REPORT OF SUBSURFACE INVESTIGATION AND GEOTECHNICAL ENGINEERING SERVICES

Bus Loop - Achilles Elementary School
9306 Guinea Road
Gloucester County, Virginia

G E T Project No: WM14-147G

July 9, 2014

PREPARED FOR:

AES CONSULTING ENGINEERS

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July 9, 2014

TO: **AES Consulting Engineers**
6421 Canon Way
Gloucester, VA 23061

Attn: Mr. Don James, P. E.

RE: Report of Subsurface Investigation and Geotechnical Engineering Services
Bus Loop – Achilles Elementary School
9306 Guinea Road
Gloucester County, Virginia
G E T Project No: WM14-147G

Dear Mr. James:

In compliance with your instructions, we have completed our Subsurface Investigation and Geotechnical Engineering Services for the above referenced project. The results of this study, together with our recommendations, are presented in this report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **G E T Solutions, Inc.** would be pleased to continue its role as Geotechnical Engineer during the project implementation.

We appreciate the opportunity to work with you on this project. We trust that the information contained herein meets your immediate need, and should you have any questions or if we could be of further assistance, please do not hesitate to contact us.

Respectfully Submitted,
G E T Solutions, Inc.

James R. Wheeler
Project Geologist

Bruce R Spiro, P.E.
Principal Engineer

COMMONWEALTH OF VIRGINIA
BRUCE R SPIRO
Lic. No. 015791
PROFESSIONAL ENGINEER

Distribution: Client via email (don.james@aesva.com)

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GET Solutions, Inc.

1.0 PROJECT INFORMATION

1.1 Project Authorization

G E T Solutions, Inc. has completed our subsurface investigation and geotechnical engineering services for the proposed Bus Loop project at Achilles Elementary School which is located in Gloucester County, Virginia. The geotechnical engineering services were conducted in general accordance with the scope presented in **G E T** Proposal No. PWM14-196G. Authorization to proceed with the services was obtained from Mr. Don James with AES Consulting Engineers.
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1.2 Project Location and Site Description

The project site is located at Achilles Elementary School at 9306 Guinea Road in Gloucester County, Virginia. The site contains an existing 1-story elementary school structure, adjacent pavement areas, playground, and other associated infrastructure. The proposed development will be located to the northeast of the existing school structure within an open grass covered field. Towards Guinea Road the project site contains an area of isolated trees within the grass field area. Based on our visual observations, the site appeared to be relatively flat with only minimal grade changes (less than 1 foot every 50 linear feet).

1.3 Project Construction Description

The development at this site is planned to consist of constructing a bus loop asphalt pavement area. The bus loop with be accessed from Guinea Road and will include 10 bus parking spaces. In addition, the development will include the construction of a BMP facility. The specific design of the BMP facility is not known at this time; however, it is our understanding the BMP facility will be created entirely by excavation and will likely include an infiltration component.

If any of the noted information is incorrect or has changed, please inform G E T Solutions, Inc. so that we may amend the recommendations presented in this report, if appropriate.

1.4 Purpose and Scope of Services

The purpose of this study was to obtain information on the general subsurface conditions at the proposed project site. The subsurface conditions encountered were then evaluated with respect to the available project characteristics. In this regard, engineering assessments for the following items were formulated:

1) General assessment of the soils revealed by our borings performed at the proposed project site.

2) General location and description of potentially deleterious material encountered in the borings that may interfere with construction progress or structure performance, including existing fills or surficial/subsurface organics.

3) Soil subgrade preparation, including stripping, grading and compaction. Engineering criteria for placement and compaction of approved structural fill material.

4) Construction considerations for fill placement and subgrade preparation. Evaluation of the on-site soils for re-use as structural fill.

5) Pavement design recommendations based on the field exploration activities (2 pavement borings and 2 CBR tests) and our experience with similar soil conditions.

6) Determine pertinent information regarding the groundwater conditions at the site for storm water management purposes (1 BMP boring and 1 associated infiltration test).

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic material in the soil, bedrock, surface water, groundwater or air, on or below or around this site.

2.0 FIELD AND LABORATORY PROCEDURES

2.1 Field Exploration

In order to explore the general subsurface soil types and to aid in developing associated pavement design parameters, two (2) 10-foot deep Standard Penetration Test (SPT) borings (designated as CBR-1 and CBR-2) were advanced within the proposed pavement areas.

Two (2) bulk soil samples (designated as CBR-1 and CBR-2) were collected from their respective boring locations. The bulk subgrade soil samples were collected from depths ranging from 1 to 2 feet below existing grades. The bulk soil samples were returned to our laboratory and subjected to CBR testing in accordance with ASTM standards.

To aid in developing associated storm water management parameters, one (1) 20-foot deep SPT boring (designated as BMP-1) was drilled within the proposed BMP facility footprint. A temporary groundwater monitoring well was installed at the BMP boring location. Also, an in-situ soil permeability test was performed at the BMP boring location.

The SPT borings were performed with the use of hollow stem auger and rotary wash "mud" drilling procedures in general accordance with ASTM D 1586. The tests were performed continuously from the existing ground surface to depths of 6 to 12-feet, and at 5-foot intervals thereafter. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches, using an automatic hammer. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value (uncorrected for automatic hammer). A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a glass jar, sealed, labeled, and returned to our laboratory for review.

The boring locations were established and staked in the field by a representative of **G E T Solutions, Inc.** The approximate boring locations are shown on the attached "Boring Location Plan" (Appendix I), which was reproduced based on a drawing provided by AES Consulting Engineers. The accuracy of the boring locations does not conform to survey accuracies.

2.2 Laboratory Testing

Representative portions of all soil samples collected during drilling were sealed in glass jars, labeled and transferred to our laboratory for classification and analysis. A Geotechnical Engineer performed the soil classification in general accordance with ASTM Specification D 2487. A summary of the soil classification system is provided in Appendix II.

Three (3) representative soil samples were selected and subjected to natural moisture, Atterberg limits, and -#200 sieve wash testing and analysis in order to corroborate the visual classification. These test results are tabulated below (Table I) and are also presented on the "Boring Log" sheets (Appendix III).

Table I - Laboratory Test Results

Boring No.	Depth (Feet)	Natural Moisture (%)	Percent Passing #200	Atterberg Limits (LL/PL/PI)	USCS Classification
BMP-1	0.3-2	11	18	Non Plastic	SM
BMP-1	2-4	15	6	Non Plastic	SP-SM
BMP-1	7.5-8	46	86	42/21/21	CL

The selected representative bulk subgrade soil samples (designated CBR-1 and CBR-2) were subjected to natural moisture content, -#200 sieve, Atterberg Limits, Standard Proctor, and CBR testing in accordance with ASTM standards. A summary of the CBR test results, the CBR curves, and the moisture density relationship curves (Proctor Curves) are presented in Appendix V.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The project site lies within a major physiographic province called the Atlantic Coastal Plain. Numerous transgressions and regressions of the Atlantic Ocean have deposited marine, lagoonal, and fluvial (stream lain) sediments. The regional geology is very complex, and generally consists of interbedded layers of varying mixtures of sands, silts and clays. Based on our review of existing geologic and soil boring data, the geologic stratigraphy encountered in our subsurface explorations generally consisted of marine deposited sands and clays.

3.2 Subsurface Soil Conditions

The results of our soil test borings are included below:

Table II – Subsurface Soil Conditions

AVERAGE DEPTH (Feet)	STRATUM	DESCRIPTION	RANGES OF SPT(1) N-VALUES
0 to 0.33-0.5	Topsoil	4 to 6 Inches of Topsoil.	-
0.33 - 0.5 to 1.5 - 3	FILL	Silty SAND (SM) with trace Gravel and/or organics and Poorly-graded GRAVEL (GP-GM) with Silt and Sand.	9 - 54
1.5 - 3 to 7.5 - 10	I	SAND (SP-SM, SM) with varying amounts of Silt	WOH(2) - 18
7.5 to 10 - 20	II	Lean CLAY (CL), some containing trace amounts of marine shell fragments	WOH(2) - 6

Notes: (1) SPT = Standard Penetration Test, N-Values in Blows-per-foot uncorrected
(2) WOH = Weight of Hammer

The subsurface description is of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface exploration are included on the “Boring Log” sheets (Appendix III) and in the “Generalized Soil Profile” (Appendix IV), which should be reviewed for specific information as to the individual borings. The stratifications shown on the records of the subsurface exploration represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual or occur between sample intervals. It is noted that the topsoil designation references the presence of surficial organic laden soil, and does not represent any particular quality specification. This material is to be tested for approval prior to use.

3.3 Groundwater Information

The groundwater level was recorded at the boring locations and as observed through the wetness of the recovered soil samples during the drilling operations. The initial groundwater table was measured to occur at depths ranging from 4 to 5 feet below the existing site grades at the boring locations. The boreholes were backfilled upon completion for safety considerations. As such, the reported groundwater levels may not be indicative of static groundwater levels.

A temporary groundwater monitoring well was installed at boring location BMP-1 and a groundwater reading was obtained at 24-hours after installation. The groundwater information associated with this well is presented below (Table III).

