City of Lynchburg
Procurement Division
900 Church Street
Lynchburg, Virginia 24504
Telephone No.: (434) 455-3970
Fax No.: (434) 845-0711

Addendum for Invitation for Bids
Wingate Water Storage Tank #2

14-888

Date: 1/24/2014
From: Lisa Moss, Buyer VCA
RE: Addendum No. 1

This Addendum supplements and amends the original Plans and Specifications and shall be taken into account in preparing proposals and shall become a part of the Contract Documents. The Bidder shall indicate receipt of this Addendum and all previously issued Addenda on the Bid Form.

1. **The City did a preliminary engineering study of construction options and has selected AWWA standard D-115 as the preferred construction method for this tank based on estimated construction and lifetime maintenance costs. The project is to be bid in accordance with the project manual and specifications. No alternates will be accepted.**

2. **Revision to the Contract Document Paragraph 2: That the Contractor shall commence Work within ten (10) days after Notice to Contractor to proceed with the work under Contract (Notice to Proceed), and shall substantially complete the work within 150 (one hundred fifty) days.**

3. **Site is a securely fenced site (manually locked gate) with an existing water storage tank. Additional land has been purchased to construct the new tank. Work will include removing and resetting the security fence at the new property line (some additional fence length will be required). During construction, contractor shall maintain site security with temporary fence around opening when the fence is taken down.**

4. **Access to the site is on a private road off Candlers Mountain Road. The road is paved for a short distance and is well maintained gravel for the rest. Since construction will be spring/summer, winter weather site access will not be a concern.**

5. **Should precast panels be the selected construction option, a laydown are at the WWTP on Concord Turnpike is available. This site is plenty big enough to allow multiple panels to be delivered and stored and is easily accessible off US 460. The job site is difficult to access for large 18 wheel trucks. Contractor would need to coordinate transfer of panels to the job site, approximately 6 miles away.**

6. Who will be responsible for special inspections?
   The City has a contract with Wiley Wilson (the Engineer) for special inspections. The contractor is only responsible for notifying the Engineer and the City when inspections are needed.

7. **A Geotechnical Report was prepared for the project and is attached below.**

8. What are the working hours for this project?
   The area is very isolated with only a FAA radar facility adjacent to the site. Working hours can be sun up to sun down with much of the construction anticipated during the longest days of the year (April-July). Saturday work is allowed, however work on Sundays/Holidays will need to be preapproved by Scott Parkins.

9. **There are no limits on work due to FAA radar or airport flight path restrictions.**

10. **Clarification of Contract Terms: The 150 days for substantial completion timeframe does not take effect on the actual contract date. As stated in the contract document, the Contractor is to commence work within 10 days after the Notice to Proceed. The 150 days for substantial completion timeframe will not start until the date the contract is onsite and ready to commence work.**

*Company Name:*_____*Address:*_____*Date:*_____

*Authorized Signature:*_____*Title:*_____

*Print Name:*_____*Telephone No.:*_____

*Fax No.:*_____

ENGINEERING CONSULTING SERVICES

GEOTECHNICAL • CONSTRUCTION MATERIALS • ENVIRONMENTAL • FACILITIES

REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ANALYSIS
WINGATE TANK 2
CANDLER'S MOUNTAIN ROAD, CAMPBELL COUNTY, VIRGINIA

ECS REPORT NO. 12:7049

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CLOSING 9

May 20, 2013

Mr. Aaron Tice, P.E.
WileyIWilson
127 Nationwide Drive
Lynchburg, VA 24502-4272

ECS Project No. 12:7049

Reference: Report of Subsurface Exploration and Geotechnical Analysis
Wingate Tank 2
Candler's Mountain Road
Campbell County, Virginia

Dear Mr. Tice:

ECS Mid-Atlantic, LLC (ECS) respectfully submits this Report of Subsurface Exploration and Geotechnical Analysis for the above-referenced project. Our services have been provided in accordance with ECS Proposal No. 103510-P, dated February 15, 2013. This report includes the results of the soil test borings, laboratory analysis, and geotechnical recommendations for this project.

SCOPE OF SERVICES

The conclusions and recommendations contained in this report are based upon the results of our field exploration. Our exploration consisted of a site visit by engineering personnel and five soil test borings drilled to depths of up to 25 feet below the existing ground surface. Laboratory testing performed on several representative samples obtained during the field exploration aided in the evaluation of the field data. The borings were located in the field by an engineer from our office by measuring distances and estimating angles from existing site features. The boring locations shown on the diagram provided in the Appendix of this report should be considered approximate.

The recommendations contained herein were developed from our interpretation of the subsurface data obtained from the soil test borings. The borings indicate subsurface conditions at specific locations at the time of the exploration. If, during the course of construction, variations appear evident, the geotechnical engineer should be informed so that the conditions can be addressed.

Design recommendations were developed based on building design criteria considered typical for this type of structure and the specific information provided. Should structural loading characteristics differ from those discussed herein, ECS should be contacted for review of these conditions and possible revisions to the recommendations of this report.

PROJECT CHARACTERISTICS

Project information was provided by Aaron Tice of WileylWilson. We have been provided with a drawing entitled "Lynchburg New LU Pressure Zone Evaluation", dated February 5, 2013, which shows the location of the proposed construction relative to existing site features and surface topography.

Based on the information provided, we understand that the project will consist of the construction of a new 0.5-million-gallon (MG) tank with a proposed diameter of 60 feet. The tank is to be situated just off of Candler's Mountain Road near an existing water tank in Campbell County, Virginia. The actual design of the tank has not yet been completed and options for a Crom-type tank and a welded steel tank are under evaluation.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

In order to characterize the general subsurface conditions, 5 soil test borings (B-1 through B-5) were performed within the limits of the proposed construction. The borings were performed with track-mounted drilling equipment utilizing continuous-flight, hollow stem augers (HSA) to advance the boreholes to auger refusal. Drilling fluid was not used in this process.

