ECS Mid-Atlantic, LLC

Geotechnical Engineering Report

Altavista Generator Structure

208 Pittsylvania Avenue
Altavista, Virginia

ECS Project No. 12:19098

October 16, 2020

October 16, 2020

Mr. Scott Bortz
Peed & Bortz, Inc.
20 Midway Plaza Drive
Suite 100
Christiansburg, Virginia 24073

ECS Project No. 12:19098

Reference: Geotechnical Engineering Report
Altavista Generator Structure
208 Pittsylvania Avenue Altavista, Virginia

Dear Mr. Bortz:

ECS Mid-Atlantic, LLC (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations.

It has been our pleasure to be of service to Peed & Bortz, LLC during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify subsurface conditions assumed for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Mid-Atlantic, LLC

Chris O'Hara, EIT
Staff Engineer
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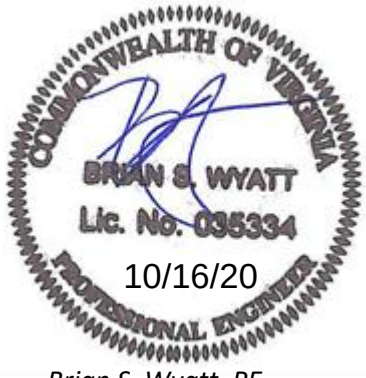

Brian S. Wyatt, PE
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APPENDICES

EXECUTIVE SUMMARY

This Executive Summary is intended as a very brief overview of the primary geotechnical conditions that are expected to affect design and construction. Information gleaned from the Executive Summary should not be utilized in lieu of reading the entire geotechnical report.

Based on the results of our SPT soil borings and assumed structural loads, the proposed structures may be supported on conventional shallow foundations with an allowable net bearing capacity of 1,500 psf.

Existing fill was encountered in one of our borings to a depth of approximately 3 feet below existing grades. These soils appeared to have been placed with some compactive effort, however no documentation of compaction was provided and soft material may be encountered in isolated areas.

The alluvial soils encountered near the anticipated footing bearing elevations varied in consistency. Soft alluvial soils requiring isolated undercuts should be anticipated.

1.0 INTRODUCTION

The purpose of this study was to provide geotechnical information for the design of foundations for a raised generator structure. The project will include the construction of a raised platform to support a generator and related equipment and utilities. The recommendations developed for this report are based on project information supplied by you of Peed & Bortz, Inc.

Our services were provided in accordance with our Proposal No. 14325-P, dated September 4, 2020, as authorized by you on September 16, 2020, which includes our Terms and Conditions of Service.

This report contains the procedures and results of our subsurface exploration and laboratory testing programs, review of existing site conditions, engineering analyses, and recommendations for the design and construction of the project.

The report includes the following items.

- A brief review and description of our field and laboratory test procedures and the results of testing conducted
- A review of surface topographical features and site conditions
- A review of area and site geologic conditions
- A review of subsurface soil/rock stratigraphy with pertinent physical properties
- Final soil test boring log
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills and identification of potentially unsuitable soils and/or soils exhibiting excessive moisture at the time of sampling
- Recommended foundation type(s)

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE/PAST SITE USE

The site is located approximately 3,800 feet west of the intersection of Broad Street and 3rd Street in the Town of Altavista, Virginia. At the time of our visit, the ground surface over the site consisted of grass covered topsoil. The overall site is bounded to the south and west by the Roanoke River, to the north by an access road, and to the east by a wooded area.

Figure 2.1.1. Site Location

The site is located immediately west of an existing fenced compound containing a small raised structure. Grades within the site appeared to vary on the order of about a few feet. The Roanoke River to the south appeared to be on the order of 10 to 15 feet below grades within the site.

2.2 PROPOSED CONSTRUCTION

The following information explains our understanding of the planned structure.

SUBJECT	DESIGN INFORMATION / ASSUMPTIONS
Usage	Generator Platform
Framing	Platform supported by four steel columns
Column Loads	10 kips
Lowest Finish Floor Elevation	EL. 540 ft (or about 20 feet above present site grades)

3.0 FIELD EXPLORATION AND LABORATORY TESTING

Our exploration procedures are explained in greater detail in Appendix B including the insert titled Subsurface Exploration Procedures. Our scope of work included drilling two soil test borings. Our borings were located by estimating angles from existing site features. Their approximate locations are shown on the Boring Location Diagram in Appendix A.

3.1 SITE GEOLOGY

Based on our review of the Geologic Map of the Roanoke 30 x 60 Minute Quadrangle (1997), the site is located within the Piedmont Geologic Province of Virginia. Specifically, mapping indicates the site is located within the Proterozoic-aged Alligator Back Formation. Bedrock in this area primarily consists of varying types of gneiss and schist. Bedrock within the site is overlain by layers of alluvium deposited by the Roanoke River.

3.2 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil strata. Please refer to the boring logs in Appendix B.

