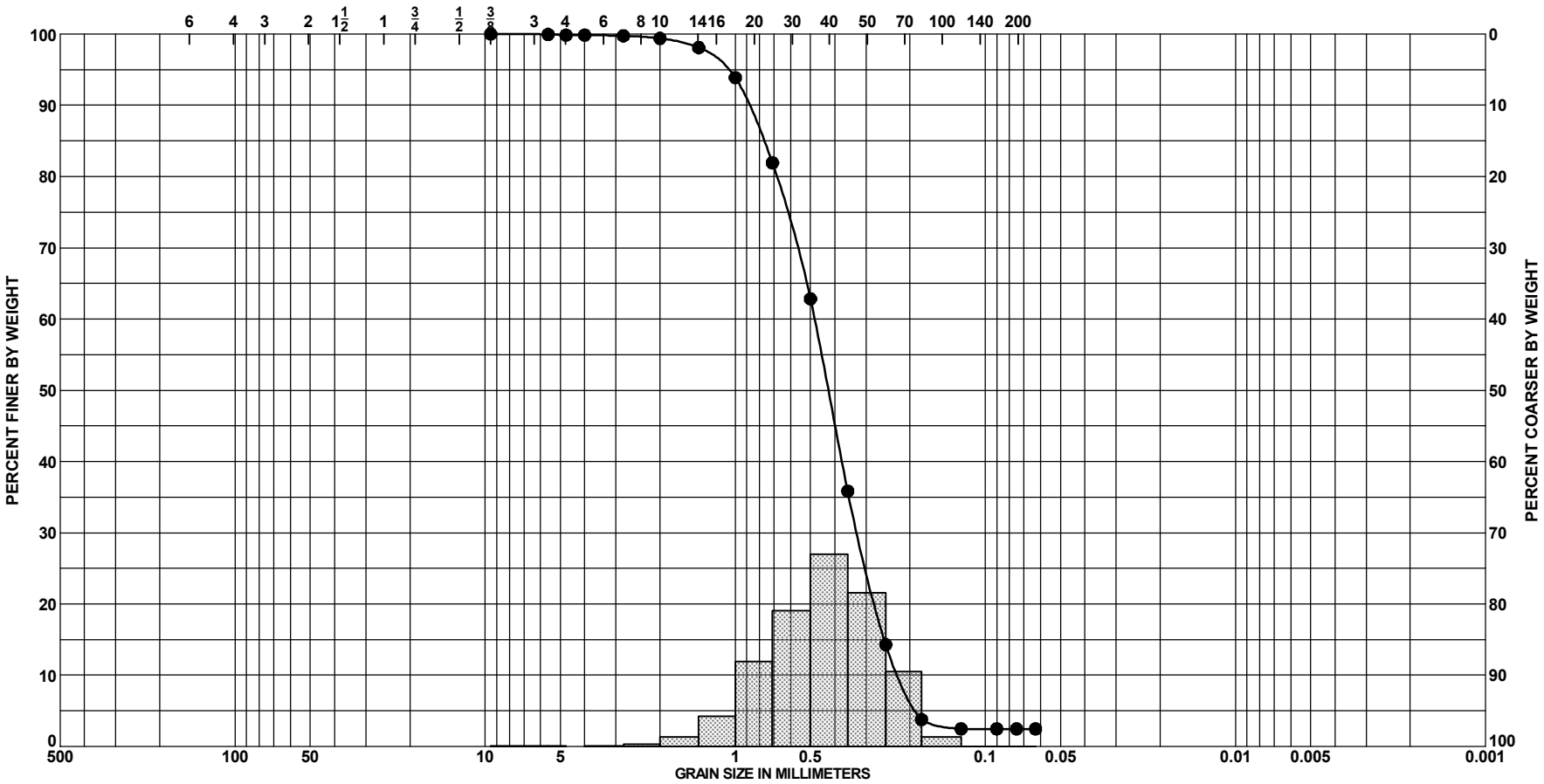
Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 18	Rincon Sand Mine	SAND, poorly-graded (SP)		12	24						

