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REPORT

ON THE GEOTECHNICAL EXPLORATION CONDUCTED AT THE SITE OF THE PROPOSED VIRGIN ISLAND HOUSING FINANCE AUTHORITY MIXED USE PROJECT, CHARLOTTE AMALIE, ST. THOMAS, USVI

Submitted to:

Arch. Carlos Ferreyra

C.A.Ferreyra and Associates

Prepared by:
Carlos R. Sierra MSCE, PE

Date:
December 19, 2017
Job No. 7807

This report contains 27 pages including cover

REPORT

ON THE GEOTECHNICAL EXPLORATION PERFORMED AT THE SITE OF THE PROPOSED VIHFA MIXED USE PROJECT, ST. THOMAS, USVI

1.0 INTRODUCTION:

The present soil report covers the results of the geotechnical exploration performed at the site of the proposed Virgin Islands Housing Finance Authority (VIHFA) mixed use project located in parcels no. 26A, no. 102, no. 103 and no. 104, Estate Taarneberg, St. Thomas, U.S. Virgin Islands (USVI). The mixed use project includes two (2) new concrete structures. Figure 1 below presents a satellite image showing the project site location.

Jaca & Sierra Engineering, PSC was contracted by *C.A. Ferreyra & Associates, Inc.* to conduct site investigations and prepare geotechnical recommendations for the project. The exploration program was directed to obtain subsurface soil information to be utilized in our engineering evaluation and in the formulation of pertinent recommendations for the intended structure foundation system and earthwork operations.

This geotechnical study was carried out in function of the following documents provided to us:

- Drawing illustrating the existing and new planned structure locations within the project parcels;
- Required geotechnical data for the project dated August 24, 2017.

This soil report has been prepared for the exclusive use of the owner, their architects, engineers and/or others involved in the preparation of design plans and specifications for the project.

Figure 1: Project site location in Google Earth satellite image[1].

2.0 FIELD AND LABORATORY WORK:

The field exploration consisted of drilling a total of four (4) test borings, two (2) within the footprint of each new structure. Borings were drilled to depths of 10 and 20 feet Beneath Existing Ground Surface (BEGS). Refer to boring location plan in Appendix A.

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[1] Google Earth, "St. Thomas, U.S. Virgin Islands", 18°20'29" N 64°55'18" W, Imagery Date: 8/10/2017.

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

The soil samples were secured in closed plastic bags and transported to our laboratory for visual-manual description (ASTM D2488) and moisture content determination (ASTM D2216).

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

3.0 SUBSOIL GENERALIZED CONDITIONS:

3.1 Site Geology:

According to the U.S. Geological Survey (USGS) geologic map of the St. Thomas and St. John islands, the explored area falls within a geologic zone that corresponds to *Lousenhoj Formation (Kl)*. Figure 2 below shows a portion of the geologic map and the approximate site location. The mentioned geology is described as a volcanoclastic rock formation.

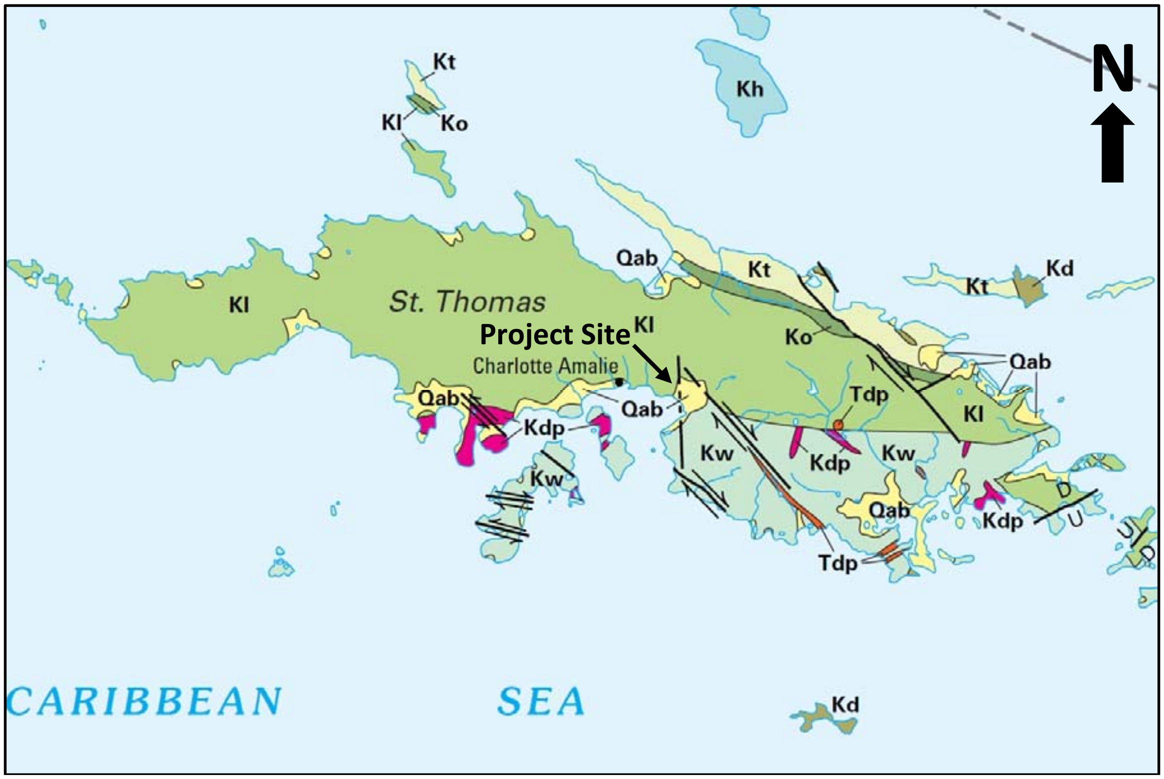

Figure 2: Project site location in USGS geologic map[2].