Representative samples were obtained by means of the split-barrel sampling procedure in accordance with ASTM Specification D-1586. In this procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval is termed the Standard Penetration Test (SPT) N-value and is indicated for each sample on the boring logs. This value can be used as a qualitative indication of the in-place relative density of cohesionless soils. In a less reliable way, it also indicates the consistency of cohesive soils. This indication is qualitative, since many factors can significantly affect the Standard Penetration resistance value and prevent a direct correlation between drill crews, drill rigs, drilling procedures, and hammer-rod sampler assemblies. Samples were obtained at 2.5-foot intervals in the upper 10 feet of the boring, and at 5-foot intervals thereafter.

After recovery, representative portions of each soil sample were removed from the sampler and sealed in glass jars. The samples were taken to our laboratory in Roanoke, Virginia for visual classification and laboratory testing.

Laboratory Testing Program

Representative soil samples were selected and tested in our laboratory to substantiate visual classifications and to aid in the estimation of pertinent engineering properties. The laboratory testing program included natural moisture content tests (ASTM D 2216), grain size analyses tests (ASTM D 422), percent passing the No. 200 sieve tests (ASTM D 1140), and Atterberg

Limits tests (ASTM D 4318). The results of all laboratory testing conducted are included in the Appendix of this report.

An experienced engineer visually classified each soil sample on the basis of texture and plasticity (ASTM D 2488) and identified each soil sample using the classification group symbols and names as prescribed in the Unified Soil Classification System (USCS) (ASTM D 2487). A brief explanation of the USCS is included with this report. The engineer grouped the various soil types into the major strata noted on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in-situ, the transitions may be gradual.

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition.

SITE AND SUBSURFACE CONDITIONS

Site Conditions

The subject site is located adjacent to the existing water tank located off of Candler's Mountain Road in Campbell County, Virginia.

Topographically, the site generally slopes downward to the south. The existing tank pad located to the west, has been graded level, and appears to be slightly within the proposed tank area. The site is partially wooded to the east and a chain-linked fence bisects the proposed tank location and runs northeast to southwest.

Site Geology

As part of the subsurface exploration, we reviewed the digital version of the Geologic Map of Virginia, (1993), released by the Virginia Division of Mineral Resources in 2003. The project site is located within the Lynchburg Group, Blue Ridge Anticlinorium, of the Blue Ridge Physiographic and Geologic Provinces of Virginia. Specifically, geologic mapping indicates that the site is underlain by the Pre-Cambrian (Proterozoic Z age) Ashe Formation (Zam). This formation consists predominately of biotite gneiss, quartz-mica schist, and quartzite. The residuum weathered from this formation typically consists of fine-grained micaceous silts and fine- to medium-grained silty sands.

The boundary between soil and rock is not sharply defined. A transitional zone termed "highly weathered rock" (HWR) is normally found overlying the parent bedrock. HWR is defined, for engineering purposes, as residual material with Standard Penetration resistance greater than 100 blows per foot (bpf). Because weathering is facilitated by fractures, joints, and the presence of less resistant rock types, the profile of the HWR and hard rock is typically irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and natural boulders of hard rock floating within zones of HWR within the soil mantle, well above the general bedrock level.

Soil Conditions

Based on the borings, the subsurface conditions at the site primarily consist of residual soils including fine-grained soils, weathered rock and bedrock.

Topsoil depths at the boring locations were measured to range from approximately 0 to 4 inches in thickness, with an approximate average of 3 inches. Depths of surficial materials may vary in unexplored areas.

Fine grained soils consisting of Clay and Silt were encountered in the upper 3.5 to 8.5 feet of the borings. SPT N-values in this layer generally ranged from 5 blows per foot (bpf) to 37 bpf, with an approximate average N-value of 20 bpf.

HWR, which has been defined previously, was encountered at depths from 3.5 to 8.5 feet below existing grades. Hard rock, which is defined by the depth of auger refusal (AR), was encountered in the borings from depths of 16 to 25 feet below the ground surface. There is the potential that hard rock ledges, pinnacles, or boulders could be encountered at varying depths which could require blasting or use of a pneumatic hoe ram for removal. The table below shows the approximate depths and elevations of HWR and AR encountered:

Rock Contact Summary

Boring No.	Surface Elev. (ft)	HWR Depth (ft.)	HWR Elev. (ft)	AR Depth (ft)	AR Elev. (ft)
B-1	1286	3.5	1282.5	20	1266
B-2	1290	3.5	1286.5	18	1270
B-3	1290	4.0	1286	16	1274
B-4	1282	8.5	1273.5	25	1257
B-5	1280	6.0	1274	17	1263

AR: Auger Refusal
HWR: Highly Weathered Rock

Atterberg Limits testing performed on several representative soil samples indicated Liquid Limits ranging from 34 to 35, with corresponding Plasticity Indices ranging from 1 to 11. Percent passing the No. 200 sieve ranged from 26% to 75%. Natural moisture contents varied from 11.7% to 24.0%.

Boring logs describing the soil conditions encountered in the soil test borings are included in the Appendix of this report.

Groundwater Observations

Groundwater observations were made during soil sampling and upon completion of the drilling operations at each boring location. In auger drilling operations, water is not introduced into the borehole, and the groundwater position can often be determined by observing water flowing into or out of the borehole. Furthermore, visual observations of the soil samples retrieved during the auger drilling exploration can often be used in evaluating the groundwater conditions.

Generally, the soil samples were dry to moist, and observable groundwater was not encountered in the borings. However, perched water could be encountered at the interface between higher and lower permeability soils, such as at the transition from residuum to the HWR surface. If perched water is encountered in the foundation and utility excavations, we anticipate that seepage will be slow enough to control with submersible pumps.

