GEOTECHNICAL REPORT
AT PARCEL "A" AND "B"
OF CAMP SANTIAGO
SALINAS, PUERTO RICO

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Suelos, PSC

Soil & Construction Materials Laboratory and Environmental Drilling Services

GEOTECHNICAL REPORT
AT PARCEL "A" AND "B"
OF CAMP SANTIAGO
SALINAS, PUERTO RICO

CMA, ARCHITECTS & ENGINEERS
Prepared for

Boring Logs Performed & Supervised By
***SUELOS, PSC.**

Submitted on December 18, 2019
Job No. 4897.rep

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1.0 INTRODUCTION

This report covers the results of the Geotechnical Investigation undertaken at the request of **Eng. Carlos Medina**, on behalf of **CMA, Architects & Engineers**, pursuant to the terms and conditions stated in our proposals dated March 25 and April 9, 2019. It contains the results of the geotechnical exploration performed for the proposed buildings at Parcels A and B of Camp Santiago, Salinas, Puerto Rico.

The geotechnical study embracing this work has been targeted to evaluate the index and physical properties of the underlying soils in order to provide geotechnical recommendation for the design of buildings. **CMA Purchase Orders #7451** and **#7452** were issued to cover our services.

2.0 GENERAL PROJECT DESCRIPTION AND LOCATION

The site selected for the new buildings is located within Camp Santiago facilities, just north of PR-154, in Salinas, Puerto Rico. Parcels A and B are currently occupied by various structures, some of which will be demolished to accommodate new buildings. **Figure 1** shows an aerial photo with the project site depicted on it.

Based on the site plan provided to this office, the proposed project considers the construction of personnel sheds, administration offices, barracks and HQ building among other facilities. The 11.5 acres (Site A and B combined) are comprised by relatively flat grounds. Site plan is presented in **Figure 2**.

Figure 1. Site location

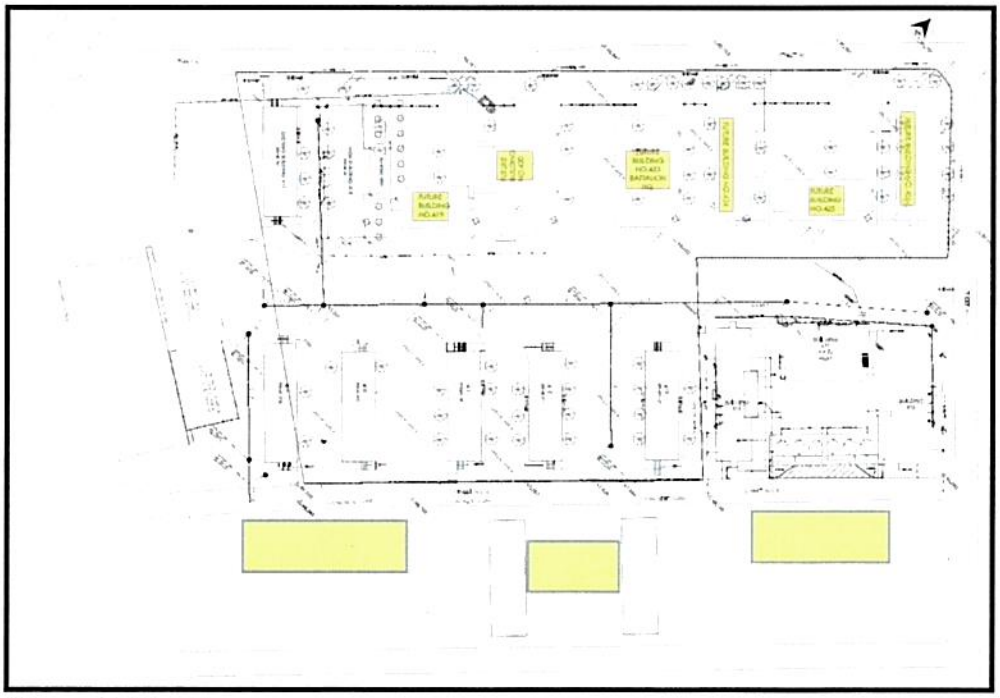

Figure 2. Site plan

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At the time of writing, a grading plan was not available. Reportedly, the proposed grading does not require significant cut or fill operations. We are considering that only minor cut and fill operations would be required (<1 mt) in order to achieve proposed elevations.

3.0 WORK PERFORMED

The drilling program consisted of sixteen (16) test holes. Boring locations were selected by the geotechnical engineer and laid out by our personnel at the field. The approximate location of the borings are depicted in **Figure 3**.

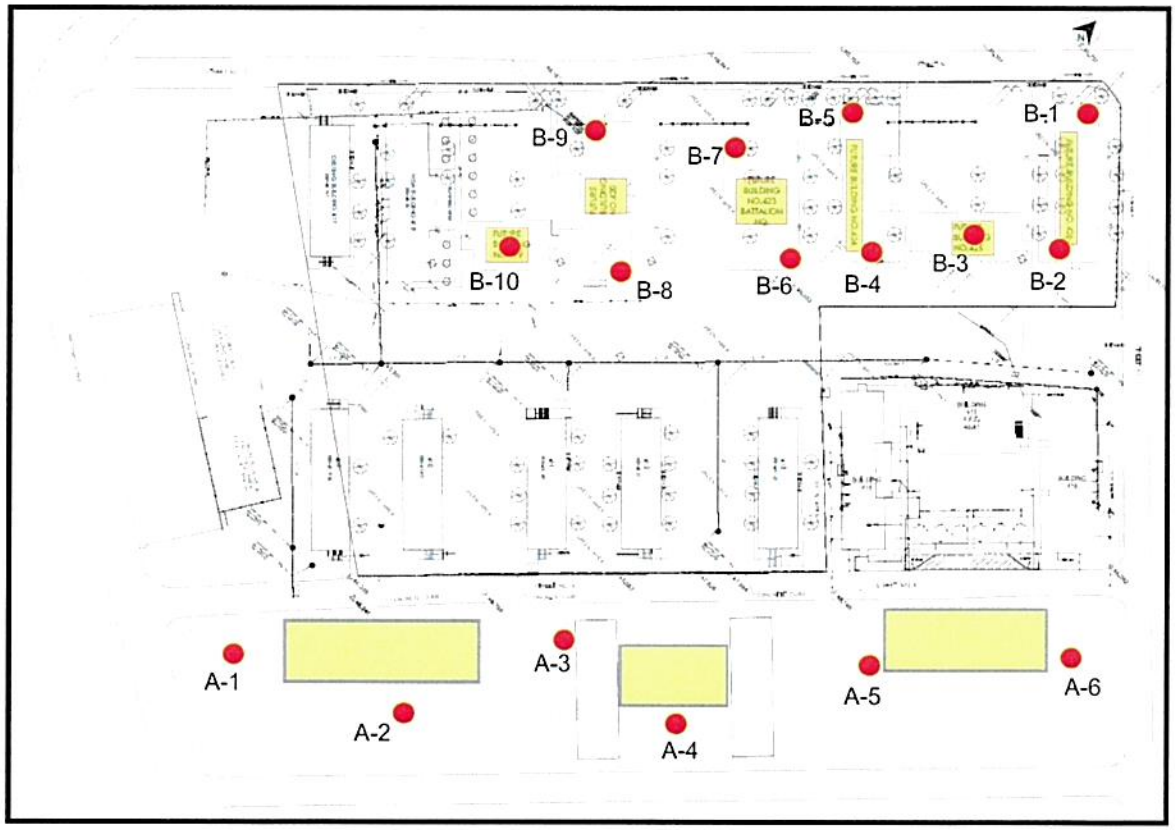

Figure 3. Approximate boring locations

The test holes were advanced by means of the Power Auger Drilling Methods employing a CME-55 drilling rig. The borings were bottomed at 30 ft deep into man-made fills, residual soils and saprolitic material. Visual/manual procedures were used to characterize the underlying soils. As part of the work, natural moisture contents were obtained from all samples. The results of the testing program are discussed further in this report.