3.2 Soil Stratigraphy:

The stratigraphy is characterized by an upper 3 to 9 feet thick layer of man-made fill material, followed by 5 to 11 feet thick layer of saprolitic soil, underlain by weathered rock from the above mentioned Lousenhoj Formation extending to the end of boreholes (10 to 20 feet depth BEGS). Each stratum is described as follows:

[2] R.A. Renken, W.C. Ward, I.P. Gill, F. Gómez-Gómez, J. Rodríguez-Martínez, and others (2002). "Geology and Hydrogeology of the Caribbean Islands Aquifer System of the Commonwealth of Puerto Rico and the U.S. Virgin Islands", Regional Aquifer-System Analysis – Caribbean Islands, U.S. Geological Survey Professional Paper 1419, pp. 9, 11 & 12.

Stratum no. 1 – Man-Made Fill

The upper man-made fill material is composed of sandy silt with clay and clayey silt with sand, both with rock fragments and occurring roots and construction debris. SPT-N values recorded are varying from 5 to 27 blows per foot (bpf) of penetration. This layer varied in depth from 3 to 9 ft depth, at boring no.3 and no.1, respectively.

Stratum no. 2 – Saprolitic Soil

The above described fill stratum overlays natural saprolitic soil comprised of clayey silt with rock fragments. SPT-N values registered are ranging from 7 to 28 bpf for a medium stiff to very stiff consistency.

Stratum no. 3 – Weathered Rock

The lower stratum encountered was weathered rock sampled as rock fragments. The SPT tests resulted in N values over 100 bpf (i.e. refusal blow counts, e.g. 50 blows per 1 inch of penetration depicted as 50/1" in boring no. 1).

3.3 <u>Groundwater Level:</u>

The observations made at the time of our fieldwork revealed groundwater level from 6 to 8 feet depth BEGS. However, groundwater level may rise during and after prolonged rain events. In addition, perched or temporary bodies of water might be found trapped within the upper fill deposits or along the zone of transition between fill and native soil strata.

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

4.0 RESULTS AND RECOMMENDATIONS:

The proposed project consists of two (2) new concrete structures having footprint areas of approximately 2,500 and 3,500 ft^2, respectively. The new structures will be built within a lot covering an approximate area of 30,000 ft^2. At present, the lot is relatively empty, since four (4) previous structures were completely demolished.

A grading plan for the project was not available at the moment of preparation of this report. However, it is assumed that final grade elevations and Finish Floor Elevations (FFE) will be near the existing ground surface elevations.

The geotechnical investigation uncovered 3 to 9 feet of man-made fill followed by 5 to 11 feet of clayey silt with gravel soil underlain by weathered rock. Based on the uncovered subsoil conditions, it is our opinion that the new structures can be designed over conventional shallow foundations provided that proper site preparation, consisting of removal and replacement of the upper 3 to 4 feet of existing fill, is performed as recommended in this report.

The following subsections provide geotechnical recommendations for design and earthwork operations.

4.1 Shallow Foundation Design:

The new structures can be built over shallow foundation system such as isolated spread footings, continuous strip footings or mat foundations. Shallow foundations shall be designed for a net allowable bearing capacity (q_a) of 2,500 psf. The allowable bearing capacity can be increased by 33% for cases of combined static and transient (wind and earthquake) loading conditions. Base shear coefficient of friction (μ) shall be assumed to be 0.35.

In case of footings, its base shall be lowered to a minimum depth of 2.5 feet below adjoining final grade. In order to avoid localized shear failure, the minimum footing size shall be 2.5 feet for isolated spread footings and 2 feet for continuous strip footings. All footings shall be placed over a minimum 1-foot thick layer of new fill material consisting of A-2-4, A-1-b or A-1-a as per AASHTO classification system (AASHTO).

Mat foundations (flexible or rigid) can be designed to match FFE and its required structural thickness. A vertical peripheral apron of at least 1.5 feet depth shall be extended below adjoining ground at final grade. Mats shall be placed over a minimum of 1-foot thick layer of new A-2-4, A-1-b or A-1-a fill material (AASHTO. A modulus of subgrade reaction (k) of 100 psi/in shall be considered for design. In designing mat foundations for these structures, it is important to verify eccentricity along perimeter wall foundations and confirm foundation stresses not exceeding the herein recommended allowable. The final design should include polyethylene moisture barriers below foundation slabs.

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It is our opinion that total settlements of structures will not be greater than 1 inch. For design purposes, differential settlements shall be considered for an angular distortion of 1/500.

Grading shall provide for positive drainage to direct runoff away from the structures and its foundations. No roof downspouts should be allowed. All roof and surface drainage shall be directed away from the structures or connected to the storm sewer system. This is necessary to prevent localized water infiltrations that may trigger migration of fines and related ground subsidence.