Table III - Groundwater Readings

Boring No.	Initial Groundwater Reading (ft)(1)	24-hour Groundwater Reading (ft)(1)
BMP-1	4	3.5

Note: (1) Depth below existing site grades

As subsurface soils begin to dry moisture moves upwards through the soil profile by means of capillary action. Based on the subsurface soil composition (soils containing more than 30% of fines by weight), these initial groundwater readings (based on the relative wetness of the soils) could be in part attributed to the capillary action of the soils. As such, if the static groundwater elevation is critical to the design of the proposed structures and site infrastructure it is recommended to install temporary groundwater monitoring wells to substantiate these initial readings.

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.). In the project's area, seasonal groundwater fluctuations of ± 2 feet are common; however, greater fluctuations have been documented. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on the construction procedures, if necessary.

4.0 EVALUATION AND RECOMMENDATIONS

Our recommendations are based on the previously discussed project information, our interpretation of the borings and laboratory data, and our observations during our site reconnaissance. If the proposed construction should vary from what has been described herein, or should differing conditions be encountered during construction, we request the opportunity to review our recommendations and make any necessary changes.

4.1 Clearing and Grading

The proposed construction area should be cleared by means of removing the topsoil material, trees, associated root mat and any other unsuitable materials. It is estimated that a cut of up to 6 inches in depth will be required to remove the topsoil and root mat material. This cut is expected to extend deeper in isolated areas (particularly where trees are currently located) to remove deeper deposits of organic soils, or unsuitable soils, which becomes evident during the clearing. Also, FILL materials were observed as deep as 3 feet below existing site grades at some of the boring locations which may be required to be undercut pending proofroll, test pits, and densification testing at the time of construction. It is recommended that the clearing operations extend laterally at least 5 feet beyond the perimeter of the proposed construction areas.

Following the initial clearing, the resulting exposed subgrade will consist of FILL materials generally comprised of GRAVEL (GP-GM) and Silty SAND (SM), some containing organics. Combinations of excess surface moisture from precipitation ponding on the site and the construction traffic, including heavy compaction equipment, may create pumping and general deterioration of the bearing capabilities of the surface soils. Therefore, undercutting to remove loose/soft soils in isolated areas should be expected. The extent of the undercut will be determined in the field during construction based on the outcome of the field testing procedures (subgrade proofroll). In this regard, and in order to reduce undercutting, care should be exercised during the grading and construction operations at the site.

Inherently wet subgrade soils combined with potential poor site drainage make this site particularly susceptible to subgrade deterioration. Thus, grading operations at this site will be more economical if performed during the drier months of the year (historically April through November). This should minimize these potential problems, although they may not be eliminated. If grading is attempted during the winter months, undercutting of wet soils should be anticipated. However, during the drier months of the year, wet soils could be dried by disking or other drying procedures to achieve moisture contents necessary to achieve adequate degrees of compaction.

The site should be graded to enhance surface water runoff to reduce the ponding of water. Ponding of water often results in softening of the near-surface soils. In the event of heavy rainfall within areas to receive fill, we recommend that the grading operations cease until the site has had a chance to dry.

4.2 Subgrade Preparation

Following the clearing and excavation operations, the newly exposed subgrade soils should be densified with a large static drum roller (if possible). After the subgrade soils have been densified, they should be evaluated by a qualified geotechnical inspector for stability. Accordingly, the subgrade soils should be proofrolled to check for pockets of loose material hidden beneath a crust of better soil. Several passes should be made by a large rubber-tired roller or loaded dump truck over the construction areas, with the successive passes aligned perpendicularly. The number of passes will be determined in the field by the Geotechnical Engineer depending on the soils conditions. Any pumping and unstable areas observed during proofrolling (beyond the initial cut) should be undercut and/or stabilized at the directions of the Geotechnical Engineer.

In addition to the proofroll, several 2 to 4-foot deep test pits should be excavated within the proposed construction areas. The test pits are considered necessary to determine the thickness and composition of the FILL materials. The test pits should be performed under the observation of a representative **G E T Solutions, Inc.**, who will evaluate the composition of the recovered soils. In addition to the test pits, several compaction tests should be performed on the FILL material within the proposed pavement areas to further substantiate the suitability of the existing material. It is possible that some subgrade improvements will be required to provide suitable soils for pavement support. The FILL material may remain in place under pavements if approved by the Geotechnical Engineer (to be determined following the completion of the test pits and compaction testing).

Recommendations concerning the subgrade improvements (as necessary) will be provided in the field following the testing procedures. The project's budget should include an allowance for subgrade improvements (undercut and backfill with aggregate base material or structural fill).

4.3 Structural Fill and Placement

Following the approval of the natural subgrade soils by the Geotechnical Engineer, the placement of the fill required to establish the design grades may begin. Any material to be used for structural fill should be evaluated and tested by an independent testing laboratory prior to placement to determine if they are suitable for the intended use. Suitable structural fill material should consist of sand or gravel containing less than 25% by weight of fines (SP, SM, SW, GP, GW - with dimensions not to exceed 2 inches in diameter), having a liquid limit less than 20 and plastic limit less than 6, and should be free of rubble, organics, clay, debris and other unsuitable material.

All structural fill should be compacted to a dry density of at least 95% of the Standard Proctor maximum dry density, in accordance with ASTM Specification D 698. The moisture content of the structural fill should be within +/- 2% of the optimum moisture content at the time of placement. In general, the compaction should be accomplished by placing the fill in maximum 8 to 10-inch loose lifts and mechanically compacting each lift to at least the specified minimum dry density. A qualified inspector should perform field density tests on each lift as necessary to assure that adequate compaction is achieved.

Backfill material in utility trenches within the construction areas should consist of structural fill (as previously described), and should be compacted to at least 95% of ASTM Specification D 698. This fill should be placed in 4 to 6 inch loose lifts when hand compaction equipment is used.

If applicable, care should be used when operating the compactors near existing structures to avoid transmission of the vibrations that could cause settlement damage or disturb occupants. In this regard, it is recommended that the vibratory roller remain at least 25 feet away from existing structures; these areas should be compacted with small, hand-operated compaction equipment.

4.4 Suitability of On-site Soils

Based on the laboratory testing program and visual classifications, some of the Stratum I soils (SP-SM and SM) encountered at the boring locations appear to meet the criteria recommended in this report (Section 4.3) for reuse as structural fill. However, these soils were generally encountered near or below the groundwater table; therefore, moisture manipulation will be required prior to their reuse.

Further classification testing (natural moisture content, gradation analysis, and Proctor testing) should be performed in the field during construction to evaluate the suitability of excavated soils for reuse as backfill within building and pavement areas.

4.5 Pavement Design

The CBR results indicated an average soaked CBR value of 30. In accordance with VDOT standards, the average soaked CBR value was multiplied by a factor of two-thirds to determine a pavement design CBR value. The two-thirds factor provides the necessary safety margins to compensate for some non-uniformity of the soil. Therefore, a CBR value of 20 should be used in designing the pavement section. A typical pavement section is provided on Table IV on the following page.

Table IV - Typical Pavement Sections

Section	Hot Mix Asphalt		Aggregate Base[(1)]	Subgrade[(2)]
	Surface (SM-12.5A)	Base (BM-25.0)		
Heavy Duty Asphalt – Bus Loop Pavement (estimated ADT of 40 bus trips per day or less)	2"	3"	8"	Stable

Notes: (1) VDOT Type 21-A or 21-B, compacted to a dry density of at least 98% of the Standard Proctor maximum dry density, in accordance with ASTM Specification D 698.
(2) Compacted to a dry density of at least 95% of the Standard Proctor maximum dry density, in accordance with ASTM Specification D 698.

Actual pavement section thickness should be provided by the design civil engineer based on traffic loads, volume, and the owners design life requirements. The above sections correspond to thickness representative of typical local construction practices and as such periodic maintenance should be anticipated. All pavement material and construction procedures should conform to Virginia Department of Transportation (VDOT) requirements.

Following pavement rough grading operations, the exposed subgrade should be observed under proofrolling. This proofrolling should be accomplished with a fully loaded dump truck or 7 to 10 ton drum roller to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed should be removed and replaced with a well-compacted material. The inspection of these phases should be performed by the Geotechnical Engineer or his representative. The subgrade soils are likely to be unstable at the time of construction and some ground improvements are likely. As such, the project's budget should include a contingency to accommodate the potential ground improvements. Where excessively unstable subgrade soils are observed during proofrolling and/or fill placement, it is expected that these weak areas can be stabilized by means of thickening the base course layer by 4 to 6 inches and/or lining the subgrade with geotextile fabric (Mirafi HP270 or equivalent). These alternates are to be addressed by the Geotechnical Engineer during construction, if necessary, who will recommend the most economical approach at the time.

4.6 Infiltration Testing

The specific design of the proposed BMP facility is not known at this time; however, it is our understanding the BMP facility will be created entirely by excavation and will likely include an infiltration component. Therefore, one (1) infiltration test (designated as BMP-1) was performed within the BMP facility area corresponding to boring location BMP-1. The infiltration test borehole was prepared utilizing a planer auger to remove soil clippings from its base. Infiltration testing was then conducted within the vadose zone utilizing a Precision Permeameter and the following testing procedures.