4.0 GEOLOGICAL CONDITIONS OF THE SITE

The project lays within the Geologic Map of the Coamo Quadrangle, Puerto Rico. According to this map the project site is underlain by Colluvium (**Qc**) and by the Coamo Formation (**Kcos**).

Colluvium is comprised of silt, clay, fine sand and some gravel, mainly slope wash. It grades into and includes small deposits of alluvial gravel and sand on fans.

The Coamo Formation is made of sandstone and siltstone, generally calcareous and partly tuffaceous, thin-bedded to medium-bedded, olive, weathering to very pale orange and brownish gray.

A portion of the Coamo Geologic Map is included as **Figure 4**. It depicts the approximate site location and the boundaries of the above described geologic units.

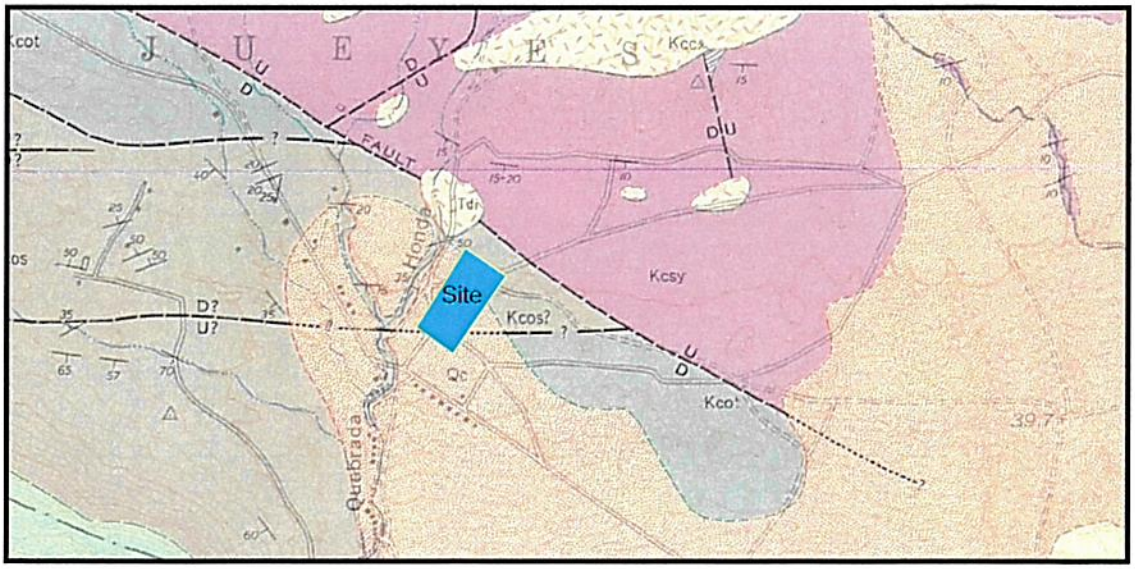

Figure 4. Geologic setting

5.0 SUBSOIL STRATIGRAPHY

The knowledge gained from the subsoil explorations shows us that the site is underlain by minor fill followed by silty sand and sandy silt of either colluvial nature or residual to severely weathered sandstone (Kcos unit).

The results of the Standard Penetration Tests (SPT) in the fill and colluvium vary from 13 to 20 blows per foot (BPF). Here, that natural moisture contents average 13 percent.

Residual to saprolitic soils from the Coamo Formation underlay the fill and/or colluvial soils. Standard Penetration Tests resulted in over 20 bpf, many of them reaching refusal count (>100 bpf). Natural moisture contents vary from 6 to about 20 percent.

In order to investigate possible swelling behavior of native soils, free swell tests were performed on selected samples. The free swell test consist of placing a known volume of dry soil passing the No. 40 sieve into a graduated cylinder filled with water and measuring the swelled volume after it has completely settled. The free swell of a soil is determined as the ratio of the change in volume to the initial volume, expressed as a percentage.

Holtz and Gibbs (1956) stated that soils having free swell values in the order of 100% may exhibit considerable expansion in the field when wetted under light loading. The free swell test values varied from 20% to 30%, meaning low swell potential.

6.0 GROUNDWATER AND DEWATERING CONSIDERATIONS

The groundwater table was not found during the drilling phase of our work. However, the fact of not encountering a stabilized water table during the field work does not necessarily indicate its absence.

It should be understood that the groundwater level is always being affected by natural factors such as the distance from water sources, the permeability of the subsoil, the topography of the area, and the amount of precipitation. Consequently, the information given about the actual groundwater condition is not to be taken as reliable or invariant.

Moreover, it should be taken into account that changes in the groundwater characteristics of the region frequently occur. Such conditions are difficult to detect within the normal scope of time of the exploration. Usually, springs are detected during the construction period, when excavations or ground surface stripping are made.

7.0 SEISMIC GROUND MOTION VALUES

7.1 Mapped Acceleration Parameters

According to the Puerto Rico Building Code, the 0.2 sec spectral response acceleration (Ss) for the town of Salinas corresponds to 0.90. The 1.0 sec spectral response acceleration (S1) corresponds to 0.28.

7.2 Site Class Definition

Based on the included **Figure 5** (site classification), a Class C type may be assigned to the project site (very dense soil and soft rock having shear wave velocities between 1,200 and 2,500 ft/sec). The following table describes the criteria to categorize the soil profiles in order to model the seismic response of the structures.