PROJECT Puerto Rico CSRM

Pre-fill Beach Samples 2019

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #2 Rincon - Conserga

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined
Rincon - Conserga@0.012
Rincon - Conserga@0.013
Rincon - Conserga@0.014
Rincon - Conserga@0.015

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW		#200 - 0.93 #230 - 0.92		24.55	23.73

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.34	0.34
#4	-2.25	4.75	0.04	0.39
#5	-2.00	4.00	0.28	0.66
#7	-1.50	2.80	0.67	1.33
#10	-1.00	2.00	1.23	2.56
#14	-0.50	1.40	2.39	4.95
#18	0.00	1.00	4.25	9.20
#25	0.50	0.71	7.56	16.76
#35	1.00	0.50	13.35	30.11
#45	1.50	0.36	18.45	48.56
#60	2.00	0.25	22.56	71.11
#80	2.50	0.18	21.01	92.12
#120	3.00	0.13	6.66	98.79
#170	3.50	0.09	0.25	99.03
#200	3.75	0.08	0.04	99.07
#230	4.00	0.06	0.01	99.08

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.72	2.31	2.09	1.53	0.81	0.45	-0.49

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.35	0.39	1.53	0.35	0.98	-1.03	4.46

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #3 Rincon - Stella

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined
Rincon - Stella@0.008
Rincon - Stella@0.009
Rincon - Stella@0.01
Rincon - Stella@0.011

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW		#200 - 0.85 #230 - 0.84		33.62	30.85

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.63	0.63
#4	-2.25	4.75	0.23	0.86
#5	-2.00	4.00	0.38	1.24
#7	-1.50	2.80	0.84	2.08
#10	-1.00	2.00	0.97	3.06
#14	-0.50	1.40	1.49	4.55
#18	0.00	1.00	2.30	6.84
#25	0.50	0.71	4.71	11.55
#35	1.00	0.50	9.82	21.37
#45	1.50	0.36	16.34	37.70
#60	2.00	0.25	19.66	57.36
#80	2.50	0.18	22.92	80.28
#120	3.00	0.13	17.50	97.78
#170	3.50	0.09	1.24	99.02
#200	3.75	0.08	0.13	99.15
#230	4.00	0.06	0.02	99.16

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.61	2.38	1.81	1.11	0.73	-0.40

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.61	0.33	1.81	0.29	1.05	-1.4	5.77

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #4 Rincon - Dona Lala

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined
Rincon - Dona Lala@0.004
Rincon - Dona Lala@0.005
Rincon - Dona Lala@0.006
Rincon - Dona Lala@0.007

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP		#200 - 0.82 #230 - 0.80		36.11	28.05

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
#5	-2.00	4.00	0.00	0.00
#7	-1.50	2.80	0.03	0.03
#10	-1.00	2.00	0.15	0.17
#14	-0.50	1.40	0.48	0.66
#18	0.00	1.00	1.99	2.65
#25	0.50	0.71	6.04	8.68
#35	1.00	0.50	12.37	21.05
#45	1.50	0.36	16.87	37.92
#60	2.00	0.25	17.25	55.18
#80	2.50	0.18	24.78	79.95
#120	3.00	0.13	17.82	97.78
#170	3.50	0.09	1.15	98.93
#200	3.75	0.08	0.25	99.18
#230	4.00	0.06	0.02	99.20

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.92	2.61	2.40	1.85	1.12	0.80	0.19

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.72	0.30	1.85	0.28	0.84	-0.51	2.71

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Composite Samples
Puerto Rico CSRM

Sample Name: Composite #16 Rincon - Beaches

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined

Rincon - Conserga@0.012
Rincon - Conserga@0.013
Rincon - Conserga@0.014
Rincon - Conserga@0.015
Rincon - Dona Lala@0.004
Rincon - Dona Lala@0.005
Rincon - Dona Lala@0.006
Rincon - Dona Lala@0.007
Rincon - Stella@0.008
Rincon - Stella@0.009
Rincon - Stella@0.01
Rincon - Stella@0.011