ANALYSIS AND RECOMMENDATIONS

Foundations

Based on the results of our exploration, it is our opinion that the proposed structure can be supported by shallow spread footings bearing in suitable natural soils or properly compacted, engineered fill. Based on the information provided, we anticipate that up to 7 feet of new engineered fill may be required to achieve design grades within the proposed footprint. All new fill, which will support the foundations, should be placed in accordance with the recommendations provided in the section of this report entitled Subgrade Preparation and Earthwork Operations.

For preliminary purposes, we recommend that a net allowable soil bearing pressure of 3000 pounds per square foot (psf) be utilized for design of the foundation. The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. Suitable natural bearing soils can be identified on our boring logs as those soils having a minimum SPT N-value of 10 bpf. The bearing capacity at the final foundation elevation should be verified in the field by the geotechnical engineer to assure that the in-situ bearing capacity at the bottom of the excavation is adequate for the design loads.

In order to attain this allowable capacity, minimum footing widths of 18 inches and 24 inches should be maintained for wall and column footings, respectively. These minimum dimensions will help reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" action in potentially soft surficial soils.

Based on laboratory classification testing, the on-site residual soils will likely possess a low potential for moisture-related volume change (shrink-swell). Therefore, we recommend that all footings bear a minimum of 24 inches below finished grade to provide adequate frost protection. Footings beneath interior, heated spaces may bear at nominal depths.

Any excessively soft or wet soils encountered in the footing excavations should be removed from below all footings. In areas where soft or unsuitable material is undercut, the footing could be lowered or the excavation may be backfilled to re-establish the desired footing elevations. We recommend that a crushed angular gravel (VDOT No. 57 Stone) be used for backfilling. This gravel can be placed readily with minimal compactive effort and will not be susceptible to deterioration from moisture. As an alternative, cementitious, flowable fill or compacted VDOT No. 21-A Stone may be used as backfill.

Provided the foundation design and construction recommendations discussed herein are employed, the maximum total settlement for the individual proposed structure is estimated to be less than about 1 inch, with differential settlements of less than approximately one-half this amount. The structural design and specification of architectural finishes should consider the potential aesthetic impact of these settlements.

Drainage

Positive drainage should be provided around the perimeter of the structure and pavement structures to reduce moisture infiltration into the foundation and/or subgrade soils. We recommend landscaped areas adjacent to the building be provided with a fall of least 6 inches for the first 10 feet outward from the building. The parking lot, sidewalks, and paved areas should be sloped away from the proposed building.

Seismic Considerations

The 2009 Edition of the International Building Code (IBC) requires that a Seismic Site Class be assigned for new structures. The Seismic Site Class may be determined by calculating a weighted average of the SPT N-values of subsurface materials to a depth of 100 feet. For the determination, the N-values recorded in the borings are used for overburden soil, and then, typically, all materials below the depth that HWR or hard rock is encountered (to a depth of 100 feet) are assigned an N-value of 100 bpf.

For this report, the Seismic Site Class was determined using the SPT N-value method. HWR and hard rock (AR) were encountered in all of the borings within the proposed footprint. Based on this data and that obtained within the overburden soils, along with our experience in the area, we have estimated an average depth to HWR and AR of approximately 5 feet and 20 feet below the existing ground surface across the site. With this information, a weighted average N-value in excess of 50 bpf was calculated, indicating a Seismic Site Class B.

Although the SPT N-value method can be relatively conservative, we do not anticipate the Seismic Site Class could be improved through the use of alternate methods on this site due to the conditions encountered in the borings.

Subgrade Preparation and Earthwork Operations

The near-surface silts and clays at the site are moisture-sensitive, will be difficult to adequately compact and are subject to excessive deflection under wheel loads when they are wet. In order to reduce the potential for moisture-related soil problems, we recommend that site grading operations be performed during the typically drier months of the year (May through October). If this is not possible, substantial undercutting of these soils could be required to achieve stable subgrade conditions.

Prior to proceeding with construction, all topsoil should be stripped from the proposed construction limits. Stripping should be accomplished a minimum distance of 5 feet outside the building lines and 2 feet beyond curb lines. **It may be necessary to remove the upper 2-3 feet of the softer soils in the vicinity of Boring B-4 in order to achieve appropriate bearing and/or stable soils for placement of new fill. Care should be taken prior to the placement of the new fill in this area and a geotechnical engineer should evaluate the soil conditions and provide the appropriate recommendations once the site is stripped of surficial materials.**

After stripping to the desired grade and prior to fill placement or foundation construction, the stripped surface should be observed by an experienced geotechnical engineer or his authorized representative. Proofrolling using a 10-ton drum roller or a loaded, tandem-axle dump truck having an axle weight of at least 10 tons should be used at this time to aid in identifying localized soft or unsuitable material. Any soft or unsuitable materials encountered during this proofrolling should be removed and replaced with engineered fill. The excavation and backfilling should be observed by a representative of the geotechnical engineer so that excessive or inadequate removal of material can be avoided.

Following stripping, proofrolling, and subgrade preparation procedures, engineered fill can be placed. Fill used to support buildings and pavements should be placed in lifts not exceeding 8 inches in loose thickness, moisture conditioned to within +/- 3% of the optimum moisture content, and compacted to at least 95% of the maximum dry density obtained in accordance with ASTM Specification D-698, Standard Proctor Method.

Field density testing of subgrades and each lift of fill should be performed at a rate of no less than one test per 2,500 square feet in the building area and 5,000 square feet in pavement areas.

The following fill types are recommended for use on this project:

Engineered Fill: All low-plasticity on-site soils which are free of organics and other deleterious, non-soil materials. If off-site borrow is required, imported material should classify as CL, ML, SM, SC, SP, or better. Suitable imported material should have a maximum Liquid Limit of 50 and maximum Plasticity Index of 25. Maximum aggregate size for all materials should be limited to 4 inches.