SITE CLASS	SOIL PROFILE NAME	AVERAGE PROPERTIES IN TOP 100 feet, SEE SECTION 1613.5.5		
		Soil shear wave velocity, $\bar{v}_s$, (ft/s)	Standard penetration resistance, $\bar{N}$	Soil undrained shear strength, $\bar{s}_u$, (psf)
A	Hard rock	$\bar{v}_s > 5{,}000$	N/A	N/A
B	Rock	$2{,}500 < \bar{v}_s \leq 5{,}000$	N/A	N/A
C	Very dense soil and soft rock	$1{,}200 < \bar{v}_s \leq 2{,}500$	$\bar{N} > 50$	$\bar{s}_u \geq 2{,}000$
D	Stiff soil profile	$600 \leq \bar{v}_s \leq 1{,}200$	$15 \leq \bar{N} \leq 50$	$1{,}000 \leq \bar{s}_u \leq 2{,}000$
E	Soft soil profile	$\bar{v}_s < 600$	$\bar{N} < 15$	$\bar{s}_u < 1{,}000$
E	—	Any profile with more than 10 feet of soil having the following characteristics: 1. Plasticity index $PI > 20$, 2. Moisture content $w \geq 40\%$, and 3. Undrained shear strength $\bar{s}_u < 500$ psf		
F	—	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays (H > 10 feet of peat and/or highly organic clay where H = thickness of soil) 3. Very high plasticity clays (H >25 feet with plasticity index PI >75) 4. Very thick soft/medium stiff clays (H >120 feet)		

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m², 1 pound per square foot = 0.0479 kPa. N/A = Not applicable

Figure 5. Site Class Definitions

7.3 Discussion/Conclusions

The soils at site consist of fill/colluvial material followed by residual to saprolitic sandy silt and silty sand delivered from the Coamo Formation. These soils resulted to be very competent from the foundation stand point. The project designer can consider shallow foundations like mats or spread footings.

The buildings shall consider a mat foundation designed for an allowable soil bearing pressure (**qa**) of 2,800 psf at a depth of 2 feet below grade. A modulus of subgrade reaction of 135 pci can be consider to design the mat using the flexible method. The inspection of the bottom of excavation is recommended particularly on the portion of the building where the existing grade is close to the proposed final grade. In this case footing may require to be deepened, as necessary so they rest on the denser soil.

Beneath the mat foundation, a granular base course should consist of well-graded gravel or crushed rock with a maximum nominal size of ¾ inch and having less than 5 percent by weight passing the No. 200 sieve. The base course should be compacted to at least 95 percent of its maximum dry density as measured by the modified Proctor test (ASTM Standard D-1557). We recommend a modulus of subgrade reaction of 200 pounds per cubic inch (pci) for the base course.

The bottom of the mat excavation shall be treated by means of a vibratory roller with a minimum centrifugal force of 25,000 lb and a minimum operating weight of 12,000 lb, under the lead of the observing Geotechnical Engineer.

Alternatively, the structures can also be placed on strip footings and/or spread footings designed for allowable bearing pressure of 3,000 psf at 3 ft deep. For the spread footings, the resistance to lateral loads may be provided by earth pressure mobilized on the buried vertical faces of the footings and by shearing forces acting along the subgrade interface. Earth pressure resistance may be determined using the coefficient of passive earth pressure (**$Kp = Tan^2 (45°+Phi/2)$**). An internal friction angle (**Phi**) equal to **28°** may be used to calculate the **Kp value**. The total pressure of a unit width of a vertical plane extending from surface to a depth **H** is **$Pp = 0.5* Kp *115 pcf * H^2$**. A friction factor of 0.35 should be used to determine base shear resistance.

The floor slab of the buildings can be designed as a cast-on-grade slab, provided the upper 10 inches of the existing material is removed and replaced with a granular base course at least 10-inch thick to provide uniformity of support. A-2-4 backfill properly compacted should be considered.

To avoid potential problems with cracking because of differential loadings, the floor slab should be liberally jointed and separated from columns and walls. An impervious membrane should be installed between the soil subgrade and the bottom of the floor slab to be overlain by moisture sensitive coverings. The use of such a moisture barrier should minimize slab moisture problems. All earthwork specifications and pre-construction site treatment presented in this report shall be fulfilled.

8.0 EARTHWORK RECOMMENDATIONS

8.1 Excavation and Filling Operations

Since the project site is covered by vegetation and top soil, the clearing operations shall be performed thoroughly and consciously. Also, it may be necessarily to remove or relocate existing underground utilities, underground tanks, old manholes, old foundations or other related underground structures. This report does not contain recommendation for existing buried utilities nor addressees their current or future condition.

Once the topsoil are removed and the required undercut completed, the exposed surface shall be proof rolled using a vibratory roller (Ingersoll-Rand SD-100, CAT CS 563-D, or similar). Remove any soft spots disclosed during proof rolling that cannot properly stabilized. Use A-2-4 material, compacted to 95% its Modified Proctor, to replace the removed material and to bring low areas to a level plateau.

Worth mentioning is that this report does not consider up-grading fills in excess of 1 mt above existing grade elevation. If the project site requires more than 1 mt of new fill above existing grade, we shall be informed so as to modify our recommendations, if deemed necessary.

We anticipate that the foundation soils will be sensitive to moisture, which may be damaged if subjected to disturbance from construction equipment. Delays in site earthwork activities should be anticipated during periods of heavy rainfall. During wet weather, we recommend that site excavation be performed using an excavator with a straight-edged bucket that does not traverse the subgrade.

During or after wet weather, if the bottom of the excavation becomes unstable, saturated or disturbed, it will be necessary to import granular materials for structural fill to protect and stabilize open subgrade materials. The granular working base used to protect open subgrade material and allow construction equipment, should consist of a suitable thickness of crushed rock or ballast placed by end-dumping off an advancing pad of rock fill. We expect about 4 to 6 inches of granular material (working base), however, because construction practices can greatly affect the amount of

rock required, we recommend that if conditions require the installation of a granular working blanket, the design, installation, and maintenance be made the responsibility of the contractor. After installation, the working base should be compacted to the satisfaction of the observing geotechnical engineer.

We recommend that the contractor minimize soil exposure during the rainy season by proper timing of grading and construction activities and be prepared to shut down all earthwork if heavy precipitation occurs. We also recommend that water run-off be diverted from the excavations, and that all runoff water be directed to proper drainage areas and not be allowed to pond. During and after heavy rain events temporary dewatering will be required at the bottom of the excavation.

Temporary fill or cut slopes shall follow a 1H:1V geometry after the approval of the geotec hnical engineer on site. Permanent fill slopes shall not be steeper than 2H:1V.

8.2 Fill Requirements

Native soils have a poor grade classification and are not adequate to be used as foundation soils.

New fill (or backfill) used to attain the final grade below the new buildings shall resemble the characteristic of an A-2-4, or better type of soil (based on the AASHTO Soil Classification System). The select A-2-4 fill should be placed in single layers not exceeding 10 inches thick. Every layer shall be compacted so that the dry unit weight of the material is equal to or greater than 95 percent of its maximum dry unit weight as obtained in the laboratory under a Modified Proctor Compaction Test. It should be the responsibility of the Resident Engineer to instruct the Geotechnical Engineer retained by the owner on a consultative basis to determine the optimum moisture and corresponding dry density of the fill to be used in this project.

Over the A-2-4 material the contractor should employ a vibratory steel roller capable of obtaining the required percentage of compaction. He shall not place any additional fill until the preceding compacted layer has been found to fulfill the aforementioned compaction criteria.