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW		#200 - 0.87 #230 - 0.85		31.43	27.54

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.32	0.32
#4	-2.25	4.75	0.09	0.41
#5	-2.00	4.00	0.22	0.63
#7	-1.50	2.80	0.51	1.15
#10	-1.00	2.00	0.78	1.93
#14	-0.50	1.40	1.46	3.39
#18	0.00	1.00	2.84	6.23
#25	0.50	0.71	6.10	12.33
#35	1.00	0.50	11.84	24.17
#45	1.50	0.36	17.22	41.39
#60	2.00	0.25	19.82	61.22
#80	2.50	0.18	22.90	84.12
#120	3.00	0.13	14.00	98.11
#170	3.50	0.09	0.88	98.99
#200	3.75	0.08	0.14	99.13
#230	4.00	0.06	0.02	99.15

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.89	2.50	2.30	1.72	1.02	0.65	-0.22

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.56	0.34	1.72	0.30	0.97	-1.08	4.89

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 8/6/20

Granularmetric Report

Project Name: Upland Sand Mine Samples
Puerto Rico CSRM Study

Sample Name: Composite #1 Rincon Mine

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (U.S. Ft.)	

Samples Combined
Rincon 1@1
Rincon 2@1
Rincon 3@1
Rincon M-2@1
Rincon M-3@1

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP		#200 - 2.47 #230 - 2.47		23.67	12.44

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.05	0.05
#4	-2.25	4.75	0.10	0.15
#5	-2.00	4.00	0.00	0.15
#7	-1.50	2.80	0.11	0.26
#10	-1.00	2.00	0.34	0.60
#14	-0.50	1.40	1.31	1.91
#18	0.00	1.00	4.21	6.12
#25	0.50	0.71	11.96	18.08
#35	1.00	0.50	19.10	37.17
#45	1.50	0.36	26.99	64.16
#60	2.00	0.25	21.55	85.71
#80	2.50	0.18	10.50	96.21
#120	3.00	0.13	1.32	97.53
#170	3.50	0.09	0.00	97.53
#200	3.75	0.08	0.00	97.53
#230	4.00	0.06	0.00	97.53

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.44	1.96	1.75	1.24	0.68	0.41	-0.13

