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GEOTECHNICAL DATA REPORT

Slide MP CFP-102.9

ALEXANDRIA, VIRGINIA

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

June 2018

S&W No: 100749-001

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Slide MP CFP-102.9
Alexandria, Virginia

Geotechnical DATA Report

Shannon & Wilson participated in this project as a consultant to CSX Transportation, Inc. (CSXT). Our scope of services was directed to obtain six borings in the vicinity of the slide area and to develop alternatives to the slide repair including a new slope and a retaining wall.

This report was prepared and reviewed by:

[redacted]

Roberto J. Guardia
Vice President
VA PE 48174

SSS:DDF:RJG/rjg

CONTENTS

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CONTENTS

Exhibits

CONTENTS

Figures

Appendices

ACRONYMS

ASCE	American Society of Civil Engineers
ASTM	ASTM International
bgs	below ground surface
CSXT	CSX Transportation, Inc.
FS	factor of safety
H	wall height
H:V	horizontal to vertical
pcf	pounds per cubic foot
psf	pounds per square foot
psi	pounds per square inch
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey

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1 INTRODUCTION

On the morning of May 19, 2018, a derailment occurred on Track No. 1, near MP CFP 102.9 near the 4300 block of Wheeler Avenue in Alexandria, Virginia. At the time of the derailment a slide scarp was observed approximately 300 feet north of the nearby overpass bridge. This geotechnical data report was prepared to describe the geotechnical conditions of the site. The slide is located on the Baltimore Division, RF&P Subdivision.

This report presents our field explorations and associated laboratory testing, and initial geotechnical engineering analyses. The following subsections summarize our scope of services and the basis for our report.

2 SCOPE OF SERVICES

On May 20, CSXT directed Shannon & Wilson, Inc. to perform borings in the embankment of the slide area and to provide alternative recommendations to repair the slide area. Mr. Tod Echler, Mr. Edward Sparks and Mr. Brandon Knapp met onsite with Mr. Roberto Guardia around 11 AM. At approximately 4:30 PM a representative of SaLUT arrived at the site to review the access, site conditions and the locations of the proposed borings. The six borings to a depth of 40 feet were performed on May 21 to May 23. Utility locates were requested in the morning of May 21. CenturyLink marked the fiber optic locations in the vicinity of the borings.

Our scope of services was to perform six borings in the Railroad embankment, perform slope stability analysis representative of the slide and to provide slide repair recommendations and retaining wall alternatives.

3 SITE AND PROJECT DESCRIPTION

The site is located south of Wheeler Avenue, as shown in Figure 1. The triple track is supported on an approximately 27-foot-high embankment that leads to the overpass bridge. The overpass bridge, the slide and boring locations are shown in Figure 2.

The slide scarp is approximately 40 feet wide at the track location. At the time of the derailment, the ballast had slumped approximately a foot below the bottom of the concrete ties. The slump progressed and by May 22 the slump was measured to about 4 feet below the bottom of the tie. Seepage was observed at the slide scarp in the ballast pocket. At the toe of the approximately 30-degree slope, bulging soil and vegetation was observed. Remnants of an approximately 2-foot high retaining wall made of timber ties was observed in the bulging soil. Figure 3 shows photos of the top of the slide undermining the track and the scarp on the left side of the slide. Figure 4 shows the right scarp of the slide and the seepage observed near the bottom of the ballast pocket. Figure 5 shows the slide scarp at the top of the slide and a view of the toe of the slide.

4 SUBSURFACE CONDITIONS

We evaluated the subsurface conditions at the site by reviewing completed borings and performing laboratory testing, as summarized below:

- **Borings:** We reviewed the six borings, designated B-1 through B-6, completed between May 21 and May 23, 2018. A description of the field explorations and the logs of the borings are presented in Appendix A.
- **Laboratory Testing:** Samples collected from the borings were tested to evaluate index properties of select soil samples and to estimate the strength of the soils. Descriptions of the laboratory tests and the results are presented in Appendix B.

The approximate locations of the explorations are shown in Figure 2 and summarized below.

Exhibit 4-1: Field Exploration Summary

Boring Name	Date Drilled	Depth Drilled (feet)	Approximate Ground Surface Elevation[1] (feet)	Approximate Location[2]	
				Latitude	Longitude
B-1	5-21-2018	40	71	38.806799°	-77.104873°
B-2	5-22-2018	40	70	38.806884°	-77.104579°
B-3[3]	5-22-2018	40	69	38.806928°	-77.104398°
B-4	5-23-2018	40	68	38.807045°	-77.103904°
B-5	5-23-2018	40	67	38.807148°	-77.103369°
B-6	5-23-2018	40	66	38.807240°	-77.102695°

NOTES:

1 Vertical Datum = Mean Sea Level

2 Horizontal Datum = North American Datum of 1989/2011 (NAD89).

3 The boring locations were not surveyed and should be considered approximate.

The following sections describe the regional geology and observed subsurface conditions as estimated from the field explorations.

4.1 Regional Geology

The site is situated in the Cameron Run Valley just below the confluence of Holmes Run and Backlick Run, and is located just west of the boundary between the Appalachian Highlands division of the Piedmont Physiographic Province and the Atlantic Coastal Plain Physiographic Province to the east.

Topographic mapping contours range from about 50 to 250 feet above mean sea level (msl) north and south of the Cameron Run Valley (USGS 1965). Locally, groundwater may exist as shallow, unconfined conditions in alluvial sediments along drainages and rivers, surficial bedrock, or under confined condition in confined bedrock.

The northeast trending, high angle reverse Fort Williams Fault is mapped approximately 160 feet west of the railroad embankment, with the upthrown side to the west.

Geology at the site is mapped as the Cretaceous Potomac group overlain by Quaternary sediments. Quaternary/ Holocene (Qt) terrace sediments consisting of one or more fining upward cycles consisting of cobble, gravel, sand, silt, and clay sediment overlying older Quaternary/Pleistocene Old Town (Qto) terrace sediments of similar depositional sequencing. However, fining upward cycles in Qto may be separated by organic sediments. Quaternary/Holocene alluvium has been described as a mixture of boulders, gravel, sand, and fine-grained sediments and is mapped along the Cameron Run valley. Quaternary/Holocene Swamp deposits are mapped just north of the site and consist primarily of organic silt and clay and deposited locally in swales associated with Holocene and Pleistocene terrace deposits. (CAV 2016)

4.2 Subsurface Soil Conditions

The triple track embankment is approximately 60 feet wide and approximately 27 feet high with an approximate 1.73H:1V slope on the south side of the embankment. Six borings designated B-1 to B-6 were advanced from the track level to a depth of 40 feet below ground surface (bgs) to characterize the embankment soils and underlying base soils.

The embankment consists of 5.5 feet of ballast and dirty ballast underlain by a heterogeneous fill. At a depth of 32 feet there is a five-foot-thick consistent native layer of dense to very dense poorly graded gravel with sand underlain by very dense to medium dense well graded sand or stiff to very stiff lean clay.

At the slide location (Borings B-2 and B-3) the embankment fill consists of 10 to 14 feet of soft to stiff lean clay, underlain by a 3 to 7.5-foot layer of loose, poorly graded sand and a 10-foot-thick layer of soft lean clay.

The stick logs of the borings are summarized in Figure 6. Borings B-5 indicates that the embankment fill is predominantly granular, while the rest of the borings indicate interbedded sand layers in clay.

The boring logs in Appendix A provide more detail about the conditions encountered at each boring. Our interpretation of the available subsurface information is provided in the generalized subsurface profile shown in Figure 6.

4.3 Groundwater Conditions

The depth to groundwater was measured in the open boreholes for all borings during drilling and several hours after drilling. Groundwater was typically between 30 to 33.5 feet bgs, slightly above or in the dense poorly graded gravel with sand. During drilling sand heaved into the casing at this depth. No groundwater monitoring devices were installed at the site. We have no information on seasonal groundwater variation.

4.4 Potential Variation

The explorations were performed to evaluate the subsurface conditions below and around the proposed bridge foundations. Our observations are specific to the locations and depths noted on the boring logs and profiles and may not be applicable to all areas of the site. No amount of explorations can precisely predict the characteristics, quality, or distribution of subsurface and site conditions. Potential variation includes, but is not limited to:

- The conditions between and below explorations may be different.
- Groundwater levels and flow directions may fluctuate due to seasonal variations.
- Contaminated soil may be present at areas where we did not perform testing.

If conditions different from those described herein are encountered during construction, we should review our description of the subsurface conditions and reconsider our recommendations presented in the next section.

5 ENGINEERING STUDIES

Based on our evaluation of the subsurface conditions, we performed slope stability analyses and modeled failure conditions to recommend a new slope. In addition, we considered the use of retaining walls to increase slope stability.

For the purposes of our analyses, it was necessary for us to assume that the results of the explorations are representative of conditions throughout the site. However, subsurface conditions should be expected to vary. We may need to revise our recommendations during construction if different conditions are encountered.

5.1 Slope Stability Analysis

We performed two sets of slope stability analyses as follows:

- Slope stability back-analyses to evaluate the conditions that caused the slide, and estimate existing soil conditions.
- Slope stability analyses to evaluate slope repair alternatives.

We used the computer program SLOPE/W (Geo-Slope International, 2016) for all our slope stability analyses. Given a slope geometry and soil conditions, the analyses program evaluates many failure surfaces with respect to a factor of safety, computed as the ratio of the forces resisting slope instability to the forces driving slope instability, and presents the failure surface that produces the minimum factor of safety. The failure surface with the minimum factor of safety is referred to as the critical failure surface.

The following sections present the results of our slope stability analyses of the existing conditions and the slope repair alternatives. Each section includes a description of the slope geometry and soil conditions we used as input into SLOPE/W.

5.1.1 Back-analyses of Existing Conditions

We performed slope stability back-analysis to evaluate the conditions that caused the slide on May 19, 2018. The ground surface profile was based on observations at the site that included slide dimensions, measured adjacent slopes with a compass/inclinometer, and Google Earth aerial photography and elevations. Based on the conditions observed in the field, we modeled the existing embankment with a top width of 60 feet, a height of 27 feet, and side slopes at 1.73H:1V. The top of the embankment was assumed to be approximately +71 feet in elevation, and the toe of the embankment was assumed to be at approximately +44 feet in elevation.

To evaluate the soil conditions that caused the slide, we first evaluated initial estimates of the soil strength properties using the borings adjacent to the approximate slide scarp location, Borings B-2 and B-3 (see Figure 2), and our experience with similar soils. We then varied these properties until the stability analyses produced a critical failure surface with a factor of safety of 1.0 that matched the failure geometry as observed in the field. A summary of our assumed soil properties is as follows:

- **Medium Dense GP**: We modeled the upper 5 feet of the embankment fill, from elevation +71 to +66, as medium dense poorly graded gravels (GP). In these soils the Standard Penetration Test (SPT) blow counts were generally between 12 and 40 blows per foot (bpf). Based on the SPT blow counts and our experience with gravel ballast/fill soils we assumed a unit weight of 125 pounds per cubic foot (pcf) and a friction angle of 38 degrees.