Porous Fill: Clean crushed gravel (VDOT No. 57 Stone) with a maximum aggregate size of 1.5 inches placed in a minimum 4-inch-thick layer or Aggregate Base Material placed and compacted in a minimum 6-inch-thick layer.

Aggregate Base: Aggregate Base Material Type I, Size 21-A.

It is noted that the on-site soils are non-cohesive and tend to “track” under wheel traffic when they are not confined. During proofroll, this is often mistaken as instability, leading to undercuts or other stabilization which may not be appropriate. It is critical that the geotechnical engineer observe such conditions to reduce the potential for unnecessary costs. In addition, we recommend the early placement of crushed stone in slab and pavement areas to limit deterioration of an otherwise stable subgrade due to moisture intrusion and/or wheel traffic.

Slope Design and Construction

In general, we anticipate that the soils available for use as engineered fill will consist of silt and HWR. Temporary and permanent cut slopes for the project should be designed at grades no steeper than 3H:1V. If seepage water is noted along slope faces during construction, the geotechnical engineer should be contacted for further evaluation and recommendations for seepage control and possible revisions to these recommendations.

It is noted that loose soils along the slope face at these grades will be unstable, increasing the potential for chronic maintenance issues or possible impact to site improvements or structures along the slope crest. In order to reduce the potential for surficial instability, it is critical all soil along the face of the slope be placed and compacted in accordance with our previous recommendations. This is often accomplished by constructing the fill slope on benches to allow safe equipment access. During placement, each compacted lift should extend beyond the design slope face, and then be cut back after compaction to the design grade.

Construction Considerations

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, we recommend that a 1- to 3-inch-thick "mud mat" or "lean" concrete be placed on the bearing soils before the placement of reinforcing steel.

In a dry and undisturbed state, the subgrade soils at the site will provide moderate subgrade support for fill placement and construction operations. However, when wet, these soils will degrade quickly with disturbance from contractor operations. Therefore, good site drainage should be maintained during earthwork operations so as to help maintain the stability of the

soils. It should be incumbent on the contractor to protect all subgrades from damage due to construction, or to repair all damaged subgrades.

It is considered essential that any existing fills be evaluated at the time of construction. Where observed to be unstable, they should be undercut from below building and pavement areas at the direction of the geotechnical engineer.

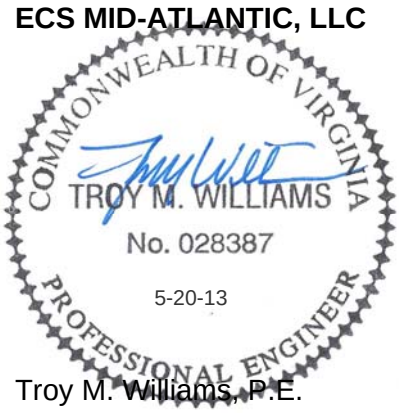
CLOSING

The recommendations contained herein were developed from the data obtained in the soil test borings, which indicate subsurface conditions at specific locations at the time of exploration. Soil conditions may vary between the borings. If, during the course of construction, variations appear evident, the geotechnical engineer should be informed so that the conditions can be addressed. Design recommendations were developed based on the information provided and on building design criteria considered typical for this type of structure. Should structural loading characteristics differ from those discussed herein, ECS should be contacted for review of these conditions and possible revisions to the recommendations of this report.

We have appreciated the opportunity to be of service to you. If you have any questions with regard to the information and recommendations contained in this report, or if we can be of further assistance to you during construction, please do not hesitate to contact us.

Respectfully,

ECS MID-ATLANTIC, LLC



Troy M. Williams, P.E.
Project Engineer

Stephen D. Hjelle, P.E.
Principal Engineer
Geotechnical Department Manager

APPENDIX

Site Location Map (Figure 1)