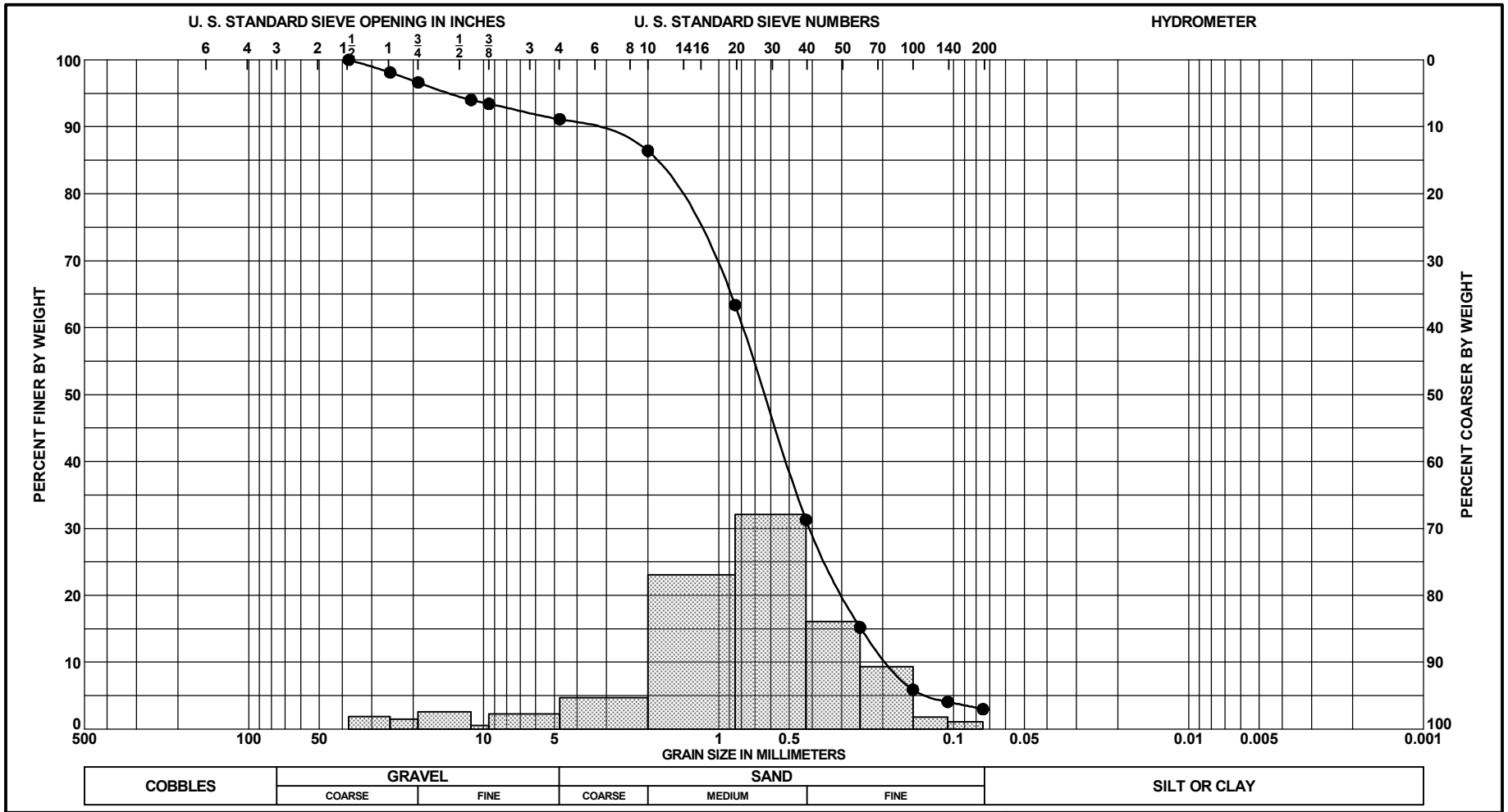
Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.16	0.45	1.24	0.42	0.75	-0.56	3.81

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO RINCON_CONCRETOS-MINE-COMBINED.GPJ CESAJ 20171021.GDT 8/31/20

9.2.4.3 Rincon Sand Sources Composite Samples

For sand sources where sieve data are available.

- Gradation Graphs
- Granularmetric Reports



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 1	composite shoal	SAND, poorly-graded (SP)									

PROJECT FY20 RIO GRANDE DE ARECIBO GEOTECHNICAL

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name: Arecibo Flood Control
FY20 RIO GRANDE DE ARECIBO
GEOTECHNICAL

Sample Name: Composite #1 composite shoal

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (U.S. Ft.)	

Samples Combined
CB-RGA-20-01@0
CB-RGA-20-01@4
CB-RGA-20-01@8
CB-RGA-20-61A@4
CB-RGA-20-61A@10
CB-RGA-20-62A@2
CB-RGA-20-62A@8
CB-RGA-20-63A@6
CB-RGA-20-63A@12