- **Medium Stiff CL**: We assumed the embankment fill soils from elevation +66 to +54 feet consist of medium stiff lean clay (CL). The SPT blow counts measured in the medium stiff CL soils were generally between 4 and 12 bpf. Based on the SPT blow counts, and the location of this unit within the embankment, we assumed these soils were placed as fill and likely subjected to some degree of compactive effort. We assigned a unit weight of 120 pcf and a uniform cohesion of 700 pounds per square foot (psf) based on the SPT blow counts, the assumed construction procedure, and the results of the back-analyses calibration.
- **Loose SP**: We assumed the embankment fill soils from elevation +54 to +49 feet consist loose poorly graded sand (SP). The measured SPT blow counts in this unit was generally between 3 and 5 bpf. Based on the SPT blow counts and our experience with similar soils we assumed a unit weight of 120 pcf and a friction angle of 30 degrees.
- **Soft CL**: From elevation +49 to +41 feet, we modeled the soil as soft lean clay (CL). Borings B-2 and B-3 all measured a blow count of 4 bpf. Borings B-2 and B-3 encountered soft CL soil below the bottom of the embankment, at elevation +44 feet. We believe that these soils are the naturally occurring surficial soils at the site. The soft CL soils within the embankment may have been reworked and placed as fill during grading and construction activities during initial construction of the embankment. We assumed a unit weight of 110 pcf based on our experience with similar soils. We assumed a pressure dependent shear strength based on the recommendations of Ladd and Foott (1974) and Mesri (1975) for normally consolidated clays, such that the shear strength, S_U, is computed as $S_U = 0.22\ \sigma'_V$, where σ'_V is the vertical effective stress.
- **Native Dense GP**: Below the Soft CL soil, from elevation +41 to +36 feet, we assumed the soil consisted of dense native GP. The SPT blow counts ranged from 26 bpf to refusal. We assumed a unit weight of 130 pcf and a friction angle of 40 degrees based on the measured SPT blow counts and our experience with similar soils.
- **Dense SW**: Below elevation +36 feet we assumed the soil consists of dense well graded sand (SW). The measured SPT blow counts in this soil was between 14 bpf and refusal. Based on the recorded SPT blow counts and our experience with similar soils, we assumed a unit weight of 125 pcf and a friction angle of 35 degrees.

The results of our back-analyses of the existing conditions are provided in Figure 7. The results show a failure plane that begins approximately 6 feet back from the top of the slope, and an exit point just above the toe of the slope. This result is in agreement with our field observations, and supports the assumed soil properties provided above.

6 CLOSURE

This report was prepared for the exclusive use of CSX Transportation, Inc. for specific application to the repair of the Slide at MP CFP 102.9. This report is not intended to be used or relied upon for any other purpose. Shannon & Wilson has prepared a document titled, "Important Information About Your Geotechnical/Environmental Report," which is enclosed as Appendix C. Please read this document to learn how you can lower your risks for this Project.

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7 REFERENCES

City of Alexandria Virginia (CAV) 2016, Geologic Atlas of the City of Alexandria, Virginia and Vicinity, Scale 1:12000

Geo-Slope International, 2016, SIGMA/W v. 8.16: Calgary, Alberta, Geo-Slope International, August.

Ladd, C.C., and Foott, R., 1974, New design procedure for stability of soft clays: ASCE Journal of the Geotechnical Engineering Division, v.100, no. GT7, p. 763-786.

Mesri, G., 1975, Discussion on: New design procedure for stability of soft clays: ASCE Journal of the Geotechnical Engineering Division, v.101, no. GT4, p. 409-412.

U.S. Geological Survey (USGS), 1965, Alexandria, Virginia 7.5-minute topographic map, scale 1:24000

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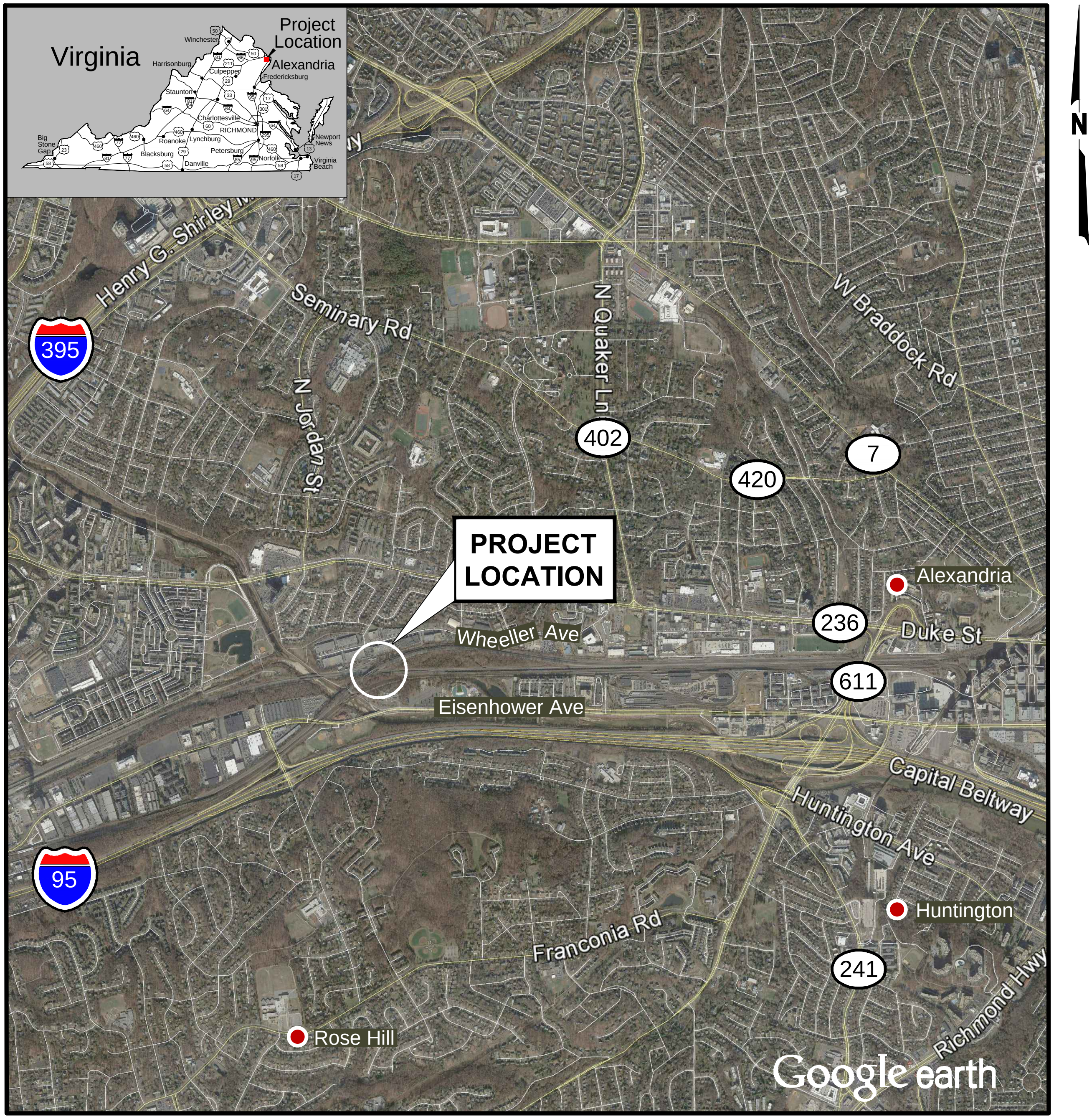

NOTE

Map adapted from aerial imagery provided by Google Earth Pro, reproduced by permission granted by Google Earth ™ Mapping Service.

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VICINITY MAP

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FIG. 1

Filename: J:_JAX\100749\001\100749-001 Fig 1 - Vicinity Map.dwg Layout: Layout Date: 06-01-2018 Login: SAC

0 60 120

Approximate Scale in Feet

N

NOTE

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LEGEND

B-1 ⊕ Boring Designation and Approximate Location

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SITE AND EXPLORATION PLAN

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FIG. 2

Filename: J:_JAX\100749\001\100749-001 Fig 2 - Site Plan.dwg Layout: Layout Date: 06-01-2018 Login: SAC

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Top – Overall View of Slide
Bottom – Right Flank of Scarp

June 2018 | 100794-001

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FIG. 3

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Top – Right Flank Scrap
Bottom – Seepage at Ballast Pocket

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FIG. 4

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Top – Top slide plane
Bottom – View from Toe

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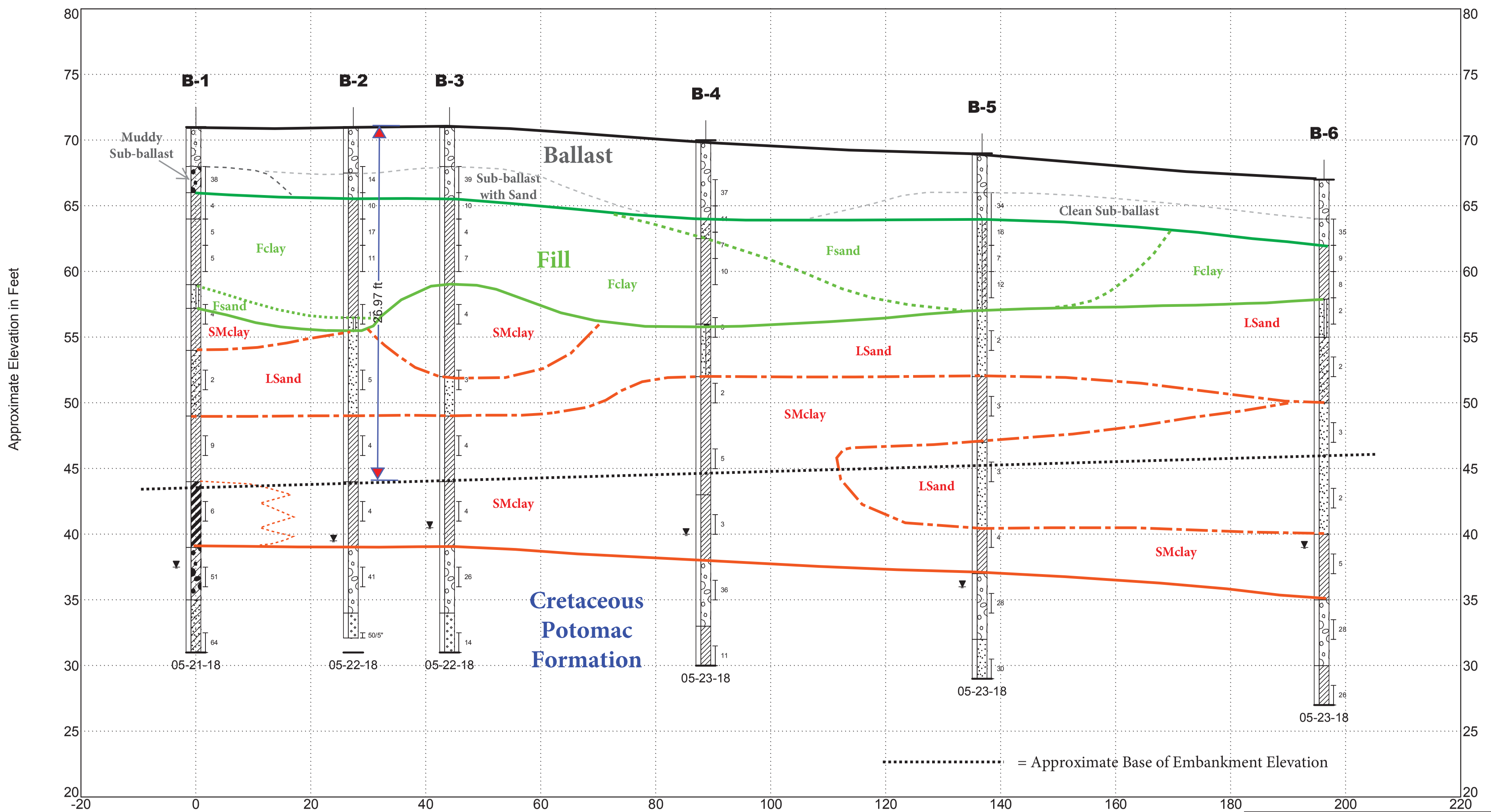

Horizontal Scale: 1 Inch = 17.1428571428571 Feet
Vertical Scale: 1 Inch = 7.5 Feet