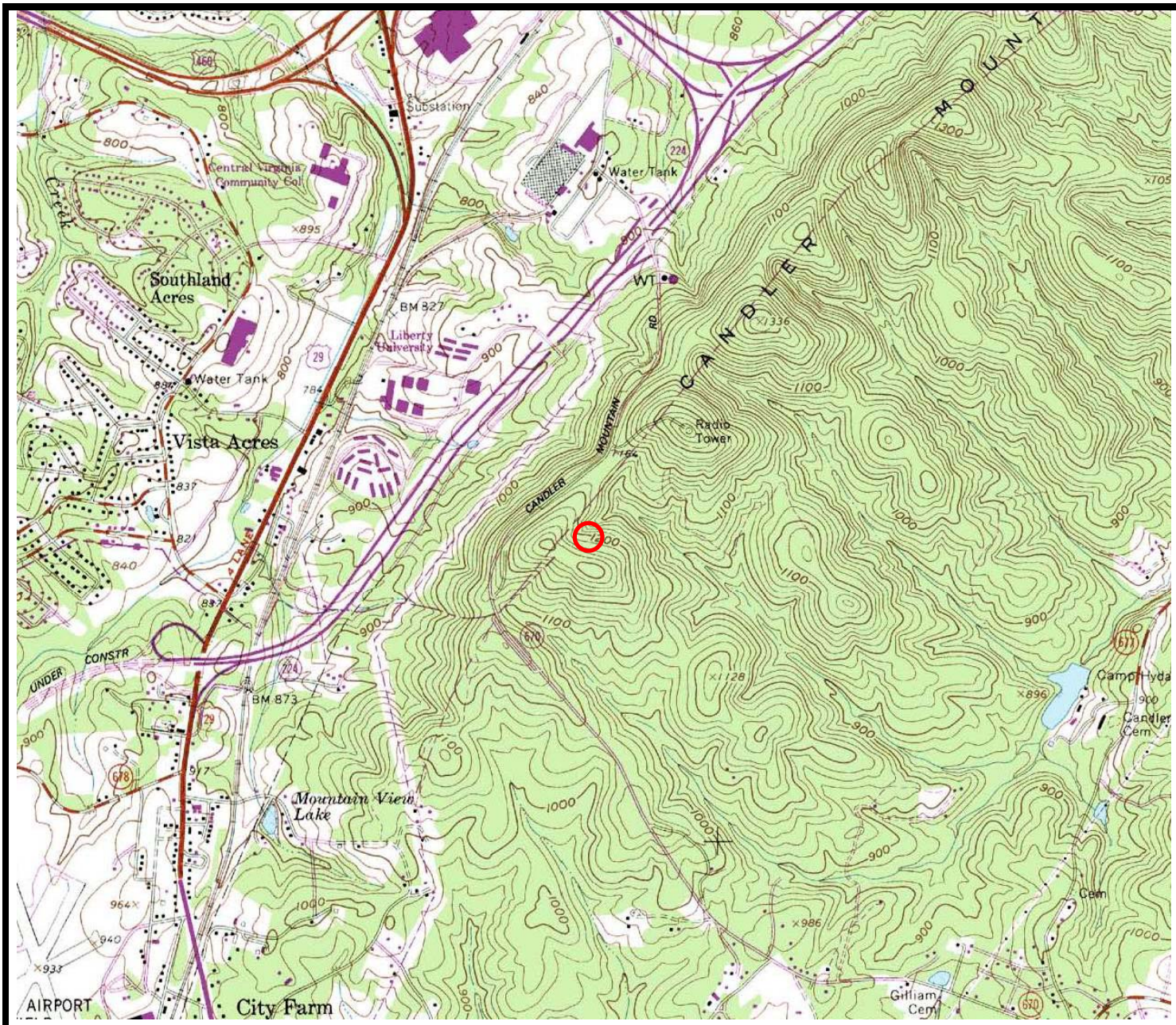
Boring Location Diagram (Figure 2)

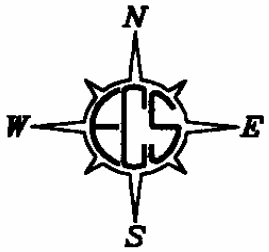
Unified Soil Classification System (USCS)

Reference Notes for Boring Logs

Boring Logs B-1 through B-5

Summary of Laboratory Test Data





LEGEND

○ - Approximate Site Location

SCALE (IN FEET)

1000 2000

2000 0

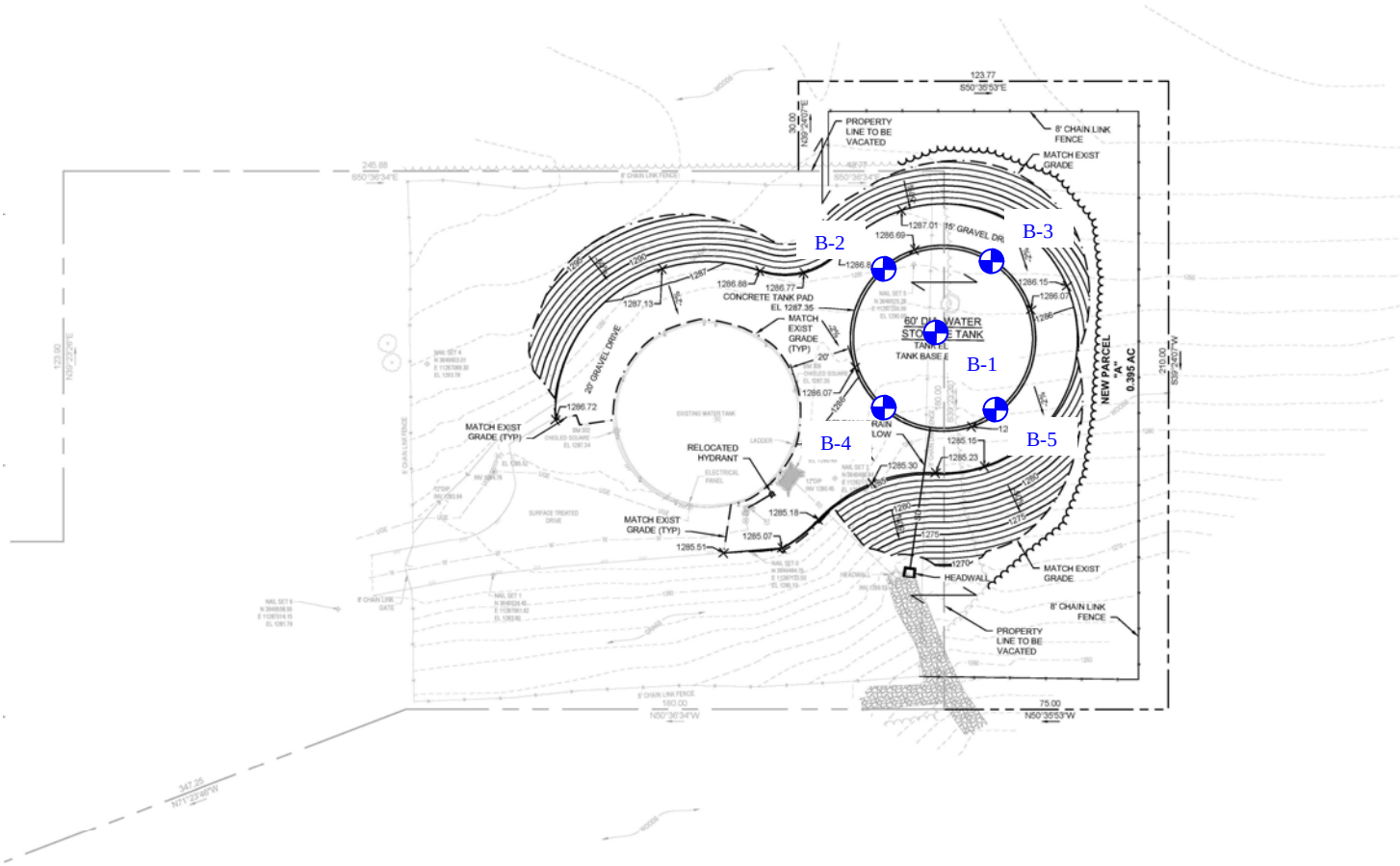
SOURCE:
U.S.G.S. 7.5 MINUTE SERIES
TOPOGRAPHIC MAP
CITY FARM
QUADRANGLE, VIRGINIA