Regarding the compaction operations, each successive pass should overlap the preceding adjacent pass by ten (10) percent. Roller passes made on material in unsuitable condition will not be considered in judging compliance with our recommendations. In case the Contractor fails to obtain the required compaction energy, he must get the appropriate type of equipment to comply with these compaction criteria.

9.0 RECOMMENDATIONS FOR DRAINAGE CONDUITS

For drainage pipe installation, it is recommended to over-excavate below the proposed pipe invert a minimum depth corresponding to ¼ the outer diameter (**D**) of the pipe or 6" whichever is larger. In that way, the pipe would be laid over a **D/4 or 6"** thick slightly tamped granular bedding. **D** shall represent the outer diameter of the pipe.

If the pipe excavation is to exceed five (5) feet in depth, it is recommended the use of a well braced shoring system to retain the earth material within the excavation. A trench box can also be used if properly designed and if proceed to be satisfactory.

The pipe bedding consists of the material placed between the pipe and the foundation soil. This bedding plays an important role on the distribution of the soil reaction against the bottom of the pipe and, thereafter, it influences the supporting strength of the pipe as installed.

Based on the average soil conditions disclosed by the boring program, drainage pipes can be laid at the required invert elevation over a bedding type consisting of A-1-a or A-1-b compacted granular material placed on a flat trench bottom (**Figure 6**). The haunching material shall extend from the top of the bedding to the pipe spring line, and shall consist of A-1-a or A-1-b material as well (refer to **Figure 7**). Care must be exercised to ensure placement and compaction of the embedment material in the haunches. Embedment material should be worked under the haunches by hand. Both the bedding and haunching must be compacted to a degree not less than 90% and 80%, respectively, based on results of Standard Proctor Tests.

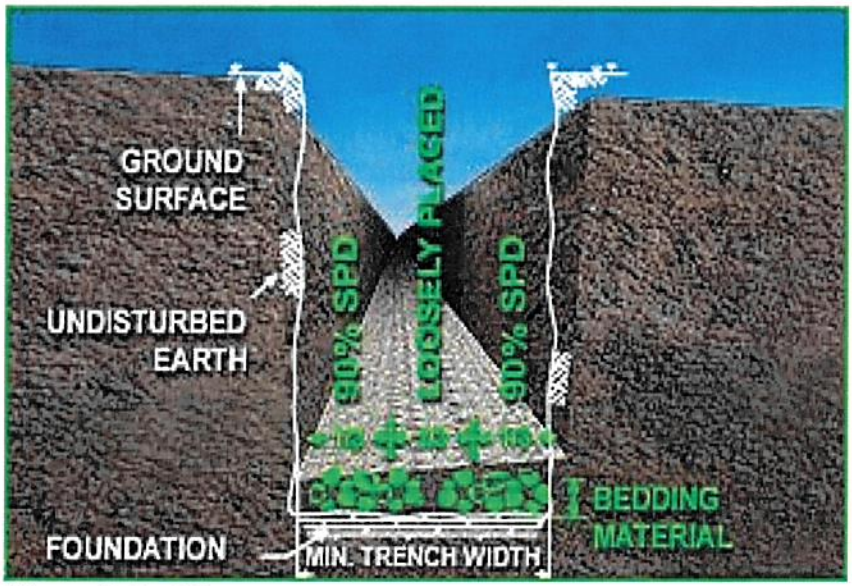

Figure 6. Bedding

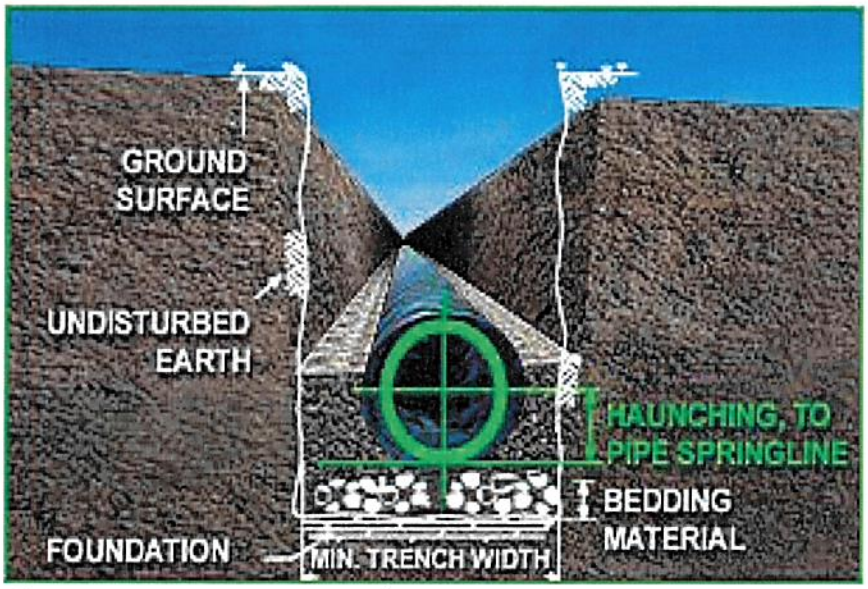

Figure 7. Haunching

The initial backfill shall consists of A-2-4 or better material carefully compacted with tampers. Rolling equipment shall not be allowed in the initial backfill zone. The initial backfill should be placed to a thickness of at least 12 inches or O.D./2 above the top of the pipe, whichever is larger, and shall be compacted to 90% of the material Standard Proctor Density. Refer to **Figure 8**. Trench details for buried pipes are shown in **Figure 9**.