A support stand was assembled and placed adjacent to the borehole. This stand holds a calibrated reservoir (2000 ml) and a cable used to raise and lower the water control unit (WCU). The WCU establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The WCU was attached to the flow reservoir with a 2-meter (6.6 foot) braided PVC hose and then lowered by cable into the borehole to the test depth elevation. As required by the Glover solution, the WCU was suspended 6-inches above the bottom of the boreholes. The shut-off valve was then opened allowing water to pass through the WCU to fill the borehole to the constant water level elevation. The absorption rate slowed as the soil voids became filled and an equilibrium developed as a wetting bulb developed around the borehole. Water was continuously added until the flow rate stabilized. The reservoir was then re-filled in order to begin testing. During testing, as the water drained into the borehole and surrounding soils, the water level within the calibrated reservoir was recorded as well as the elapsed time during each interval. The test was continued until a relatively consistent flow rate was documented. During testing the quick release connections and shutoff valve were monitored to ensure that no leakage occurred. The flow rate (Q), height of the constant water level (H), and borehole diameter (D) were used to calculate K_s utilizing the Glover Solution.

Based on the field testing and corroborated with laboratory testing results (published values compared to classification results), the hydraulic conductivity of the shallow soils as identified at the location and depth of the infiltration test is presented on the Infiltration Test Data in Appendix VI and is illustrated in Table V - Infiltration Test Results below.

Table V - Infiltration Test Results

Boring No.	Boring depth (ft) (1)	24-hour Water depth (ft)(1)	Ksat Value (in/hour)	Ksat Value (cm/sec)	Ksat Class
BMP-1	2.5	3.5	0.638	4.50×10^{-4}	Moderately High

Note: (1) Depth below existing site grade

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Drainage and Groundwater Concerns

It is expected that dewatering may be required for excavations that extend near or below the existing groundwater table. Dewatering above the groundwater level could probably be accomplished by pumping from sumps. Dewatering at depths below the groundwater level may require well pointing.

It would be advantageous to construct all fills early in the construction. If this is not accomplished, disturbance of the existing site drainage could result in collection of surface water in some areas, thus rendering these areas wet and very loose. Temporary drainage ditches should be employed by the contractor to accentuate drainage during construction.

Establishing a system of drainage ditches to carry surface and shallow groundwater away from the constructions areas should reduce grading costs. No permanent subsurface drainage systems are needed for this project.

5.2 Site Utility Installation

The base of the utility trenches should be observed by a qualified geotechnical inspector prior to the pipe and structure placement to verify the suitability of the bearing soils. Utilities and structures located beneath the groundwater elevation will bear in wet granular and/or cohesive soils. In these instances the bearing soils may require some stabilization to provide suitable bedding. This stabilization is typically accomplished by providing additional bedding materials (VDOT No. 57 stone). In addition depending on the depth of the utility trench excavation, some means of dewatering may be required to facilitate the utility installation and associated backfilling.

The resulting excavations should be backfilled with structural fill, as described in Section 4.3 of this report.

5.3 Excavations

In Federal Register, Volume 54, No. 209 (October, 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its “Construction Standards for Excavations, 29 CFR, part 1926, Subpart P”. This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new (OSHA) guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. 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.

We are providing this information solely as a service to our client. **G E T Solutions, Inc.** 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 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by **G E T Solutions, Inc.** and the information supplied by the client and their consultants for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **G E T Solutions, Inc.** should be notified immediately to determine if changes in the foundation recommendations are required. If **G E T Solutions, Inc.** is not retained to perform these functions, **G E T Solutions, Inc.** can not be responsible for the impact of those conditions on the geotechnical recommendations for the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete the Geotechnical Engineer should be provided the opportunity to review the final design plans and specifications to assure our engineering recommendations have been properly incorporated into the design documents, in order that the earthwork and foundation recommendations may be properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of AES Consulting Engineers and their consultants for the specific application to the proposed Bus Loop project at Achilles Elementary School in Gloucester County, Virginia.

APPENDICES

I BORING LOCATION PLAN

II SUMMARY OF SOIL CLASSIFICATION

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IV GENERALIZED SOIL PROFILE

V CBR TEST RESULTS

VI INFILTRATION TEST DATA

APPENDIX I

BORING LOCATION PLAN

Locations are approximate based on site visit sketch.

Boring Location Plan

Project: Bus Loop - Achilles Elementary School
9306 Guinea Road
Gloucester County, Virginia

Project No: WM14-147G

Client: AES Consulting Engineers

Scale: As Drawn

Date: 7/9/2014

Plotted By: JW

APPENDIX II

SUMMARY OF SOIL CLASSIFICATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach Office
204 Grayson Road
Virginia Beach, VA 23462
(757) 518-1703

Williamsburg Office
1592 Penniman Rd. Suite E
Williamsburg, Virginia 23185
(757) 564-6452

Elizabeth City Office
504 East Elizabeth St. Suite 2
Elizabeth City, NC 27909
(252) 335-9765

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

Standard Penetration Test (SPT), N-value

Standard Penetration Tests (SPT) were performed in the field in general accordance with ASTM D 1586. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment (4 increments for each soil sample) of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value.

NON COHESIVE SOILS

(SILT, SAND, GRAVEL and Combinations)

Relative Density

Very Loose	4 blows/ft. or less
Loose	5 to 10 blows/ft.
Medium Dense	11 to 30 blows/ft.
Dense	31 to 50 blows/ft.
Very Dense	51 blows/ft. or more

COHESIVE SOILS

(CLAY, SILT and Combinations)

Consistency

Very Soft	2 blows/ft. or less
Soft	3 to 4 blows/ft.
Medium Stiff	5 to 8 blows/ft.
Stiff	9 to 15 blows/ft.
Very Stiff	16 to 30 blows/ft.
Hard	31 blows/ft. or more

Particle Size Identification

Boulders	8 inch diameter or more	
Cobbles	3 to 8 inch diameter	
Gravel	Coarse	1 to 3 inch diameter
	Medium	$^{1}/_{2}$ to 1 inch diameter
	Fine	$^{1}/_{4}$ to $^{1}/_{2}$ inch diameter
Sand	Coarse	2.00 mm to $^{1}/_{4}$ inch (diameter of pencil lead)
	Medium	0.42 to 2.00 mm (diameter of broom straw)
	Fine	0.074 to 0.42 mm (diameter of human hair)
Silt		0.002 to 0.074 mm (cannot see particles)

Relative Proportions

Descriptive Term	Percent
Trace	0-5
Few	5-10
Little	15-25
Some	30-45
Mostly	50-100

Strata Changes

In the column "Description" on the boring log, the horizontal lines represent approximate strata changes.

Groundwater Readings

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as tidal influences and man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.).

CLASSIFICATION SYMBOLS (ASTM D 2487 and D 2488)

Coarse Grained Soils

More than 50% retained on No. 200 sieve

GW - Well-graded Gravel
GP - Poorly graded Gravel
GW-GM - Well-graded Gravel w/Silt
GW-GC - Well-graded Gravel w/Clay
GP-GM - Poorly graded Gravel w/Silt
GP-GC - Poorly graded Gravel w/Clay
GM - Silty Gravel
GC - Clayey Gravel
GC-GM - Silty, Clayey Gravel
SW - Well-graded Sand
SP - Poorly graded Sand
SW-SM - Well-graded Sand w/Silt
SW-SC - Well-graded Sand w/Clay
SP-SM - Poorly graded Sand w/Silt
SP-SC - Poorly graded Sand w/Clay
SM - Silty Sand
SC - Clayey Sand
SC-SM - Silty, Clayey Sand

Fine-Grained Soils

50% or more passes the No. 200 sieve

CL - Lean Clay
CL-ML - Silty Clay
ML - Silt
OL - Organic Clay/Silt

Liquid Limit 50% or greater

CH - Fat Clay
MH - Elastic Silt
OH - Organic Clay/Silt

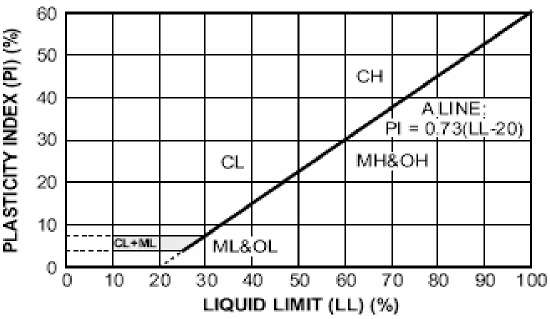
Highly Organic Soils

PT - Peat

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

Plasticity Chart



APPENDIX III

BORING LOGS

RECORD OF SUBSURFACE EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach — 204 Grayson Road, Virginia Beach, VA 23642, 757-518-1703
Williamsburg — 1592-E Penniman Road, Williamsburg, VA 23185, 757-564-6452
Elizabeth City — 106 Capital Trace Unit E, Elizabeth City, NC 27909, 252-335-9765
Jacksonville — 415-A Western Blvd, Jacksonville, NC 28546, 910-478-9915

BORING ID BMP-1

PROJECT NAME: **Bus Loop - Achilles Elementary School**
CLIENT: **AES Consulting Engineers**
PROJECT LOCATION: **Gloucester County, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ▽: **4** AFTER **24** HOURS (ft) ▼: **3.5** CAVE-IN (ft) ⊆: ___

The initial groundwater readings are not intended to indicate the static groundwater level.

