



# REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING SERVICES

**Windsor Maintenance Building**

**Windsor, Virginia**

**G E T Project No: VB20-115G**

**February 27, 2020**

**PREPARED FOR:**



**Town of Windsor**  
*Virginia*



February 27, 2020

TO: **Town of Windsor**  
8 East Windsor Boulevard  
P.O. Box 307  
Windsor, VA 23487

Attn: Mr. Michael Stallings, Town Manager

RE: Report of Subsurface Exploration and Geotechnical Engineering Services  
**Windsor Maintenance Building**  
Windsor, Virginia  
**G E T** Project No: VB20-115G

Dear Mr. Stallings:

In compliance with your instructions, we have completed our Subsurface Exploration 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.**

Jennifer Maginniss, EIT  
Staff Engineer



D. Mark Scholefield, P.E.  
Principal Engineer  
VA Reg. # 033932

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## EXECUTIVE SUMMARY

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The project site is located at 9 East Griffin Street in the City of Windsor, Virginia. The site is an open grassy lot bordered by residential structures, an open field, a water tower and East Griffin Street. Based on visual observations, the site appears to be relatively level.

The proposed construction will consist of building a new maintenance building for town hall. The building will be approximately 50-feet by 80-feet in plan area and will be a pre-engineered metal structure supported on a monolithic slab with turn-down edges. The maximum wall and column loads are not expected to exceed 1.5 klf and 25 kips, respectively. Floor loads are anticipated to be approximately 150 psf. The finish grades are expected to roughly coincide with current grades, thus cuts and fills are not expected to exceed 1 foot. New pavements, BMP areas, and associated infrastructure will also be constructed (these have already been designed).

Our field exploration program included:

- One (1) 35-foot and one (1) 25-foot deep Standard Penetration Test (SPT) borings drilled within the proposed building footprint.

The initial groundwater level was measured to occur at a depth of 4.5 to 5 feet below existing grades at the boring locations. A summary of the subsurface and groundwater conditions encountered at the SPT soil test borings is presented in Section 3 of this report.

The following evaluations and recommendations were developed based on our field exploration and laboratory-testing program:

- A field testing program during construction is recommended, which should include subgrade proof rolling, compaction testing and foundation excavation observations for bearing capacity verification.
- The shallow subsurface SAND (SC) and CLAY (CL) soils encountered at the boring locations do not appear to meet the criteria recommended in this report for reuse as structural fill. The project's budget should include an allowance for subgrade improvements (undercut and backfill with structural fill).
- The proposed structure can be supported by a monolithic slab with turn-down edges bearing upon firm natural soil or well compacted structural fill material. The turn-down edges can be designed using a net allowable soil pressure of 1,500 pounds per square foot (minimum 16-inch embedment and minimum 16-inch width for the turned down edges). Estimated post-construction total and differential settlements may range up to 1-inch and ½-inch, respectively. Settlement values are pending on the additional consolidation testing.

This summary briefly discusses some of the major topics mentioned in the attached report. Accordingly, this report should be read in its entirety to thoroughly evaluate the contents.

## 1.0 PROJECT INFORMATION

### 1.1 Project Authorization

**G E T Solutions, Inc.** has completed our subsurface exploration and geotechnical engineering services for the proposed Windsor Maintenance Building project in the City of Windsor, Virginia. The geotechnical engineering services were conducted in general accordance with **G E T** Proposal No. PVB16-800G dated January 15, 2020. Authorization to proceed with our services was in the form of electronic mail dated January 16, 2020.

### 1.2 Project Site Location and Description

The project site is located at 9 East Griffin Street in the City of Windsor, Virginia. The site is an open grassy lot bordered by residential structures, an open field, a water tower and East Griffin Street. Based on visual observations, the site appears relatively level. A site vicinity map is provided in Figure 1 with the project site indicated.

Figure 1: Project Site Vicinity Map



Source: Google Maps 2018

### **1.3 Project Construction Description**

The proposed construction will consist of building a new maintenance building for town hall. The building will be approximately 50-feet by 80-feet in plan area and will be a pre-engineered metal structure supported on a monolithic slab with turn-down edges. The maximum wall and column loads are not expected to exceed 1.5 klf and 25 kips, respectively. Floor loads are anticipated to be approximately 150 psf. The finish grades are expected to roughly coincide with current grades, thus cuts and fills are not expected to exceed 1 foot. New pavements, BMP areas, and associated infrastructure will also be constructed (these have already been designed).