Compacted Fill
Fclay - Fill clay
Fsand - Fill sand/clayey sand and silty sand

Reworked and In PLace Quaternary Sediments
SMclay - Soft to Medium stiff clay
LSand - Loose sand/clayey sand and silty sand

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GENERALIZED GEOLOGIC PROFILE: SECTION

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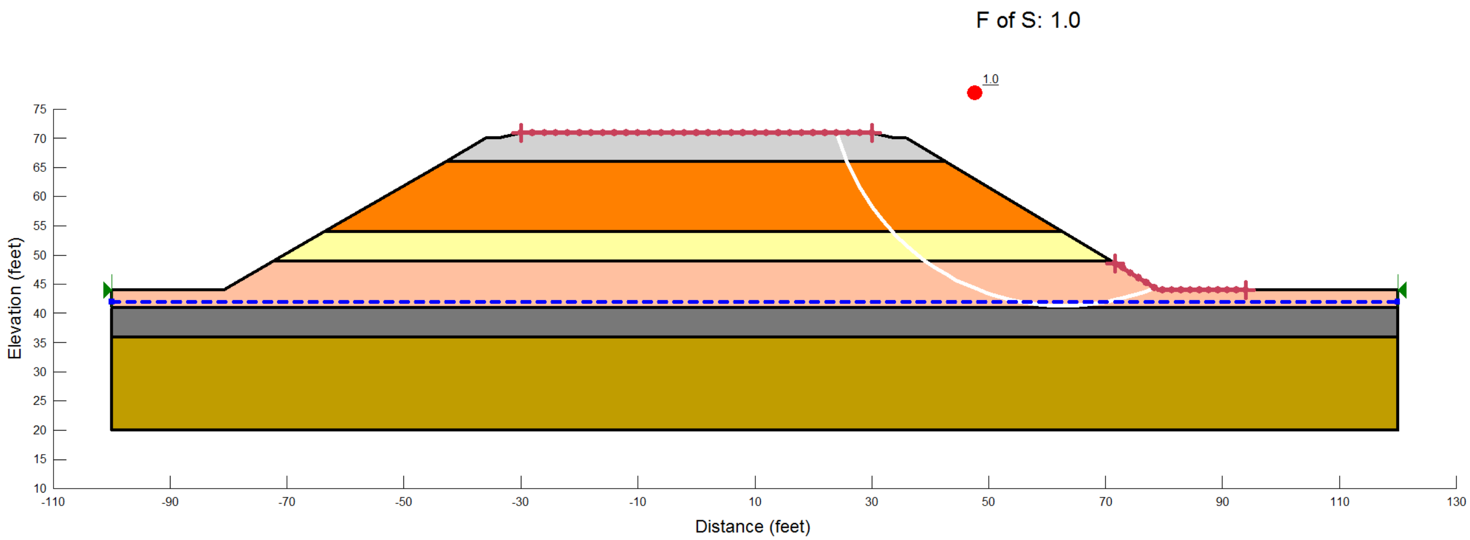
FIG. 6

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Tau/Sigma Ratio	Minimum Strength (psf)
	M. Dense GP	Mohr-Coulomb	125	0	38		
	M. Stiff CL	Mohr-Coulomb	120	700	0		
	Loose SP	Mohr-Coulomb	120	0	30		
	Soft CL	S=f(overburden)	110			0.22	150
	Dense Native GP	Mohr-Coulomb	130	0	40		
	Dense SW	Mohr-Coulomb	125	0	35		



Notes:
1. Analysis performed with the computer program SLOPE\W version 8.16 (Geo-Slope International, 2016).
2. The assumed material properties are provided above. The units for the provided soil parameters are: Unit Weight - pounds per cubic foot (pcf); Cohesion = pounds per square foot (psf); and Friction Angle - degrees.

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STABILITY ANALYSIS
EXISTING CONDITIONS

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FIG. 7

FIG. 7

APPENDIX A: FIELD EXPLORATIONS

Appendix A

Field Explorations

Field Exploration Details and Boring Logs

CONTENTS

- Explanation
- Logs of Borings

A.1 DRILLING PROCEDURES

The borings were drilled using an all-terrain-mounted CME 550X drill equipped with 4-¼ -inch ID hollow-stem augers.

A.2 SOIL SAMPLING

Soil samples were typically obtained every 2 feet to a depth of 10 feet and then every five feet thereafter unless driven to refusal at a shallower depth. Soil samples from borings were collected by performing Standard Penetration Tests (SPTs) in general accordance with the American Society for Testing and Materials (ASTM) Designation: D 1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM, 2005). In the SPT, a 2-inch outside-diameter (O.D.), 1.375-inch inside-diameter (I.D.), split-spoon sampler is driven 24 inches with a 140-pound hammer falling 30 inches. An automatic hammer using hydraulics to lift the hammer and released after reaching a height of 30 inches was used to drive the sampler. The number of blows required to achieve each of the 6-inch increments of sampler penetration was recorded. The number of blows required to cause the last two increments of penetration is termed the Standard Penetration Resistance (N-value). When penetration resistances exceeded 50 blows for 6 inches or less of penetration, the test was terminated and the number of blows was recorded.

The SPT values were recorded by our field representative and are plotted in the boring logs. These values are empirical parameters that provide a means of evaluating the relative density or compactness of cohesionless (granular) soils and the relative consistency (stiffness) of cohesive soils. The terminology used to describe the relative density or consistency of the soil is presented in Figure A-1 in Appendix A.

The split-spoon sampler used during the penetration testing recovers a relatively disturbed sample of the soil, which is useful for identification and classification purposes. The samples were classified and recorded on field logs by our representative. The samples were collected in sealed containers and labeled, recording the boring designation, sample number, sample depth, blow count, and date, and were returned to our soils laboratory for further classification and testing.

A.3 SOIL CLASSIFICATION

Soil sample classification was based on ASTM Designation: D 2487-98, Standard Test Method for Classification of Soil for Engineering Purposes, and ASTM Designation: D 2488, Standard Recommended Practice for Description of Soils (Visual-Manual Procedure). The Unified Soil Classification System (USCS) was used to classify the soils encountered in the soil borings.

A.4 BORING LOGS

The boring logs in this report (presented in Appendix A) represent our interpretation of the contents of the field logs. A boring log is a written record of the subsurface conditions encountered. It graphically illustrates the soils encountered in the boring and the USCS symbol of each soil type. It also includes the natural water content and SPT blow count. Other information shown on the boring logs includes the groundwater level observations made during drilling, ground surface elevation, and types and depths of sampling.

Shannon & Wilson, Inc. (S&W), uses a soil classification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following page. Soil descriptions are based on visual-manual procedures (ASTM D2488-93) unless otherwise noted.

S&W CLASSIFICATION OF SOIL CONSTITUENTS

- MAJOR constituents compose more than 50 percent, by weight, of the soil. Major consituents are capitalized (i.e., SAND).
- Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).
- Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace of gravel).

MOISTURE CONTENT DEFINITIONS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

ABBREVIATIONS

ATD	At Time of Drilling
Elev.	Elevation
ft	feet
FeO	Iron Oxide
MgO	Magnesium Oxide
HSA	Hollow Stem Auger
ID	Inside diameter
in	inches
lbs	pounds
Mon.	Monument cover
N	Blows for last two 6-inch increments
NA	Not applicable or not available
NAD	North American Datum (year)
NAVD	North American Vertical Datum (year)
NGVD	National Geodetic Vertical Datum (year)
NP	Non plastic
OD	Outside diameter
OVA	Organic vapor analyzer
PID	Photo-ionization detector
ppm	parts per million
PVC	Polyvinyl Chloride
SS	Split spoon sampler
SPT	Standard penetration test
USC	Unified soil classification
WOH	Weight of hammer
WOR	Weight of drill rods

GRAIN SIZE DEFINITION

DESCRIPTION	SIEVE NUMBER AND/OR SIZE
FINES	< #200 (0.08 mm)
SAND* - Fine	#200 to #40 (0.08 to 0.4 mm)
- Medium	#40 to #10 (0.4 to 2 mm)
- Coarse	#10 to #4 (2 to 5 mm)
GRAVEL* - Fine	#4 to 3/4 inch (5 to 19 mm)
- Coarse	3/4 to 3 inches (19 to 76 mm)
COBBLES	3 to 12 inches (76 to 305 mm)
BOULDERS	> 12 inches (305 mm)

* Unless otherwise noted, sand and gravel, when present, range from fine to coarse in grain size.

RELATIVE DENSITY / CONSISTENCY

COARSE-GRAINED SOILS		FINE-GRAINED SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
0 - 4	Very loose	Under 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
Over 50	Very dense	15 - 30	Very stiff
		Over 30	Hard

WELL AND OTHER SYMBOLS

Bent. Cement Grout	Surface Cement Seal
Bentonite Grout	Asphalt or Cap
Bentonite Chips	Slough
Silica Sand	Bedrock
Well Screen	
Vibrating Wire	

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Alexandria, Virginia

SOIL CLASSIFICATION AND LOG KEY

May 2018 100749-001

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FIG. A-1
Sheet 1 of 2

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(From USACE Tech Memo 3-357)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Clean Gravels *(less than 5% fines)*	GW	Well-graded gravels, gravels, gravel/sand mixtures, little or no fines.
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with Fines *(more than 12% fines)*	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Clean Sands *(less than 5% fines)*	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sand, gravelly sands, little or no fines
		Sands with Fines *(more than 12% fines)*	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML	Inorganic silts of low to medium plasticity, rock flour, sandy silts, gravelly silts, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		Organic	OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt
			CH	Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay
		Organic	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat, humus, swamp soils with high organic content (see ASTM D 4427)

NOTE: No. 4 size = 5 mm; No. 200 size = 0.075 mm

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, slightly silty fine SAND)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, silty CLAY/clayey SILT; GW/SW, sandy GRAVEL/gravelly SAND)* indicate that the soil may fall into one of two possible basic groups.

CSXT Slide MP CFP-102.9
Alexandria, Virginia

SOIL CLASSIFICATION AND LOG KEY

May 2018 | 100749-001

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FIG. A-1
Sheet 2 of 2

Total Depth:	40 ft.	Northing:	4,297,441 ft.	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	71.0 ft.	Easting:	317,231 ft.	Drilling Company:	Salut	Rod Diam.:	AW
Vert. Datum:	Mean Sea Level	Station:		Drill Rig Equipment:	Acker XLS	Hammer Type:	Automatic
Horiz. Datum:	NAD 1989/2011	Offset:	-	Other Comments:			