Approximate Depth (ft)	Stratum	Description	Ranges of SPT(1) N-values (bpf)
0-0.5 (Surface cover)	n/a	Topsoil	N/A
0.5-3	I	FILL, very stiff SILT WITH SAND (ML)	18
0.5-17	II	Alluvium, very loose to loose, SILTY SAND and very soft to soft SANDY SILT	3 to 6
12-22	III	Alluvium, loose to dense, Gravel with sand, contains rounded pebbles	6 to 36
18+	IV	River Jack (alluvial cobbles and boulders)	N/A

Notes:
(1) Standard Penetration Testing

3.3 GROUNDWATER OBSERVATIONS

Water levels were measured in our borings in Appendix B. Groundwater depths measured at the time of drilling ranged from 13.5 to 17.8 feet below the ground surface, corresponding to approximate elevations of EL. 512 to EL. 507 ft. Due to the proximity of the Roanoke River to the site, the groundwater encountered in our borings is likely hydraulically connected to the river.

3.4 LABORATORY TESTING

The laboratory testing consisted of selected tests performed on samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil samples. The laboratory testing program included natural moisture content tests (ASTM D2216), percent passing the No. 200 sieve tests (ASTM D1140), and Atterberg Limits tests (ASTM D4318). The results of all laboratory testing conducted are included in the Appendix of this report.

Each sample was visually classified on the basis of texture and plasticity in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures) and including USCS classification symbols, and ASTM D2487 Standard Practice for Classification for Engineering Purposes (Unified Soil Classification System (USCS)). After classification, the samples were grouped in the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses along with the soil descriptions. The stratification lines between strata on the logs are approximate; in situ, the transitions may be gradual.

4.0 DESIGN RECOMMENDATIONS

4.1 FOUNDATIONS

Provided subgrades and Structural Fills are prepared as recommended in this report, the proposed structure can be supported by shallow foundations including column footings and continuous footings. Deep foundations were considered for scour protection, however based on the conditions encountered and the scale of the structure, we anticipate that a foundation providing scour protection may not be practical. Placement of rip rap around column footings may be desired to provide some level of protection. We recommend the foundation design use the following parameters:

Design Parameter	Column Footing
Net Allowable Bearing Pressure(1)	1,500 psf
Acceptable Bearing Soil Material	Loose SILTY SAND (SM) or SILT (ML) - Stratum II
Minimum Width	24 inches
Minimum Exterior Frost Depth (below final exterior grade)	36 inches
Estimated Total Settlement (2)	Less than 1- inch
Estimated Differential Settlement (3)	Less than ¾ inches between columns

(1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
(2) Based on assumed structural loads. If final loads are different, ECS must be contacted to update foundation recommendations and settlement calculations.
(3) Based on maximum column/wall loads and variability in borings. Differential settlement can be re-evaluated once the foundation plans are more complete

Potential Undercuts: Most of the soils at the foundation bearing elevation are anticipated to be suitable for support of the proposed structure. If soft or unsuitable soils or uncontrolled fill are observed at the footing bearing elevations, the unsuitable soils should be undercut and removed. Any undercut should be backfilled with cementitious flowable fill ($f'_c \geq 200$ psi at 28 days), crushed angular gravel (VDOT No. 57 Stone), or compacted VDOT No. 21-A Stone up to the original design bottom of footing elevation; the original footing shall be constructed at the desired footing elevations.

SOIL PARAMETER	ESTIMATED VALUE
Coefficient of Passive Earth Pressure (K_p)	3.0
Soil Moist Unit Weight (γ)	120 pcf
Cohesion (C)	50 psf
Interface Friction Angle [Concrete on Soil] (ϕ_f)	18°
Sliding Friction Coefficient [Concrete on Soil] (μ)	0.30
Passive equivalent fluid pressure	360H (psf)

4.2 SEISMIC DESIGN CONSIDERATIONS

Seismic Site Classification: The International Building Code (IBC) 2015 requires site classification for seismic design based on the upper 100 feet of a soil profile. At least two methods are utilized in classifying sites, namely the shear wave velocity (v_s) method and the Standard Penetration Resistance (N-value) method. The latter method (N-value) was used in classifying this site.

SEISMIC SITE CLASSIFICATION			
Site Class	**Soil Profile Name**	**Shear Wave Velocity, Vs, (ft./s)**	**N value (bpf)**
A	Hard Rock	Vs > 5,000 fps	N/A
B	Rock	2,500 < Vs ≤ 5,000 fps	N/A
C	Very dense soil and soft rock	1,200 < Vs ≤ 2,500 fps	>50
D	Stiff Soil Profile	600 ≤ Vs ≤ 1,200 fps	15 to 50
E	Soft Soil Profile	Vs < 600 fps	<15

Based upon our interpretation of the subsurface conditions, the appropriate Seismic Site Classification is "D" as shown in the preceding table.