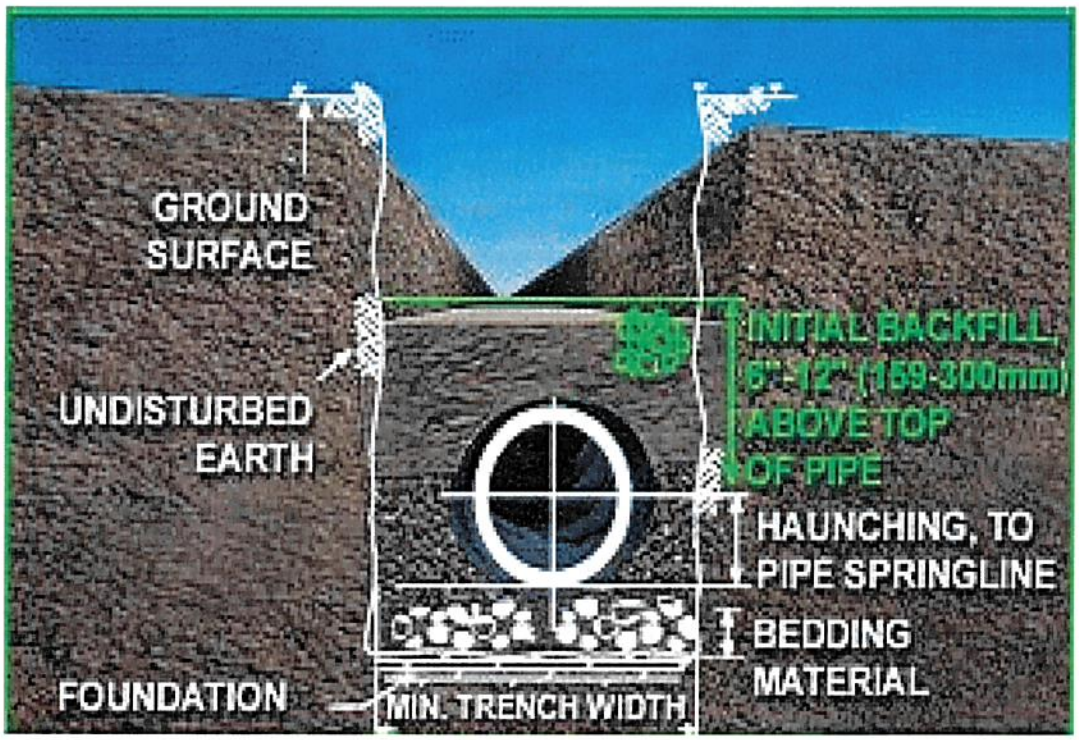

Figure 8. Initial backfill

Notes:
①A-1a or A-1-b material for bedding and haunching.
②Bedding and haunching placed in 6"thick lifts.
③A-2-4 or better material for initial and final backfill under roads.
④Initial and final backfill placed in 12"thick lifts.

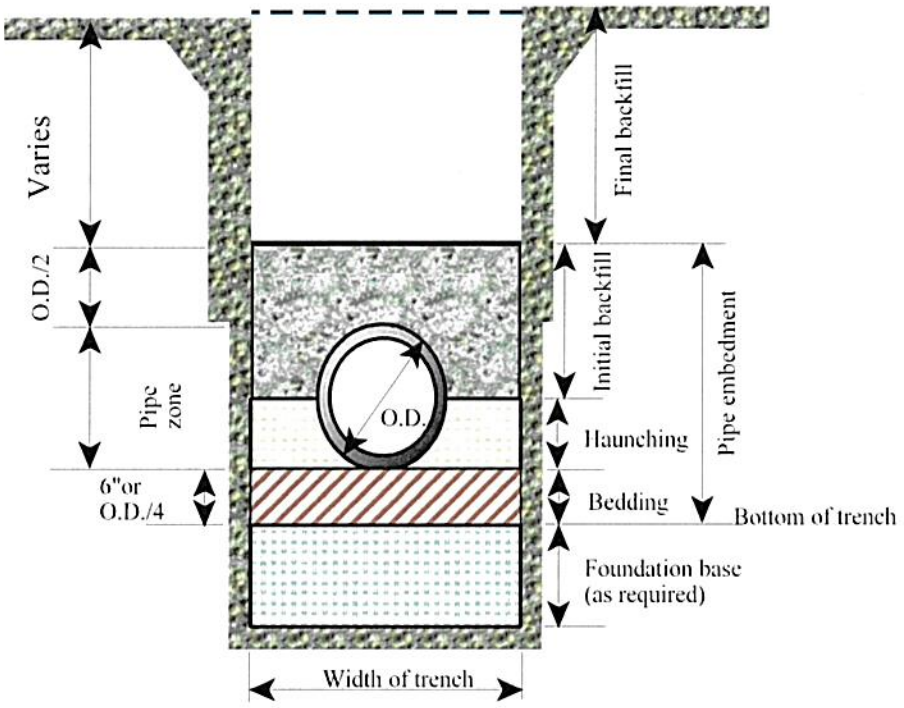

Figure 9. Trench detail for buried pipe

During construction, the pipe shall be installed concurrently with the fill embankment so that there will be no need for large excavations after the new fill is completed. The practice of filling first and then excavate to install the conduit shall not be permitted, as this favors the development of weak zones within the trench sides.

10.0 PARAMETERS FOR PAVEMENT DESIGN

Likely, this project will be provided with on-ground parking areas and access roads. For pavements servicing light vehicles, a 10-inch minimum sub-base of an A-2-4 non-swelling type of soil compacted to 95% its Modified Proctor test is recommended. The A-2-4 soil sub-base should be overlaid by a 4-inch thick base of A-1-a material. CBR values of 20 and 40 can be assigned to the A-2-4 sub-base and the A-1-a base, respectively. A CBR value higher than 3 should not be assigned to the in-situ soils.

All the above information describes minimum requirements and parameters to be used by the designer or site engineer to develop the actual pavement design. It is not intended to be used in construction drawings without the approval of the structural or site engineer.

A well designed drainage system shall constitute an important part of the pavement design itself. A drainage system should be developed to control storm water run-off that may enter from outside or fall within the road curses. Concrete ditches along the roadways may prove to be efficient for collecting storm water run-off that develops on slopes. However, the hydraulic capacity of these will govern their shape and size.

11.0 FINAL COMMENTS

It should be understood that since the testing of every square meter of land in this project would not be economically feasible, the above conclusions, foundation and earthwork recommendations are based on various test holes and site visits considered appropriate by us to form a judgment pursuant to the best standards of engineering practice. However, some variations may

be encountered in the soil profile, especially at areas around the boreholes. Any variations encountered during the period of this project construction must be reported to the inspecting Geotechnical Engineer to study such conditions and present corresponding solutions.

The supervision of earthworks is, in general, a very delicate and specialized matter. In some cases, this service is not rendered by the Geotechnical Engineer who conducted the subsoil investigation and recommended the specific foundation alternatives for a given project. In a large number of projects, these operations are successfully completed due to a prevalence of ideal and uniform subsoil conditions and the execution of the work by a competent and responsible contractor. But, there are cases where the lack of proper construction techniques and the lack of adequate supervision have given rise to the occurrence of foundation problems and failures.

It is a common practice to assign almost all the responsibility for these failures, both professionally and legally, to the Geotechnical Engineer, who is sometimes unable to disclose and gather all necessary evidence and information to prove that the failure or problem was not his responsibility and that his recommendations were correct.

Aware of the above mentioned problem, we wish to state that the validity of our recommendations given for this project is subordinated to the geotechnical supervision by us. If the supervision contract is not awarded to this office, the selected Inspecting Geotechnical Engineer shall receive a copy of this report, evaluate the same and adopt it as his own or request additional soil data to verify our recommendations or modify them according to his personal knowledge and judgment.

This report has been prepared taking into consideration the design factors presently known to us. The project designers shall be alerted to any item that might have been overlooked, that could require clarification or that may need additional recommendations to those discussed herein.

The standard procedures followed during the drilling of the test borings are discussed in the Appendix to this soil report.

Respectfully submitted,

IVAN JACKSON MADURO, P.E., M.S.C.E., CWI
Partner

mgn

Reference No. 4897.rep

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BORING LOGS

Suelos, PSC
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BORING LOGS

The description of subsurface profile and results of field and laboratory tests, as enclosed, pertain to conditions actually encountered at the borings location proper and at the depths indicated. Profile tracings between borings, when give, represent a reasonable interpolation of subsoil characteristics and should not be taken to indicate true intermediate conditions.