**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 the borings performed at the proposed development.
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. Discussion of the existing or anticipated groundwater conditions and depth to groundwater (encountered or estimated from available data).
3. Construction considerations for soil subgrade preparation (stripping, grading, and compaction) and foundation excavations. Engineering criteria for placement and compaction of approved structural Fill material.
4. Feasibility of utilizing a shallow foundation system for support of the proposed building. Design parameters required for the foundation system, including foundation sizes, allowable bearing pressures, foundation levels, and expected total and differential settlements.
5. Pavement design recommendations based on the field exploration activities and our experience with similar soil conditions.

**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. Prior to development of this site, an environmental assessment is advisable.**



## 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 foundation design parameters and recommendations, the following exploration program was performed:

- One (1) 35-foot and one (1) 25-foot deep Standard Penetration Test (SPT) borings drilled within the proposed building footprint.

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586. The tests were performed continuously from the existing ground surface to a depth of 12 feet, and at 5-foot intervals thereafter, starting at a depth of 13 feet below grade. 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 a safety 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 and overburden pressure). A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a sealed glass jar, and returned to our laboratory for review.

The boring locations were established by **G E T Solutions, Inc.**, approved by the client, and staked in the field by a representative of **G E T Solutions, Inc.** with the use of a hand-held Global Positioning System (GPS) device and by corroborating with easily identifiable landmarks. Upon completion of the soil borings, the boreholes were backfilled with the soil clippings. Approximate soil boring locations are shown in Appendix I (Boring Location Plan).

### 2.2 Field and Laboratory Testing

Soil testing provided by **G E T Solutions, Inc.** was performed in accordance with American Society for Testing and Materials (ASTM) standards. All soils and materials tests were performed in our AASHTO re:source (formally AMRL) and US Army Corps of Engineers certified Virginia Beach laboratory.

#### 2.2.1 Soil Classification and Index Testing

Representative portions of all soil samples collected during drilling operations were labeled, preserved and transferred to our laboratory in accordance with ASTM D4220 for classification and analysis. Soil descriptions on the boring logs are provided using visual-manual methods in general accordance with ASTM D2488 using the Unified Soil Classification System (USCS). Soil samples that were selected for index testing were classified in general accordance with ASTM D2487. It should be noted that some variation can be expected between samples classified using the visual-manual procedure (ASTM D2488) and the USCS (ASTM D2487). A summary of the soil classification system is provided in Appendix II.

Representative split-spoon soil samples were selected and subjected to natural moisture, #200 sieve wash, and Atterberg Limits testing in order to corroborate the visual classification. These test results are presented in Appendix III and on the soil test boring logs provided in Appendix IV. Generalized subsurface soil profiles are provided in Appendix V.