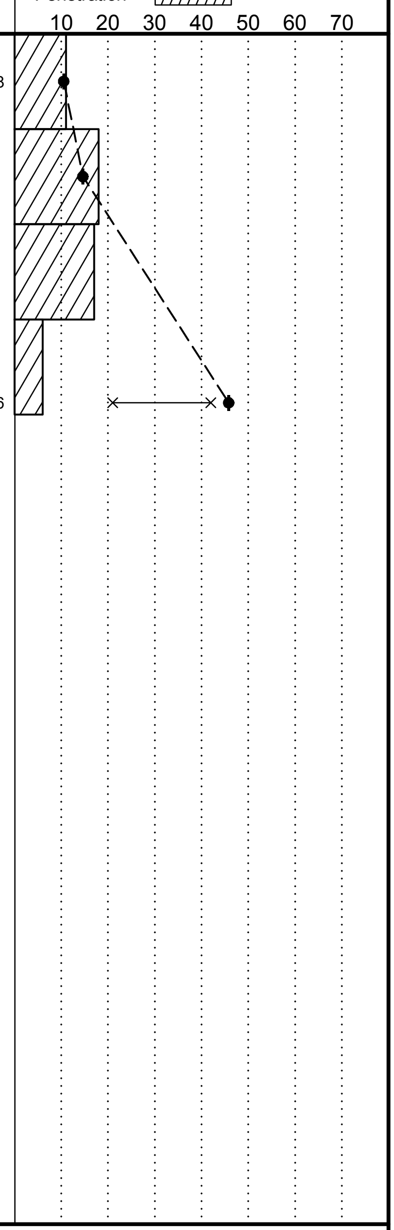
PROJECT NUMBER: **WM14-147G**
SURFACE ELEVATION (MSL) (ft): ___
LOGGED BY: **J. Wheeler**
DATE STARTED: **6/16/2014**
DATE COMPLETED: **6/16/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION
	0.3	4-in Topsoil
	1.5	Dark brown, moist, Silty fine to medium SAND (SM) with trace organics, medium dense "Fill"
▼ ▽	7.5	Gray and brown, moist to wet, Poorly-graded fine to medium SAND (SP-SM) with Silt, loose to medium dense Wet below 3.5 ft
	16.5	Gray, wet, lean CLAY (CL), very soft to medium stiff
	20.0	Gray, wet, lean CLAY (CL) with trace marine shell fragments, very soft
		Boring terminated at 20 feet below existing grade.

Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
1	SS	20	2-4-7-8 (11)	18
2	SS	18	7-8-10-14 (18)	6
3	SS	24	11-9-8-6 (17)	
4	SS	24	6-4-2-2 (6)	86
5	SS	24	0-0-0-0 (0)	
6	SS	24	0-0-0-0 (0)	
7	SS	24	0-0-0-0 (0)	
8	SS	24	0-0-0-0 (0)	

TEST RESULTS

Plastic Limit ×———× Liquid Limit
Water Content - ●
Penetration - ▨



Sample Type(s):
SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

RECORD OF SUBSURFACE EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach
204 Grayson Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

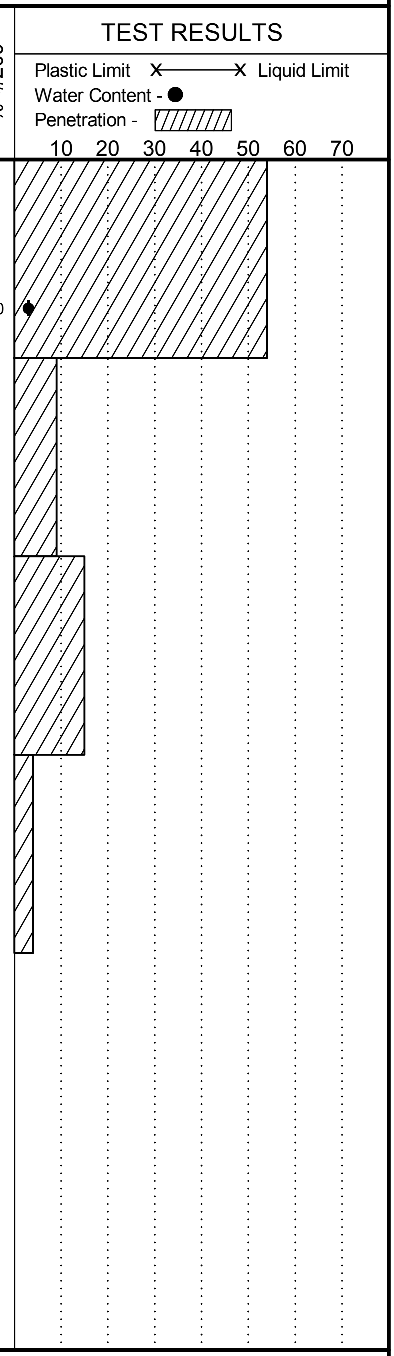
BORING ID CBR-1

PROJECT NAME: **Bus Loop - Achilles Elementary School**
CLIENT: **AES Consulting Engineers**
PROJECT LOCATION: **Gloucester County, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ▽: **5** AFTER ____ HOURS (ft) ▼: ____ CAVE-IN (ft): ____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM14-147G**
SURFACE ELEVATION (MSL) (ft): ____
LOGGED BY: **J. Wheeler**
DATE STARTED: **6/16/2014**
DATE COMPLETED: **6/16/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200
	0.3	4-in Topsoil					
		Gray, moist, Poorly-graded fine to coarse GRAVEL (GP-GM) with Silt and Sand, loose to very dense "Fill"	1	SS	12	6-33-21-14 (54)	10
	3.0		2	SS	24	6-5-4-4 (9)	
		Brown, moist, Silty fine to medium SAND (SM), loose					
	4.0	Gray and brown, moist to wet, Poorly-graded fine to medium SAND (SP-SM), very loose to medium dense					
▽	5	Wet below 5 ft	3	SS	20	8-8-7-5 (15)	
			4	SS	24	3-2-2-1 (4)	
	7.5	Gray, wet, lean CLAY (CL), very soft to soft					
			5	SS	24	0-0-0-0 (0)	
	10 / 10.0	Boring terminated at 10 feet below existing grade.					

TEST RESULTS



This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Sample Type(s):
SS - Split Spoon

Notes:

RECORD OF SUBSURFACE EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach
204 Grayson Road
Virginia Beach, VA 23642
757-518-1703

Williamsburg
1592-E Penniman Road
Williamsburg, VA 23185
757-564-6452

Elizabeth City
106 Capital Trace Unit E
Elizabeth City, NC 27909
252-335-9765

Jacksonville
415-A Western Blvd
Jacksonville, NC 28546
910-478-9915

BORING ID CBR-2

PROJECT NAME: **Bus Loop - Achilles Elementary School**
CLIENT: **AES Consulting Engineers**
PROJECT LOCATION: **Gloucester County, VA**
BORING LOCATION: **See Attached Boring Location Plan**
DRILLING METHOD(S): **Rotary wash "mud"**
GROUNDWATER*: INITIAL (ft) ∇: **4** AFTER ____ HOURS (ft) ▼: ____ CAVE-IN (ft): ____
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **WM14-147G**
SURFACE ELEVATION (MSL) (ft): ____
LOGGED BY: **J. Wheeler**
DATE STARTED: **6/16/2014**
DATE COMPLETED: **6/16/2014**
DRILLER: **GET Solutions, Inc.**

Elevation (ft)	Depth (ft)	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS
	0.5	6-in Topsoil							
	2.0	Dark brown, moist, Silty fine to coarse SAND (SM) with trace Gravel and organics, medium dense "Fill"		1	SS	18	2-8-10-7 (18)	16	
∇	4.0	Brown, moist, Silty fine to medium SAND (SM), loose		2	SS	20	6-5-5-5 (10)		
	6.0	Orange-brown and brown, wet, Poorly graded fine to medium SAND (SP-SM), medium dense		3	SS	24	6-8-9-9 (17)		
	8.0	Gray, wet, Silty fine to medium SAND (SM), loose		4	SS	24	6-6-4-4 (10)		
	10.0	Gray, wet, Poorly-graded fine to medium SAND (SP-SM) with Silt, very loose		5	SS	24	0-0-0-0 (0)		
		Boring terminated at 10 feet below existing grade.							