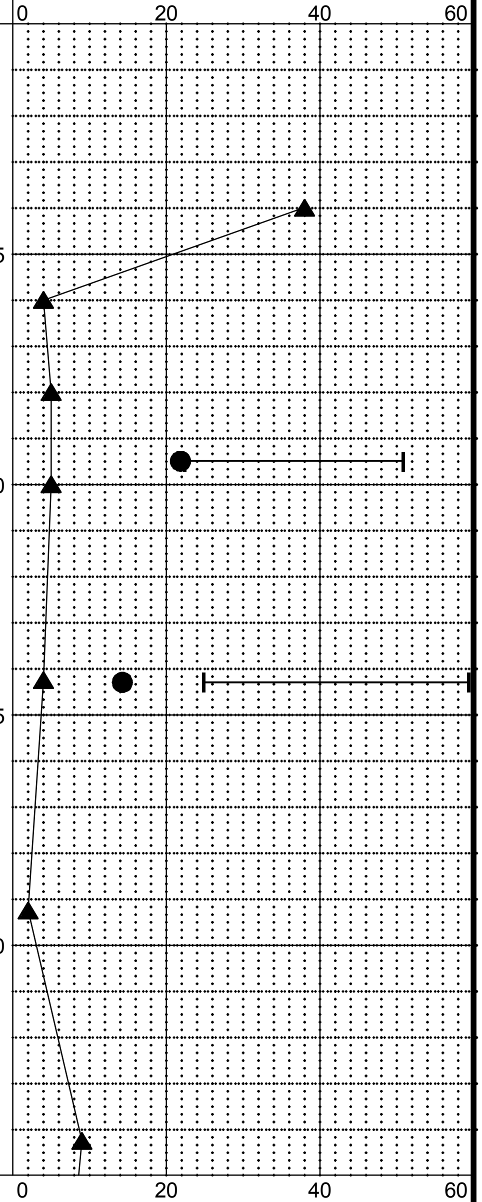
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples
Medium dense, grey, *Poorly Graded Gravel (GP)*; dry to moist (Ballast/Fill)		
Dense, grey, *Clayey Gravel (GC)*; moist (Fill)	3.0	S-1
Medium stiff, light grey-brown to red-brown, *Lean Clay (CL)*; moist; trace angular gravel (Fill)	5.0	S-2
Medium stiff, light grey-brown to red-brown, *Fat Clay with Sand (CH)*; moist (Fill)	7.0	S-3, S-4
Loose, black, *Poorly Graded Sand with Silt (SP-SM)*; moist (Fill)	12.0	
Medium stiff, light grey-brown to red-brown, *Sandy Fat Clay (CH)*; moist; fine to coarse grained sand (Possible reworked native material/Fill)	13.8	S-5
Loose, light grey-brown, *Clayey Sand (SC)*; moist; trace fine angular gravel	17.0	S-6
Stiff, light grey-brown, *Lean Clay (CL)*; moist	22.0	S-7

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



CONTINUED NEXT SHEET

LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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Alexandria, Virginia

LOG OF BORING B-1

June 2018 100749-001

SHANNON & WILSON, INC.
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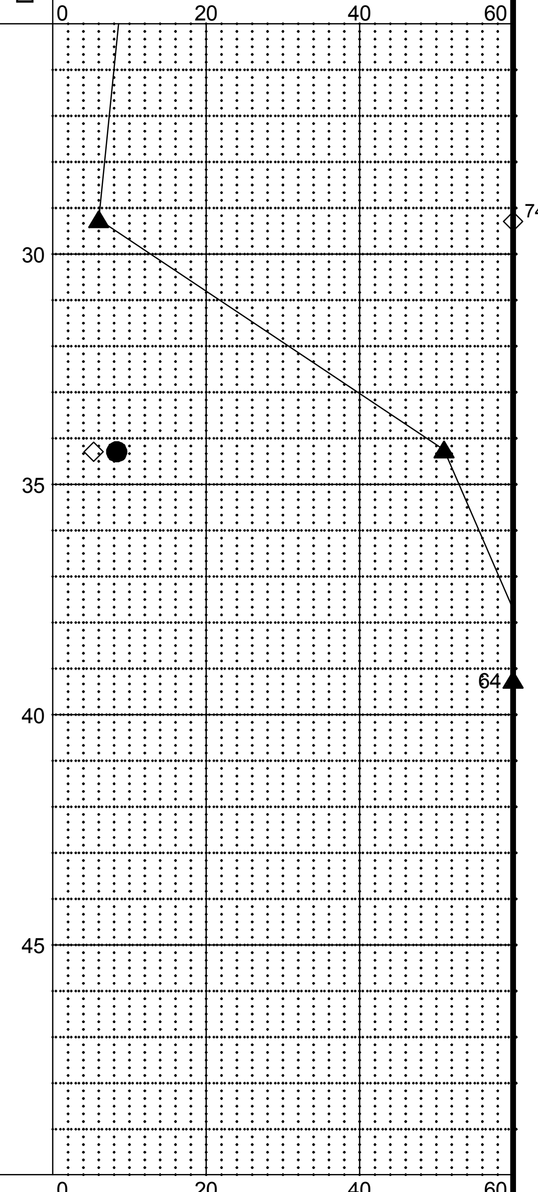
FIG. A-2
Sheet 1 of 2

MASTER_LOG_E 100749-001 - ALEXANDRIA DERAILMENT R1.GPJ SHAN_WIL.GDT 6/7/18

Total Depth:	*40 ft.*	Northing:	*4,297,441 ft.*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation:	*71.0 ft.*	Easting:	*317,231 ft.*	Drilling Company:	*Salut*	Rod Diam.:	*AW*
Vert. Datum:	*Mean Sea Level*	Station:		Drill Rig Equipment:	*Acker XLS*	Hammer Type:	*Automatic*
Horiz. Datum:	*NAD 1989/2011*	Offset:	-	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Samples	Ground Water
Medium stiff, light grey, *Fat Clay with Sand (CH)*; moist; lensed with red-brown sand.	27.0	S-8	
Very dense, light grey-brown, *Poorly Graded Gravel with Clay and Sand (GP-GC)*; wet; subangular gravel	32.0	S-9	During Drilling ▽
Very dense, light grey-brown, *Clayey Sand (SC)*; wet; fine to coarse subangular sand	36.0	S-10	
BOTTOM OF BORING COMPLETED 5/21/2018	40.0		

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered
⌶ Standard Penetration Test
▽ Ground Water Level ATD

◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING B-1

June 2018 | 100749-001

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FIG. A-2
Sheet 2 of 2

Total Depth:	*40 ft.*	Northing:	*4,297,450 ft.*	Drilling Method:	*Hollow Stem Auger*
Top Elevation:	*71.0 ft.*	Easting:	*317,257 ft.*	Drilling Company:	*Salut*
Vert. Datum:	*Mean Sea Level*	Station:		Drill Rig Equipment:	*Acker XLS*
Horiz. Datum:	*NAD 1989/2011*	Offset:	-	Other Comments:	

Hole Diam.:	*8 in.*
Rod Diam.:	*AW*
Hammer Type:	*Automatic*

SOIL DESCRIPTION

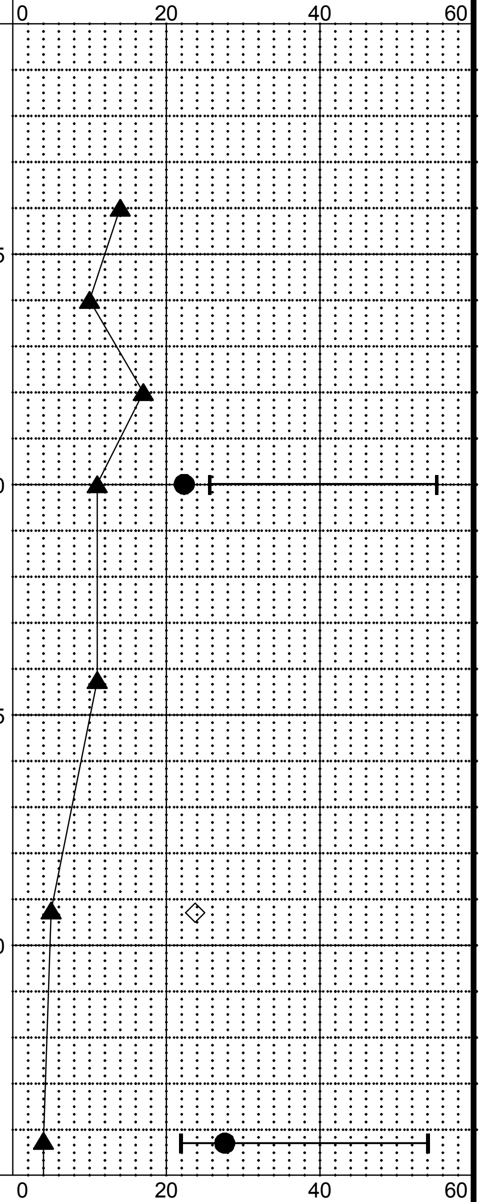
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples
Medium dense, grey, *Poorly Graded Gravel (GP)*; dry to moist (Ballast/Fill)		
Medium dense, grey to light grey, *Poorly Graded Gravel with Sand (GP)*; moist (Fill)	3.5	S-1
Stiff, red-brown to grey-brown, *Fat Clay (CH)*; moist (Fill)	5.5	S-2, S-3, S-4, S-5
Medium dense, black, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist (Fill)	14.5	
Loose, red-brown to red-yellow, *Silty Sand (SM)*; moist	15.5	S-6
Soft, red-brown to grey-brown, *Sandy Fat Clay (CH)*; moist	22.0	S-7

CONTINUED NEXT SHEET

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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Alexandria, Virginia

LOG OF BORING B-2

June 2018 | 100749-001

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FIG. A-3
Sheet 1 of 2

Total Depth:	40 ft.	Northing:	4,297,450 ft.	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	71.0 ft.	Easting:	317,257 ft.	Drilling Company:	Salut	Rod Diam.:	AW
Vert. Datum:	Mean Sea Level	Station:		Drill Rig Equipment:	Acker XLS	Hammer Type:	Automatic
Horiz. Datum:	NAD 1989/2011	Offset:	-	Other Comments:			

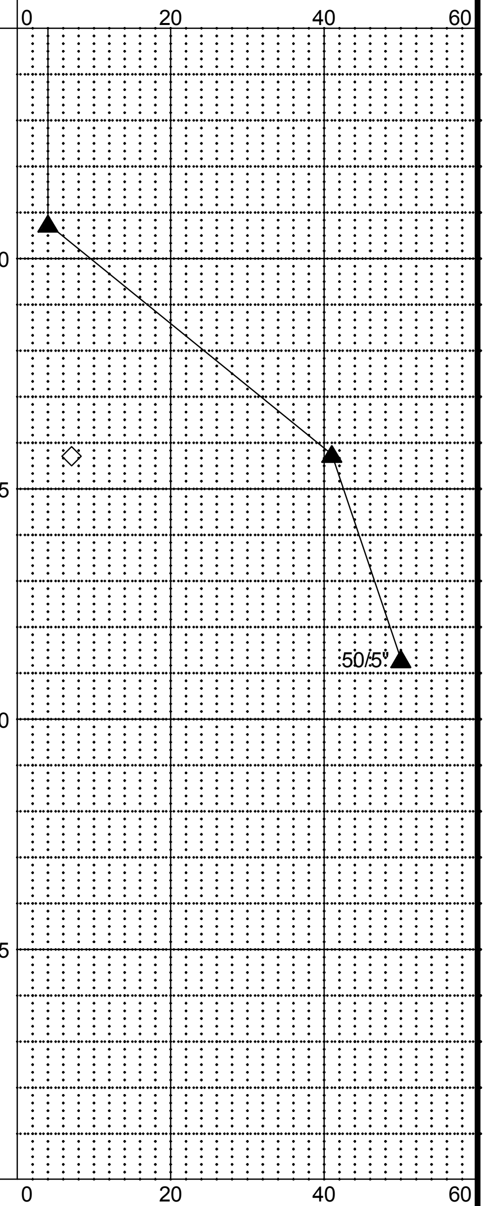
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples	Ground Water
Soft, grey to grey-brown, *Lean Clay (CL)*; moist to wet	27.0	S-8	
Dense, light grey to grey-brown, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; wet	32.0	S-9	During Drilling ▽
Very dense, light grey to white, *Well Graded Sand (SW)*; wet	37.0	S-10	
BOTTOM OF BORING COMPLETED 5/22/2018	38.9		

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered

Standard Penetration Test

▽ Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING B-2

June 2018 100749-001

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FIG. A-3
Sheet 2 of 2

Total Depth: 40 ft.	Northing: 4,297,455 ft.	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation: 71.0 ft.	Easting: 317,273 ft.	Drilling Company:	Salut	Rod Diam.:	AW
Vert. Datum: Mean Sea Level	Station:	Drill Rig Equipment:	Acker XLS	Hammer Type:	Automatic
Horiz. Datum: NAD 1989/2011	Offset: -	Other Comments:			