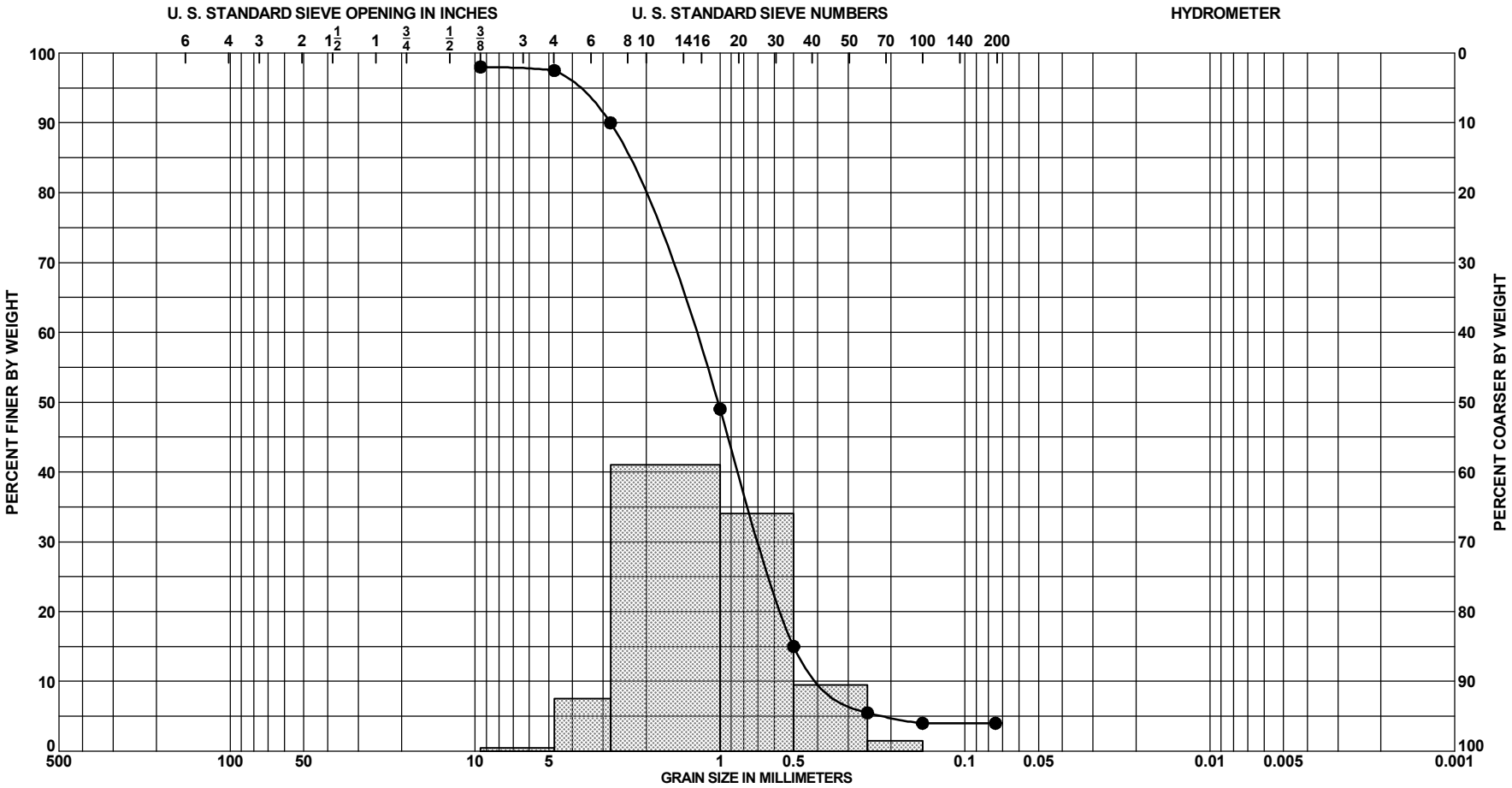
USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SW		#200 - 2.99			

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
1.5"	-5.25	37.50	0.00	0.00
1"	-4.75	25.00	1.88	1.88
3/4"	-4.25	19.00	1.49	3.37
11/16"	-3.50	11.31	2.62	5.99
3/8"	-3.25	9.50	0.58	6.57
#4	-2.25	4.75	2.31	8.87
#10	-1.00	2.00	4.72	13.59
#20	0.25	0.85	23.04	36.63
#40	1.25	0.43	32.11	68.74
#60	2.00	0.25	16.07	84.81
#100	2.75	0.15	9.30	94.11
#140	3.25	0.11	1.82	95.93
#200	3.75	0.08	1.08	97.01