Test results legend: Plastic Limit X—X Liquid Limit; Water Content - ●; Penetration - (hatched bar). Scale: 10 20 30 40 50 60 70

Sample Type(s):
SS - Split Spoon

Notes:

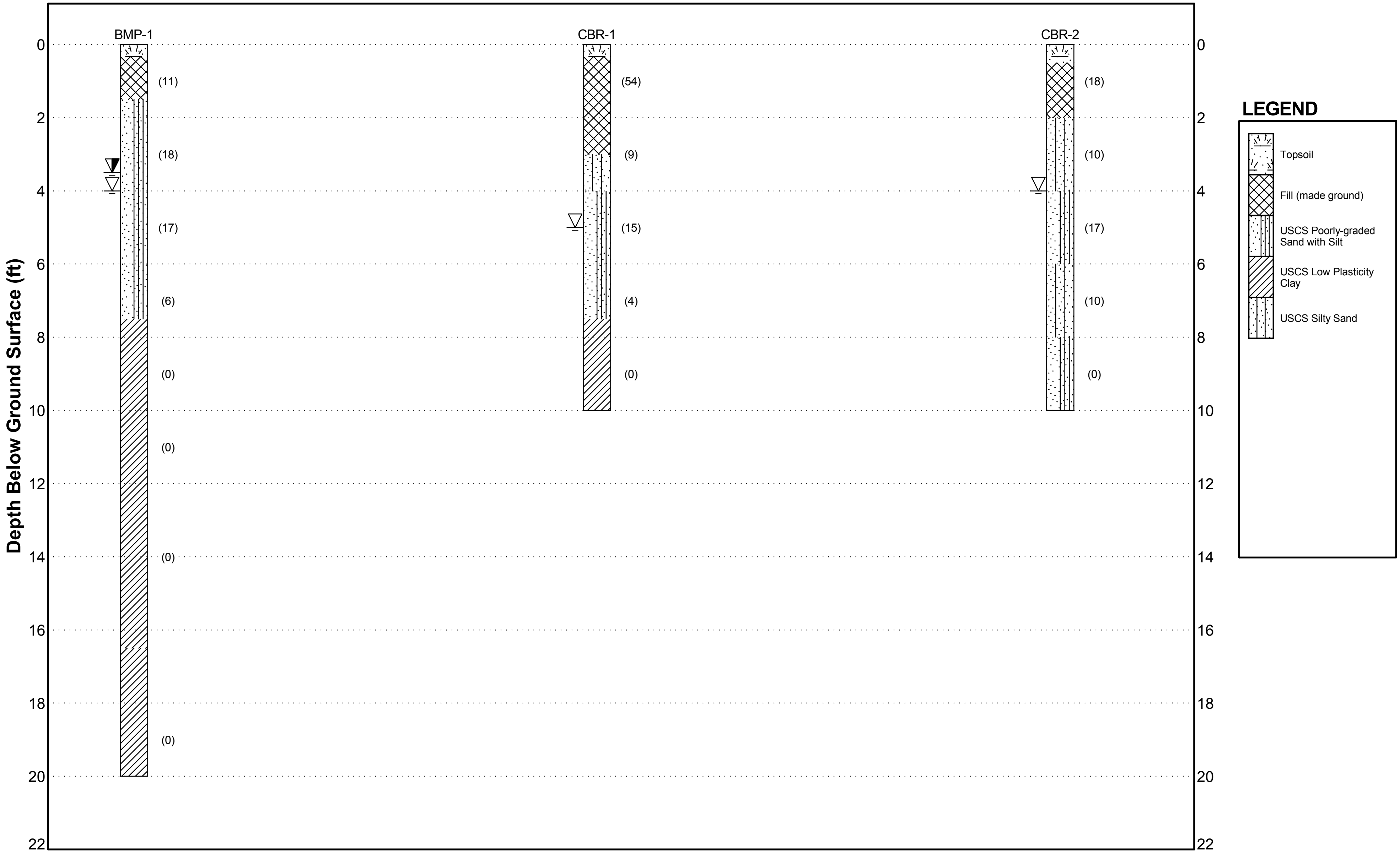
This information pertains only to this boring and should not be interpreted as being indicitive of the site.

APPENDIX IV

GENERALIZED SOIL PROFILE

GENERALIZED SOIL PROFILE

PROJECT NAME: Bus Loop - Achilles Elementary School
PROJECT NUMBER: WM14-147G
PROJECT LOCATION: Gloucester County, VA
CLIENT: AES Consulting Engineers



(Numerical Value) = Sample N-Value

APPENDIX V

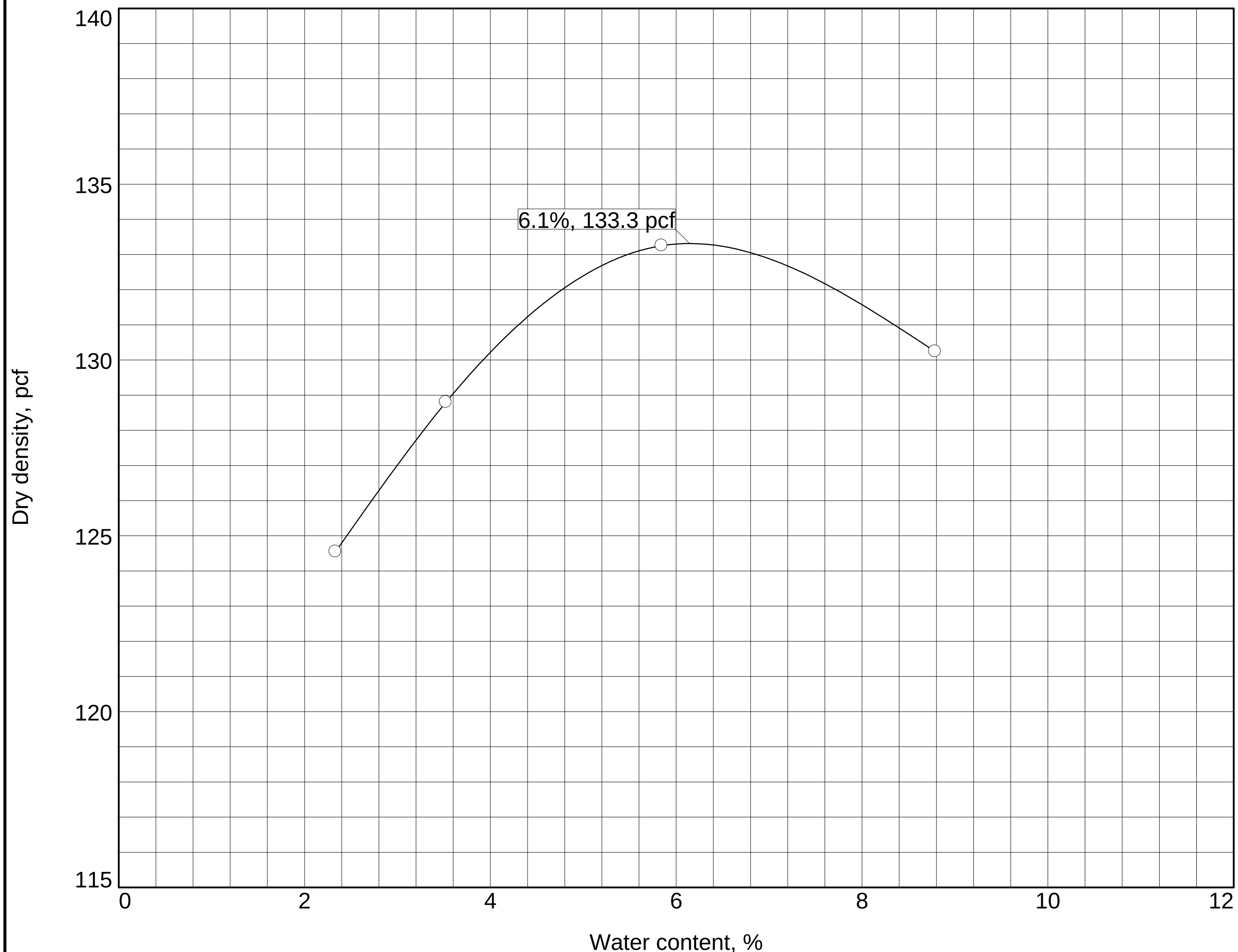
CBR TEST RESULTS

SUMMARY OF CBR TEST RESULTS

Sample Number	CBR-1	CBR-2
Sample Depth (ft.)	1-2	1-2
Unified Soil Classification Symbol	GP-GM	SM
Natural Moisture Content (%)	3	4
Atterberg Limits LL/PL/PI	Non Plastic	Non Plastic
% Passing #200 Sieve	10.2	15.9
Maximum Dry Density, pcf	133.3	119.8
Optimum Moisture %	6.1	10.6
Soaked CBR Value	29.6	30.3
Resiliency Factor	3.0	3.0
Swell %	0.0	0.0

Bus Loop – Achilles Elementary School
9306 Guinea Road
Gloucester County, Virginia
G E T Project No: WM14-147G

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



Test specification: ASTM D 698-07 Method C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
1-2 Ft.	GP-GM	A-1-b	3	Estimated	NP	NP	25.2	10.2

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 133.3 pcf Optimum moisture = 6.1 %	Gray, Poorly graded fine to coarse GRAVEL (GP-GM) with Silt and Sand

Project No. WM14-147G **Client:** AES Consulting Engineers
Project: Bus Loop - Achilles Elementary School

○**Location:** Boring Location CBR-1 **Sample Number:** CBR-1

GET Solutions, Inc.