Ground Motion Parameters: In addition to the seismic site classification, ECS has determined the design spectral response acceleration parameters following the IBC methodology. The Mapped Responses were estimated from the USGS website https://www.usgs.gov/natural-hazards/earthquake-hazards/design-ground-motions. The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are noted in bold at the far right end of the following table.

GROUND MOTION PARAMETERS [IBC 2015 Method]								
Period (sec)	**Mapped Spectral Response Accelerations (g)**		**Values of Site Coefficient for Site Class**		**Maximum Spectral Response Acceleration Adjusted for Site Class (g)**		**Design Spectral Response Acceleration (g)**	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_S	0.15	F_a	1.6	$S_{MS}=F_aS_s$	0.24	$S_{DS}=2/3\ S_{MS}$	0.16
1.0	S_1	0.058	F_v	2.4	$S_{M1}=F_vS_1$	0.14	$S_{D1}=2/3\ S_{M1}$	0.093

The Site Class definition should not be confused with the Seismic Design Category designation which the Structural Engineer typically assesses. If a higher site classification is beneficial to the project, we can provide additional testing methods that may yield more favorable results.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 SUBGRADE PREPARATION

5.1.1 Stripping and Grubbing

The subgrade preparation should consist of stripping all vegetation, rootmat, topsoil, existing fill, and any soft or unsuitable materials from the 5-foot expanded structure and 2-foot expanded pavement limits, and 5 feet beyond the toe of Structural Fills. Borings performed in "undisturbed" areas of the site contained an observed 5 to 6 inches of topsoil. Deeper topsoil or organic laden soils may be present in wet, low-lying, and poorly drained areas. ECS should be retained to verify that topsoil and unsuitable surficial materials have been removed prior to the placement of structural fill or construction of structures.

5.1.2 Proofrolling

Prior to fill placement or other construction on subgrades, the subgrades should be evaluated by an ECS field technician. The exposed subgrade should be thoroughly proofrolled with construction equipment having a minimum axle load of 10 tons [e.g. fully loaded tandem-axle dump truck]. Proofrolling should be traversed in two perpendicular directions with overlapping passes of the vehicle under the observation of an ECS technician. This procedure is intended to assist in identifying any localized yielding materials.

Where proofrolling identifies areas that are unstable or "pumping" subgrade those areas should be repaired prior to the placement of any subsequent Structural Fill or other construction materials. Methods of stabilization include undercutting, moisture conditioning, or chemical stabilization. The situation should be discussed with ECS to determine the appropriate procedure. Test pits may be excavated to explore the shallow subsurface materials to help in determining the cause of the observed unstable materials, and to assist in the evaluation of appropriate remedial actions to stabilize the subgrade.

5.2 EARTHWORK OPERATIONS

5.2.1 Existing Man-Placed Fill

Fill Content: Existing fill encountered in Boring B-2 consisted of SILT (ML), containing root fragments.

Fill Removal: - All existing fill should be removed from below the planned structure areas.

5.2.2 Structural Fill

Prior to placement of Structural Fill, representative bulk samples (about 50 pounds) of on-site and/or off-site borrow should be submitted to ECS for laboratory testing, which will typically include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships (i.e., Proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications. Alternatively, Proctor data from other accredited laboratories can be submitted if the test results are within the last 90 days.

Satisfactory Structural Fill Materials: Materials satisfactory for use as Structural Fill should consist of inorganic soils with the following engineering properties and compaction requirements.

STRUCTURAL FILL INDEX PROPERTIES	
Subject	**Property**
Structure and Pavement Areas (Borrow Soils)	LL < 50, PI<25
Structure and Pavement Areas (On-site Soils)	LL < 60, PI < 30
Max. Particle Size	4 inches
Max. organic content	5% by dry weight

STRUCTURAL FILL COMPACTION REQUIREMENTS	
Subject	**Requirement**
Compaction Standard	Standard Proctor, ASTM D698
Required Compaction	95% of Max. Dry Density
Moisture Content	+/-3 % points of the soil's optimum value
Loose Thickness	8 inches prior to compaction

Fill Placement: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and all frozen or frost-heaved soils should be removed prior to placement of Structural Fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

5.3 FOUNDATION AND SLAB OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation

concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1 to 3-inch thick "mud mat" of "lean" concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: Most of the soils at the foundation bearing elevation are anticipated to be suitable for support of the proposed structure. It is important to have ECS observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated.

Slab Subgrade Verification: Prior to placement of a drainage layer, the subgrade should be prepared in accordance with the recommendations found in **Section 5.1.2 Proofrolling**.

5.4 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrades should be observed and probed for stability by ECS. Any loose or unsuitable materials encountered should be removed and replaced with suitable compacted Structural Fill, or pipe stone bedding material.

Utility Backfilling: The granular bedding material (AASHTO #57 stone) should be at least 4 inches thick, but not less than that specified by the civil engineer's project drawings and specifications. We recommend that the bedding materials be placed up to the springline of the pipe. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for Structural Fill and Fill Placement.