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
3.00	1.96	1.54	0.67	-0.38	-0.87	-3.78

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	0.32	0.80	0.67	0.63	1.73	-1.18	4.55

GRANULARMETRIC REPORT % - COMPOSITES ARECIBO MODIFICATION GINT BORING LOG FILE 2020.GPJ CESAJ 20171021.GDT 8/16/22



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 21	Cabo Rojo	SAND, poorly-graded (SP)									

PROJECT Puerto Rico CSRM

Cabo Rojo Composite

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

US Army Corps of Engineers
Jacksonville District

Project Name:
Puerto Rico CSRM

Sample Name: Composite #21 Cabo Rojo

Analysis Date:

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined
Cabo Rojo B-5@1
Cabo Rojo B-6@1

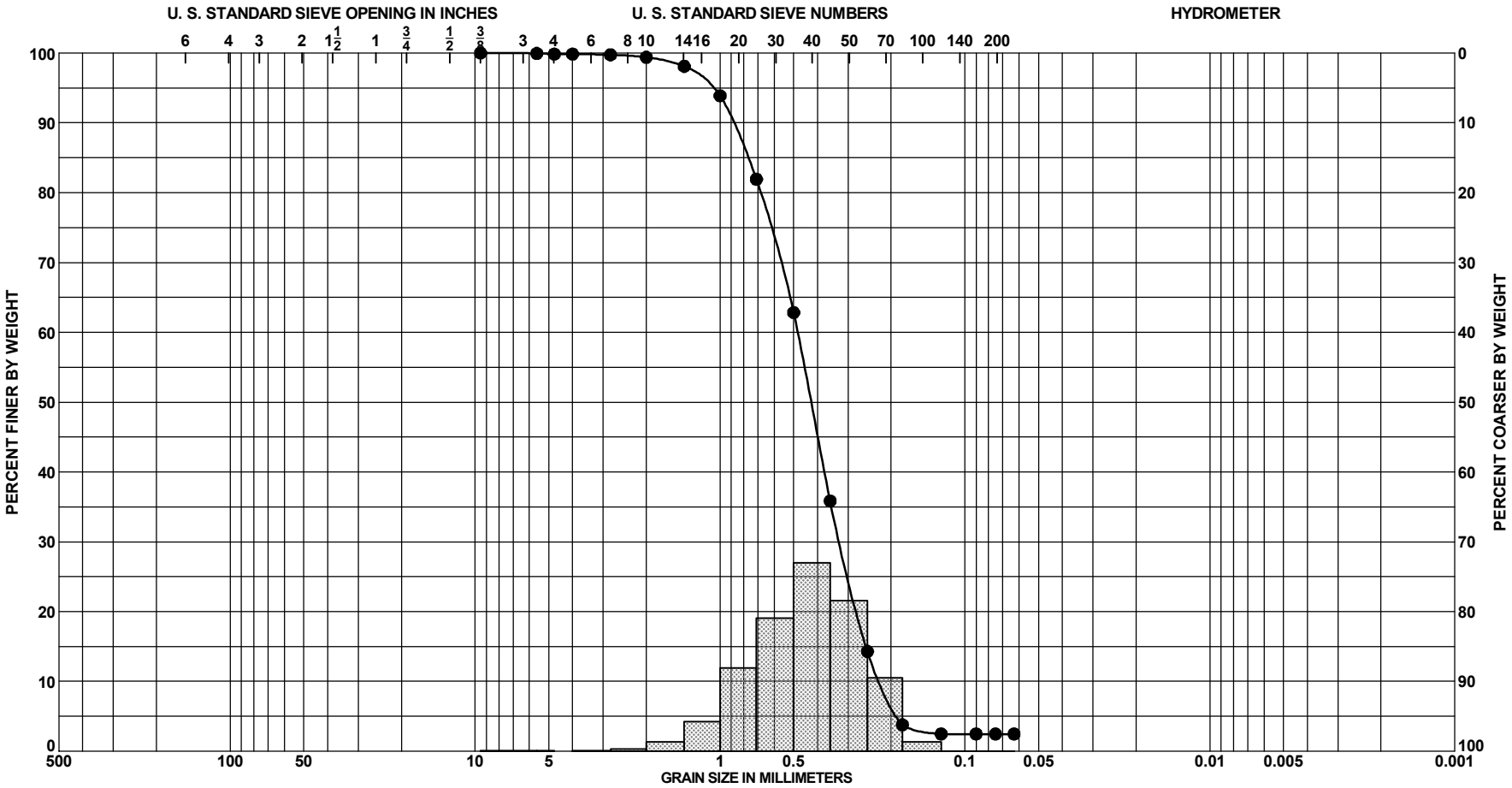
USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
		#200 - 4.00			