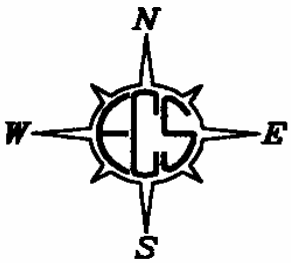
DATED 1963
PHOTOREVISED 1985

FIGURE 1

SITE LOCATION MAP
WINGATE TANK NO. 2- CANDLERS MT ROAD
LYNCHBURG, VIRGINIA

ECS PROJECT NO. 12:7049





LEGEND

- Approximate Boring Location

SCALE:

NOT TO SCALE

SOURCE:

WILEYWILSON

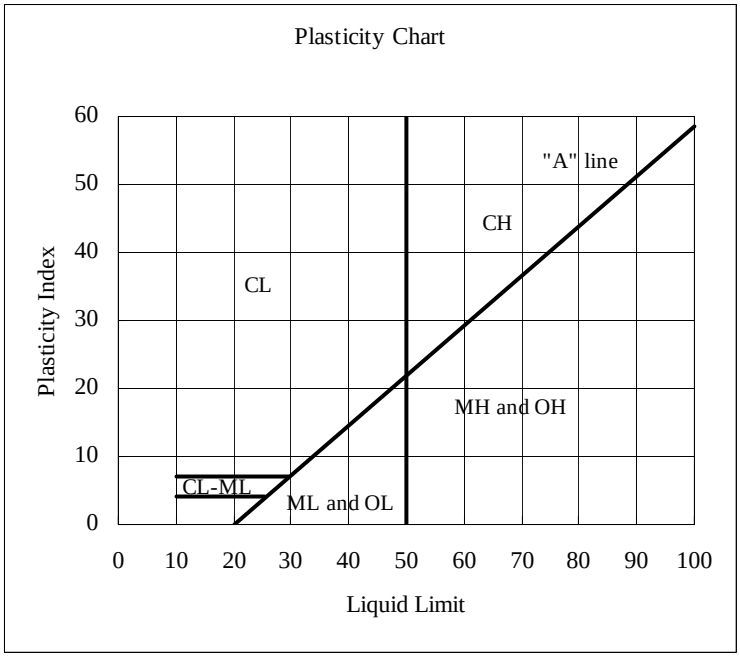
DATED:
02/05/10

FIGURE 2

BORING LOCATION DIAGRAM
WINGATE TANK NO. 2 – CANDLERS MT ROAD
LYNCHBURG, VA
ECS PROJECT NO. 12:7049

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 Sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP; More than 12 percent GM, GC, SM, SC; 5 to 12 percent Borderline cases requiring dual symbols [b]	$C_u = D_{60}/D_{10}$ greater than 4 $C_c = (D_{30})^2/(D_{10} x D_{60})$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below "A" line or P.I. less than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ greater than 6 $C_c = (D_{30})^2/(D_{10} x D_{60})$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. less than 4	Limits plotting in CL-ML zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 Sieve)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly Organic soils		Pt		Peat and other highly organic soils			



[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC,well-graded gravel-sand mixture with clay binder. (From Table 2.16 - Winterkorn and Fang, 1975)

REFERENCE NOTES FOR BORING LOGS

I. Drilling Sampling Symbols

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

II. Correlation of Penetration Resistances to Soil Properties

Standard Penetration (blows/ft) refers to the blows per foot of a 140 lb. hammer falling 30 inches on a 2-inch OD split-spoon sampler, as specified in ASTM D 1586. The blow count is commonly referred to as the N-value.

A. Non-Cohesive Soils (Silt, Sand, Gravel and Combinations)

Density		*Relative Properties*	
Under 4 blows/ft	Very Loose	Adjective Form	12% to 49%
5 to 10 blows/ft	Loose	With	5% to 12%
11 to 30 blows/ft	Medium Dense		
31 to 50 blows/ft	Dense		
Over 51 blows/ft	Very Dense		

Particle Size Identification		
Boulders		8 inches or larger
Cobbles		3 to 8 inches
Gravel	Coarse	1 to 3 inches
	Medium	½ to 1 inch
	Fine	¼ to ½ inch
Sand	Coarse	2.00 mm to ¼ inch (dia. of lead pencil)
	Medium	0.42 to 2.00 mm (dia. of broom straw)
	Fine	0.074 to 0.42 mm (dia. of human hair)
Silt and Clay		0.0 to 0.074 mm (particles cannot be seen)

B. Cohesive Soils (Clay, Silt, and Combinations)

Blows/ft	*Consistency*	*Unconfined Comp. Strength Q_p (tsf)*	*Degree of Plasticity*	*Plasticity Index*
Under 2	Very Soft	Under 0.25	None to slight	0 – 4
3 to 4	Soft	0.25-0.49	Slight	5 – 7
5 to 8	Medium Stiff	0.50-0.99	Medium	8 – 22
9 to 15	Stiff	1.00-1.99	High to Very High	Over 22
16 to 30	Very Stiff	2.00-3.00		
31 to 50	Hard	4.00–8.00		
Over 51	Very Hard	Over 8.00		

III. Water Level Measurement Symbols

WL	Water Level	BCR	Before Casing Removal	DCI	Dry Cave-In
WS	While Sampling	ACR	After Casing Removal	WCI	Wet Cave-In
WD	While Drilling	▽	Est. Groundwater Level	▼	Est. Seasonal High GWT

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 a granular soil. In clay and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.