4.2 Seismic Site Classification:

Based on our evaluation of the test borings completed and our knowledge of the site geological conditions, it is our opinion that the seismic site classification as per ASCE Standards and IBC Codes is Site Class D, which corresponds to a stiff soil profile. The design spectral acceleration parameters at short period (S_{DS}) and at 1 second period (S_{D1}) are presented in Table 1 below.

Table 1: Design spectral acceleration parameters.

ASCE Standard	IBC Code	S_{DS} (g)	S_{D1} (g)
ASCE 7-05	IBC 09	0.766	0.379
ASCE 7-10	IBC 15	0.828	0.451
ASCE 7-16	IBC 18	0.828	0.537

St. Thomas is located northeast of the Caribbean Plate. The Anegada Through represents the nearest seismic hazard of the island. The fault is an extension zone between the Caribbean plate and Northeast Caribbean Microplate of PR, USVI and BVI located at an approximate distance of 30 kilometers to the south. In 1867, an earthquake of 7.3 on the Richter magnitude scale (M_L) occurred in the Anegada Trough. The focal depth was less than 30 kilometers and the epicenter was located between the islands of St. Thomas and St. Croix. This earthquake caused damages to masonry structures in St. Thomas and produced a Tsunami that affected the Charlotte Amalie Harbor and other coastal developments in the region. Other seismic hazards are present to the north along the Puerto Rico Trench which is an oblique fault consisting of the plate boundary between the Northeast Caribbean microplate and the Atlantic Plate. This seismic zone tends to generate relatively deep crust earthquakes closer to the island region and shallower focal depths in the crust towards the deep waters to the north farther away from the islands. This zone produces more seismic activity in the form of more recurrent small magnitude earthquakes if compared to activity in the Anegada Through. There are no inland active faults in the island of St. Thomas.

The soil conditions on the site below the upper loose fill, that is proposed to be removed, consist mostly of stiff cohesive soils. Based on our reasonable understanding and literature of soil response to seismic events, it is our opinion that these soils will not be prone to seismic liquefaction.

4.3 <u>Excavations and Site Preparation:</u>

The upper 3 to 4 feet of subsoil shall be excavated with conventional excavation equipment. These excavations shall be extended a minimum horizontal distance of 3 feet beyond the perimeter of the structures. Minimum depths of excavations required at each boring location are shown in Table 2 below.

Table 2: Excavation depths at boring locations.

Boring no.	Excavation Depth (ft)
1	4
2	4
3	3
4	4

This excavations shall cover the building footprint and 3 ft beyond its periphery. After excavations, the exposed grade shall be roller compacted and then proof rolled with loaded truck for detection of weak spots. Any weak spots encountered have to be completely excavated. Then, all the removed soil shall be replaced with new properly placed and compacted A-2-4, A-1-b or A-1-a fill material (AASHTO) up to reach final grade elevations or foundation bottom grade level, following the "Fill Placement Guidelines" provided in subsection below.

Excavations and site preparation works shall be coordinated with the consultant geotechnical engineer to monitor earthwork in progress and to direct any required variations on the provided recommendations, if deemed necessary. Different subsoil conditions may be found within the project site area, especially in unexplored zones. Therefore, the final extensions of excavations and site preparation will be determined on field during earthwork operations. A full-time resident geotechnical engineering technician is recommended to monitor proper implementation of these measures.

Any existing abandoned underground utilities, substructures, buried debris and/or other unsuitable material encountered during excavations shall be completely removed and replaced with new A-2-4, A-1-b and A-1-a fill (AASHTO). Any known abandoned underground utilities beyond excavation depths should be grouted. Any active underground utilities within the footprints of the new structures shall be relocated.

The excavations shall be maintained in a dry state. Runoff shall be diverted away from any open excavations. Water stagnation shall be avoided as this may deteriorate the soil bearing capacity.

Groundwater level was encountered at 6 to 8 feet depth BEGS at the time of our fieldwork. This has to be considered for excavations and foundation design and construction. If necessary, we could provide recommendations for dewatering and design considering hydrostatic pressures upon request and submission of excavation plan and foundation design to us. If perched or temporary bodies of water are found during excavations, it should be managed by means of direct pumping.

4.4 Excavation Protection:

In areas where shallow temporary excavations will be performed (not more than 5 feet depth), open excavations may prove satisfactorily. However, deeper temporary excavations will require a designed excavation protection. Lateral protection for temporary excavations can be designed considering a soil cohesion (c) and an angle of internal friction (ϕ) of 500 psf and 28°, respectively, for lateral earth pressure calculations.

As an alternative, the sides of the temporary excavations could be sloped or supported by means of timber or aluminum shoring systems following the rules, regulations, requirements and guidelines provided in OSHA 29 CFR Part 1926 Subpart P – Excavations. The soil profile should be classified as Type B soil. The maximum allowable slope for temporary excavations less than 10 feet depth is 1H:1V ratio.

The project contractor is responsible for providing safe excavation environment for working personnel in accordance to pertinent OSHA regulations at the time of construction. The contractor should also ensure that his methods or protection systems safeguard adjacent structures or substructures against potential damages during construction.

4.5 Earth Retaining Structures:

Any retaining wall system required within the project may consist of MSE walls, concrete cantilever walls or other types of gravity walls. The lateral earth pressure parameters will depend on many factors including the type of soil used as backfill and the equipment used to perform the compaction procedures. Table 3 below displays our suggested soil parameters for earth pressure calculations and design assuming A-2-4 soil material (AASHTO) as backfill. In case of MSE walls, we recommend use of the same soil parameters for engineered backfill (external stability check) and reinforced soil zone (internal stability design).