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	2.00	2.00
#4	-2.25	4.75	0.50	2.50
#7	-1.50	2.80	7.50	10.00
#18	0.00	1.00	41.00	51.00
#35	1.00	0.50	34.00	85.00
#60	2.00	0.25	9.50	94.50
#100	2.75	0.15	1.50	96.00
#200	3.75	0.08	0.00	96.00

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.58	0.97	0.71	-0.04	-0.95	-1.28	-2.00

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	-0.20	1.15			0.97	0.37	2.76

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 10/27/22



Sample No.	Composite Sample	Classification	Munsell	Visual % Shell (est)	%CO_3	G_s	Org %	w_n	LL	PL	PI
● 18	Rincon Sand Mine	SAND, poorly-graded (SP)		12	24						

PROJECT Puerto Rico CSRM

Rincon Sand Mine Composite

COMPOSITE SAMPLES

DATE

GRADATION CURVES

SAJ FORM 2087
JUN 02

Granularmetric Report

Project Name:
Puerto Rico CSRM

Sample Name: Composite #18 Rincon Sand Mine

Analysis Date:

US Army Corps of Engineers
Jacksonville District

Easting (ft):	Northing (ft):	Coordinate System:	Elevation (ft):
		State Plane, PR/VI (M)	

Samples Combined
Upland Mine Proposed Rincon@0.01
Upland Mine Proposed Rincon@0.02
Upland Mine Rincon@0
Upland Mine Rincon@0.01
Upland Mine Rincon@0.02

USCS:	Munsell:	Fines (%):	Organics (%):	Carbonates (%):	Shells (%):
SP		#200 - 2.47 #230 - 2.47		23.67	12.44

Sieve Number	Sieve Size (Phi)	Sieve Size (Millimeters)	% Weight Retained	C. % Weight Retained
3/8"	-3.25	9.50	0.00	0.00
#3.5	-2.50	5.60	0.05	0.05
#4	-2.25	4.75	0.10	0.15
#5	-2.00	4.00	0.00	0.15
#7	-1.50	2.80	0.11	0.26
#10	-1.00	2.00	0.34	0.60
#14	-0.50	1.40	1.31	1.91
#18	0.00	1.00	4.21	6.12
#25	0.50	0.71	11.96	18.08
#35	1.00	0.50	19.10	37.17
#45	1.50	0.36	26.99	64.16
#60	2.00	0.25	21.55	85.71
#80	2.50	0.18	10.50	96.21
#120	3.00	0.13	1.32	97.53
#170	3.50	0.09	0.00	97.53
#200	3.75	0.08	0.00	97.53
#230	4.00	0.06	0.00	97.53

Phi 5	Phi 16	Phi 25	Phi 50	Phi 75	Phi 84	Phi 95
2.44	1.96	1.75	1.24	0.68	0.41	-0.13

Moment	Mean Phi	Mean mm	Median Phi	Median mm	Sorting	Skewness	Kurtosis
Statistics	1.16	0.45	1.24	0.42	0.75	-0.56	3.81

GRANULARMETRIC REPORT % - COMPOSITES PUERTO RICO-BCSRM_ALL-GINT-JUNE2020.GPJ CESAJ 20171021.GDT 10/27/22