## 3.0 SITE AND SUBSURFACE CONDITIONS

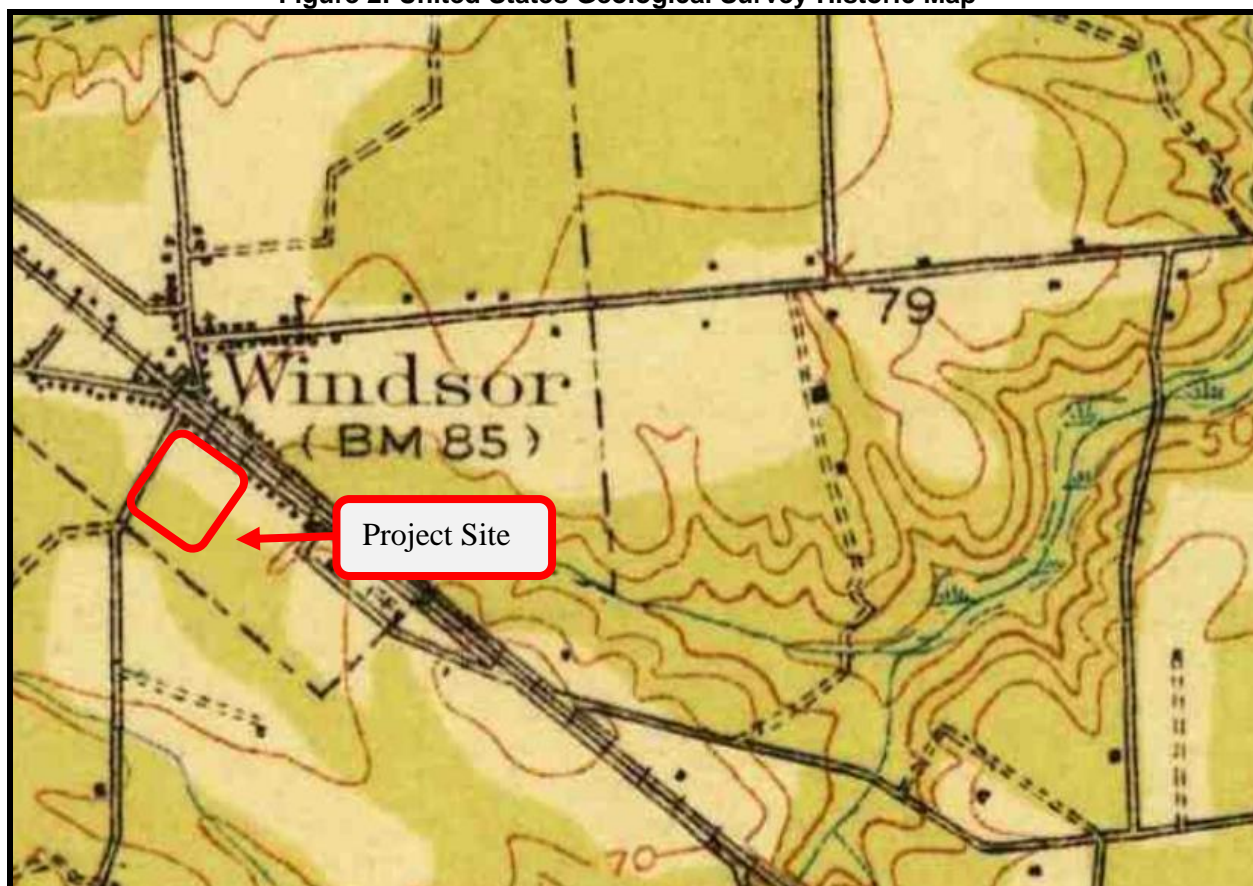
### 3.1 Site Geology

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 Silts.

### 3.2 Recent Land Reclamation and Site Development

Based on a review of historical United States Geological Survey (USGS) topographic maps of Smithfield, Norfolk, and Windsor, Virginia produced between the years of 1919 and 2019, the project site does not appear to be reclaimed. A historic map is shown in Figure 2.

Figure 2: United States Geological Survey Historic Map



Source: United States Geological Survey, Smithfield Quadrangle 1919



### 3.3 Subsurface Soil Conditions

A summary of the subsurface soils conditions encountered at the SPT boring locations is presented in Table I, while comprehensive bore logs are presented in Appendix IV.

**Table I – Subsurface Soil Conditions**

Average Depth (ft)	Stratum	Description	Ranges of SPT <sup>(1)</sup> N-Values
0 to 0.77 – 1.1	Surficial	➤ 10 to 13 inches of Topsoil	---
0.77 – 1.1 to 13.3 –14.3	I	➤ Grey, Orange SAND (SC) ➤ Grey, Orange CLAY (CL)	<u>Coarse-grained</u> 0 - 6  <u>Fine-grained</u> 5 - 8
13.3 –14.3 to 18.8 - 20	II	➤ Grey CLAY (CH)	0 - 13
18.8 – 20 to 33.5	III	➤ Grey SAND (SP-SM, SP, SC) <i>* B-2 boring termination depth at 25 feet</i>	3 - 13
33.5 to 35	IV	➤ Grey CLAY (CL) <i>* B-1 boring termination depth at 35 feet</i>	3
Note(s): (1) SPT = Standard Penetration Test, N-Values in Blows-per-foot (uncorrected)			

The subsurface descriptions are of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface exploration are included in Appendix IV (Boring Logs) and in Appendix V (Generalized Soil Profiles) 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. It is noted that the “Topsoil” designation references the presence of surficial organic laden soil, and does not represent any particular quality specification. It is recommended that this material be tested for approval prior to use as topsoil.

### 3.3 Groundwater Discussion

The groundwater level was recorded at the boring locations and as observed through the relative wetness of the recovered soil samples during the drilling operations. The initial groundwater level was measured to occur at depths between 4.5 and 5 feet below current grades at the boring locations.

The soils encountered within the borings at the presumed groundwater levels consisted of granular soils; thus, drilling fluids (water) were introduced into the boreholes during the drilling operations to prevent cave-ins from occurring, impairing the ability to accurately determine the groundwater levels. Therefore, the reported initial groundwater levels may not be indicative of the static groundwater level.

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, sidewalks, etc.). Seasonal groundwater fluctuations of +/- 2 feet are common in the project's area; 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.

## **4.0 EVALUATIONS AND RECOMMENDATIONS**

Our recommendations are based on the previously discussed project information, our interpretation of the soil test borings and laboratory data, and our observations during our site reconnaissance. If the proposed construction should vary from what was described, we request the opportunity to review our recommendations and make any necessary changes.

### **4.1 Clearing and Grading**

The proposed construction areas should be cleared by means of removing the topsoil material and any other unsuitable materials. It is estimated that a cut of up to 13 inches in depth will be required to remove the topsoil material. This cut is expected to extend deeper in isolated areas to remove deeper deposits of organic soils, or unsuitable soils, which become evident during the clearing. The resulting excavations should be backfilled with compacted structural Fill as described in section 4.3 of this report. It is recommended that the clearing operations extend laterally at least 5 feet beyond the perimeter of the proposed construction area.