NOTES:

N	**-**	**Number of blows required to drive the sampling spoon a distance of 12" with a 140 lbs hammer falling 30".**
NW	**-**	**No water.**
WH	**-**	**Weight of hammer.**
WR	**-**	**Weight of Rods.**
W	**-**	**Natural moisture content in % of dry weight.**
qu	**-**	**Unconfined compressive strength in tons/sq ft.**
*	**-**	**Penetrometer value.**

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SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-1

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D.	Driller : M. GALVEZ	Date Started : 11/18/19	WATER LEVEL:	N < 100 = 30.5
Hammer: 140#	Method : AUGER	Date Completed: 11/18/19	Date : 11/18/19	N > 100 =
Drop : 30"	Drill Type: CME-55	Total Depth : 30.5	Depth: N/O	CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	5-5-6		Dark brown sandy silt with fine roots	11		16
	2	100	7-8-9		-same as above;	17		19
5	3	100	14-26-21		Hard olive gray silty sand with some weathered rock fragments (residual soil)	47		13
	4	100	13-15-16		-dark olive	31		15
10	5	100	17-16-20		-same as above;	36		13
15	6	100	14-16-24		-same as above;	40		15
20	7	100	18-21-22		Dark gray, dense-very dense, saprolitic silty sand	43		22
25	8	100	16-18-20		-with some weathered, friable volcanic, rock fragments, wet	38		14
30	9	100	15-25-26		-same as above;	51		15
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-2

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/19/19 Date Completed: 11/19/19 Total Depth : 30.5	WATER LEVEL: Date : 11/19/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	10-11-9		Very stiff, dark gray silt with some sand, few small angular gravel, roots	20		9
	2	100	8-11-13		-same as above;	24		19
	3	100	11-16-21		Hard olive gray sandy silt with some weathered gravel (residual soil)	37		12
5								
	4	100	19-22-20		-same as above;	42		17
	5	100	16-17-21		-same as above;	38		18
10								
	6	100	10-12-20		-same as above;	32		18
15								
	7	100	14-26-28		-same as above;	54		19
20								
	8	100	13-28-30		Hard, olive silt with some fine-medium sand	58		19
25								
	9	100	18-19-23		-same as above;	42		20
30								
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-3

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/19/19 Date Completed: 11/19/19 Total Depth : 30.5	WATER LEVEL: Date : 11/19/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	5-9-6		Grayish brown fine-coarse grained silty sand roots, dry, few small angular gravel	15		5
	2	100	6-7-8		Medium density, olive brown fine-medium grained silty sand, trace roots with trace angular small gravel	15		8
5	3	100	5-8-6		-same as above;	14		8
	4	100	5-5-4		-same as above;	9		7
10	5	100	5-9-10		Stiff-very stiff, yellowish brown, sandy silt	19		11
15	6	100	5-8-16		Medium density, olive brown silty sand with few small-medium angular, round gravel	24		7
20	7	100	11-12-10		Dark olive brown clayey silt with some small-coarse angular gravel (residual soil)	22		18
25	8	22	50/5"----- -		-same as above;	50/5"		8
30	9	0	50/1"----- -		-no recovery	50/1"		--
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-4

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/20/19 Date Completed: 11/20/19 Total Depth : 30.5	WATER LEVEL: Date : 11/20/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	4-5-6		Strong brown angular, rock fragments with silty sand	11		11
	2	100	5-7-8		Stiff, dark brown, sandy silt	15		9
5	3	100	5-8-10		Very stiff, strong brown sandy clay with trace angular-subangular gravel	18		9
	4	100	8-7-9		-same as above;	16		12
10	5	100	20-11-14		Very dense, fine-medium grained silty sand with few angular gravel	25		9
15	6	100	14-20-26		Hard, strong brown sandy silt with small-medium grained traces	46		13
20	7	100	8-9-14		Strong brown, medium density, fine-medium grained, silty sand	23		7
25	8	100	13-18-20		Olive brown colored, hard sandy silt with some small-coarse angular gravel	38		12
30	9	100	19-21-28		-same as above;	49		10
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-5
Job No. 4897
Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/20/19 Date Completed: 11/20/19 Total Depth : 30.5	WATER LEVEL: Date : 11/20/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	56	5-7-9		Topsoil: dark brown sandy silt with angular gravel, roots	16		9
	2	67	9-11-14		Small-coarse angular subangular gravel with silty sand	25		7
5	3	100	9-12-15		Very stiff-hard, yellowish brown sandy silt with little angular subrounded gravel	27		11
	4	100	18-16-20		-same as above;	36		9
10	5	100	13-16-21		-same as above;	37		7
15	6	100	11-14-13		-same as above;	27		9
20	7	100	10-19-20		-same as above;	39		10
25	8	100	14-21-32		Dense, pale olive-brown silty sand with some cemented gravel	53		23
30	9	78	12-32-50/4"		Hard, olive sandy silt (saprolite)	50/4"		16
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-6

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/21/19 Date Completed: 11/21/19 Total Depth : 30.5	WATER LEVEL: Date : 11/21/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	67	11-10-12		Strong brown, small-coarse angular gravel with some silty sand	22		8
	2	100	10-12-14		-same as above;	26		14
5	3	100	8-11-16		Very stiff, olive brown, sandy silt, dry, trace roots	27		14
	4	100	13-14-11		-same as above;	25		7
10	5	100	28-10-11		Medium density, yellowish brown sandy silt with few angular volcanic rock fragments	21		7
15	6	0	50/2"------		-same as above;	50/2"		7
20	7	0	50/2"------		-same as above;	50/2"		--
25	8	28	38-50/2"---		-same as above; with some angular gravel	50/2"		7
30	9	0	50/1"------		-same as above;	50/1"		--
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-7

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/21/19 Date Completed: 11/21/19 Total Depth : 30.5	WATER LEVEL: Date : 11/21/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	11-20-17		Hard, dark brown sandy silt, dry, fine roots	37		11
	2	100	15-16-18		-same as above;	34		15
5	3	100	15-14-9		Very stiff, grayish brown sandy silt with angular rock fragments	23		10
	4	100	8-6-7		Medium density, yellowish brown, fine grained silty sand	13		7
10	5	100	9-11-14		-same as above;	25		8
15	6	100	15-18-19		Hard yellowish brown, sandy silt, dry	37		12
20	7	100	16-21-20		-same as above; with trace rock fragments	41		12
25	8	33	43-50/1"---		Saprolite: crushed small-coarse angular gravel fragments with silty sand	50/1"		10
30	9	0	50/2"------		-no recovery	50/2"		--
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-9