CLIENT	JOB #	BORING #	SHEET
Wiley|Wilson	7049	B-1	1 OF 1

PROJECT NAME: Wingate Tank No. 2 - Candlers Mt Road

ARCHITECT-ENGINEER:

SITE LOCATION: Lynchburg, Virginia

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% — — REC.% — 20% 40% 60% 80% 100%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

Soil Descriptions 1286

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	STANDARD PENETRATION BLOWS/FT
0					Topsoil Depth [4"]				
	S-1	SS	18	18	Red, Brown and Tan, Sandy SILT, Trace Rock Fragments, Moist, Dense (ML)		1285	8 18 19	37
	S-2	SS	12	12	Red, Brown and Tan, Silty SAND, Trace Rock Fragments, Moist to Dry, Dense to Very Dense, Partially Weathered Rock			24 50/6	17.0; 50/6
5	S-3	SS	9	6			1280	28 50/3	50/3
	S-4	SS	18	18				16 25 28	53
10							1275		
	S-5	SS	14	14				36 36 50/2	86/8
15							1270		
	S-6	SS	4	4				50/4	50/4
20					AUGER REFUSAL @ 20.00'		1265		
25							1260		
30									

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

WL DRY WS ☐ WD ☐	BORING STARTED 05/02/13	
WL(BCR) WL(ACR)	BORING COMPLETED 05/02/13	CAVE IN DEPTH @ 11.60'
WL	RIG CME45 FOREMAN J. Jones	DRILLING METHOD HSA

CLIENT	JOB #	BORING #	SHEET
Wiley|Wilson	7049	B-2	1 OF 1

PROJECT NAME: Wingate Tank No. 2 - Candlers Mt Road

ARCHITECT-ENGINEER:

SITE LOCATION: Lynchburg, Virginia

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

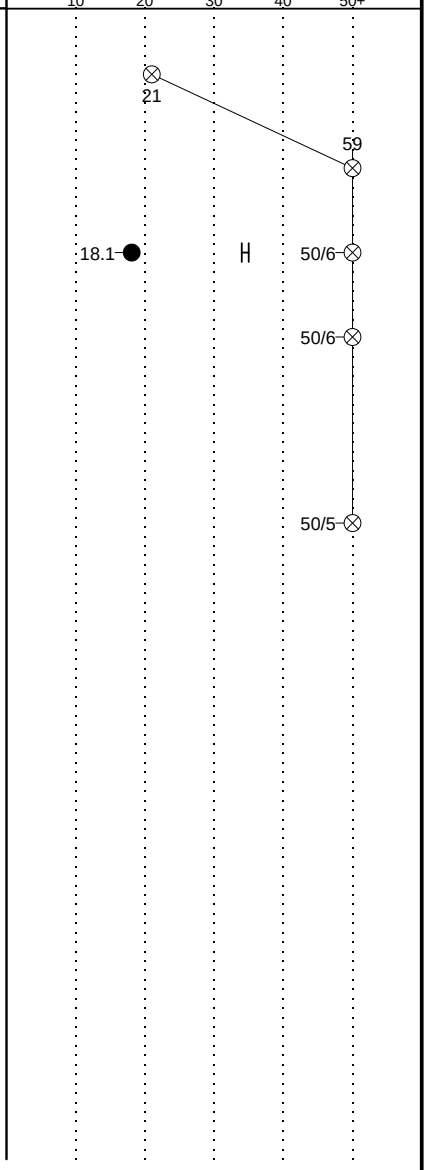
DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

Soil Descriptions 1290

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	16	Reddish Brown, Sandy SILT, With Rock Fragments, Moist, Medium Dense to Dense (ML)	1290	6 8 13
	S-2	SS	18	18			18 21 38
5	S-3	SS	12	12	Red, Brown and Tan, Silty SAND, Trace Rock Fragments, Moist to Dry, Very Dense, Partially Weathered Rock	1285	21 50/6
	S-4	SS	6	6			50/6
10	S-5	SS	5	0		1280	50/5
15						1275	
					AUGER REFUSAL @ 18.00'		
20						1270	
25						1265	
30						1260	

WATER LEVELS



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

WL DRY WS☐ WD☐	BORING STARTED 05/02/13	
WL(BCR) WL(ACR)	BORING COMPLETED 05/02/13	CAVE IN DEPTH @ 15.60'
WL	RIG CME45 FOREMAN J. Jones	DRILLING METHOD HSA

CLIENT	JOB #	BORING #	SHEET
Wiley|Wilson	7049	B-3	1 OF 1

PROJECT NAME: Wingate Tank No. 2 - Candlers Mt Road

ARCHITECT-ENGINEER:

SITE LOCATION: Lynchburg, Virginia

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

Soil Descriptions 1290

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"	STANDARD PENETRATION BLOWS/FT
0					Topsoil Depth [4"]	1290		
	S-1	SS	18	18	Brownish Red and Brown, Sandy SILT, With Rock Fragments, Moist, Medium Dense (ML)		9 12 16	28
	S-2	SS	18	18	Brownish Red and Brown, Silty SAND, With Rock Fragments, Moist to Dry, Dense to Very Dense, Partially Weathered Rock		20 28 46	74
5						1285		
	S-3	SS	14	14			22 38 50/2	88/8
	S-4	SS	9	8			39 50/3	15.6 50/3
10						1280		
	S-5	SS	1	0			50/1	50/1
15						1275		
					AUGER REFUSAL @ 16.00'			
20						1270		
25						1265		
30						1260		