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Table 3: Design soil parameters for earth pressure calculations.

Soil Parameters	Design Values
Soil Material	A-2-4 Fill
Cohesion, c (psf)	0
Angle of Internal Friction, ϕ (°)	34
Moist Unit Weight, γ (pcf)	135

The base of the footings shall be embedded a minimum depth of 2 feet beneath adjoining final grade. All yielding retaining walls shall be designed using active lateral earth pressures. Meanwhile, at-rest lateral earth pressures shall be used for unyielding walls such as in basements, cisterns or any buried portions of structures that will be rigid.

A net allowable bearing capacity (q_a) of 2,500 psf shall be considered for footing design. Base shear coefficient of friction (μ) shall be assumed to be 0.35.

In order to collect any water infiltrating into the backfill and drain any migrating or perched bodies of water, an underground drainage system shall be installed at the bottom of the inner face of the walls. The underground drainage may consist of a minimum 4-inch diameter perforated drain pipe covered with clean crushed rock (i.e. free draining soil). The perforated pipe and crushed rock should be wrapped or enclosed within a permeable non-woven geotextile (Mirafi 140N or equivalent). The drainage system should drain by gravity to daylight at suitable location or should be connected to the storm sewer system. In addition, weep holes will be necessary as part of the drainage in case of concrete cantilever walls.

Any sloping backfill above retaining walls and permanent fill slopes required within the project shall have a maximum inclination of 2:1 (H:V) ratio. The face of the slopes should be covered with vegetation to control soil erosion. Overland runoff over slopes should not be allowed.

4.6 <u>Access Roads and Parking Lots:</u>

The areas for access roads and parking lots will require site preparation by means of clearing and grubbing (i.e. removal of topsoil, vegetation, roots and foreign debris) and proof rolling as recommended in "Excavations and Site Preparation" subsection above. This clearing and grubbing procedures should be performed within the upper 6 to 12 inches of subsoil, approximately.

The California Bearing Ratio (CBR) value for subgrade consisting of existing man-made fill material (after clearing and grubbing and proof rolling) is estimated to be 5 for asphalt and/or concrete pavement design. In the event that it is desire to improve subgrade in order to attain a higher CBR value, we recommend a minimum of 2 feet thick layer of new A-2-4, A-1-b or A-1-a fill material (AASHTO) below pavement section. The design can assume a CBR value of 20 for the improved subgrade. For concrete pavement, a modulus of subgrade reaction (k) of 150 psi/in shall be considered for the existing subgrade and 250 psi/in for the improved subgrade.

Pavement layers and thicknesses shall be based on final design pavement section. The design of the pavement section is out of our scope of work.

We recommend the performance of field CBR tests over the prepared subgrade prior to pavement construction in order to confirm the CBR values used in design. CBR tests should be conducted following ASTM D4429. The quantity and location of the tests should be coordinated with the consultant geotechnical engineer.

4.7 Trenches and Underground Utilities:

New underground utilities will require trench excavations and placement of foundation fill, bedding and backfill. Figure 3 below illustrates the different pipeline embedment zones required for proper installation. Table 4 below summarizes our recommendations for the fill material types allowed per zone and the recommended handling and compaction.

In order to overcome possible weak spots within the exposed existing man-made fill after trench excavations, the foundation fill shall consist of a minimum 12-inch layer of A-2-4, A-1-b or A-1-a fill material (AASHTO) or 1-inch down size crushed rock (angular shape, hard and durable) with no fines content. Foundation fill thickness may be adjusted in the field per observations made by geotechnical supervision.

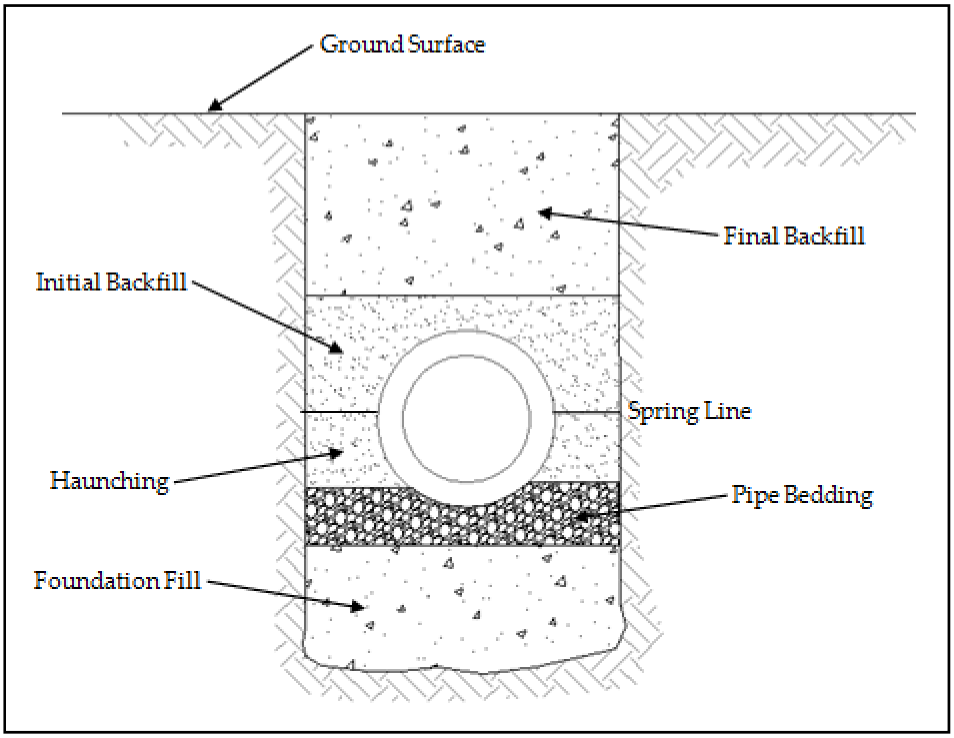

Figure 3: Typical detail of pipeline embedment zones (not to scale).