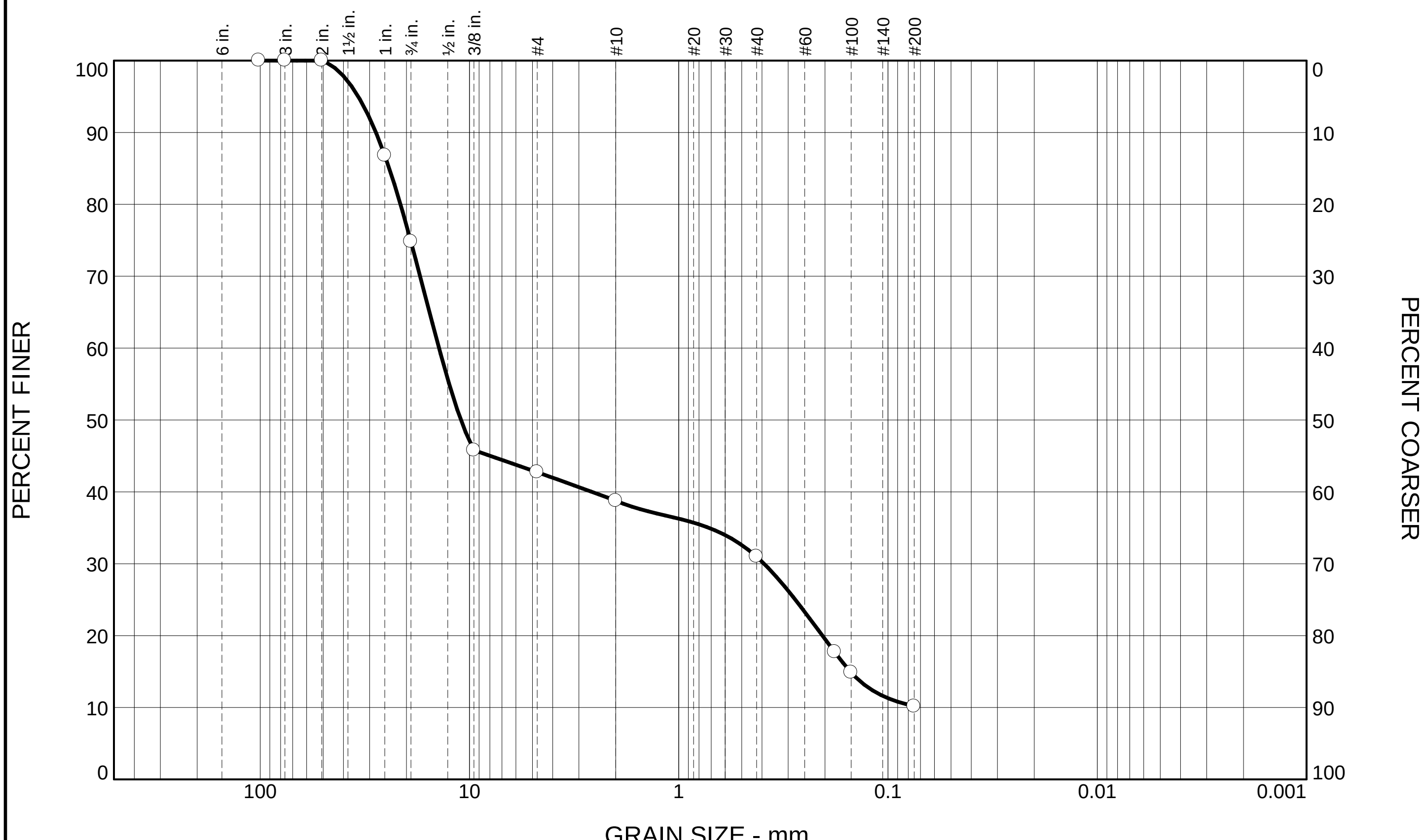
Williamsburg, VA

Remarks:
CBR #1
Sample received: 6/6/2014
Sample tested: 6/6/2014

Figure 1

Tested By: A. Kotyk **Checked By:** J. Wheeler

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	25.2	32.1	3.9	7.8	20.8	10.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4"	100.0		
3"	100.0		
2"	100.0		
1"	86.8		
0.75"	74.8		
0.375"	45.8		
#4	42.7		
#10	38.8		
#40	31.0		
#80	17.7		
#100	14.9		
#200	10.2		

* (no specification provided)

Material Description

Gray, Poorly graded fine to coarse GRAVEL (GP-GM) with Silt and Sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 27.9994 D_{85}= 24.1870 D_{60}= 13.9849
D_{50}= 10.9919 D_{30}= 0.3911 D_{15}= 0.1514
D_{10}= C_u= C_c=

Classification

USCS= GP-GM AASHTO= A-1-b

Remarks

CBR #1
Sample received: 6/6/2014
Sample tested: 6/6/2014

Location: Boring Location CBR-1
Sample Number: CBR-1 **Depth:** 1-2 Ft. **Date:** 6/6/2014

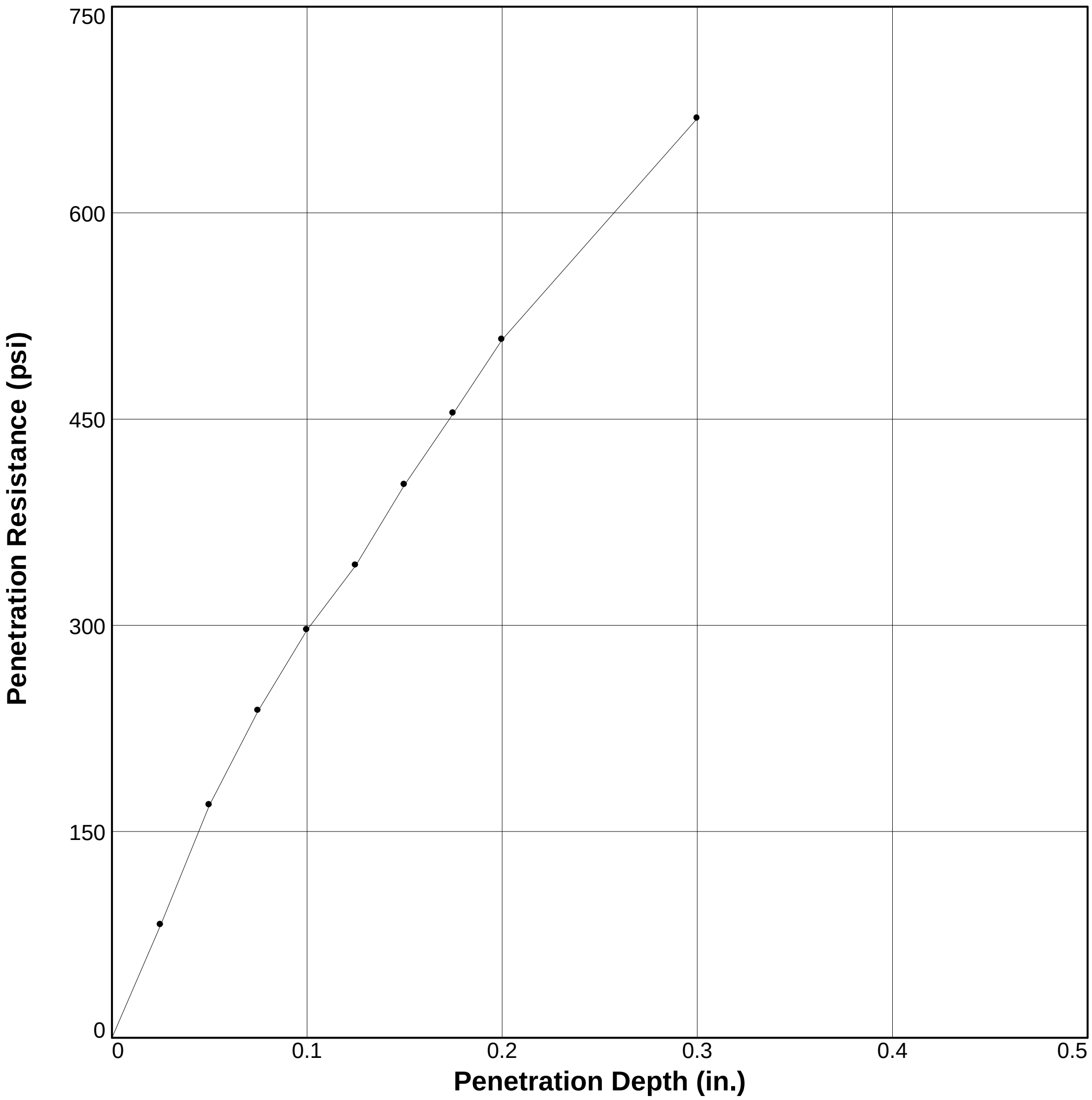
GET Solutions, Inc.

Williamsburg, VA

Client: AES Consulting Engineers
Project: Bus Loop - Achilles Elementary School
Project No: WM14-147G **Figure** 1a

Tested By: A. Kotyk **Checked By:** J. Robinson

BEARING RATIO TEST REPORT
ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	133.3	100	5.6	133.3	100	9.6	29.6	33.8	0.000	10	0
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Gray, Poorly graded fine to coarse GRAVEL (GP-GM) with Silt and Sand	GP-GM	133.3	6.1	NP	NP

Project No: WM14-147G

Project: Bus Loop - Achilles Elementary School

Location: Boring Location CBR-1

Sample Number: CBR-1 **Depth:** 1-2 Ft.