The results of our field exploration program indicated that the soils below the surficial materials were generally comprised of CLAY (CL) and SAND (SC) with appreciable amounts of fines. Accordingly, 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 very soft/loose soils should be anticipated. The extent of the undercut will be determined in the field during construction based on the outcome of the field testing procedures (subgrade proofroll).

To reduce the potential for subgrade improvements (undercutting due to saturated soils in conjunction with heavy construction traffic), it is recommended that the grading operations be performed during the drier months of the year (historically April through November as indicated by the NCDC *Climate Atlas of the United States*). This should minimize these potential problems, although they may not be eliminated. If grading is attempted during the winter months, stabilization of wet soils should be anticipated. Methods to address wet soils may include excavation-substitution (undercutting and backfilling with structural fill) or the introduction of chemical additives (cement, lime, etc.). However, during the drier months of the year, wet soils could be dried by discing or implementing other drying procedures (stockpiling or spreading in thin lifts) to achieve moisture contents necessary to achieve adequate degrees of compaction. The project's budget should include an allowance for subgrade improvements as described above.

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. If the subgrade becomes deteriorated due to the above-mentioned or other reasons, difficulty maneuvering construction equipment and machinery is likely.

The undercut and backfill should be performed under the observation of a representative of **G E T Solutions, Inc.** who will evaluate the composition of the recovered soils. Recommendations concerning the subgrade improvements (as necessary) will be provided in the field following the testing procedures.

#### **4.2 Subgrade Preparation**

Following the clearing operation, the exposed subgrade soils should be densified with a large static drum roller. After the subgrade soils have been densified, they should be evaluated by **G E T Solutions, Inc.** 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. The number of passes will be determined in the field by the Geotechnical Engineer depending on the soils conditions. Any pumping or unstable areas observed during proofrolling (beyond the initial cut) should be undercut and/or stabilized at the direction of the Geotechnical Engineer.

#### **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 **G E T Solutions, Inc.** 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 20% by weight of fines (SP, SM, SW, GP, GW), 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 98% of the Standard Proctor maximum dry density (ASTM D 698) unless specified differently in this report. In general, the compaction should be accomplished by placing the Fill in maximum 10-inch loose lifts and mechanically compacting each lift to at least the specified minimum dry density. A representative of **G E T Solutions, Inc.** should perform field density tests on each lift as necessary to assure that adequate compaction is achieved.

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, the shallow subsurface SAND (SC) and CLAY (CL) soils encountered at the boring locations does not appear to meet the criteria recommended in this report for reuse as structural fill; however, may be used as Fill in green areas.

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 structural fill. The project's budget should include an allowance for imported structural fill.

#### **4.5 Shallow Foundation Design Recommendations**

Provided that the construction procedures are properly performed, the proposed structure can be supported by a monolithic slab with turn-down edges bearing upon firm natural soil or well compacted structural fill material. Some foundation undercut may be required to remove the unsuitable soft material beneath the footings (very loose/very soft soils). The turn-down edges can be designed using a net allowable soil pressure of 1,500 pounds per square foot (psf). In using net pressures, the weight of the footings and backfill over the footings, need not be considered. Hence, only loads applied at or above the finished floor need to be used for dimensioning the footings.

It is suggested that the exterior turn-down edges should be sealed at the surface with 6 to 8 inches of Clayey SAND/ Sandy CLAY, sloping away from the structure to promote surface water runoff. Based on our field exploration the shallow soils encountered at the boring locations may be suitable for this application. The foundations should have suitable drainage provided in accordance with local building codes.

In order to develop the recommended bearing capacity of 1,500 pounds per square foot (psf), the base of the footings should have an embedment of at least 16 inches beneath finished grades and a minimum width of 16 inches. The recommended 16-inch footing embedment is considered sufficient to provide adequate cover against frost penetration to the bearing soils.

## **4.6 Foundation Excavations**

In preparation for shallow foundation support, the footing excavations should extend into firm natural soil or well compacted structural fill. The foundation bearing capacities should be verified in the field during construction by means of performing a footing inspection. At that time, the Geotechnical Engineer should also explore the extent of excessively loose, soft, or otherwise unsuitable material within the exposed excavations. Also, at the time of footing observations, the Geotechnical Engineer should make hand auger borings or use a hand penetration device in the bases of the foundation excavations. The necessary depth of penetration will be established during the subgrade observations.

If pockets of unsuitable/unstable soils requiring undercut are encountered in the footing excavations, the proposed footing elevation should be re-established by means of backfilling with "flowable fill", or compacted # 57 stone prior to concrete placement. This construction procedure will provide for a net allowable bearing capacity of 1,500 psf.