SOIL DESCRIPTION

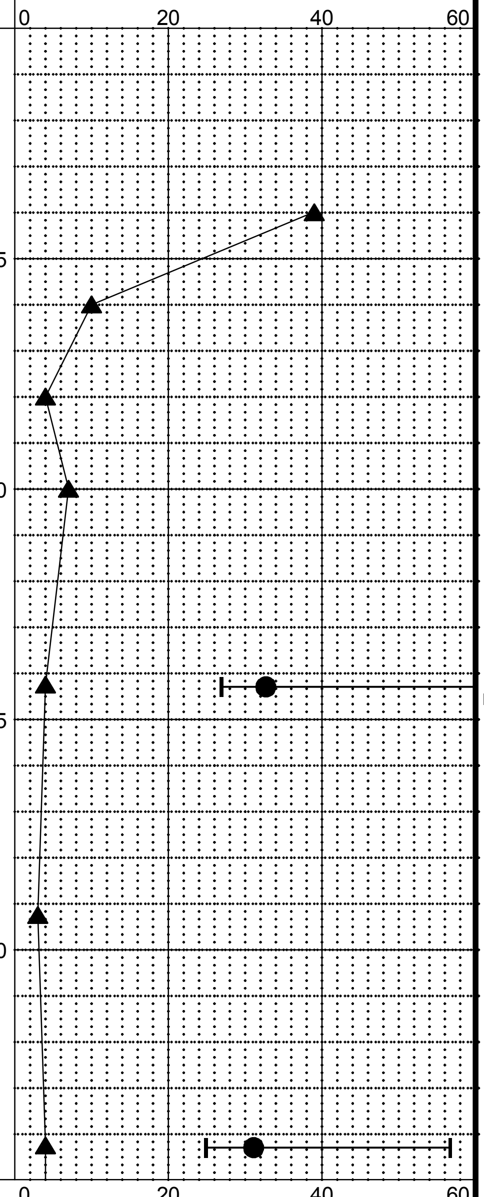
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples
Medium dense, grey, *Poorly Graded Gravel (GP)*; dry to moist; (Ballast/Fill)		
Dense, dark grey and black, *Poorly Graded Gravel with Sand (GP)* ; moist (Sub-ballast/Fill)	3.0	S-1
Stiff to medium stiff, grey with grey-brown and red-brown, *Lean Clay (CL)*; moist (Fill) (Upper contact based on drill action/cuttings and SPT blow counts)	5.5	S-2 *, S-3, S-4
Medium stiff, grey-brown to red-brown, *Fat Clay (CH)*; moist	12.0	S-5
Loose, brown, *Poorly Graded Sand (SP)*; moist	19.0	S-6
Soft, red-brown to light grey, *Fat Clay (CH)*; moist	22.0	S-7

CONTINUED NEXT SHEET

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

⊻ Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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Alexandria, Virginia

LOG OF BORING B-3

June 2018 | 100749-001

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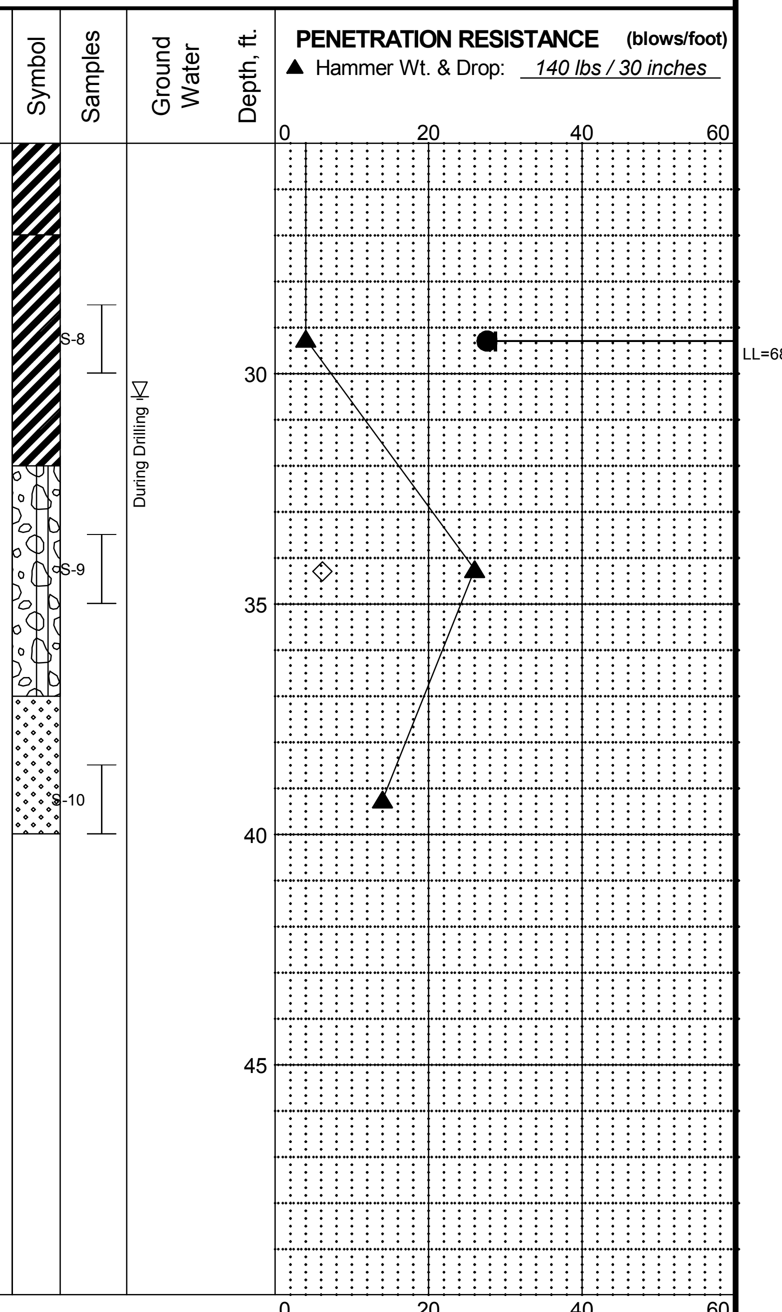
FIG. A-4
Sheet 1 of 2

Total Depth:	40 ft.	Northing:	4,297,455 ft.	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	71.0 ft.	Easting:	317,273 ft.	Drilling Company:	Salut	Rod Diam.:	AW
Vert. Datum:	Mean Sea Level	Station:		Drill Rig Equipment:	Acker XLS	Hammer Type:	Automatic
Horiz. Datum:	NAD 1989/2011	Offset:	-	Other Comments:			

SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples
Soft, light grey, *Fat Clay (CH)*; moist	27.0	S-8
Medium dense, light grey, *Poorly Graded Gravel with Silt and Sand (GP-GM)*; wet	32.0	S-9
Medium dense, grey to white, *Well Graded Sand (SW)*; wet	37.0	S-10
BOTTOM OF BORING COMPLETED 5/22/2018	40.0	



LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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Alexandria, Virginia

LOG OF BORING B-3

June 2018 100749-001

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FIG. A-4
Sheet 2 of 2

Total Depth:	40 ft.	Northing:	4,297,467 ft.	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	70.0 ft.	Easting:	317,316 ft.	Drilling Company:	Salut	Rod Diam.:	AW
Vert. Datum:	Mean Sea Level	Station:		Drill Rig Equipment:	Acker XLS	Hammer Type:	Automatic
Horiz. Datum:	NAD 1989/2011	Offset:	-	Other Comments:			

SOIL DESCRIPTION

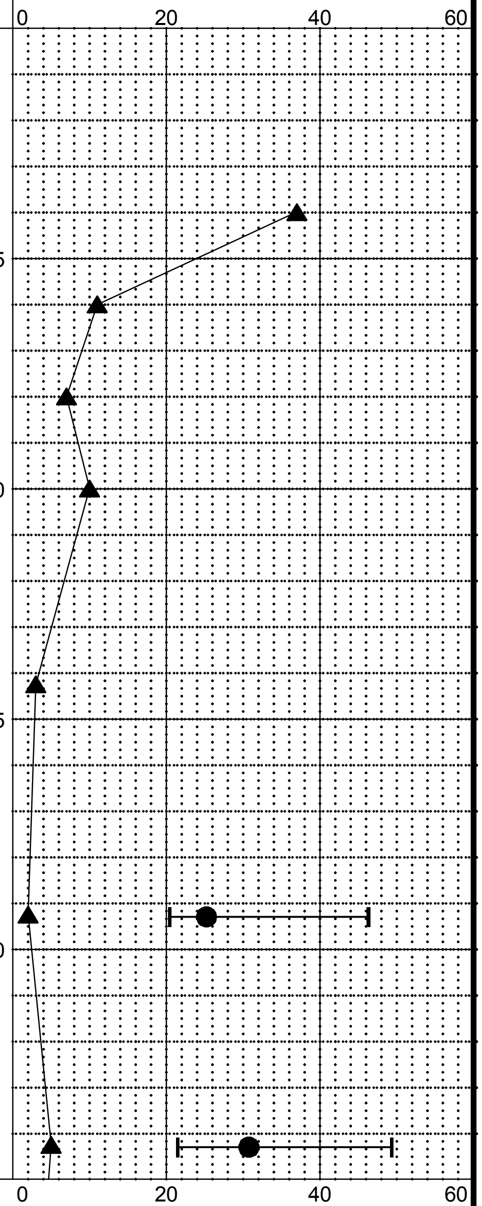
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples
Dense, grey, *Poorly Graded Gravel (GP)*; dry; (Ballast/Fill)		S-1
Medium dense, grey-brown, *Clayey Sand (SC)*; moist (Fill)	6.0	S-2
Stiff, grey-brown to light grey, *Lean Clay (CL)*; moist (Fill)	7.5	S-3, S-4
Coal / Cinder Layer (Fill)	14.0	S-5
Very loose, grey-brown, *Poorly Graded Sand with Clay (SP-SC)*; moist	14.2	
Soft to medium stiff, red-brown to grey-brown, *Lean Clay with Sand (CL)*; moist	18.0	S-6, S-7

CONTINUED NEXT SHEET

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING B-4

June 2018 100749-001

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FIG. A-5
Sheet 1 of 2

Total Depth:	40 ft.	Northing:	4,297,467 ft.	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	70.0 ft.	Easting:	317,316 ft.	Drilling Company:	Salut	Rod Diam.:	AW
Vert. Datum:	Mean Sea Level	Station:		Drill Rig Equipment:	Acker XLS	Hammer Type:	Automatic
Horiz. Datum:	NAD 1989/2011	Offset:	-	Other Comments:			