Excavation Safety: All excavations and slopes should be constructed and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing, constructing, and maintaining stable temporary excavations and slopes. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.0 CLOSING

ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation, expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by our client. If any of this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our

recommendations and provide additional or alternate recommendations that reflect the proposed construction.

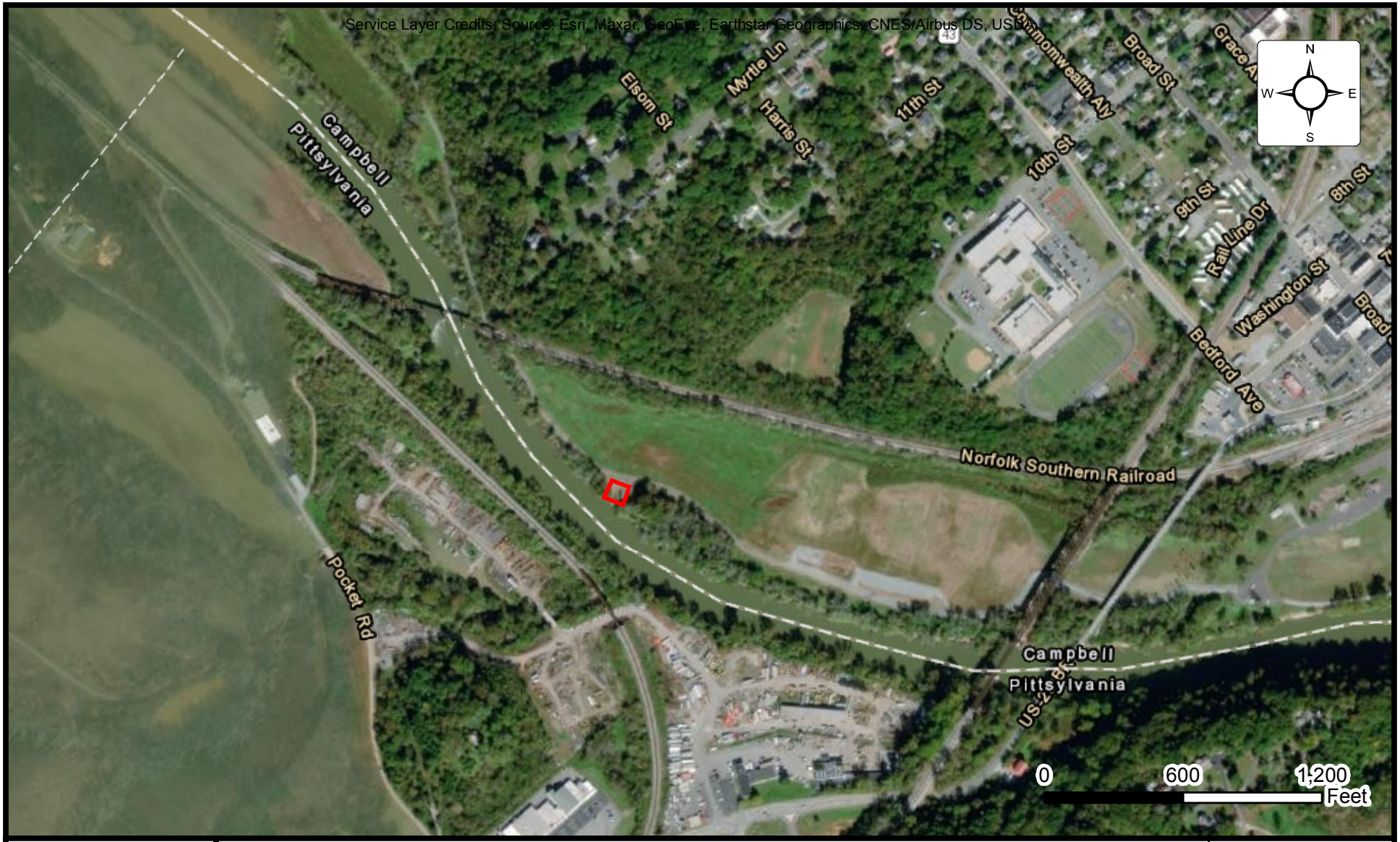
We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

Field observations, and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Diagrams & Reports