Date: 6/6/2014

Test Description/Remarks:

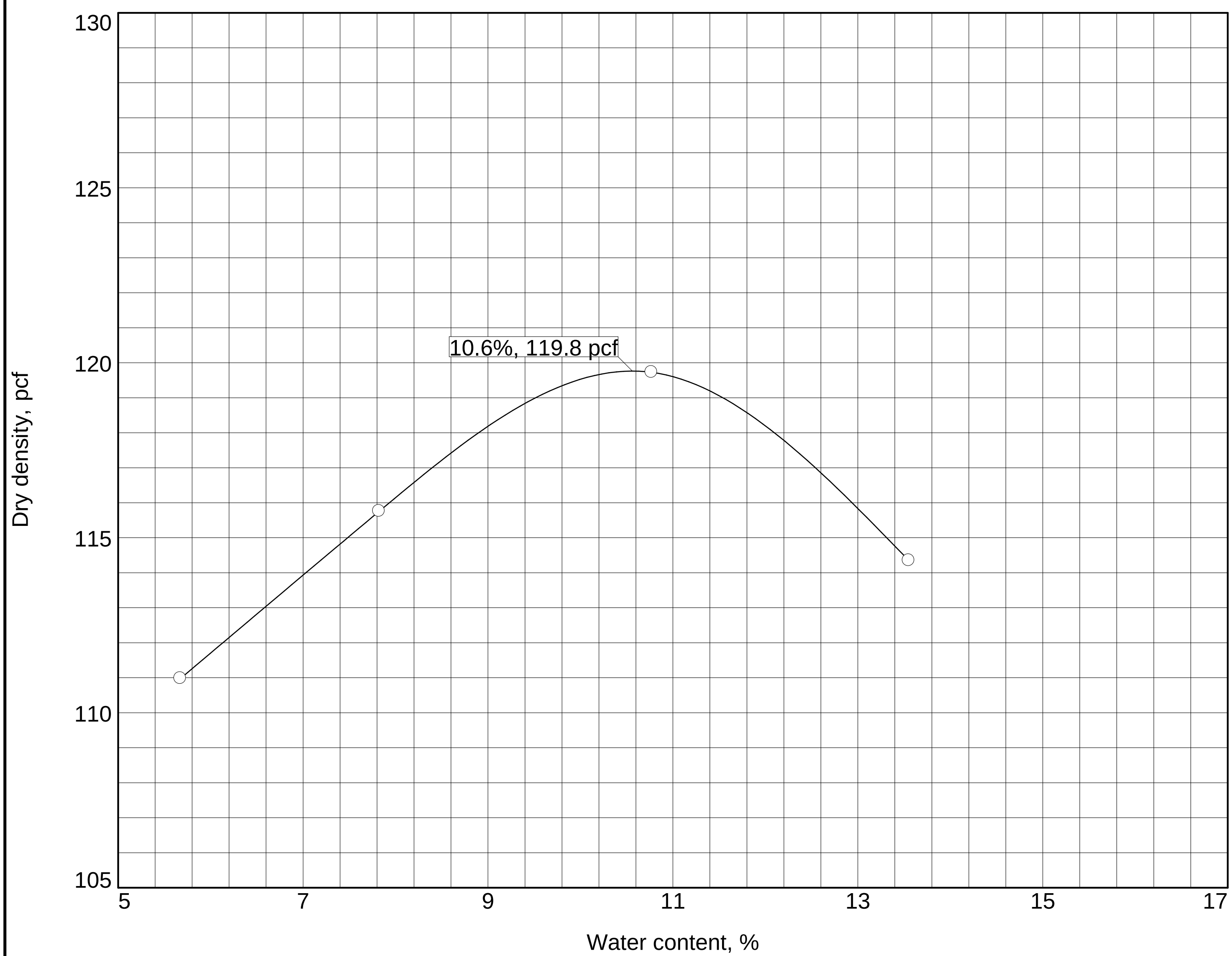
Sample Obtained: 6/5/2014
Sample Tested: 6/11/2014
Resiliency Factor = 3.0

BEARING RATIO TEST REPORT

GET Solutions, Inc.

Figure 1b

MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)



Test specification: ASTM D 698-07 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1-2 Ft.	SM	A-2-4(0)	4	Estimated	NP	NP	4.3	15.9

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 119.8 pcf Optimum moisture = 10.6 %	Dark brown, Silty fine to coarse SAND (SM) with trace Gravel and organics

Project No. WM14-147G **Client:** AES Consulting Engineers
Project: Bus Loop - Achilles Elementary School

○**Location:** Boring Location CBR-2 **Sample Number:** CBR-2

GET Solutions, Inc.

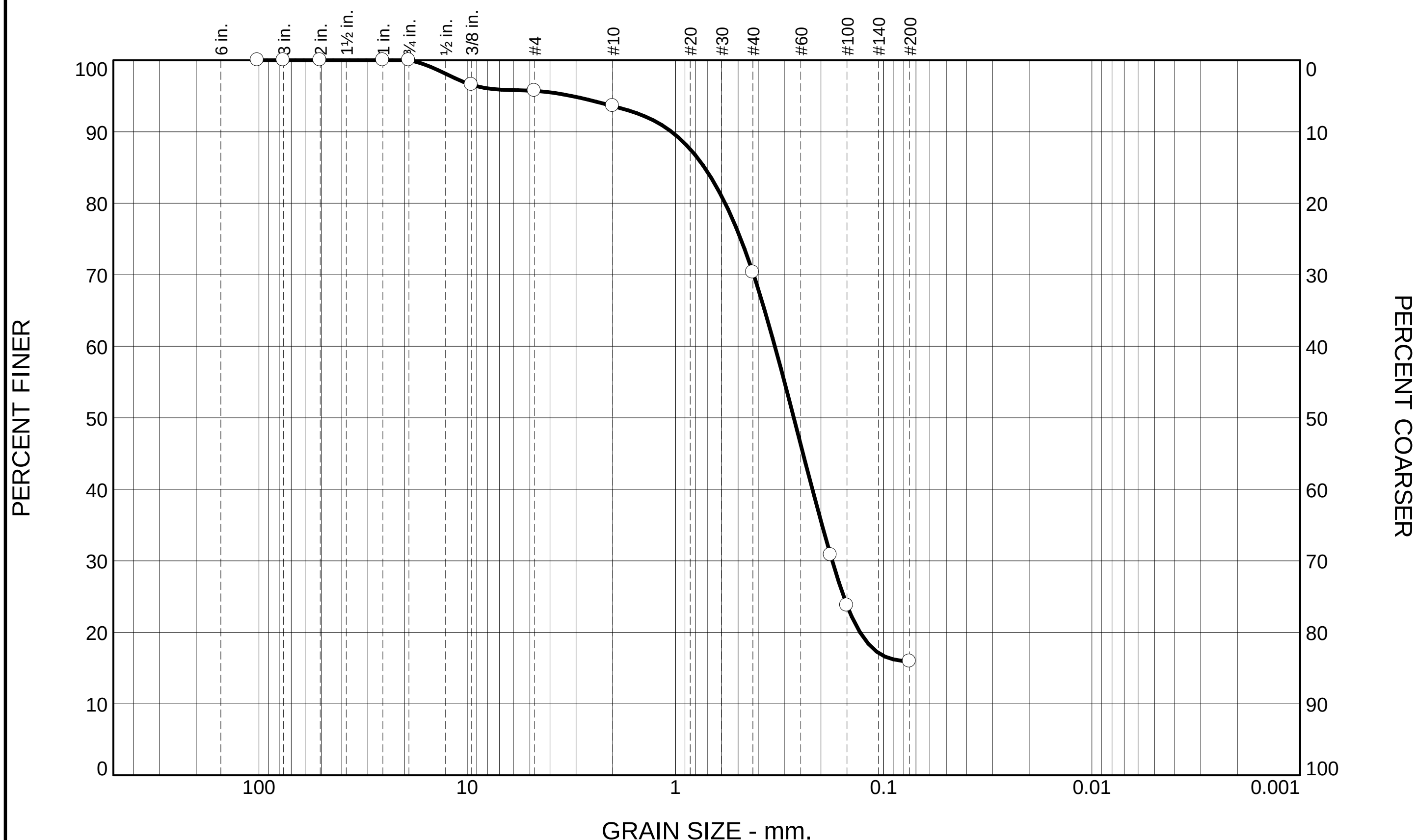
Williamsburg, VA

Remarks:
CBR #2
Sample received: 6/6/2014
Sample tested: 6/6/2014

Figure 2

Tested By: A. Kotyk **Checked By:** J. Wheeler

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.3	2.1	23.3	54.4	15.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4"	100.0		
3"	100.0		
2"	100.0		
1"	100.0		
0.75"	100.0		
0.375"	96.6		
#4	95.7		
#10	93.6		
#40	70.3		
#80	30.8		
#100	23.8		
#200	15.9		

* (no specification provided)