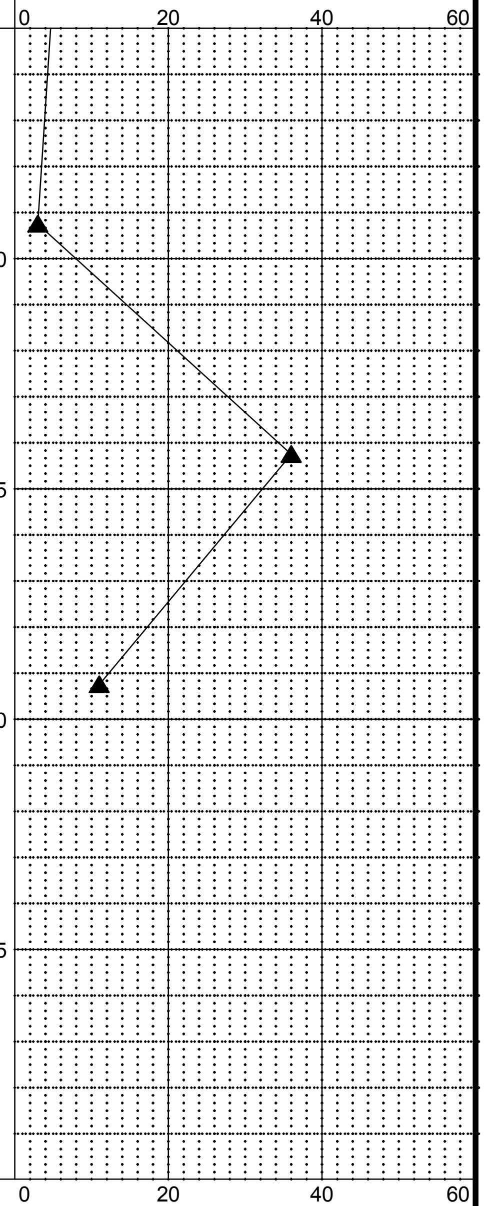
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples	Ground Water
			27.5 ft after 2 hrs
Soft, light grey to red-yellow, *Lean Clay (CL)*; moist	27.0	S-8	During Drilling ∇
Dense, light grey to grey brown, *Poorly Graded Gravel with Sand (GP)*; wet	32.0	S-9	
Medium dense, grey and grey-brown, *Lean Clay (CL)*; moist	37.0	S-10	
BOTTOM OF BORING COMPLETED 5/23/2018	40.0		

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered

Ɪ Standard Penetration Test

∇ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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Alexandria, Virginia

LOG OF BORING B-4

June 2018 100749-001

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FIG. A-5
Sheet 2 of 2

Total Depth:	40 ft.	Northing:	4,297,477 ft.	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	69.0 ft.	Easting:	317,363 ft.	Drilling Company:	Salut	Rod Diam.:	AW
Vert. Datum:	Mean Sea Level	Station:		Drill Rig Equipment:	Acker XLS	Hammer Type:	Automatic
Horiz. Datum:	NAD 1989/2011	Offset:	-	Other Comments:			

SOIL DESCRIPTION

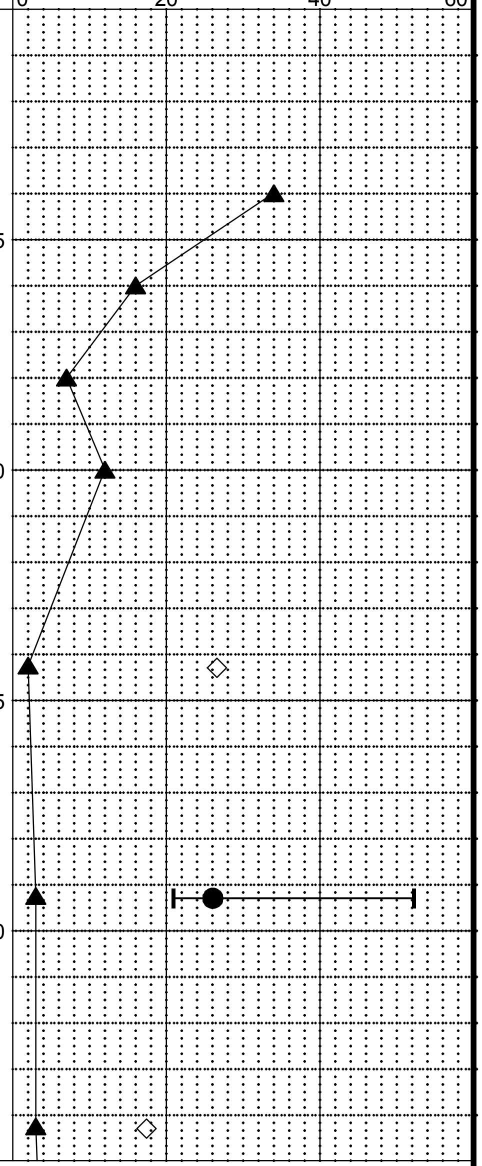
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples
Dense, grey, *Poorly Graded Gravel (GP)*; dry to moist; (Ballast/Fill)		
Dense, grey, *Poorly Graded Gravel (GP)*; moist (Sub-ballast/Fill)	3.0	S-1
Medium dense to loose, grey-brown, *Poorly Graded Sand with Clay (SP-SC)*; moist (Fill)	5.0	S-2, S-3, S-4
Very loose, grey-brown, *Silty Sand (SM)*; moist	12.0	S-5
Soft, grey-brown to red-brown, *Sandy Fat Clay (CH)*; moist	17.0	S-6
Very loose, yellow-brown, *Silty Sand (SM)*; moist	22.0	S-7

CONTINUED NEXT SHEET

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered

Standard Penetration Test

Ground Water Level ATD

◇ % Fines (<0.075mm)

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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Alexandria, Virginia

LOG OF BORING B-5

June 2018 — 100749-001

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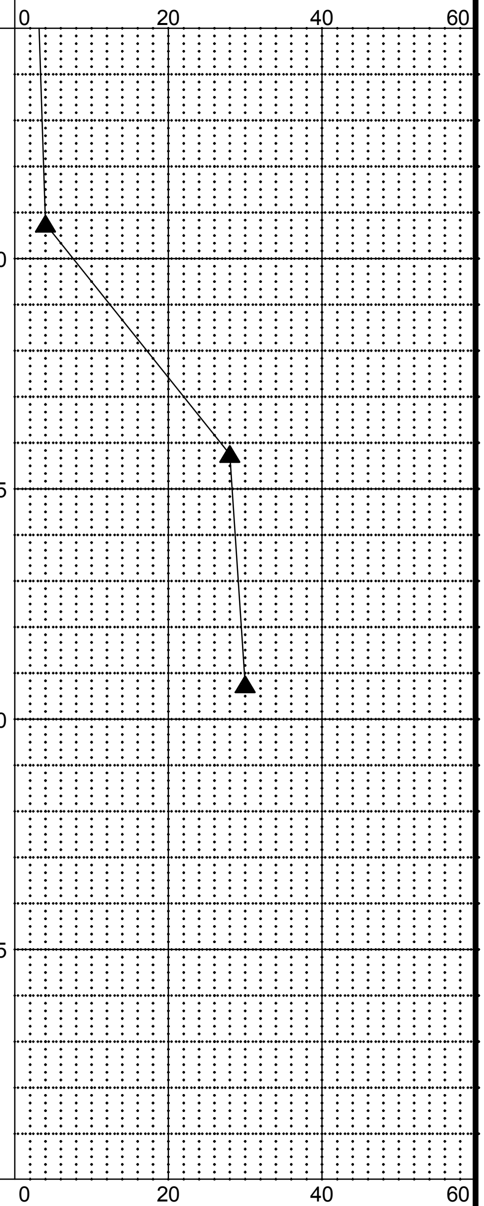
FIG. A-6
Sheet 1 of 2

Total Depth:	*40 ft.*	Northing:	*4,297,477 ft.*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation:	*69.0 ft.*	Easting:	*317,363 ft.*	Drilling Company:	*Salut*	Rod Diam.:	*AW*
Vert. Datum:	*Mean Sea Level*	Station:		Drill Rig Equipment:	*Acker XLS*	Hammer Type:	*Automatic*
Horiz. Datum:	*NAD 1989/2011*	Offset:	-	Other Comments:			

SOIL DESCRIPTION *Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.*	Depth, ft.	Samples	Ground Water
			27 ft after 3 hrs
Soft, grey, *Lean Clay (CL)*; moist	28.5	S-8	
Medium dense, light grey, *Poorly Graded Gravel with Sand (GP)*; wet	32.0	S-9	During Drilling ▽
Medium dense, light grey to white, *Poorly Graded Sand (SP)*; wet	37.0	S-10	
BOTTOM OF BORING COMPLETED 5/23/2018	40.0		

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



◇ % Fines (<0.075mm)
● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

* Sample Not Recovered
⌶ Standard Penetration Test
▽ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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Alexandria, Virginia

LOG OF BORING B-5

June 2018 100749-001

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FIG. A-6
Sheet 2 of 2

Total Depth:	40 ft.	Northing:	4,297,486 ft.	Drilling Method:	Hollow Stem Auger	Hole Diam.:	8 in.
Top Elevation:	67.0 ft.	Easting:	317,422 ft.	Drilling Company:	Salut	Rod Diam.:	AW
Vert. Datum:	Mean Sea Level	Station:		Drill Rig Equipment:	Acker XLS	Hammer Type:	Automatic
Horiz. Datum:	NAD 1989/2011	Offset:	-	Other Comments:			

SOIL DESCRIPTION

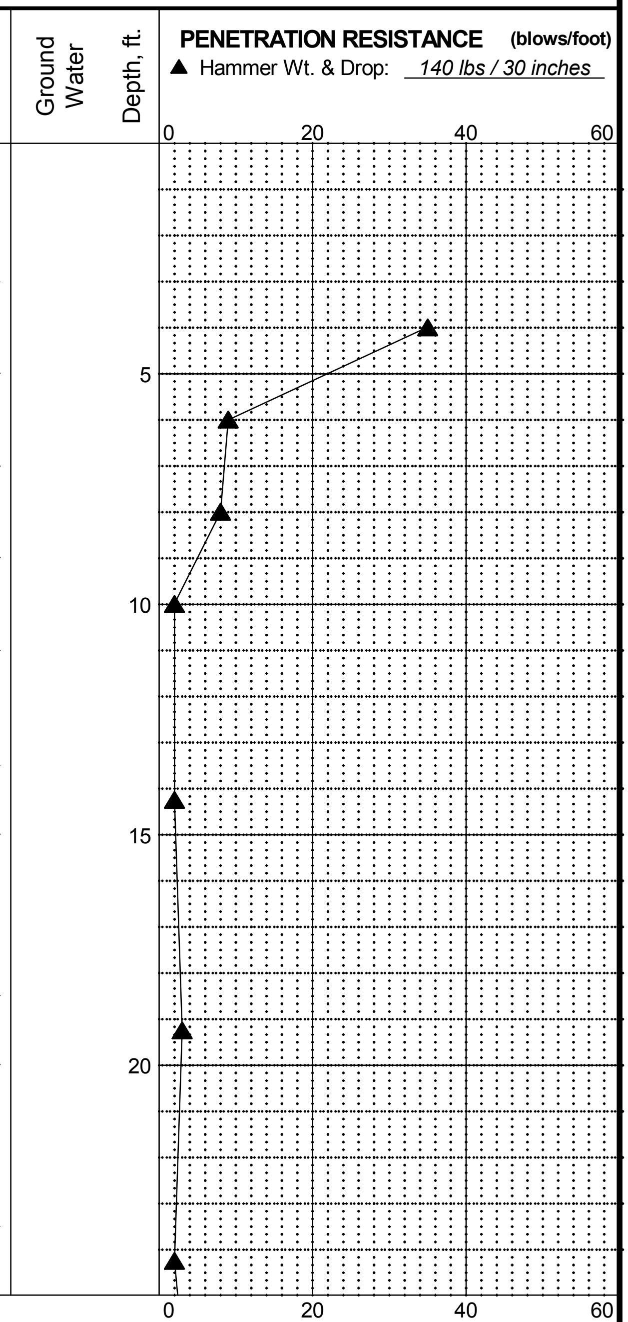
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples
Dense, grey, *Poorly Graded Gravel (GP)*; dry to moist (Ballast/Fill)		
Dense, grey, *Poorly Graded Gravel (GP)*; moist (Sub-ballast/Fill)	3.0	S-1
Stiff, grey-brown to red-brown, *Lean Clay with Sand (CL)*; moist (Fill)	5.0	S-2, S-3
Very loose, tan to light grey, *Poorly Graded Sand with Silt (SP-SM)*; moist	9.1	S-4
Very loose, red-yellow, *Clayey Sand (SC)*; moist	12.0	S-5
Very loose, tan to light grey, *Poorly Graded Sand (SP)*; moist	17.0	S-6, S-7