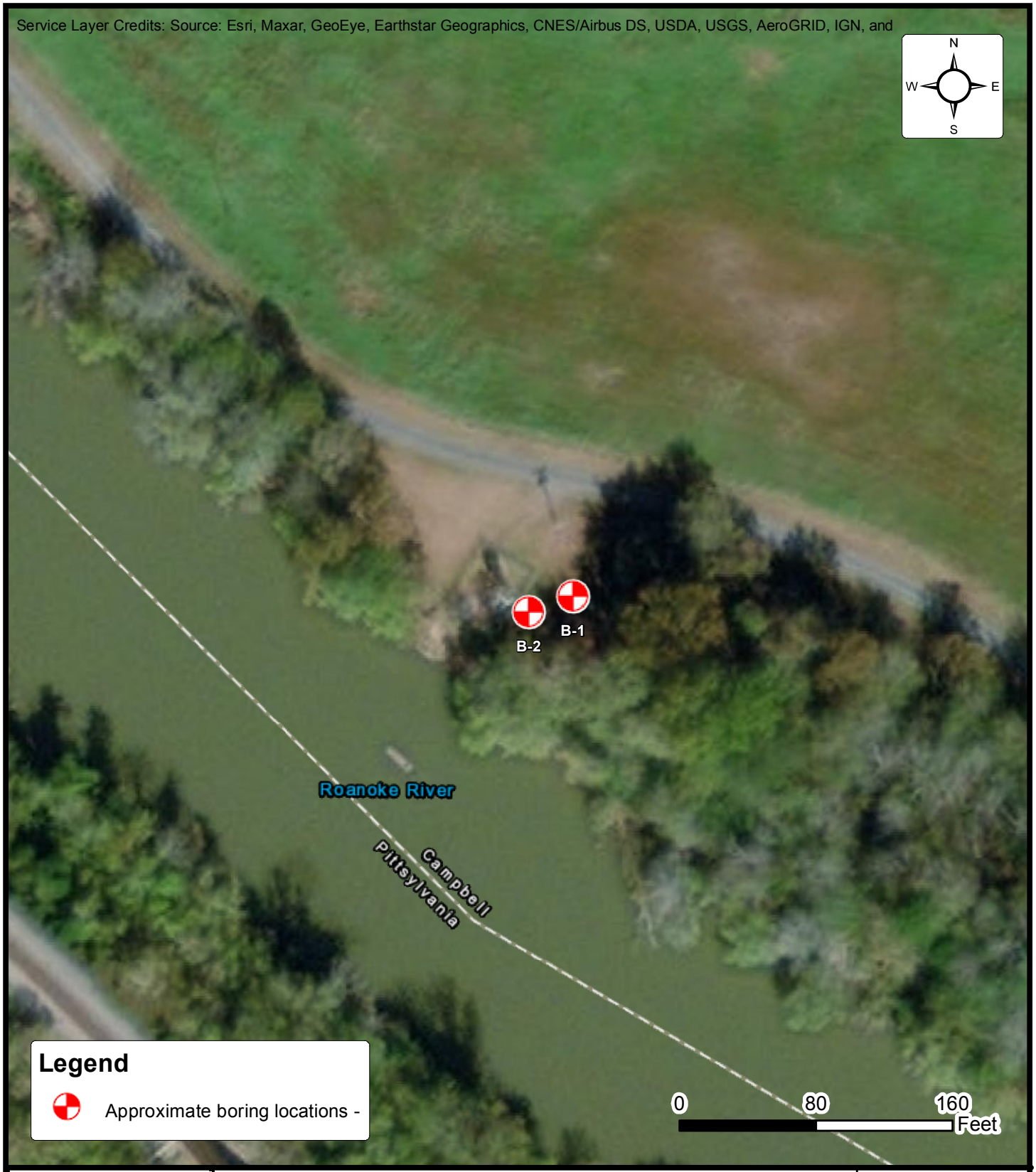
Site Location Diagram
Boring Location Diagram



Site Location Diagram
ALTAVISTA GENERATOR STRUCTURE

208 PITTSYLVANIA AVENUE, ALTAVISTA, VIRGINIA
PEED & BORTZ

ENGINEER	BMQ
SCALE	AS NOTED
PROJECT NO.	12:19098
SHEET	1 OF 1
DATE	9/21/2020



Boring Location Diagram
ALTAVISTA GENERATOR STRUCTURE

208 PITTSYLVANIA AVENUE, ALTAVISTA, VIRGINIA

PEED & BORTZ

ENGINEER	BMQ
SCALE	AS NOTED
PROJECT NO.	12:19098
SHEET	1 OF 1
DATE	10/8/2020

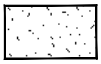
APPENDIX B – Field Operations

Reference Notes for Boring Logs
Subsurface Exploration Procedure: Standard Penetration Testing (SPT)
Boring Logs B-1 and B-2

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]


ASPHALT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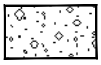
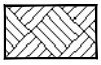
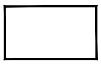
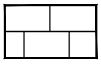

GRAVEL

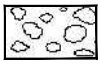

TOPSOIL

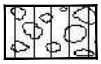

VOID


BRICK

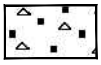

AGGREGATE BASE COURSE

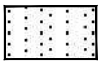

GW **WELL-GRADED GRAVEL**
gravel-sand mixtures, little or no fines

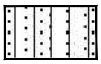

GP **POORLY-GRADED GRAVEL**
gravel-sand mixtures, little or no fines


GM **SILTY GRAVEL**
gravel-sand-silt mixtures

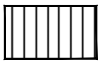

GC **CLAYEY GRAVEL**
gravel-sand-clay mixtures

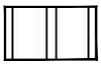

SW **WELL-GRADED SAND**
gravelly sand, little or no fines

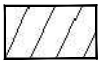

SP **POORLY-GRADED SAND**
gravelly sand, little or no fines


SM **SM SILTY SAND**
sand-silt mixtures

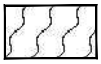

SC **CLAYEY SAND**
sand-clay mixtures

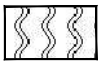

ML **SILT**
non-plastic to medium plasticity

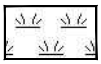

MH **ELASTIC SILT**
high plasticity


CL **LEAN CLAY**
low to medium plasticity


CH **FAT CLAY**
high plasticity


OL **ORGANIC SILT or CLAY**
non-plastic to low plasticity


OH **ORGANIC SILT or CLAY**
high plasticity


PT **PEAT**
highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

WATER LEVELS[6]

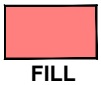

WL (First Encountered)


WL (Completion)


WL (Seasonal High Water)


WL (Stabilized)

FILL AND ROCK


FILL


POSSIBLE FILL


PROBABLE FILL


ROCK

[1]Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2]To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3]Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4]Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5]Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6]The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7]Minor deviation from ASTM D 2488-17 Note 14.

[8]Percentages are estimated to the nearest 5% per ASTM D 2488-17.

SUBSURFACE EXPLORATION PROCEDURE: STANDARD PENETRATION TESTING (SPT) ASTM D 1586 Split-Barrel Sampling

Standard Penetration Testing, or **SPT**, is the most frequently used subsurface exploration test performed worldwide. This test provides samples for identification purposes, as well as a measure of penetration resistance, or N-value. The N-Value, or blow counts, when corrected and correlated, can approximate engineering properties of soils used for geotechnical design and engineering purposes.

SPT Procedure:

- Involves driving a hollow tube (split-spoon) into the ground by dropping a 140-lb hammer a height of 30-inches at desired depth
- Recording the number of hammer blows required to drive split-spoon a distance of 12 inches (in 3 or 4 Increments of 6 inches each)

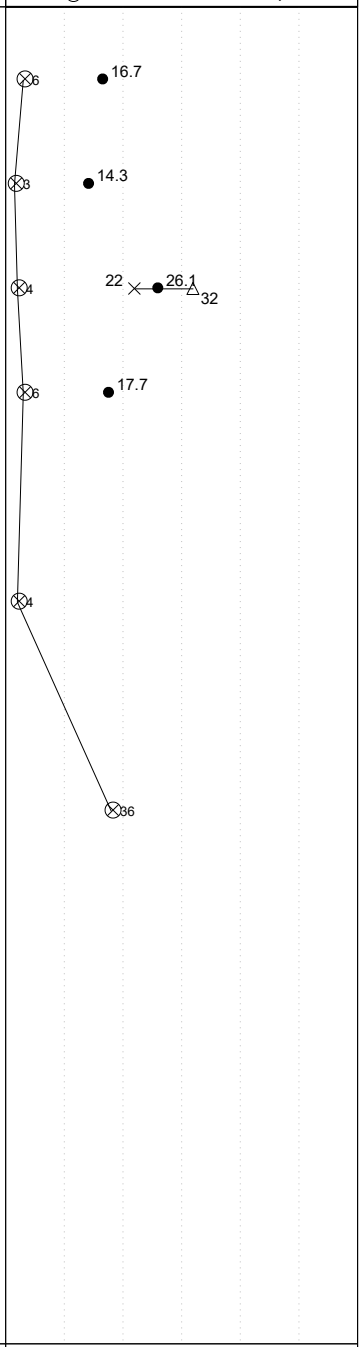
- Auger is advanced* and an additional SPT is performed
- One SPT test is typically performed for every two to five feet

- Obtain two-inch diameter soil sample

**Drilling Methods May Vary—* The predominant drilling methods used for SPT are open hole fluid rotary drilling and hollow-stem auger drilling.

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Peed & Bortz	**12:19098**	**B-1**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Altavista Generator Structure	**Blue Ridge Drilling, Inc.**		
SITE LOCATION:			LOSS OF CIRCULATION
208 Pittsylvania Avenue, Altavista, Virginia 24517			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **525**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness [5"]			
	S-1	SS	18	17	(SM) Alluvium, SILTY SAND, brown, moist, loose to very loose			4-3-3 (6)
	S-2	SS	18	15				2-2-1 (3)
5							520	
	S-3	SS	18	16	(CL) SANDY LEAN CLAY, brown, moist, soft			3-1-3 (4)
	S-4	SS	18	9	(SM) SILTY SAND, brown, moist, very loose to very loose			2-3-3 (6)
10							515	
	S-5	SS	18	0				1-2-2 (4)
15							510	
	S-6	SS	18	15	(GP) GRAVEL WITH SAND, trace silt, brown, wet, dense	▼		13-15-21 (36)
20							505	
					Refusal encountered at 22.0 feet. **END OF DRILLING AT 22.0 FT** *Refusal presumed to have occured on river jack.			
25							500	
30							495	



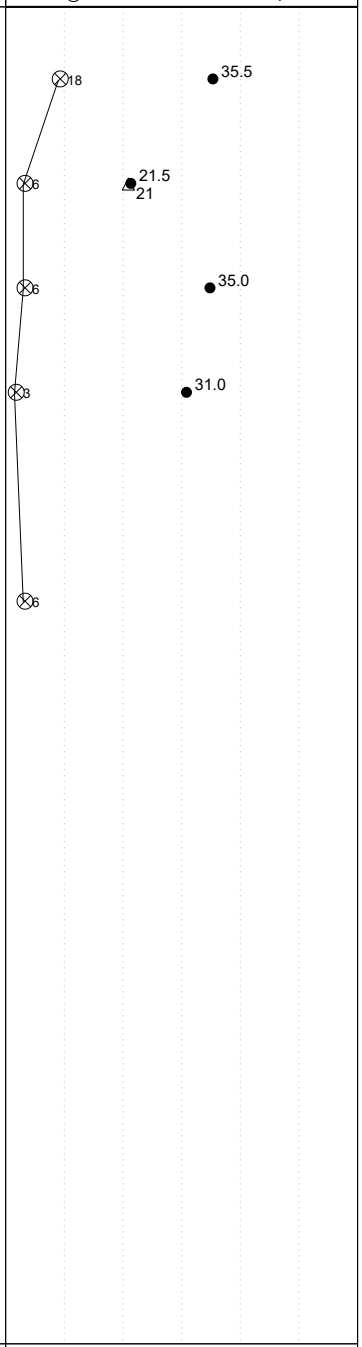
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)		BORING STARTED:	**Sep 28 2020**	CAVE IN DEPTH:	**5.8**
▼ WL (Completion)	**17.8**	BORING COMPLETED:	**Sep 28 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)		EQUIPMENT: **Truck BK-51**	LOGGED BY: **BRD**	DRILLING METHOD:	**2 1/4" HSA**
▽ WL (Stabilized)					

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Peed & Bortz	**12:19098**	**B-2**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Altavista Generator Structure	**Blue Ridge Drilling, Inc.**		
SITE LOCATION: **208 Pittsylvania Avenue, Altavista, Virginia 24517**			LOSS OF CIRCULATION
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION: **525**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [6"]			
	S-1	SS	18	6	(ML) FILL, SILT WITH SAND, contains roots, brown, moist, very stiff			6-8-10 (18)
	S-2	SS	18	16	(ML) Alluvium, SANDY SILT, brown, moist, firm to soft			5-3-3 (6)
5	S-3	SS	18	16			520	3-3-3 (6)
	S-4	SS	18	10				1-1-2 (3)
10							515	
	S-5	SS	18	16	(GP) GRAVEL WITH SAND, trace silt, brown, wet, loose	▼		3-3-3 (6)
15							510	
					Refusal encountered at 18.0 feet. **END OF DRILLING AT 18.0 FT** *Refusal presumed to have occured on river jack.			
20							505	
25							500	
30							495	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	BORING STARTED: **Sep 28 2020**	CAVE IN DEPTH:	**15.2**
▼ WL (Completion) **13.5**	BORING COMPLETED: **Sep 28 2020**	HAMMER TYPE:	**Manual**
▼ WL (Seasonal High Water)	EQUIPMENT: **Truck BK-51** / LOGGED BY: **BRD**	DRILLING METHOD:	**2 1/4" HSA**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

APPENDIX C – Laboratory Testing

Laboratory Test Results Summary
Plasticity Chart

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC (%)	Soil Type	Atterberg Limits			Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		Organic Content (%)
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)	0.1 in.	0.2 in.	
B-1	S-1	1-2.5	16.7										
B-1	S-2	3.5-5	14.3										
B-1	S-3	6-7.5	26.1	CL	32	22	10	66					
B-1	S-4	8.5-10	17.7										
B-2	S-1	1-2.5	35.5										
B-2	S-2	3.5-5	21.5	ML	21	NP		52.7					
B-2	S-3	6-7.5	35										
B-2	S-4	8.5-10	31										