Immediately prior to foundation concrete placement, it is suggested that the bearing surfaces of all foundations be compacted using hand operated mechanical tampers. In this manner, any localized areas, which have been loosened by excavation operations, should be adequately recompacted. The compaction testing in the base of the foundation may be waived by the Geotechnical Engineer, where firm bearing soils are observed during the foundation inspections.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition such as from physical disturbance, rain or frost. Surface run-off water should be drained away from the excavations and not be allowed to pond. If possible, all footing concrete should be placed the same day the excavation is made. If this is not possible, the footing excavations should be adequately protected.

## **4.7 Slab-on-Grade Design**

Floor slabs may be constructed as slab-on-grade members provided the previously recommended earthwork activities and evaluations are carried out properly. It is recommended that all ground floor slabs be directly supported by at least a 4-inch layer of relatively clean, compacted, poorly graded sand (SP) or gravel (GP) with less than 5% passing the No. 200 Sieve (0.074 mm). The purpose of the 4-inch layer is to act as a capillary barrier and equalize moisture conditions beneath the slab.

It is also recommended that the floor slab bearing soils be covered by a vapor barrier or retarder in order to minimize the potential for floor dampness, which can affect the performance of glued tile and carpet. Generally, use a vapor retarder for minimal vapor resistance protection below the slab on grade. When floor finishes, site conditions, or other considerations require greater vapor resistance protection; consideration should be given to using a vapor barrier. Selection of a vapor retarder or barrier should be made by the architect based on project requirements.



## 4.8 Settlements

It is estimated that, with proper site preparation, the maximum resulting post-construction total settlement of the proposed building foundations should be up to 1 inch. The maximum differential settlement magnitude is expected to be less than ½ -inch between adjacent footings (wall footings and column footings of widely varying loading conditions). The settlements were estimated on the basis of the results of the field penetration tests. Careful field control will contribute substantially towards minimizing the settlements.

These settlement magnitudes are based on preliminary assessments and will be verified with further consolidation testing of the soft clay layer positioned approximately 13 to 20 feet below grade. The results of the supplemental lab testing will be issued in an addendum to this report.

## 4.9 Pavement Design Recommendations

Based on our experience with similar soils, the soils in the footprint of the proposed new pavement have an average soaked CBR value of 5. The average soaked CBR value was multiplied by a factor of two-thirds for safety measures to determine a pavement design CBR value. Therefore, a CBR value of 3 should be used in designing the pavement sections. The comprehensive test results are provided in Appendix VI. A modulus of subgrade reaction (k) value of 100 pounds per square inch per inch (psi/in) can be used in structurally designing rigid pavement sections.

The minimum pavement design recommendations for the proposed parking lot are presented in Table III.

Section	Hot Mix Asphalt		Concrete <sup>(1)</sup>	Aggregate Base <sup>(2)</sup>	Subgrade <sup>(3)</sup>
	Surface (SM-12.5A)	Base (BM-25.0A)			
Light Duty Asphalt Parking Area	2"	-	-	8"	Stable
Heavy Duty Asphalt Parking Area	2"	3"	-	8"	Stable
Light Duty Rigid Pavement	-	-	6"	4"	Stable

- Notes: (1) Minimum flexural strength of 650 psi at 28 days.  
(2) VDOT Type 21-A or 21-B, compacted to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D 698).  
(3) The natural subgrade should be compacted to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D 698).

**Pavement section thicknesses and design criteria should be reviewed by the design civil engineer to determine the adequacy of the pavement section for its intended purpose.**

All pavement material and construction procedures should conform to Virginia Department of Transportation (VDOT) requirements.

In preparation for a stable subgrade support for the pavement sections, the following construction steps are recommended:

1. 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.
2. 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 adding geosynthetics, thickening the subbase course layer by 6 to 12 inches, and/or by chemical stabilization. These alternates are to be addressed by the Geotechnical Engineer during construction, if necessary, who will recommend the most economical approach at the time. Considering the very loose/very soft surface soils, undercutting of 12 or more inches may be required throughout the pavement areas.

## **5.0 CONSTRUCTION CONSIDERATIONS**

### **5.1 Anticipated Excavation Characteristics**

Based on the results of this exploration, varying soil conditions and compositions are expected to be encountered throughout the project limits. Open-cut excavations will extend through natural soils that are considered to be relatively “clean” (i.e. soil that is relatively free of deleterious debris that may hinder excavation or installation). Debris typically considered unsuitable consist of wood, glass, organics, plastics, coal, brick or any other material larger than 2 inches in diameter.