Material Description

Dark brown, Silty fine to coarse SAND (SM) with trace Gravel and organics

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.0438 D_{85}= 0.7248 D_{60}= 0.3330
D_{50}= 0.2701 D_{30}= 0.1766 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

CBR #2
Sample received: 6/6/2014
Sample tested: 6/6/2014

Location: Boring Location CBR-2
Sample Number: CBR-2 **Depth:** 1-2 Ft. **Date:** 6/6/2014

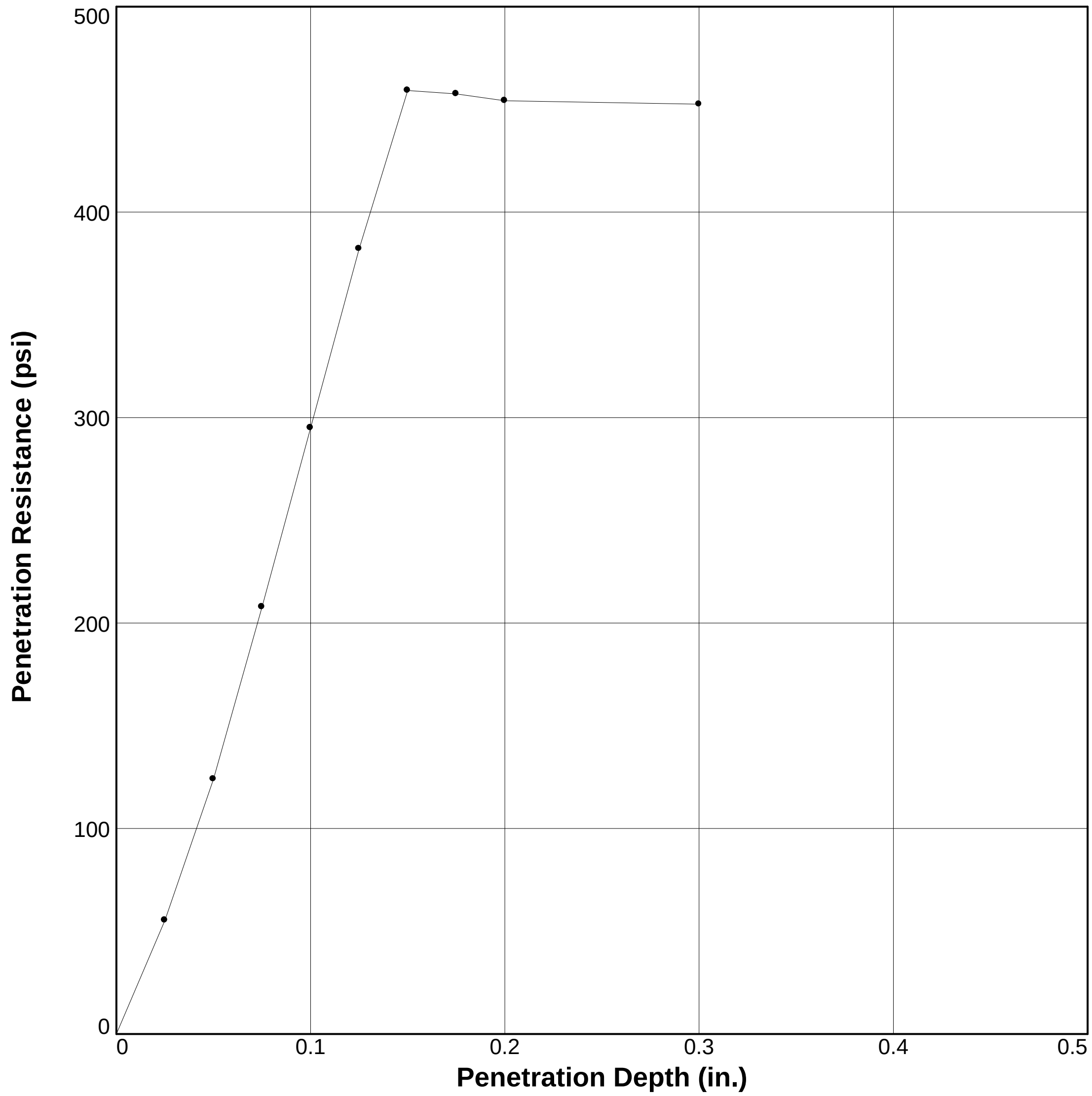
GET Solutions, Inc.

Williamsburg, VA

Client: AES Consulting Engineers
Project: Bus Loop - Achilles Elementary School
Project No: WM14-147G **Figure** 2a

Tested By: A. Kotyk **Checked By:** J. Robinson

BEARING RATIO TEST REPORT
ASTM D 1883-07



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	119.8	100	10.1	119.8	100	12.5	34.3	30.3	0.014	10	0
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Dark brown, Silty fine to coarse SAND (SM) with trace Gravel and organics	SM	119.8	10.6	NP	NP

Project No: WM14-147G

Project: Bus Loop - Achilles Elementary School

Location: Boring Location CBR-2

Sample Number: CBR-2 **Depth:** 1-2 Ft.

Date: 6/6/2014

Test Description/Remarks:

Sample Obtained: 6/6/2014
Sample Tested: 6/11/2014
Resiliency Factor = 3.0

BEARING RATIO TEST REPORT

GET Solutions, Inc.

Figure 2b

APPENDIX VI

INFILTRATION TEST DATA

Constant-Head Borehole Permeameter Test

Analytical Method: Glover Solution

GET Solutions, Inc.

Project Name......:	Bus Loop - Achilles Elementary School	**Project No......:**	WM14-147G
Boring No...........:	BMP-1	**Proj. Location...:**	Gloucester County, VA
Investigators.......:	P. Chambers	**Date..................:**	6/25/14
Boring Depth......:	2.5 ft **(m, cm, ft, in)**	**WCU Base Ht. h:**	15.0 **cm**
Boring Diameter..:	8.3 **cm**	**WCU Susp. Ht. S:**	6.4 **cm**
Boring Radius r...:	4.15 **cm**	**Const. Wtr. Ht. H:**	21.4 **cm**
Soil/Water Tmp. T:	11 **°C**	**H/r **..................:**	5.2
Dyn. Visc. @ T °C.:	0.001271 **kg/m·s**	**Dyn. Visc. @ T_B °C.:**	0.001170 **kg/m·s**

Terminology and Solution (R. E. Glover Solution)*

$Ksat_B$: (Coefficient of Permeability) @ Base Tmp. T_B (°C)	14
Q: Rate of flow of water from the borehole	
H: Constant height of water in the borehole	
r: Radius of the cylindrical borehole	
V: Dyn. Visc. of water @ Tmp. T °C/Dyn. Visc. of water @ T_B	
$Ksat = Q[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Basic Glover Solu.]	
$Ksat_B= QV[\sinh^{-1}(H/r) - (r^2/H^2+1)^{.5} + r/H]/(2\pi H^2)$ [Tmp. Correction]	

VOLUME (ml)	Volume Out (ml)	TIME (h:mm:ss A/P)	Interval Elapsed Time (hr:min:sec)	Interval Elapsed Time (min)	Flow Rate Q (ml/min)	$Ksat_B$ Equivalent Values (cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
1,900		8:55:05 AM								
1,800	100	8:57:22 AM	0:02:17	2.28	43.80	0.025	4.18E-04	36.142	0.593	1.186
1,700	100	8:59:27 AM	0:02:05	2.08	48.00	0.028	4.58E-04	39.612	0.650	1.300
1,600	100	9:01:41 AM	0:02:14	2.23	44.78	0.026	4.28E-04	36.951	0.606	1.212
1,500	100	9:03:44 AM	0:02:03	2.05	48.78	0.028	4.66E-04	40.256	0.660	1.321
1,400	100	9:05:51 AM	0:02:07	2.12	47.24	0.027	4.51E-04	38.988	0.640	1.279
1,300	100	9:07:57 AM	0:02:06	2.10	47.62	0.027	4.55E-04	39.298	0.645	1.289
1,200	100	9:10:02 AM	0:02:05	2.08	48.00	0.028	4.58E-04	39.612	0.650	1.300
1,100	100	9:12:12 AM	0:02:10	2.17	46.15	0.026	4.41E-04	38.088	0.625	1.250
1,000	100	9:14:20 AM	0:02:08	2.13	46.88	0.027	4.48E-04	38.684	0.635	1.269

Natural Moisture......:	15	**Consistency...............:**	
USDA Txt./USCS Class:	SP-SM	**Water Table Depth...:**	3.5 ft
Struct./% Pass. #200.:	6	**Init. Saturation Time.:**	8:30:00 AM

	(cm/min)	(cm/sec)	(cm/day)	(in/hr)	(ft/day)
Field-Estimated Ksat:	0.027	4.50E-04	**38.920**	0.638	1.277

Notes: Estimated field Ksat is determined by averaging and/or rounding of test results for the final three or four stabilized values and analyzing the graph.

*Glover, R. E. l953. Flow from a test-hole located above groundwater level, pp. 69-7l. in: Theory and Problems of Water Percolation. (C. N. Zanger. ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. **H/r>5 to >10 Johnson Permeameter, LLC Revised 11/29/13