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D.	Driller : M. GALVEZ	Date Started : 11/21/19	WATER LEVEL:	N < 100 = 30.5
Hammer: 140#	Method : AUGER	Date Completed: 11/21/19	Date : 11/21/19	N > 100 =
Drop : 30"	Drill Type: CME-55	Total Depth : 30.5	Depth: N/O	CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	9-11-11		Very stiff, dark brown sandy silt with fine roots, dry	22		12
	2	100	10-12-14		-same as above;	26		12
5	3	100	14-7-6		Very stiff, dry yellowish brown, sandy silt with little angular gravel	13		14
	4	100	6-7-8		-same as above; no gravel	15		10
10	5	100	11-8-9		-same as above; no gravel	17		12
15	6	100	10-20-27		Hard sandy silt with weathered angular rock fragments	47		6
20	7	100	25-27-31		-same as above;	58		9
25	8	100	23-26-28		-same as above;	54		7
30	9	33	41-50/3"---		Gray angular rock fragments with silty sand	50/3"		18
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: A-1

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/25/19 Date Completed: 11/25/19 Total Depth : 30.5	WATER LEVEL: Date : 11/25/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	2-8-9		Dark brown clayey silt with few sand, roots	17		18
	2	100	11-12-13		-same as above; sandy silt	25		15
5	3	100	14-12-10		Medium-dense, fine grained silty sand with few subangular gravel	22		12
	4	100	10-14-16		-same as above;	30		9
10	5	100	9-31-19		Strong brown, fine grained sand with few coarse round-subangular gravel	50		14
15	6	100	9-11-15		Hard, strong brown sandy silt with few round small gravel	26		12
20	7	100	27-15-17		-same as above;	32		11
25	8	56	20-21-23		-same as above;	44		12
30	9	72	26-32-50/4"		Pale olive, white, calcareous sandy silt, trace weathered cemented fragments	50/4"		--
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: A-2
Job No. 4897
Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/22/19 Date Completed: 11/22/19 Total Depth : 27	WATER LEVEL: Date : 11/22/19 Depth: N/O	N < 100 = 27 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	4-4-5		Topsoil: dark brown clayey silt with few sand, roots	9		16
	2	100	6-7-11		-same as above; wood fragments	18		16
5	3	100	20-26-21		-same as above; wood fragments	47		20
	4	100	12-21-26		Hard, strong brown sandy silt, trace small round-angular gravel	47		10
10	5	56	6-25-50/3"		-same as above;	50/3"		8
15	6	83	25-26-27		-with coarse angular gravel	53		10
20	7	100	12-20-23		-same as above;	43		9
25	8	17	50/4"----- -		Coarse, angular volcanic elastic sandstone fragments, crushed by sampling process	50/4"		6
					END OF TEST HOLE - 27 FT			
30								
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: A-3

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D.	Driller : M. GALVEZ	Date Started : 11/25/19	WATER LEVEL:	N < 100 = 30.5
Hammer: 140#	Method : AUGER	Date Completed: 11/25/19	Date : 11/25/19	N > 100 =
Drop : 30"	Drill Type: CME-55	Total Depth : 30.5	Depth: N/O	CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	16-20-15		Hard, dry grayish brown sandy silt with few roots	35		
	2	100	10-12-11		-same as above;	23		
5	3	100	10-11-13		Very stiff, sandy silt, trace small gravel, angular-subrounded	24		
	4	100	11-12-16		-same as above;	28		
10	5	100	10-7-7		Coarse, strong brown, fine grained silty sand	14		
15	6	100	12-8-11		Very stiff, strong brown sandy silt with some angular-round small-coarse gravel	19		
20	7	100	8-13-16		-same as above;	29		
25	8	100	22-31-40		-same as above;	71		
30	9	100	25-27-30		Hard, pale olive, white sandy silt with some subangular, gravel	57		
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

BORING NO.: A-4

Job No. 4897

Sheet 1 of 1

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/26/19 Date Completed: 11/26/19 Total Depth : 30.5	WATER LEVEL: Date : 11/26/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	4-3-2		Topsoil: dark brown sandy silt with some angular gravel, roots	5		12
	2	100	2-3-3		-same as above;	6		17
	3	100	8-10-12		Very stiff, dark brown, sandy silt	22		18
5								
	4	100	11-9-10		-same as above;	19		15
	5	100	8-9-11		Very stiff, strong brown sandy silt with trace small round pebbles	20		7
10								
	6	100	8-7-10		-same as above;	17		15
15								
	7	33	31-50/2"---		Crushed siltstone fragments	50/2"		8
20								
	8	0	50/2"-----		-same as above;	50/2"		--
25								
	9	0	50/1"-----		-same as above;	50/1"		--
30								
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: A-5

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/26/19 Date Completed: 11/26/19 Total Depth : 30.5	WATER LEVEL: Date : 11/26/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	7-6-5		Dark brown sandy silt with few angular gravel, roots	11		17
	2	100	5-6-5		-same as above;	11		17
	3	100	8-9-11		Very stiff, grayish brown sandy silt with some coarse angular-subrounded gravel	20		8
5								
	4	100	9-11-13		-same as above;	24		8
	5	100	10-12-12		Very stiff-hard, fine grained sandy silt	24		8
10								
	6	100	10-25-32		-same as above;	57		14
15								
	7	100	10-13-19		-same as above;	32		6
20								
	8	56	10-33-35		-same as above;	68		4
25								
	9	28	36-50/3"---		Severely weathered rock fragments, crushed by sampling process, sampled as sand and angular gravel	50/3"		3
30					**END OF TEST HOLE - 30.5 FT**			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: A-6

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/27/19 Date Completed: 11/27/19 Total Depth : 27	WATER LEVEL: Date : 11/27/19 Depth: N/O	N < 100 = 27 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material		SPT-N values	Qu TSF	Moist Cont%
	1	100	8-4-13		Topsoil: very stiff, dark brown sandy silt with roots, trace angular gravel		17		20
	2	100	10-11-13		-same as above;		24		23
5	3	100	11-14-20		Hard, strong brown sandy silt with trace angular small gravel		34		11
	4	100	13-15-21		-same as above;		36		15
10	5	100	11-13-26		Dense, strong brown fine-medium grained sand with trace subrounded gravel		39		11
15	6	22	50/5"-----		Angular silstone fragments, crushed by sampling process		50/5"		4
20	7	0	50/2"-----		-same as above;		50/2"		--
25	8	0	50/1"-----		-same as above;		50/1"		--
					END OF TEST HOLE - 27 FT				
30									
35									
40									

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-8

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/22/19 Date Completed: 11/22/19 Total Depth : 30.5	WATER LEVEL: Date : 11/22/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	4-7-8		Very stiff, dark brown sandy silt with few angular gravel, roots	15		11
	2	100	2-9-10		-same as above;	19		15
5	3	100	8-9-11		-same as above;	20		7
	4	100	10-12-13		Medium-dense, strong brown silty sand with some angular, subrounded gravel	25		5
10	5	100	8-12-8		-same as above;	20		8
15	6	100	17-32-28		-same as above;	60		5
20	7	50	19-50/5"---		Hard, strong brown sandy silt with some angular cemented rock fragments (saprolite)	50/5"		6
25	8	100	26-20-19		-same as above;	39		6
30	9	78	23-29-50/4"		Severely weathered sandstone sampled as sand, angular gravel, crushed by sampling process	50/4"		6
					END OF TEST HOLE - 30.5 FT			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

SUELOS, INC.