Table 4: Fill and compaction requirements per embedment zone.

		Compaction Requirements – Modified Proctor ASTM D1557			
Fill Type	**Max. Lift Thickness**	**Foundation Fill**	**Bedding**	**Haunching/ Initial Fill**	**Final Fill**
Clean Crushed Rock – ¾″ or 1″ down	12″	Densified to Unyielding	Spread and Leveled	Densified to Unyielding	N/A
A-1-a – AASHTO	8″	87%	N/A	82%	92%*
A-1-b or A-2-4 – AASHTO	6″	90%	N/A	85%	95%
A-2-6 – AASHTO	4″	N/A	N/A	N/A	95%

**The last lift layer under the pavement base course should be compacted to 95% with ride on compactor.*

The installation of pipelines shall be provided with properly designed bedding layer as established by manufacturer or project designer. Bedding material shall consist of free draining cohesionless soil such as clean angular crushed rock-gravel (open graded clean manufactured aggregates), ¾-inch down and a maximum of 5% passing sieve no. 8, or any other suitable material approved by the pertinent government authorities or pipe manufacturer. The crushed rock-gravel for pipeline bedding shall have a Los Angeles wear (ASTM C131) of 45% or less after 500 revolutions.

For backfill, first the haunching area shall be constructed by uniform placement of fill in lifts in both sides of the pipeline. Then, the initial backfill shall be placed around the top of the pipeline. The initial backfill extends from the pipe spring line to 6 inches above the top of the pipeline. For haunching and initial backfill, A-2-4, A-1-b or A-1-a fill material (AASHTO) or the same crushed rock material recommended for foundation fill or bedding could be used. A hand-operated vibratory plate compactor could be necessary to reach adequate compaction at both sides and at top of the pipeline.

The final backfill shall be placed after completion of initial backfill and shall consist of A-2-6, A-2-4, A-1-b or A-1-a fill material (AASHTO) compacted as per recommendations in Table 4 above. To mitigate damage to the pipeline during compaction, there should be at least 18 inches of fill cover over the pipeline before using portable or walk behind compactors. For use of larger ride on compactor, it should be consulted with the structural engineer on the loading capacity of the pipe section.

4.8 Fill Placement Guidelines:

A controlled fill construction procedure shall be performed wherever new fill material is required. The fill placement guidelines are the following:

1. The area of the proposed fill placement shall be cleared of topsoil, organic matter and foreign debris. The exposed grade, prior to placement of new fill material, shall be compacted and then proof rolled to detect weak spots. Any weak spots encountered have to be excavated and replaced with new fill material.
2. The fill soil material shall consist of well-graded granular fill complying with A-2-4, A-1-b or A-1-a soil classification as per AASHTO (SM, SW, GM or GW according to USCS), unless otherwise noted in subsections above. The consultant geotechnical engineer should approve this soil material. Boulders within fill for structures should be discarded. Maximum coarse aggregate size should be 6 inches. In-situ excavated fill material can be reused as new fill material if it is in compliance with these requirements.
3. The fill material shall be placed in layers not exceeding 8 inches of thickness (unless otherwise noted in Table 4 above), as measured before compaction, on a surface free of water. Each layer shall be compacted to a minimum of 95% (unless otherwise noted in Table 4 above) based on its maximum dry density determined from a modified Proctor compaction test following ASTM D1557.

4. The construction of the new fill layers shall be made under the direct supervision of a geotechnical engineering technician. The presence of the technician shall be continuous from the initiation of earthwork operations until the final grade is reached. The technician shall certify that fill construction was made in conformity with these specifications. The technician should be able to delimitate unsuitable material and to make the pertinent compaction tests to the new placed fill material.

5.0 ADDITIONAL COMMENTS:

It is recommended that this submitted geotechnical report be carefully studied and evaluated to coordinate those pertinent office meetings during the project design stage to discuss the various considered project design concepts and to clarify or include any other pertinent geotechnical design recommendations not covered in our soil report. These meetings are directed to avoid any future claims of the project contractors based on any potential differing site conditions. This report along with any additional letter and/or addendum revisions should be provided to bidding contractors.

Note that the herein given recommendations are based on test borings performed on spots, which are considered as representative of the subsoil conditions within the project site. However, this fact does not guarantee that different conditions may be found during

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excavations and/or construction progress. In such instances, we shall be notified to proceed with a field visual inspection directed to formulate the corresponding solution.

In the event that the present analyzed project design concept is revised, a copy of the new design shall be provided to us. Thereafter, we can evaluate additional general design recommendations and construction considerations. In addition, final design and grading plans shall be submitted to us for evaluation to confirm or adjust the herein provided recommendations, if deemed necessary.