### **5.2 Excavation Stability**

The shallow subsurface within the project limits is comprised of clayey and granular soils; however, the Contractor should anticipate these soils to have relatively little cohesion and have a high potential for caving. Additionally, water seepage at varying elevations should be expected within the side walls of the open cut areas, increasing the potential for caving. Based on these mentioned characteristics, it is recommended that all subsurface soils be considered Type C in accordance with Occupational Safety and Health Administration (OSHA) criteria.

#### *Temporary Slopes (If Applicable)*

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 ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavations, 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.

Temporary slopes may not be a feasible option. 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.

Where temporary slopes are not feasible, shoring by means of sheeting and/or trench shields may be appropriate. Where the stability of adjoining structures, pavements, or other improvements is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability. Shoring, bracing, or underpinning required for this project (if required) should be designed by a professional engineer.

### *Shoring (If Applicable)*

Shoring design and installation should be the responsibility of the Contractor. Shoring systems required for this project should be designed by a professional engineer. Shoring systems should be designed to provide positive restraint of trench walls in an effort to protect against lateral deformation that may result in ground cracks, settlement, and/or other ground movements that may affect adjacent underground utilities and pavements as well as surface improvements. The Contractor should be made aware of this potential condition in order that preventative measures can be implemented or repair measures provided for.

Depending on the shoring system used, the removal process may create voids along the walls of the excavations. If these voids are left in-place and are significant, backfill and/or the retained soil may shift laterally resulting in settlement of overlying structures/pavements. As such, care should be taken to remove the shoring systems and backfill the trenches in a manner as to not create these voids.

In all cases, the Contractor should select an excavation and/or shoring scheme that will protect adjacent and overlying improvements, including below grade utilities.

We are providing this information solely as a service to our client. **GET 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.

## **5.3 Dewatering**

It is expected that dewatering will be required for excavations that extend near or below the existing groundwater table (approximate depth of 4.5 to 5 feet or shallower). Temporary dewatering will impact construction and be dependent on construction methods and scheduling. For those reasons, we recommend the Contractor be solely responsible for the design, installation, maintenance, and performance of all temporary dewatering systems. The dewatering system should be designed to maintain a controlled environment suitable for the proposed construction and specified construction methods. Where temporary shoring is employed, the dewatering system should be compatible with the type of shoring to be used. We recommend the Contractor verify groundwater conditions and evaluate dewatering requirements prior to construction.

Lowering the groundwater table during dewatering activities will result in an increase in effective stresses and may induce settlements of the soils underlying adjacent structures/pavements. Additionally, hydraulic compaction of predominately granular soils (e.g. SP, SP-SM, SM soils) should be anticipated as a result of lowering the groundwater table. We recommend that the dewatering be performed such that the groundwater level is lowered no more than approximately 5 feet below the proposed excavation depth. It may be advantageous to install settlement monuments in areas where dewatering by means of well pointing is required.

## 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 designated agents 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 make sure 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 the client and their designated agents for the specific application to the proposed Windsor Maintenance Building project in Windsor, Virginia.

## **APPENDICES**

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<b>APPENDIX I</b>	BORING LOCATION PLAN
<b>APPENDIX II</b>	CLASSIFICATION SYSTEM FOR SOIL EXPLORATION
<b>APPENDIX III</b>	SUMMARY OF LABORATORY CLASSIFICATION RESULTS
<b>APPENDIX IV</b>	BORING LOGS
<b>APPENDIX V</b>	GENERALIZED SOIL PROFILE



## **APPENDIX I**

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### **BORING LOCATION PLAN**



## **APPENDIX II**

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### **CLASSIFICATION SYSTEM FOR SOIL EXPLORATION**

## 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

##### Particle Size Identification

<b>Boulders</b>	8 inch diameter or more
<b>Cobbles</b>	3 to 8 inch diameter
<b>Gravel</b>	Coarse 1 to 3 inch diameter
	Medium $\frac{1}{2}$ to 1 inch diameter
	Fine $\frac{1}{4}$ to $\frac{1}{2}$ inch diameter
<b>Sand</b>	Coarse 2.00 mm to $\frac{1}{4}$ 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)
<b>Silt</b>	0.002 to 0.074 mm (cannot see particles)

### 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

#### 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

##### Relative Proportions

<u>Descriptive Term</u>	<u>Percent</u>
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.

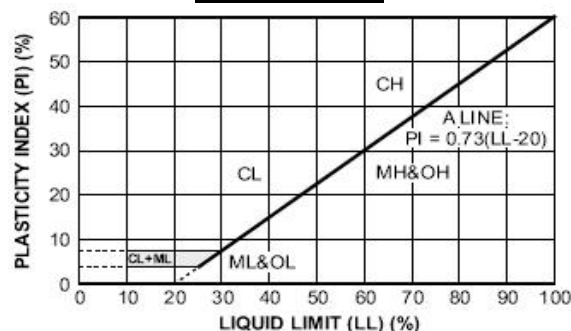
#### Groundwater Readings

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.).

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**

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### **SUMMARY OF LABORATORY CLASSIFICATION RESULTS**





GET Solutions, Inc.

# SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

**CLIENT** Town of Windsor

**PROJECT NAME** Windsor Maintenance Building

**PROJECT NUMBER** VB20-115G

**PROJECT LOCATION** Windsor, VA

Borehole	Depth	Liquid Limit <small>VTM-7 AASHTO T-89 &amp; T-90</small>	Plastic Limit <small>VTM-7 AASHTO T-89 &amp; T-90</small>	Plasticity Index <small>VTM-7 AASHTO T-89 &amp; T-90</small>	Maximum Size (mm)	%<#200 Sieve <small>VTM-25 AASHTO T-27 &amp; T-88</small>	Class-ification	Water Content (%) <small>AASHTO T-265</small>	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-1	1.0	26	14	12	0.075	57	CL	19.2			
B-1	11.0	71	26	45	0.075	93	CH	34.5			
B-1	19.0	38	19	19	0.075	80	CL	37.9			

## **APPENDIX IV**

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### **BORING LOGS**



# RECORD OF SUBSURFACE EXPLORATION

Virginia Beach  
5465 Greenwich Road  
Virginia Beach, VA 23642  
757-518-1703

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

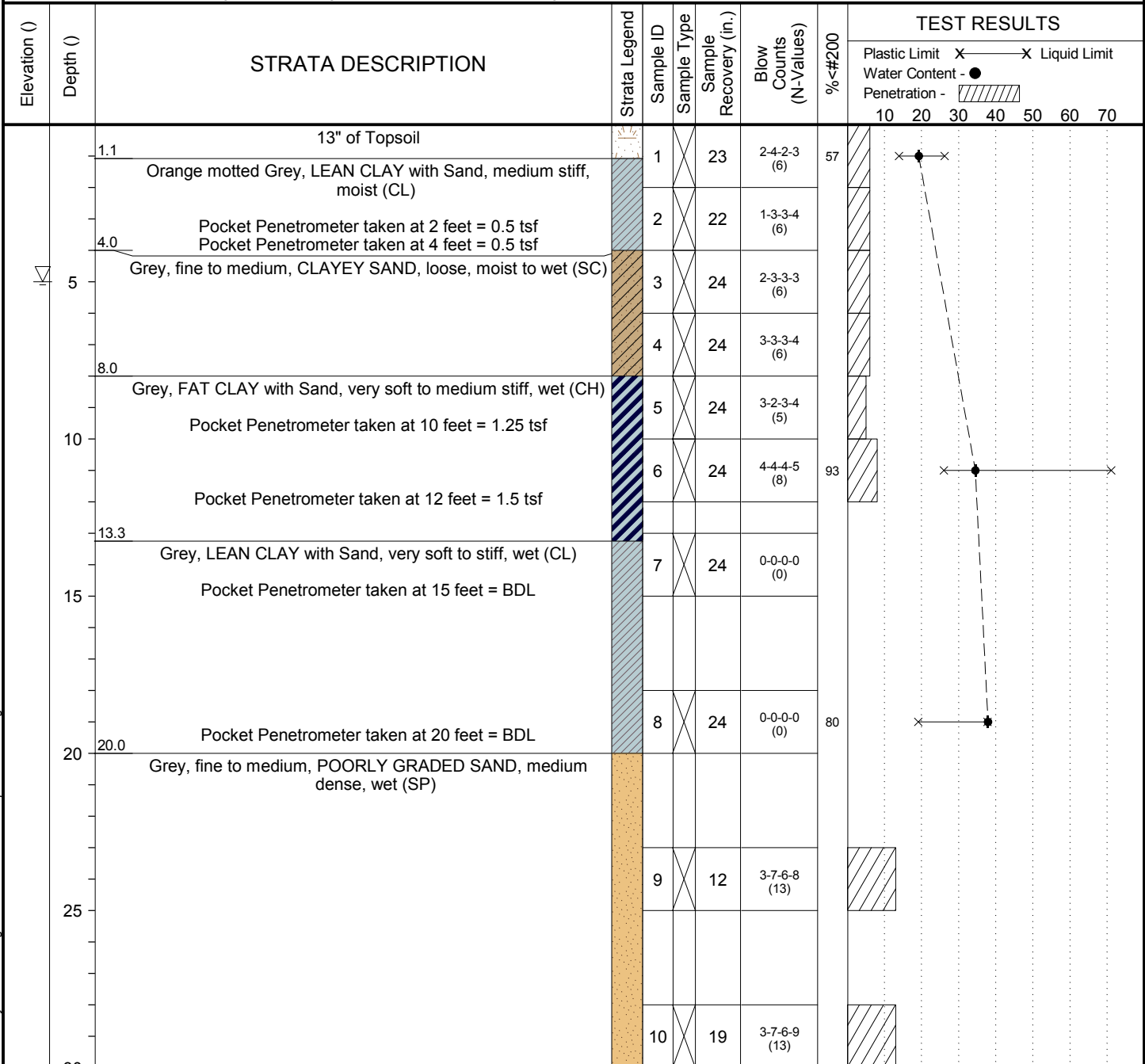
Elizabeth City  
106 Capital Trace Unit E  
Elizabeth City, NC 27909  
252-335-9765