Notes: See test reports for test method, *ASTM D2488

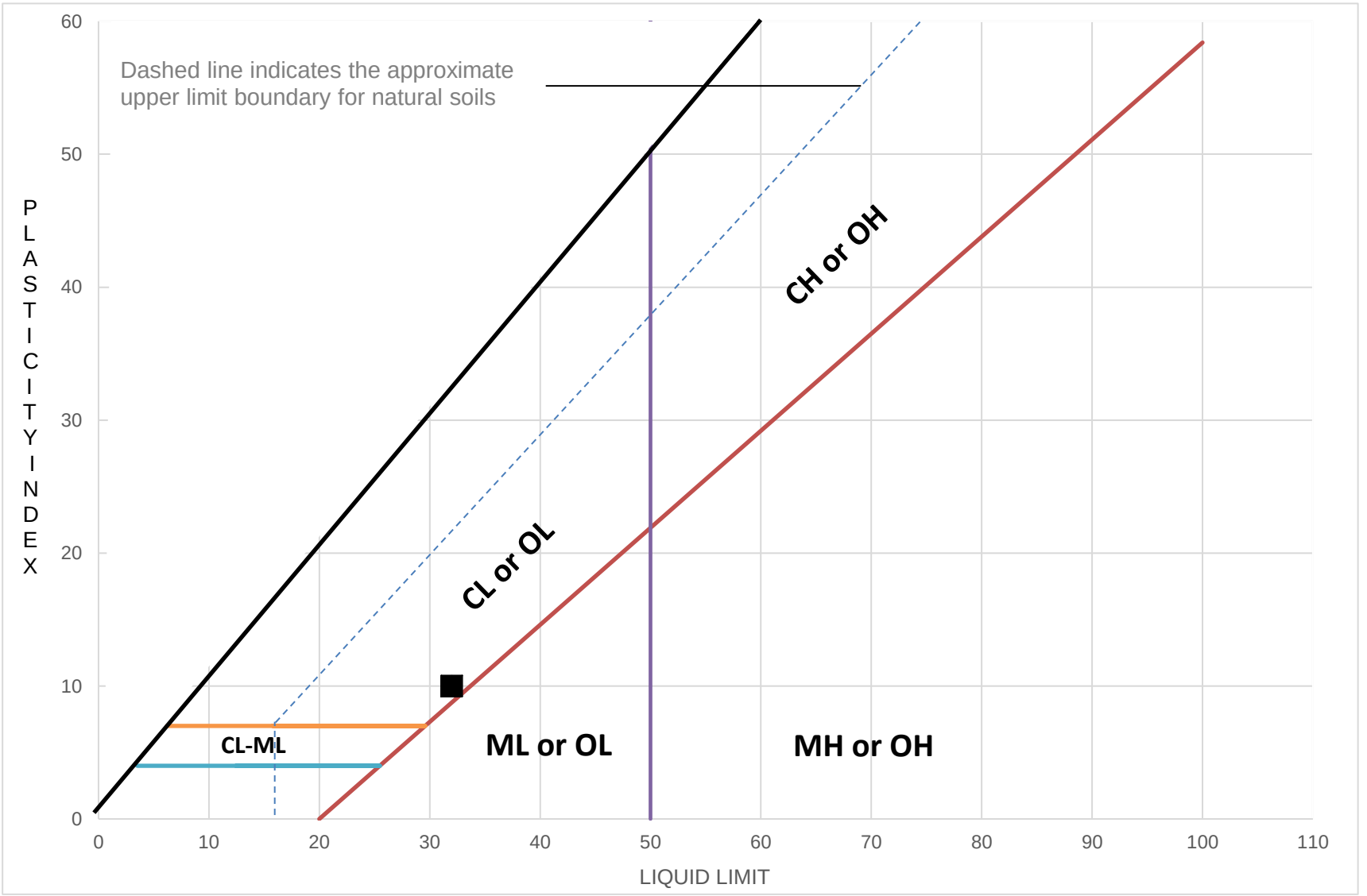
Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: Altavista Generator Structure
Client: Peed & Bortz
Project No.: 12:19098
Date Reported: 10/12/2020

Office / Lab	Address	Office Number / Fax
ECS Mid-Atlantic LLC - Roanoke	7670 Enon Drive Suite 101 Roanoke, VA 24019	(540)362-2000 (540)362-1202

Tested by	Checked by	Approved by	Date Received
JGeil	jginter	jginter	10/1/2020

LIQUID AND PLASTIC LIMITS TEST REPORT



	Sample Location	Sample Number	Sample Depth (ft)	LL	PL	PI	%<#40	%<#200	AASHTO	USCS	Material Description
■	B-1	S-3	6-7.5	32	22	10	100.0	66.0	A-4	CL	Brown SANDY LEAN CLAY
◆	B-2	S-2	3.5-5	21	NP		100.0	52.7	A-4	ML	Brown SANDY SILT

Project: Altavista Generator Structure
Client: Peed & Bortz

Project No.: 12:19098
Date Reported: 10/12/2020

Office / Lab: ECS Mid-Atlantic LLC - Roanoke

Address: 7670 Enon Drive
Suite 101
Roanoke, VA 24019

Office Number / Fax: (540)362-2000
(540)362-1202

Tested by	Checked by	Approved by	Date Received
JGeil	jginter	jginter	10/1/2020