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

Cordially yours,
JACA & SIERRA ENGINEERING, PSC

Rommel Cintrón Aponte, MSCE, PE

Carlos R. Sierra Del Llano, MSCE, PE

<u>Enclosures</u>

Appendix A: Boring Logs & Locations

Appendix A:
Boring Logs & Locations

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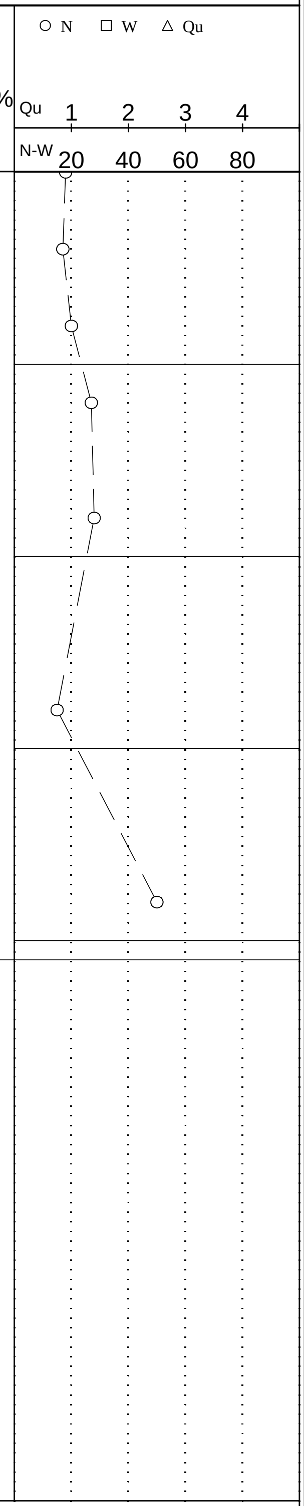
SUBSURFACE EXPLORATION LOG

BORING No.: 1

PROJECT: VIHFA Mixed Use Project	**JOB:** 7807	**SHEET** 1 **OF** 1
LOCATION: St. Thomas, USVI	**DRILLER/DRILL RIG:** Carlos I. Diaz / CME-55	
COORDINATES:	**DATE STARTED:** 10-20-17	**DATE COMPLETED:** 10-20-17
DESCRIPTION BY: Carlos R. Sierra Del Llano	**SURFACE ELEVATION (ft):**	
GROUNDWATER (ft): Initial: 8 Final: 7	**ENGINEER:** Carlos R. Sierra Del Llano	
DRILLING METHOD: Hollow-Stem Auger 2.25"	**TOTAL DEPTH (ft):** 20.5	

ELEV (ft)	DEPTH (ft) 0.00	DESCRIPTION	LEGEND	SAMPLE NO.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
0.00	0	FILL: sandy silt with clay, rock fragments and occurring construction debris, grayish brown (0–9)		S-1		4 9 9	18				
				S-2		10 10 7	17				
	5			S-3		4 11 9	20				
				S-4		9 12 15	27				
-9.00	10	CLAYEY SILT with rock fragments, very stiff, reddish brown, gray (saprolite) (9–19)		S-5		9 13 15	28				
	15			S-6		4 5 10	15				
-19.00	20	WEATHERED ROCK sampled as rock fragments, gray		S-7		50/1"	50/1"				
	25										
	30										



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

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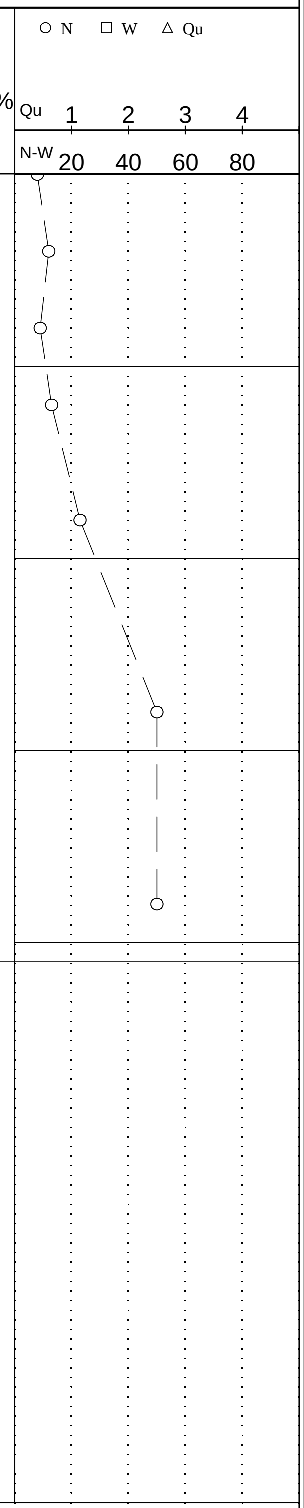
SUBSURFACE EXPLORATION LOG

BORING No.: 2

PROJECT: VIHFA Mixed Use Project	**JOB:** 7807	**SHEET** 1 **OF** 1

LOCATION: St. Thomas, USVI	**DRILLER/DRILL RIG:** Carlos I. Diaz / CME-55
COORDINATES:	**DATE STARTED:** 10-20-17 **DATE COMPLETED:** 10-20-17
DESCRIPTION BY: Carlos R. Sierra Del Llano	**SURFACE ELEVATION (ft):**
GROUNDWATER (ft): **Initial:** 9 **Final:** 8	**ENGINEER:** Carlos R. Sierra Del Llano
DRILLING METHOD: Hollow-Stem Auger 2.25"	**TOTAL DEPTH (ft):** 20.5

ELEV (ft)	DEPTH (ft) 0.00	DESCRIPTION	LEGEND	SAMPLE NO.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
0.00	0	0 FILL: clayey silt with rock fragments and sand, occurring roots and debris, brownish gray		S-1		2 4 4	8				
				S-2		14 8 4	12				
-4.00		4									
	5	CLAYEY SILT with rock fragments, stiff to very stiff, reddish brown, gray (saprolite)		S-3		4 4 5	9				
				S-4		8 7 6	13				
	10			S-5		9 11 12	23				
				S-6		11 19 50/3"	50/3"				
-15.00	15	15									
		WEATHERED ROCK sampled as rock fragments, gray		S-7		50/6"	50/6"				
	20										
	25										
	30										



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

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

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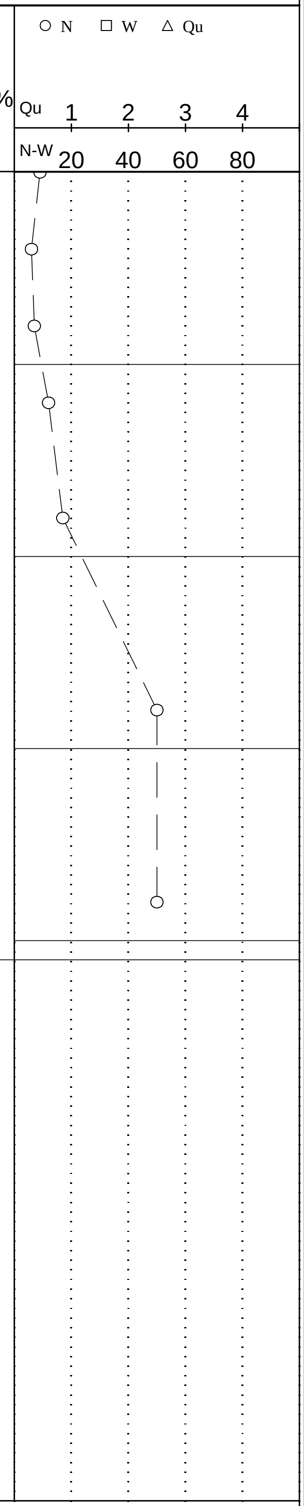
SUBSURFACE EXPLORATION LOG

BORING No.: 3

PROJECT: VIHFA Mixed Use Project		**JOB:** 7807	**SHEET** 1 **OF** 1
LOCATION: St. Thomas, USVI		**DRILLER/DRILL RIG:** Carlos I. Diaz / CME-55	
COORDINATES:		**DATE STARTED:** 10-20-17	**DATE COMPLETED:** 10-20-17
DESCRIPTION BY: Carlos R. Sierra Del Llano		**SURFACE ELEVATION (ft):**	
GROUNDWATER (ft): **Initial:** 6	**Final:** 6	**ENGINEER:** Carlos R. Sierra Del Llano	
DRILLING METHOD: Hollow-Stem Auger 2.25"		**TOTAL DEPTH (ft):** 20.5	

ELEV (ft)	DEPTH (ft) 0.00	DESCRIPTION	LEGEND	SAMPLE NO.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
0.00	0	0 FILL: clayey silt with rock fragments and sand, occurring roots and debris, brownish gray		S-1		3 6 3	9				
				S-2		3 3 3	6				
-3.00	3	CLAYEY SILT with rock fragments, medium stiff to very stiff, reddish brown, gray (saprolite)		S-3		4 3 4	7				
	5			S-4		8 6 6	12				
	10			S-5		8 9 8	17				
-14.00	14	WEATHERED ROCK sampled as rock fragments, gray		S-6		11 50/6"	50/6"				
	15–20			S-7		22 50/5"	50/5"				



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

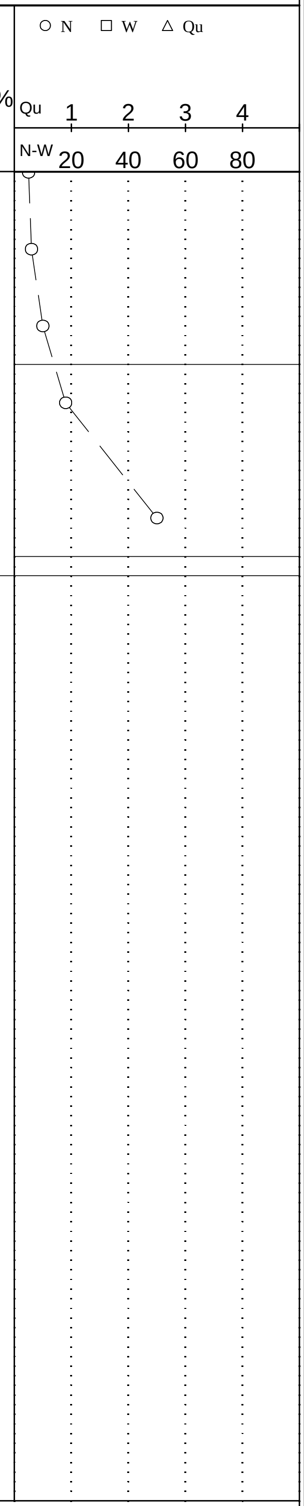
SUBSURFACE EXPLORATION LOG

JACA & SIERRA Testing Laboratories
Geotechnical Engineers

BORING No.: 4

PROJECT: VIHFA Mixed Use Project	**JOB:** 7807	**SHEET** 1 **OF** 1
LOCATION: St. Thomas, USVI	**DRILLER/DRILL RIG:** Carlos I. Diaz / CME-55	
COORDINATES:	**DATE STARTED:** 10-20-17	**DATE COMPLETED:** 10-20-17
DESCRIPTION BY: Carlos R. Sierra Del Llano	**SURFACE ELEVATION (ft):**	
GROUNDWATER (ft): Initial: Final:	**ENGINEER:** Carlos R. Sierra Del Llano	
DRILLING METHOD: Hollow-Stem Auger 2.25"	**TOTAL DEPTH (ft):** 10.5	