Soil and Construction Materials Laboratory

SUBSURFACE EXPLORATION LOG

PROJECT: CAMPAMENTO SANTIAGO, SALINAS, PUERTO RICO

BORING NO.: B-10

Job No. 4897

Sheet 1 of 1

Spoon : 1.375"I.D. Hammer: 140# Drop : 30"	Driller : M. GALVEZ Method : AUGER Drill Type: CME-55	Date Started : 11/21/19 Date Completed: 11/21/19 Total Depth : 30.5	WATER LEVEL: Date : 11/21/19 Depth: N/O	N < 100 = 30.5 N > 100 = CORE =

Depth ft	Samp No.	Recov %	S.P.T. values	RQD %	Description of material	SPT-N values	Qu TSF	Moist Cont%
	1	100	7-10-11		Very stiff, dark brown sandy silt with fine roots, dry	21		10
	2	100	9-13-14		-same as above;	27		10
	3	100	10-10-10		Stiff, yellowish brown, sandy silt some angular gravel	20		14
5								
	4	100	8-7-7		-same as above;	14		12
	5	100	8-8-9		Stiff yellowish-brown, sandy silt and fine gravel	17		12
10								
	6	100	12-19-23		Hard sandy silt with weathered angular rock fragments	42		8
15								
	7	100	23-22-22		-silty sand	44		10
20								
	8	100	25-27-30		-same as above;	57		6
25								
	9	33	50/3"-----		Gray angular rock fragments with silty sand	50/3"		16
30					**END OF TEST HOLE - 30.5 FT**			
35								
40								

"N" values are the number of blows required to drive the sampling spoon a distance of twelve inches with a 140 lbs hammer falling 30 inches. Natural Moisture Content (2) is expressed in percentage of its dry weight. Unconfined Compressive Strength (Qu) values are expressed in tons per square foot. *Pocket penetrometer values are marked with an asterisk.

DRILLING APPENDIX

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APPENDIX NO. 1

General

Comprised in this report is a description of the project as made know to **SUELOS, PSC**. and details of the project with pertinent recommendations for the design of foundations and other earth related structures. It should be considered that the design recommendations are relative to the project aspects discussed and subject to the limitations imposed by all practical considerations in the determination of subsoil conditions.

The field and laboratory data shown in boring logs represent subsoil conditions encountered at the borehole proper. The analysis and conclusions herein presented and discussed are based on such results and on a reasonable interpolation of subsoil characteristics. Whenever cross-sections with a schematic representation of the interpreted subsoil stratification between borings are included, the same should not be taken to represent true intermediate conditions but are rather given for general comparison purposes only.

Copy of this report should be made available to the Project Designers for their information and guidance, as well as to the Contractor and Resident Engineer, in order to secure maximum protection in the case of possible unexpected variations. Any such variations as well as any changes or modifications to the scope of project described after submittance of this report shall be notified by writing to these Consultants in order to evaluate same and decide upon the need to alter or modify the recommendations given.

APPENDIX NO. 2

Field and Laboratory Work

Field exploration was made by **SUELOS, PSC.**, a private laboratory to the services of these Consultants. The field work consisted of a visual observation of the area and existing structures at the site, if any, and of performance of test borings as indicated.

Test borings were made in accordance to the "Standard Penetration Test and Split-Spoon Sampling of Soils Method", as proposed by the Standards of the American Society for testing and Materials Designation ASTM D-1586, Latest Revision.

The testing hole is bored either by manual and mechanical augers or by driving a 2.5 inch inside diameter casing into the ground which is washed clean internally each time a soil sample is to be secured below its reach. While sampling, the Standard Penetration Test is performed and the "N" values recorded. This is the number of blows required to drive the split-spoon sampler 12 inches into the ground using a 140 lbs. hammer with a free fall of 30 inches.

The value gives an indication of the consistency of cohesive soils and the relative density of granular soils as shown in the following table:

COHESIVE SOILS

"N" Values	Consistency	Unconfined Comp. Strength (TSF)
less than 2	very soft	less than 0.25
2 - 4	soft	0.25 - 0.50
4 - 8	medium	0.50 - 1.00
8 - 15	stiff	1.00 - 2.00
15 - 30	very stiff	2.00 - 4.00
over 30	hard	over 4.00

GRANULAR SOILS

"N" Values	Relative Density
0 - 5	very loose
5 - 10	loose
10 - 30	medium
30 - 50	dense
over 50	very dense

Depth of water surface shown on logs indicate the phreatic level found either prior to use of any casing and water or taken 24 hours after the test borings was completed and the casing, if any, is pulled out. The information given, unless otherwise indicated, is not a adequate for study of deep excavations and is only to be used as an approximate level in the study of a normal foundation of the project. Phreatic or underground water levels may vary with seasonal rainshower variations thus water may appear where none is shown and the reader of this report should be aware of this fact. For excavations where ground water levels are of utmost importance special studies consisting of long range observations on installed wellpoint-type devices should be performed. Where deep excavations are contemplated, as in pumping stations, study of artesian or sub-artesian aquifers should be made by means of deep test borings and pumping tests.

DIAMOND CORE DRILLING

Whenever drilling through rock is necessary the same is made following the "Diamond Core Drilling for Site Investigation" method as proposed by the standards of the American Society for Testing and Materials Designation ASTM D-2113-L.R. In general a double tube core barrel with diamond bit is rotated under pressure into the rock. The drilled rock enters into the barrel using circulating water as cooling agent. At intervals of 2 to 5 feet the barrel is lifted and the core is removed. The length of each core run as well as the length of the core recovered is noted.

LABORATORY WORK

➢Water Contents

The natural moisture content was determined for all samples, except for those with high percentage of gravel or coarse sand.

The tests follow standards of the American Society for Testing and Materials ASTM Designation D-2216, Latest Revision. The water or moisture content of a given soil mass is by definition the ratio of the weight of water to the oven dry weight of the soil, expressed as a percentage.

➢Unconfined Compression Tests

All suitable samples of cohesive soil recovered from the split-spoon sampler were tested in unconfined compression. The ratio of the maximum load required for failure to the corrected cross sectional area of the sample expressed in tons per square foot is defined as the unconfined compressive strength.

➢**Examination and Description**

Soil samples are classified according to their constituents, the following terminology used to denote the approximate percentage by weight of each component.

Description Term	Percent by Weight
Trace	1 - 10
Little to some	10 - 20
Sandy, silty clayey	20 - 35
and	35 - 50

The examined samples are related into one of the following main groups; boulders, gravel, sand, clay, and silt. On peat, the presence of the decomposed and partly decomposed vegetable matter, is used for identification. The differentiation between a clay and a silt is based on the presence or lack of plasticity, dilatancy and dry strength rather than on grain size. The description of the soil includes: color, odor, minerals, presence of foreign matter, geological history, etc. These descriptions as well as the results of the laboratory testing are used in grouping similar samples into a stratigraphic unit as shown on the final boring logs. Therefore, the data on subsurface exploration logs represent subsoil conditions at the precise locations of the boreholes only.