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

**BORING ID  
B-1**

PROJECT NAME: **Windsor Maintenance Building**  
CLIENT: **Town of Windsor**  
PROJECT LOCATION: **Windsor, VA**  
BORING LOCATION: **See boring location plan**  
DRILLING METHOD(S): **Rotary wash "mud"**  
GROUNDWATER\*: INITIAL ( ) ▽: **5** AFTER \_\_\_\_\_ HOURS ( ) ▽: \_\_\_\_\_ CAVE-IN ( ) ⊖: \_\_\_\_\_  
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: **VB20-115G**  
SURFACE ELEVATION (NAVD 88) ( ): \_\_\_\_\_  
LOGGED BY: **J. Maginniss**  
DATE STARTED: **2/10/2020**  
DATE COMPLETED: **2/10/2020**  
DRILLER: **GET Solutions, Inc.**



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

Sample Type(s):  
SS - Split Spoon

Notes: BDL = Below Detection Limit; This is a composite log between the initial boring completed on 2/10/2020 and the resampling performed on 2/25/2020



# RECORD OF SUBSURFACE EXPLORATION

Virginia Beach  
5465 Greenwich 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 B-1

PROJECT NAME: Windsor Maintenance Building  
CLIENT: Town of Windsor  
PROJECT LOCATION: Windsor, VA  
BORING LOCATION: See boring location plan  
DRILLING METHOD(S): Rotary wash "mud"  
GROUNDWATER\*: INITIAL ( ) ▽: 5 AFTER      HOURS ( ) ▽:      CAVE-IN ( ) ☹:       
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB20-115G  
SURFACE ELEVATION (NAVD 88) ( ):       
LOGGED BY: J. Maginniss  
DATE STARTED: 2/10/2020  
DATE COMPLETED: 2/10/2020  
DRILLER: GET Solutions, Inc.

Elevation ( )	Depth ( )	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%<#200	TEST RESULTS									
									Plastic Limit	X	—	X	Liquid Limit	Water Content	- ●	Penetration	- ▨	
		Grey, fine to medium, POORLY GRADED SAND, medium dense, wet (SP) (layer continued from previous page)																
	33.5	Grey, LEAN CLAY with Sand, soft, wet (CL)		11	X	24	2-1-2-1 (3)											
	35.0	Pocket Penetrometer taken at 35 feet = 0.25 tsf Boring terminated at 35 feet below existing grade.																

Sample Type(s):

SS - Split Spoon

Notes: BDL = Below Detection Limit; This is a composite log between the initial boring completed on 2/10/2020 and the resampling performed on 2/25/2020

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



# RECORD OF SUBSURFACE EXPLORATION

Virginia Beach  
5465 Greenwich 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  
B-2**

PROJECT NAME: Windsor Maintenance Building  
CLIENT: Town of Windsor  
PROJECT LOCATION: Windsor, VA  
BORING LOCATION: See boring location plan  
DRILLING METHOD(S): Rotary wash "mud"  
GROUNDWATER\*: INITIAL ( ) ▽: 4.5 AFTER \_\_\_\_ HOURS ( ) ▽: \_\_\_\_ CAVE-IN ( ) ⊖: \_\_\_\_  
The initial groundwater readings are not intended to indicate the static groundwater level.

PROJECT NUMBER: VB20-115G  
SURFACE ELEVATION (NAVD 88) ( ): \_\_\_\_  
LOGGED BY: J. Maginniss  
DATE STARTED: 2/10/2020  
DATE COMPLETED: 2/10/2020  
DRILLER: GET Solutions, Inc.

Elevation (')	Depth (')	STRATA DESCRIPTION	Strata Legend	Sample ID	Sample Type	Sample Recovery (in.)	Blow Counts (N-Values)	%>#200	TEST RESULTS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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Sample Type(s):

SS - Split Spoon

Notes: BDL = Below Detection Limit

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



## **APPENDIX V**

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### GENERALIZED SOIL PROFILE



# GENERALIZED SOIL PROFILE

PROJECT NAME: Windsor Maintenance Building

PROJECT NUMBER: VB20-115G

PROJECT LOCATION: Windsor, VA

CLIENT: Town of Windsor