CONTINUED NEXT SHEET

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

* Sample Not Recovered
⌶ Standard Penetration Test
∇ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING B-6

June 2018 | 100749-001

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FIG. A-7
Sheet 1 of 2

Total Depth: *40 ft.*	Northing: *4,297,486 ft.*	Drilling Method:	*Hollow Stem Auger*	Hole Diam.:	*8 in.*
Top Elevation: *67.0 ft.*	Easting: *317,422 ft.*	Drilling Company:	*Salut*	Rod Diam.:	*AW*
Vert. Datum: *Mean Sea Level*	Station:	Drill Rig Equipment:	*Acker XLS*	Hammer Type:	*Automatic*
Horiz. Datum: *NAD 1989/2011*	Offset: -	Other Comments:			

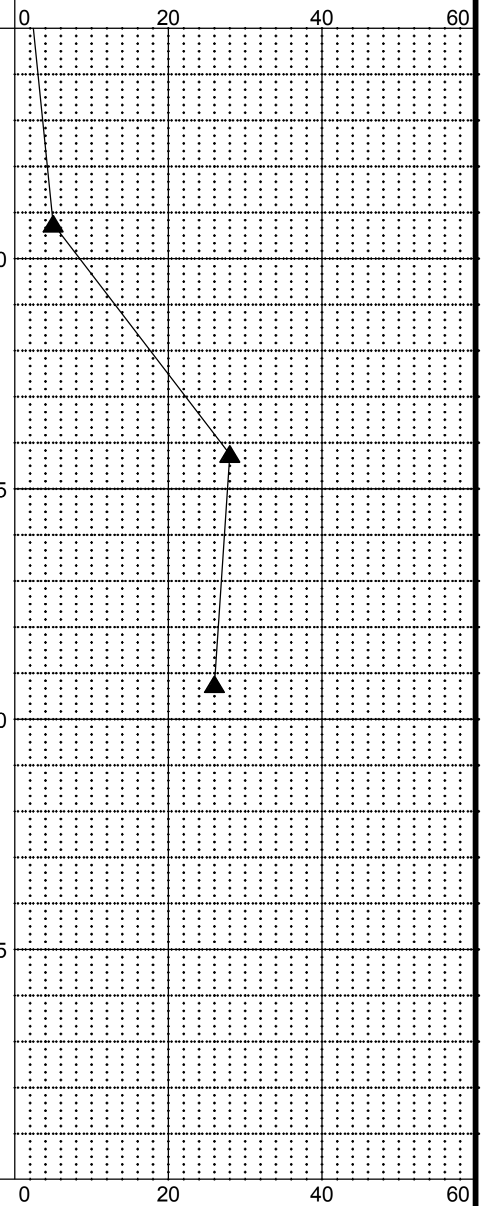
SOIL DESCRIPTION

Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.

Soil Description	Depth, ft.	Samples	Ground Water
Soft, grey, *Lean Clay (CL)*; moist to wet	27.0	S-8	During Drilling ∇
Medium dense, light grey to red-yellow, *Poorly Graded Gravel with Sand (GP)*; wet	32.0	S-9	
Very stiff, blue-grey to light grey, *Lean Clay (CL)*; moist	37.0	S-10	
BOTTOM OF BORING COMPLETED 5/23/2018	40.0		

PENETRATION RESISTANCE (blows/foot)

▲ Hammer Wt. & Drop: *140 lbs / 30 inches*



LEGEND

* Sample Not Recovered

⌶ Standard Penetration Test

∇ Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
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LOG OF BORING B-6

June 2018 100749-001

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FIG. A-7
Sheet 2 of 2

APPENDIX B: LABORATORY TESTS

Appendix B

Laboratory Tests

CONTENTS

APPENDIX B: LABORATORY TESTS

B.1 EXPLANATION

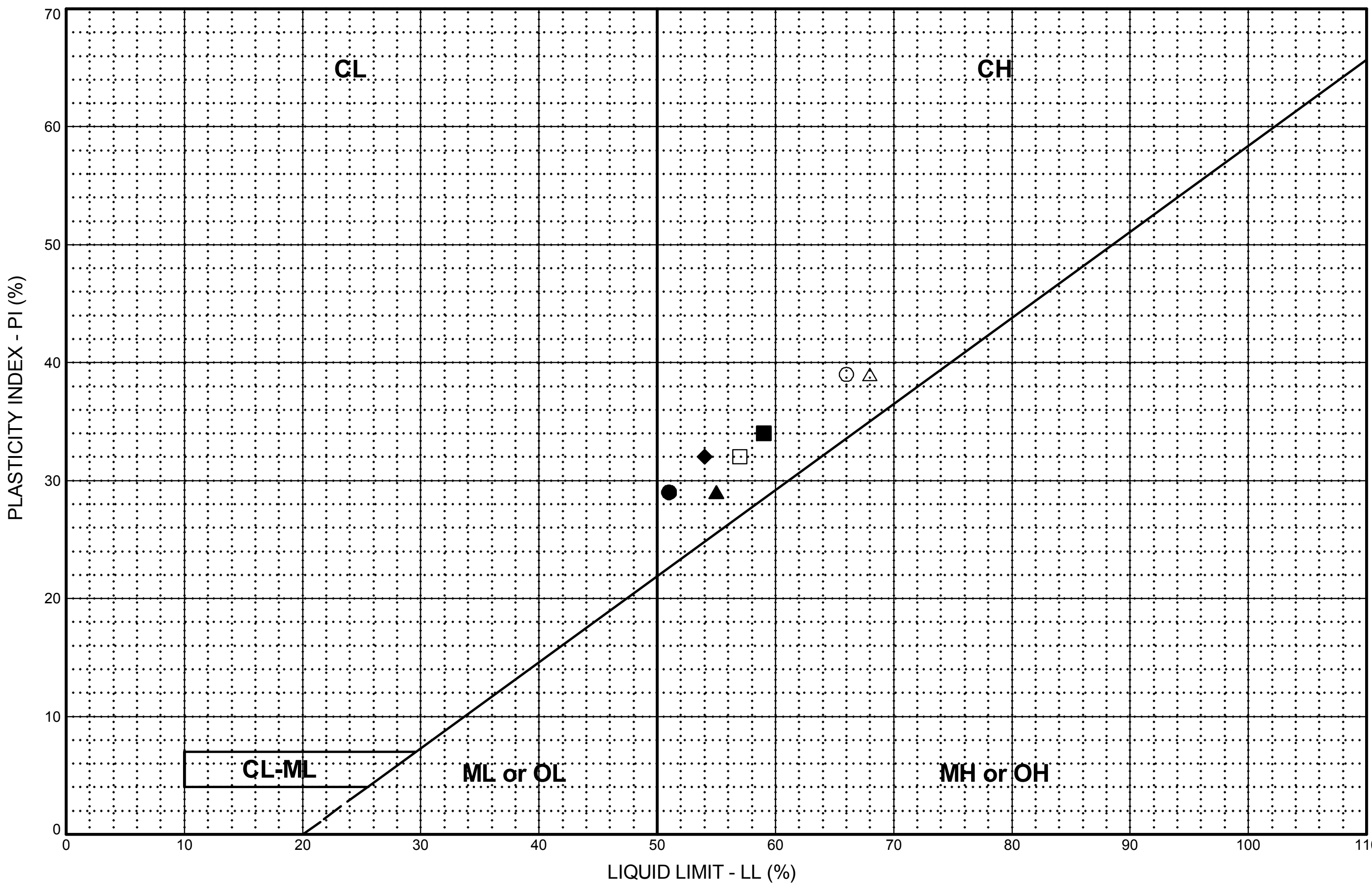
Geotechnical laboratory tests were performed on selected samples retrieved from the test pits to determine basic index and engineering properties of the soils encountered. Geotechnical laboratory tests included visual classification, water content determinations, gradation (percent of fines passing Sieve #200) and Atterberg limits. Laboratory testing was performed in general accordance with ASTM test procedures. The results from the laboratory tests are included on the logs or plots in Appendix A.

B.2 WATER CONTENT DETERMINATION

Water content was determined on selected samples in general accordance with ASTM Designation: D 2216, Test Method for Determination of Water (Moisture) Content of Soil and Rock. The water content for each sample is shown on the logs in Appendix A.

B.3 ATTERBERG LIMITS

Atterberg limit determinations were performed on selected samples in general accordance with ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. Atterberg Limits test results are shown on the logs in Appendix A and on Figure B1 of Appendix B.



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

ATTERBERG - NORMAL 100749-001 - ALEXANDRIA DERAILMENT R1.GPJ SHAN_WIL.GDT 6/7/18

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● B-1, S-4	9.5	CH	Light grey-brown to red-brown, *Fat Clay with Sand (CH)*.	51	22	29	21.8	
■ B-1, S-5	14.3	CH	Light grey-brown to red-brown, *Sandy Fat Clay (CH)*.	59	25	34	14.3	
▲ B-2, S-4	10.0	CH	Red-brown to grey-brown, *Fat Clay (CH)*.	55	26	29	22.3	
◆ B-2, S-7	24.3	CH	Red-brown to grey-brown, *Sandy Fat Clay (CH)*.	54	22	32	27.6	
○ B-3, S-5	14.3	CH	Grey-brown to red-brown, *Fat Clay (CH)*.	66	27	39	32.7	
□ B-3, S-7	24.3	CH	Red-brown to light grey, *Fat Clay (CH)*.	57	25	32	31.1	
△ B-3, S-8	29.3	CH	Light grey, *Fat Clay (CH)*.	68	29	39	27.6	