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

WL DRY WS☐ WD☐	BORING STARTED 05/02/13	
WL(BCR) WL(ACR)	BORING COMPLETED 05/02/13	CAVE IN DEPTH @ 9.00'
WL	RIG CME45 FOREMAN J. Jones	DRILLING METHOD HSA

CLIENT	JOB #	BORING #	SHEET
Wiley|Wilson	7049	B-4	1 OF 1

PROJECT NAME: Wingate Tank No. 2 - Candlers Mt Road

ARCHITECT-ENGINEER:

SITE LOCATION: Lynchburg, Virginia

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.%

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

Soil Descriptions 1282

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	STANDARD PENETRATION BLOWS/FT	PLASTIC LIMIT	WATER CONTENT %	LIQUID LIMIT %
0					Brown, Sandy CLAY, Moist, Medium Stiff to Stiff (CL)							
	S-1	SS	18	18			1280	4 2 3	5		22.7	
	S-2	SS	18	16				3 5 7	12			
5					Brown and Red to Greenish Brown, Silty SAND, With Rock Fragments, Moist to Dry, Firm to Very Dense, Partially Weathered Rock							
	S-3	SS	18	18			1275	3 7 9	16			
	S-4	SS	18	18				14 27 31	58		24.0	
10							1270					
	S-5	SS	17	17				23 37 50/5	87/11			
15							1265					
	S-6	SS	11	11				32 50/5	50/5			
20							1260					
	S-7	SS	9	9				39 50/3	50/3			
25					AUGER REFUSAL @ 25.00'		1255					
30												

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

WL DRY WS ☐ WD ☐	BORING STARTED 05/02/13	
WL(BCR) WL(ACR)	BORING COMPLETED 05/02/13	CAVE IN DEPTH @ 19.30'
WL	RIG CME45 FOREMAN J. Jones	DRILLING METHOD HSA

CLIENT	JOB #	BORING #	SHEET
Wiley|Wilson	7049	B-5	1 OF 1

PROJECT NAME: Wingate Tank No. 2 - Candlers Mt Road

ARCHITECT-ENGINEER:

SITE LOCATION: Lynchburg, Virginia

CALIBRATED PENETROMETER TONS/FT^2: 1 2 3 4 5+

ROCK QUALITY DESIGNATION & RECOVERY: RQD% 20% 40% 60% 80% 100% — REC.% —

PLASTIC LIMIT — WATER CONTENT % — LIQUID LIMIT %

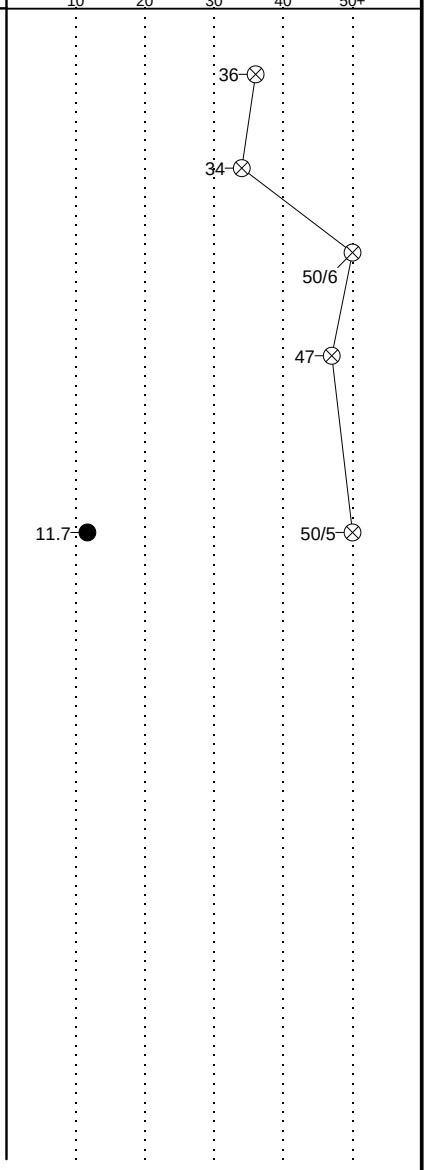
STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

Soil Descriptions 1280

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [3"]		1280	
	S-1	SS	18	18	Reddish Brown, Sandy SILT, With Rock Fragments, Moist, Medium Dense (ML)			7 14 22
	S-2	SS	18	18				8 11 23
5							1275	
	S-3	SS	12	12	Brown, Red and Tan, Silty SAND, With Rock Fragments, Medium Dense to Very Dense, Partially Weathered Rock			37 50/6
	S-4	SS	18	17				16 21 26
10							1270	
	S-5	SS	11	11				24 50/5
15							1265	
					AUGER REFUSAL @ 17.00'			
20							1260	
25							1255	
30							1250	



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

WL DRY WS ☐ WD ☐	BORING STARTED 05/02/13	
WL(BCR) WL(ACR)	BORING COMPLETED 05/02/13	CAVE IN DEPTH
WL	RIG CME45 FOREMAN J. Jones	DRILLING METHOD HSA

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-1												
	S-2	3.50 - 4.50	17.0	ML	34	24	10	75				
B-2												
	S-3	6.00 - 7.00	18.1	SM	35	34	1	26				
B-3												
	S-4	8.50 - 9.25	15.6									
B-4												
	S-1	1.00 - 2.50	22.7									
	S-4	8.50 - 10.00	24.0									
B-5												
	S-5	13.50 - 14.42	11.7									

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

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 (ASTM D 2974)

Project No. 7049
Project Name: Wingate Tank No. 2 - Candlers Mt Road
PM: Troy Williams
PE: Stephen Hjelle
Printed On: Tuesday, May 14, 2013

ECS Mid-Atlantic, LLC

Roanoke, VA