ELEV (ft)	DEPTH (ft) 0.00	DESCRIPTION	LEGEND	SAMPLE NO.	TYPE	BLOWS	SPT N	W	Qu	RC	RQD%
0.00	0	0 FILL: clayey silt with rock fragments and sand, occurring roots and debris, brownish gray		S-1		1 2 3	5				
				S-2		3 3 3	6				
-4.00		4 CLAYEY SILT with rock fragments, stiff to very stiff, reddish brown, gray (saprolite)		S-3		3 5 5	10				
	5			S-4		6 6 12	18				
-9.00		9 WEATHERED ROCK sampled as rock fragments, gray		S-5		50/2"	50/2"				
	10										
	15										
	20										
	25										
	30										



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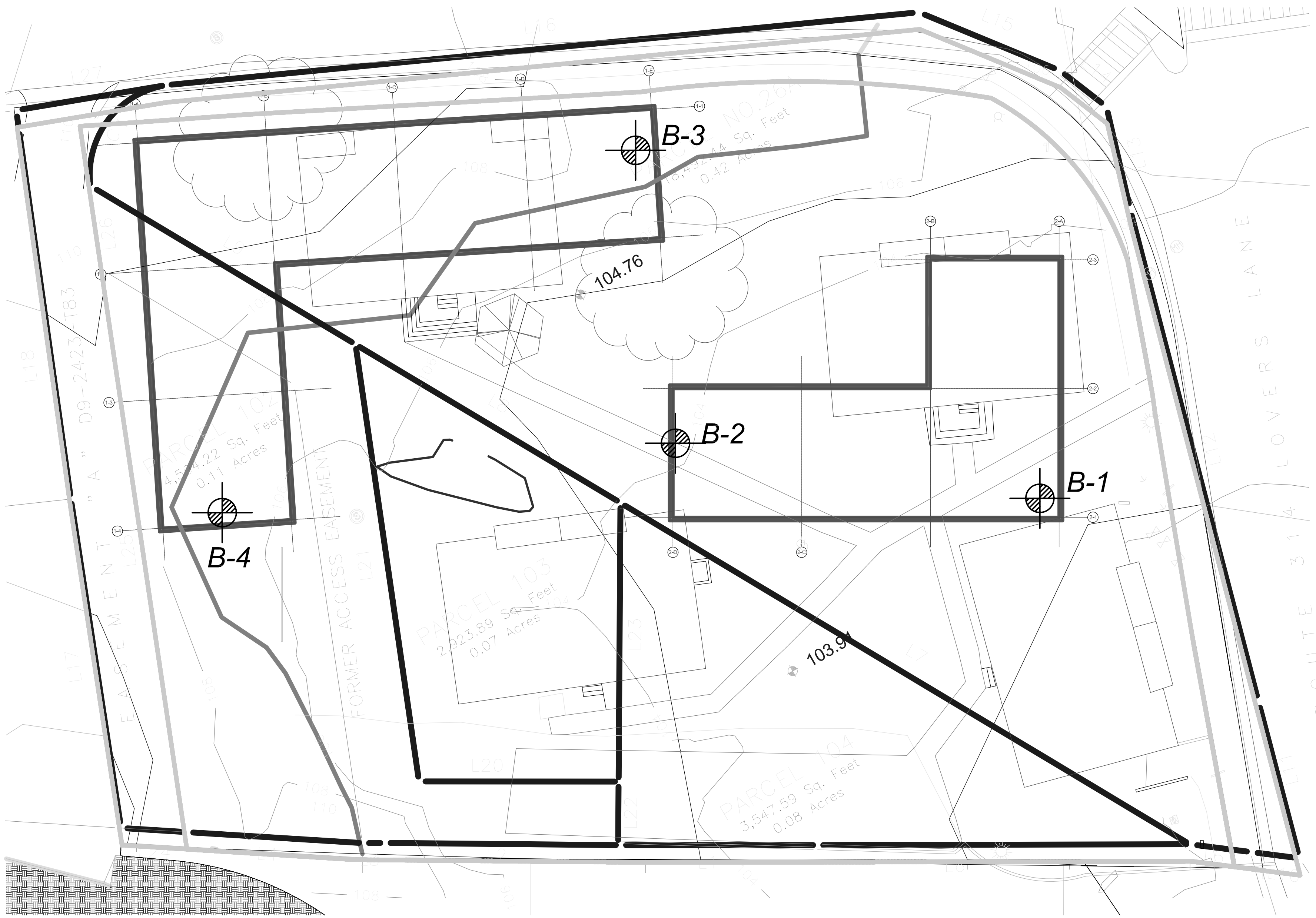
Initial G.W. Depth
Final G.W. Depth



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Geotechnical Engineers

Boring location Plan

Boring location

B-#