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PLASTICITY CHART

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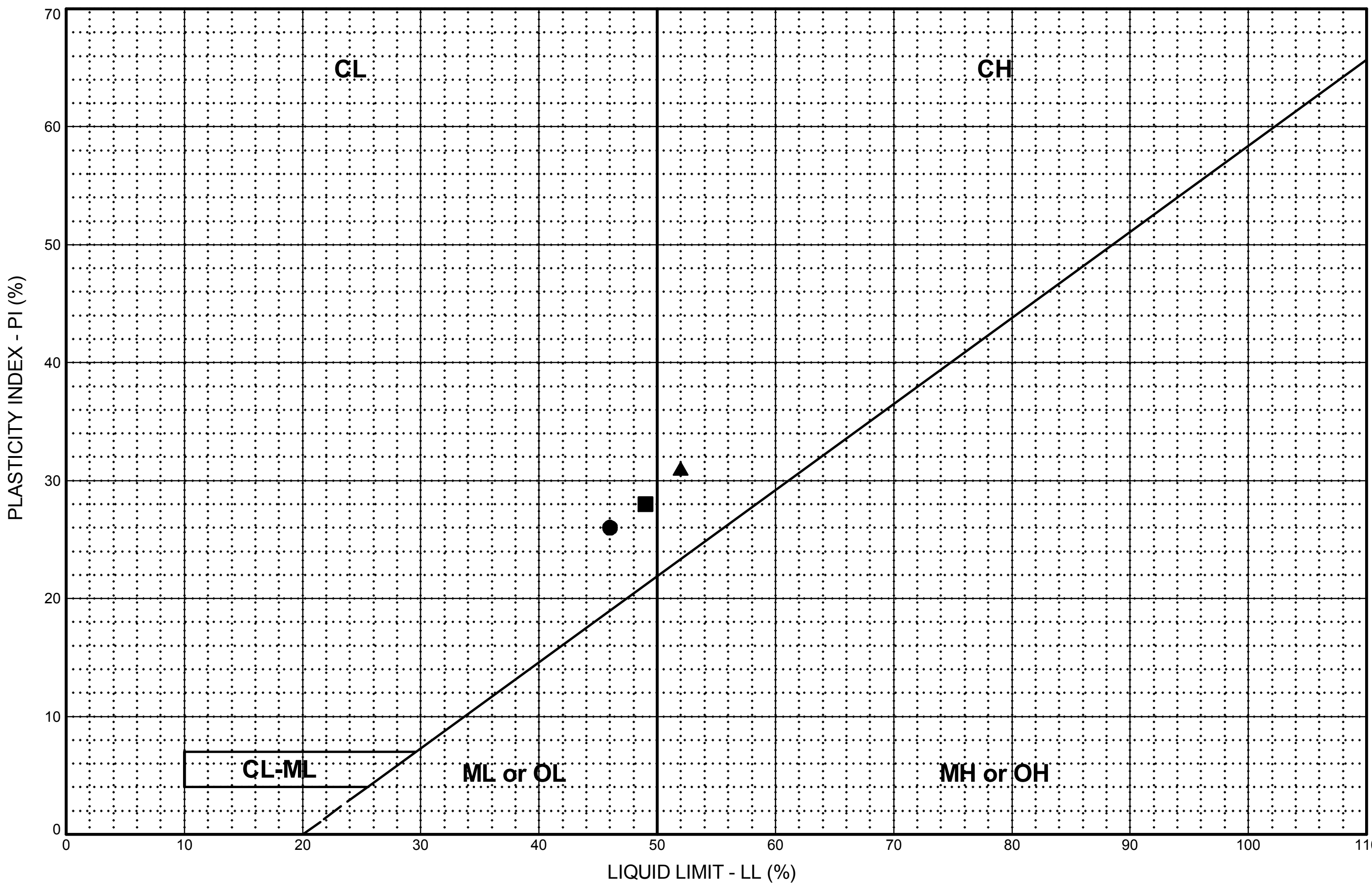
FIG.

FIG.



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

ATTERBERG - NORMAL 100749-001 - ALEXANDRIA DERAILMENT R1.GPJ SHAN_WIL.GDT 6/7/18

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● B-4, S-6	19.3	CL	Red-brown to grey-brown, *Lean Clay with Sand (CL)*.	46	20	26	25.2	
■ B-4, S-7	24.3	CL	Red-brown to grey-brown, *Lean Clay with Sand (CL)*.	49	21	28	30.7	
▲ B-5, S-6	19.3	CH	Grey-brown to red-brown, *Sandy Fat Clay (CH)*.	52	21	31	26.0	

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PLASTICITY CHART

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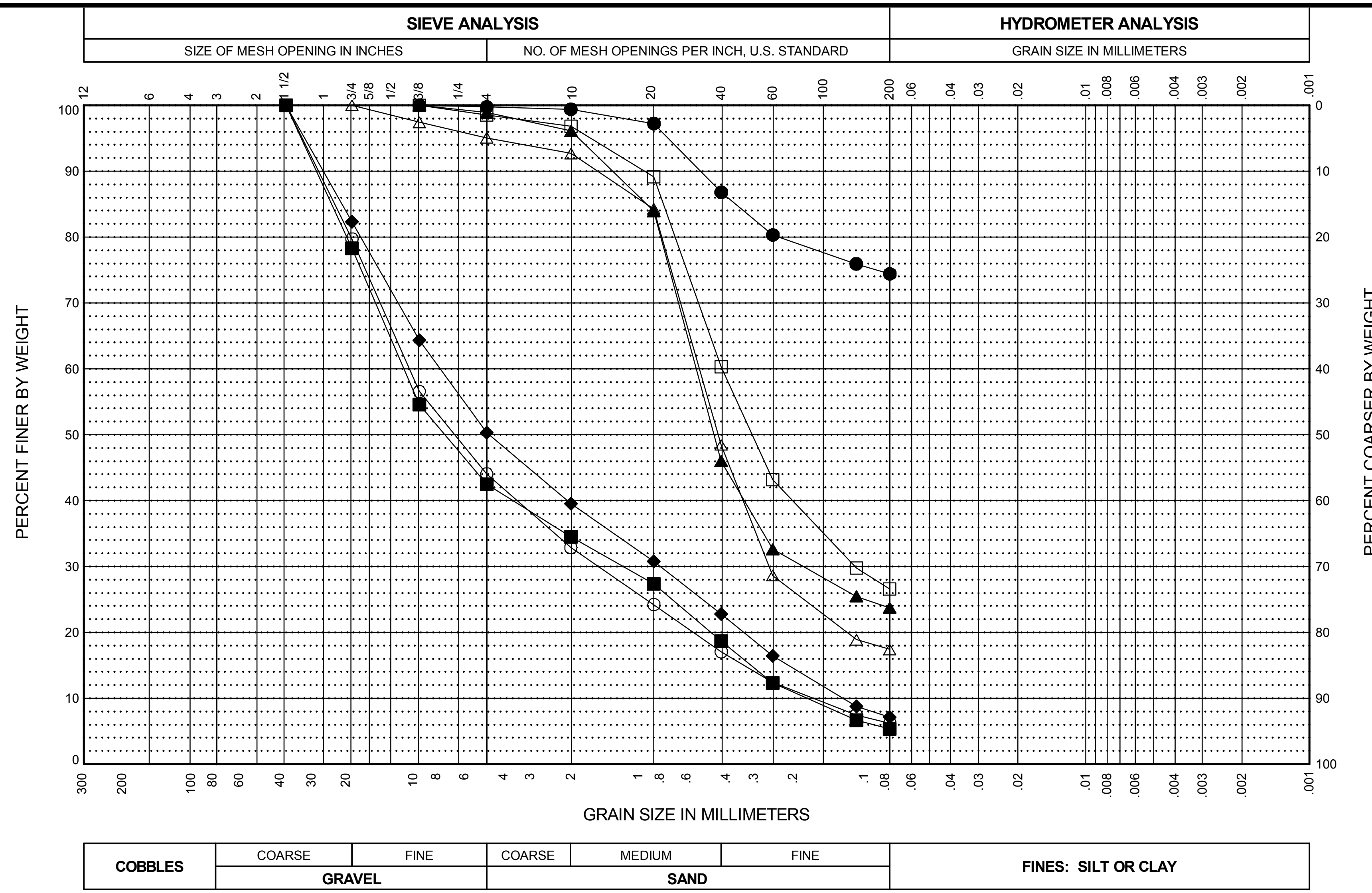
FIG.

FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● B-1, S-8	29.3	CH	Light grey, *Fat Clay with Sand (CH)*.	74.4				
■ B-1, S-9	34.3	GP-GC	Liight grey-brown, *Poorly Graded Gravel with Clay and Sand (GP-GC)*.	5.3	8.3			
▲ B-2, S-6	19.3	SM	Red-brown to red-yellow, *Silty Sand (SM)*.	23.7				
◆ B-2, S-9	34.3	GP-GM	Light grey to grey-brown, *Poorly Graded Gravel with Silt and Sand (GP-GM)*.	7.1				
○ B-3, S-9	34.3	GP-GM	Light grey, *Poorly Graded Gravel with Silt and Sand (GP-GM)*.	6.2				
□ B-5, S-5	14.3	SM	Grey-brown, *Silty Sand (SM)*.	26.6				
△ B-5, S-7	24.3	SM	Yellow-brown, *Silty Sand (SM)*.	17.4				

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GRAIN SIZE DISTRIBUTION

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FIG.

FIG.

IMPORTANT INFORMATION

Important Information

Environmental Site Assessment/Evaluation Report

IMPORTANT INFORMATION

ENVIRONMENTAL SITE ASSESSMENTS/EVALUATIONS ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

This report was prepared to meet the needs you specified with respect to your specific site and your risk management preferences. Unless indicated otherwise, we prepared your report expressly for you and for the purposes you indicated. No one other than you should use this report for any purpose without first conferring with us. No one is authorized to use this report for any purpose other than that originally contemplated without our prior written consent.

The findings and conclusions documented in this site assessment/evaluation have been prepared for specific application to this project and have been developed in a manner consistent with that level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in this area. The conclusions presented are based on interpretation of information currently available to us and are made within the operational scope, budget, and schedule constraints of this project. No warranty, express or implied, is made.

OUR REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

Our environmental site assessment is based on several factors and may include (but not be limited to) reviewing public documents to chronicle site ownership for the past 30, 40, or more years; investigating the site's regulatory history to learn about permits granted or citations issued; determining prior uses of the site and those adjacent to it; reviewing available topographic and real estate maps, historical aerial photos, geologic information, and hydrologic data; reviewing readily available published information about surface and subsurface conditions; reviewing federal and state lists of known and potentially contaminated sites; evaluating the potential for naturally occurring hazards; and interviewing public officials, owners/operators, and/or adjacent owners with respect to local concerns and environmental conditions.

Except as noted within the text of the report, no sampling or quantitative laboratory testing was performed by us as part of this site assessment. Where such analyses were conducted by an outside laboratory, Shannon & Wilson relied upon the data provided and did not conduct an independent evaluation regarding the reliability of the data.

CONDITIONS CAN CHANGE.

Site conditions, both surface and subsurface, may be affected as a result of natural processes or human influence. An environmental site assessment/evaluation is based on conditions that existed at the time of the evaluation. Because so many aspects of a historical review rely on third-party information, most consultants will refuse to certify (warrant) that a site is free of contaminants, as it is impossible to know with absolute certainty if such a condition exists. Contaminants may be present in areas that were not surveyed or sampled or may migrate to areas that showed no signs of contamination at the time they were studied.

Unless your consultant indicates otherwise, your report should not be construed to represent geotechnical subsurface conditions at or adjacent to the site and does not provide sufficient information for construction-related activities. Your report also should not be used following floods, earthquakes, or other acts of nature; if the size or configuration of the site is altered; if the location of the site is modified; or if there is a change of ownership and/or use of the property.

IMPORTANT INFORMATION

INCIDENTAL DAMAGE MAY OCCUR DURING SAMPLING ACTIVITIES.

Incidental damage to a facility may occur during sampling activities. Asbestos and lead-based paint sampling often require destructive sampling of pipe insulation, floor tile, walls, doors, ceiling tile, roofing, and other building materials. Shannon & Wilson does not provide for paint repair. Limited repair of asbestos sample locations is provided. However, Shannon & Wilson neither warranties repairs made by our field personnel, nor are we held liable for injuries or damages as a result of those repairs. If you desire a specific form of repair, such as those provided by a licensed roofing contractor, you need to request the specific repair at the time of the proposal. The owner is responsible for repair methods that are not specified in the proposal.

READ RESPONSIBILITY CLAUSES CAREFULLY.

Environmental site assessments/evaluations are less exact than other design disciplines, because they are based extensively on judgment and opinion and there may not have been any (or very limited) investigation of actual subsurface conditions. Wholly unwarranted claims have been lodged against consultants. To limit this exposure, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses may appear in this report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

Consultants cannot accept responsibility for problems that may develop if they are not consulted after factors considered in their reports have changed or conditions at the site have changed. Therefore, it is incumbent upon you to notify your consultant of any factors that may have changed prior to submission of the final assessment/evaluation.

An assessment/evaluation of a site helps reduce your risk but does not eliminate it. Even the most rigorous professional assessment may fail to identify all existing conditions.

ONE OF THE OBLIGATIONS OF YOUR CONSULTANT IS TO PROTECT THE SAFETY, HEALTH, PROPERTY, AND WELFARE OF THE PUBLIC.

If our environmental site assessment/evaluation discloses the existence of conditions that may endanger the safety, health, property, or welfare of the public, we may be obligated under rules of professional conduct, statutory law, or common law to notify you and others of these conditions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland