REPORT OF
SUBSURFACE
EXPLORATION
AND
GEOTECHNICAL
ENGINEERING
SERVICES

Suffolk Parks & Rec Operations Facility
Suffolk, Virginia

GET Project No: VB19-141G

April 5, 2019
April 5, 2019

TO: City of Suffolk  
    441 Market Street  
    P.O. Box 1858  
    Suffolk, VA 23439

Attn: Mr. Gerry L. Jones

RE: Proposal for Subsurface Exploration and Geotechnical Engineering Services  
    Suffolk Parks & Rec Operations Facility  
    Suffolk, Virginia  
    G E T Proposal No: PVB19-174G

Dear Mr. Jones:

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.

Gregory Lewis  
Project Geologist

Camille Kattan, P.E.  
Principal Engineer  
VA Reg. # 018045

Copies: (1) Client
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EXECUTIVE SUMMARY

The project site is located at the end of Tyson Court, to the east of the intersection of Tyson Court and Route 13 in Suffolk, Virginia. The proposed construction will consist of a single level Operations Facility for the Parks and Recreation Department of the City of Suffolk, Virginia and the associated access road, parking areas, and storm water management features.

Our field exploration program included eight (8) 10- to 45-foot deep Standard Penetration Test (SPT) borings within the building, pavement, and BMP pond footprints. Additionally, California Bearing Ratio (CBR) testing was performed on bulk subgrade samples collected at the borings located in the proposed pavement areas and two (2) Dynamic Cone Penetrometer tests and associated hand auger borings were performed within the existing access road alignment. Also, temporary groundwater monitoring wells were installed at the borings located within the BMP wet pond footprint.

The initial groundwater level was measured to occur at depths ranging from 6 to 8 feet below existing grades at the boring locations, roughly corresponding to elevations ranging from 55 to 57 feet NAVD88. Groundwater readings obtained from the temporary groundwater monitoring wells indicated the stabilized groundwater level at approximately 59 feet NAVD88. A summary of the subsurface and groundwater conditions encountered at the SPT soil test borings and temporary groundwater monitoring wells 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 proofrolling, compaction testing and foundation excavation observations for bearing capacity verification.

- The shallow subsurface CLAY (CL) and Clayey SAND (SC) 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 building can be supported by means of shallow spread footings designed using an allowable bearing capacity of 2,000 pounds per square foot (psf) (minimum 24-inch embedment and minimum 24-inch width). Isolated square column footings are recommended to be a minimum of 3 feet by 3 feet in area for bearing capacity consideration. Estimated post-construction total and differential settlements may range up to 1-inch and ½-inch, respectively.

- Floor slabs may also be constructed as slab-on-grade members provided the subsurface recommendations are carried out properly.

- Based on California Bearing Ratio (CBR) testing, a design CBR value of 7.2 was used in designing the pavement sections. Detailed pavement design recommendations are presented in Section 4.9.

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

GET Solutions, Inc. has completed our subsurface exploration and geotechnical engineering services for the proposed Suffolk Parks & Rec Operations Facility project located in Suffolk, Virginia. The geotechnical engineering services were conducted in general accordance with the scope presented in GET Proposal No. PVB19-174G. Authorization to proceed with our services was received from the client in the form of an executed Work Authorization Form dated February 11, 2019.

1.2 Project Site Location and Description

The project site is located at the end of Tyson Court within a gated complex in the City of Suffolk, Virginia. The parcel is relatively flat with elevations ranging from approximately 58 to 63 NAVD 88. Surficial materials range from gravel and deteriorated pavement to low lying overgrowth and grass. The lot is currently being used as a storage facility for the City of Suffolk with shipping containers and small structures throughout the site. A site vicinity map is provided in Figure 1 with the project site indicated.

Figure 1: Project Site Vicinity Map
1.3 Project Construction Description

The proposed construction will consist of building a new, one-story Parks & Rec Operations facility. The new building will be approximately 24,480 square feet in plan area with a finished floor elevation of 64.3 feet. The maximum wall and column loads are not expected to exceed 4 klf and 150 kips, respectively. The floor loads are expected to be on the order of 150 psf. The finish grades are expected to coincide with current grades, thus cuts and fills are not expected to exceed 1 to 2 feet. New pavements, storm water management, a storage area, and associated infrastructure will be constructed as well.

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. 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. Groundwater discussion including Estimated Seasonal High Water Table depths.

5. Evaluation of the on-site soils for use of structural fill.

6. 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.

7. Storm water management design recommendations based on temporary monitoring well data and infiltration tests within the proposed storm water management areas.

8. Determination of existing pavement section composition and thickness and shallow subsurface conditions based on the two (2) cores with associated shallow subsurface hand augers and DCP tests.
9. Pavement design recommendations (access road and parking areas) based on the field exploration activities (three (3) borings and associated CBR tests) and our experience with similar soil conditions.

10. Assessment of the shallow subsurface soils’ expansive properties.

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

- Three (3) 30 to 45-foot deep SPT borings (designated as B-1 through B-3) were drilled within the footprint of the proposed building.
- Three (3) 10-foot deep SPT borings (designated as CBR-1 through CBR-3) were drilled within the proposed pavement areas.
- Two (2) 15-foot deep SPT borings (designated as BMP-1 and BMP-2) were drilled within the proposed storm water management areas.
- Two (2) 4-inch diameter cores in the existing roadway to determine the pavement section composition and thickness. In addition, a 3- to 4-foot deep DCP test was performed at each of the core locations.

Standard Penetration Tests were performed in the field in general accordance with ASTM D1586. The tests were performed continuously from the existing ground surface to depths of 10 or 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.

One (1) relatively undisturbed, 3-inch diameter, thin-walled Shelby tube sample was collected from boring location B-3. Sample was obtained from between the depths of 18 and 20 feet below existing grade. The Shelby tube sample was obtained by hydraulically pressing a 3-inch outside diameter Shelby tube into the targeted soils using the drill rig. The tube was sealed in general accordance with ASTM standards and returned to GET Solutions, Inc.’s Virginia Beach laboratory for extraction, classification, and one-dimensional consolidation testing (ASTM D 2435).
A bulk subgrade sample was collected at each of the CBR borings (designated as CBR-1 through CBR-3) performed within the proposed new pavement areas. The bulk subgrade samples were collected from approximately 1 to 2 feet below existing grades. The bulk soil samples were returned to our Virginia Beach laboratory for Moisture-Density Relationship (Proctor) and CBR testing in accordance with ASTM and VTM standards, respectively.

Temporary groundwater monitoring wells were installed at borings BMP-1 and BMP-2 to a depth of 15 feet below the existing site grades for the purpose of obtaining groundwater level readings in the days following initial drilling. The wells were drilled using 5.25 I.D. hollow stem auger and constructed of 2-inch diameter Schedule 40 PVC materials. Five-foot long, 0.010-inch slotted screens were placed in the boreholes with casing threaded to the top. An appropriately graded sand/gravel pack was placed around the screen and extended one foot above the top of the screen. A one foot bentonite seal was then placed above the sand pack and hydrated with potable water. The remainder of the borehole annular spaces were pumped full of a neat cement grout. The wells were then fitted with PVC slip caps.

The boring locations were established by the design team and staked in the field by a representative of GET 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 on the attached “Boring Location Plan” (Appendix I).

2.2 Field and Laboratory Testing

Soil testing provided by GET 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 bulk and 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.
2.2.2 One Dimensional Consolidation Testing

One (1) one-dimensional consolidation test was performed at our Virginia Beach laboratory in general accordance with ASTM D 2435 on the specimen extracted from the Shelby tube samples collected at boring location B-3 between the depths of 18 and 20 feet below grade.

More detailed information on the extracted Shelby tube sample is provided on the “Shelby Tube Classification” sheet presented in Appendix VI. A summary of the consolidation test results is presented in Table I while the comprehensive test results are provided in Appendix VII.

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Depth (ft.)</th>
<th>Overburden (tsf)</th>
<th>( P_c^{(1)} ) (tsf)</th>
<th>OCR(^{(1)} )</th>
<th>( C_c^{(1)} )</th>
<th>( C_r^{(1)} )</th>
<th>( e_o )</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-3</td>
<td>18-20</td>
<td>0.59</td>
<td>1.25</td>
<td>2.12</td>
<td>1.00</td>
<td>0.11</td>
<td>1.996</td>
</tr>
</tbody>
</table>

Note(s): \(^{(1)}\) Value obtained from re-constructed consolidation curve (Schmertmann correction method).

2.2.3 Bulk Soil Sample Testing

The three (3) bulk soil samples were returned to our AASHTO re:source certified Virginia Beach laboratory and subjected to Standard Proctor and CBR testing in accordance with ASTM D698 and VTM-8, respectively. The stress-strain curve was plotted for each specimen. If necessary, the stress-strain curves were corrected by adjusting the location of the origin for concave shaped curves. Subsequently, the CBR values were selected at 0.1-inch penetration using the corrected load values. A summary of the CBR test results is presented in Table II and the Proctor curves, Particle Size Distribution Reports, and the CBR curves are provided in Appendix VIII.

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Depth Below Grade (ft)</th>
<th>USCS</th>
<th>( w_N ) (%)</th>
<th>Passing #200 Sieve (%)</th>
<th>Atterberg Limits (LL/PL/PI)</th>
<th>Max. Dry Density (pcf)</th>
<th>Optimum Moisture (%)</th>
<th>CBR Value</th>
<th>Swell (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBR-1</td>
<td>1-2</td>
<td>SC</td>
<td>15</td>
<td>49</td>
<td>25/12/13</td>
<td>123.9</td>
<td>10.4</td>
<td>17.1</td>
<td>0.2</td>
</tr>
<tr>
<td>CBR-2</td>
<td>1-2</td>
<td>CL</td>
<td>24</td>
<td>53.6</td>
<td>27/12/15</td>
<td>118.0</td>
<td>11.8</td>
<td>4.5</td>
<td>0.2</td>
</tr>
<tr>
<td>CBR-3</td>
<td>1-2</td>
<td>SC</td>
<td>15</td>
<td>40.1</td>
<td>22/12/10</td>
<td>121.6</td>
<td>10.8</td>
<td>11.0</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Note(s): \(^{(1)}\) \( w_N \) – Natural Moisture Content

2.2.3 In-situ Permeability Testing

Constant-Head Borehole Permeameter Testing was performed at boring locations BMP-01 and BMP-02 at a depth of 3.25 feet below existing grades (1 foot above estimated seasonal high water table) as directed by the project Civil Engineer. Infiltration testing procedures performed at location BMP-1 over the course of 90 minutes showed no noticeable reduction in reservoir water volume after the initial establishment of the water column within the borehole. As such, the testing procedure was terminated and no infiltration data was obtained. This may be a result of the relatively impermeable stratum resisting infiltration (as is typical of the CLAY (CL) soils at the testing elevation), high moisture content within the stratum, or a combination of both.
The boreholes were prepared utilizing an auger to remove soil clippings from the base. Permeability testing was then conducted within the vadose zone utilizing an Aardvark Permeameter™ and the following testing procedures:

An adjustable-height table was assembled and placed adjacent to the boreholes. The table was leveled at a height to provide the proper amount of overhead pressure for shallow measurements. The table holds a digital scale accurate to 0.01g upon which rests a water reservoir. A supported flexible pipe of an appropriate length so as not to induce a weight upon the reservoir served as a conduit to the Aardvark Permeameter Module (APM). The APM establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The APM was supported by a calibrated tape measure and lowered into the borehole to the test depth elevation. As required by the Glover solution, the APM was suspended above the bottom of the borehole at the height that establishes a water level approximately 5 times the borehole radius. Testing began as the shut-off valve was opened allowing water to pass through the APM 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 added to the reservoir as needed. As the water drained into the borehole and surrounding soils during testing, the water level within the reservoir was recorded by weight at a regular time interval. The test was continued until relatively consistent flow rates were 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 Ks utilizing the Glover Solution.

Based on the field testing, the hydraulic conductivities of the soils are presented in Table III. The comprehensive hydraulic conductivity worksheets are provided in Appendix IX.

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Test Depth (ft)</th>
<th>K_{sat} Value (in/hr)</th>
<th>K_{sat} Value (cm/sec)</th>
<th>K_{sat} Class</th>
<th>USCS Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP-1</td>
<td>3.25</td>
<td>Non-Permeable</td>
<td></td>
<td></td>
<td>CL</td>
</tr>
<tr>
<td>BMP-2</td>
<td>3.25</td>
<td>0.002</td>
<td>1.47x10^{-6}</td>
<td>Low</td>
<td>CL</td>
</tr>
</tbody>
</table>

Note(s): (1) Test depth refers to depth below the existing grade at the test location.

### 2.2.4 Dynamic Cone Penetrometer (DCP) Testing

Two (2) Dynamic Cone Penetrometer (DCP) tests were performed at locations C-1 and C-2 to depths of 47 and 43 inches below the top of the pavement section (pavement and aggregate base material), respectively. These tests were conducted in accordance with ASTM D 6951 test method, using a K-100 Dual Mass Kessler DCP. The approximate in-situ CBR value was obtained as an average of the readings to approximately 24 inches below the bottom of the current pavement section. These tests indicated average in-situ CBR values of 10 to 20. It is noted that these values do not include a safety factor. The comprehensive field data and results associated with the DCP tests are graphically presented on the attached “DCP Test Data” sheets (Appendix X) and are presented on Table IV.
Table IV - Dynamic Cone Penetrometer (DCP) Test Data

<table>
<thead>
<tr>
<th>Location</th>
<th>Total Exploration Depth (inches)</th>
<th>Approximate In-Situ CBR Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>38</td>
<td>7.6</td>
</tr>
<tr>
<td>C-2</td>
<td>27.5**</td>
<td>27.8</td>
</tr>
</tbody>
</table>

* Average of readings within upper 24 inches.
** Refusal depth.

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, Silts and Clays.

3.2 Recent Land Reclamation and Site Development

Based on a review of historical United States Geological Survey (USGS) topographic maps of Suffolk and Norfolk, Virginia produced between the years of 1919 and 1997, the project site does not appear to be a partially reclaimed area.
3.3 Surficial Conditions

As previously mentioned, the borings were facilitated by coring through existing pavement sections. The results of our coring exploration program indicate variable pavement sections and subgrade materials. These sections are presented in Table V. The pavement materials and thicknesses should be expected to vary at other locations along the project alignment.

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Topsoil Thickness (inch)</th>
<th>Asphalt Thickness (inch)</th>
<th>Stone Thickness (inch)</th>
<th>FILL Material Thickness (inch)</th>
<th>Shallow Subgrade Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>-</td>
<td>-</td>
<td>5.0</td>
<td>-</td>
<td>CLAY (CL)</td>
</tr>
<tr>
<td>B-2</td>
<td>0.5</td>
<td>-</td>
<td>0.5</td>
<td>-</td>
<td>CLAY (CL)</td>
</tr>
<tr>
<td>B-3</td>
<td>-</td>
<td>-</td>
<td>3.0</td>
<td>-</td>
<td>CLAY (CL)</td>
</tr>
<tr>
<td>BMP-1</td>
<td>2.0</td>
<td>-</td>
<td>-</td>
<td>2.0 (Silty SAND)</td>
<td>CLAY (CL)</td>
</tr>
<tr>
<td>BMP-2</td>
<td>-</td>
<td>-</td>
<td>2.0</td>
<td>2.0 (Silty SAND)</td>
<td>CLAY (CL)</td>
</tr>
<tr>
<td>CBR-1</td>
<td>-</td>
<td>-</td>
<td>4.0</td>
<td>1.5 (Silty SAND)</td>
<td>Clayey SAND (SC)</td>
</tr>
<tr>
<td>CBR-2</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td>-</td>
<td>CLAY (CL)</td>
</tr>
<tr>
<td>CBR-3</td>
<td>2.0</td>
<td>-</td>
<td>-</td>
<td>1.0 (Silty SAND)</td>
<td>Clayey SAND (SC)</td>
</tr>
<tr>
<td>C-1</td>
<td>-</td>
<td>1.0</td>
<td>8.0</td>
<td>-</td>
<td>Clayey SAND (SC)</td>
</tr>
<tr>
<td>C-2</td>
<td>-</td>
<td>1.0</td>
<td>15.0</td>
<td>Refusal within Aggregate Base Material</td>
<td></td>
</tr>
</tbody>
</table>
3.4 Subsurface Soil Conditions

A summary of the subsurface soils conditions encountered at the SPT boring locations is presented in Table VI.

**Table VI – Subsurface Soil Conditions**

<table>
<thead>
<tr>
<th>Average Depth (ft)</th>
<th>Stratum</th>
<th>Description</th>
<th>Ranges of SPT(1) N-Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 0.17 – 2.0</td>
<td>Surficial</td>
<td>Refer to Table V</td>
<td>–</td>
</tr>
<tr>
<td>0.17 – 2.0 to 2.0 – 6.0</td>
<td>I</td>
<td>Sandy Lean CLAY (CL) *Encountered at all boring locations with exception of CBR-1, CBR-2, and C-2</td>
<td>4-14</td>
</tr>
<tr>
<td>1.5 – 6.0 to 8.0 – 26.5</td>
<td>II</td>
<td>SAND with varying amounts of Silt and Clay (SM, SC) *Encountered at all boring locations with exception of C-2 **Borings BMP-1, BMP-2, CBR-1, CBR-2, and CBR-3 terminated within this stratum</td>
<td>0-20</td>
</tr>
<tr>
<td>8.0 – 26.5 to 21.5 – 38.5</td>
<td>III</td>
<td>CLAY with varying amounts of Sand (CL, CH) *Encountered at boring locations B-2 and B-3</td>
<td>0-6</td>
</tr>
<tr>
<td>21.5 – 38.5 to 30.0 – 45.0</td>
<td>IV</td>
<td>SAND with varying amounts of Silt (SP, SP-SM, SM)</td>
<td>5-18</td>
</tr>
</tbody>
</table>

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 Log sheets) 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.
3.5 Groundwater Discussion

The groundwater level was recorded at the boring locations 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 ranging from 6 to 10 feet below current grades at the boring locations.

The soils encountered within the borings above the presumed groundwater levels were classified as Sandy CLAY (CL) and Clayey SAND (SC) and contained appreciable amounts of fine grained clasts and can act as “Limiting Stratum”. Additionally, during the drilling process, drilling fluids (water) were introduced into the boreholes to prevent cave-ins from occurring, impairing the ability to accurately determine the groundwater levels. As a result, the reported initial groundwater levels may not be indicative of the static groundwater level.

Stabilized groundwater readings were taken at the temporary groundwater monitoring wells located at borings BMP-1 and BMP-2. The time of year at which these readings were taken (February) is regionally considered to be the time of year where groundwater levels are at their shallowest levels relative to the ground surface (based upon the City of Virginia Beach Standard Drawing C-13, Citywide 7 Year Average Groundwater Fluctuation). At the time of this reporting, the groundwater wells remain in place for future monitoring. The groundwater information associated with these wells is presented in Table VII.

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Ground Surface Elevation&lt;sup&gt;(1)&lt;/sup&gt; (ft NAVD88)</th>
<th>February 19, 2019 Groundwater Elevation (ft NAVD88)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP-1</td>
<td>63</td>
<td>59</td>
</tr>
<tr>
<td>BMP-2</td>
<td>63</td>
<td>59</td>
</tr>
</tbody>
</table>

Note(s):  
<sup>(1)</sup> Estimated based on site plan provided by the client.

As mentioned previously, the majority of the shallow subsurface soils consist of low permeability CLAY (CL). As such, perched water conditions should be expected across the project site. Controlling the perched water, if encountered, should be addressed by the Contractor prior to proceeding with construction.

The estimated seasonal high groundwater table (ESHWT) can fluctuate from year to year depending on many factors that include, but are not limited to, natural drainage, tidal patterns, man-made drainage, surrounding development, and frequency and magnitude of rainfall patterns. Historically, the ESHWT is expected to occur within the “wetter” months of the year, typically November through April. However, periods of high water tables are expected to occur at other times of the year (usually associated with major weather events). A few indicators of ESHWT include hydric soil indicators (color patterns and shades), variation in density of the soils within the presumed fluctuation zone, and current and historical monitoring well data. Of the three listed, analyzing data obtained from current and historical groundwater monitoring programs tends to be the most reliable indicator of the ESHWT. Soil coloring (redoximorphic features, mottling, etc.) is the result of saturation cycles over numerous years. Hydric indicators and relying on density variations can lead to false readings as development and added drainage features continue to alter the fluctuation zones.
Based on current and historical groundwater monitoring data within the vicinity of the project site, a review of publications referencing groundwater behavior in the local area (City of Virginia Beach Standard Drawing C-13, *Citywide 7 Year Average Groundwater Fluctuation*), and an observation of the surrounding topography in conjunction with the current performance of existing drainage features, we have estimated the seasonal high groundwater table elevations at each of the temporary well locations. A summary of these ESHWT elevations is presented in Table VIII.

### Table VIII – ESHWT Levels

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Ground Surface Elevation(^{(1)}) (ft NAVD88)</th>
<th>ESHWT Elevation (ft NAVD88)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP-1</td>
<td>63</td>
<td>59</td>
</tr>
<tr>
<td>BMP-2</td>
<td>63</td>
<td>59</td>
</tr>
</tbody>
</table>

Note(s): (1) Estimated based on site plan provided by the client.

### 3.6 Shrink-Swell Soils Discussion

The soils recovered during our field investigation were tested and evaluated for their potential to expand or contract with moisture changes (typically termed shrink-swell). Shallow foundations and other on-grade features constructed on expansive soils at certain depths may be subjected to detrimental uplift or horizontal forces caused by the swelling of these soils as a result of an increase in the moisture content. Conversely, as these Clays lose moisture they may shrink, adversely affecting the foundations. The depth to which soils are normally affected by moisture changes extends from the ground surface to approximately 30 inches below existing grades in this area, depending on site topography and drainage characteristics.

The predominant soils within the project site are mapped by the USDA Natural Resources Conservation Service as the 8A—Eunola Loamy Fine Sand, the 14—Lynchburg Fine Sandy Loam, and 22B—Suffolk Loamy Sand. The soils encountered in the borings appear to be consistent with these soil series. These soils are described by the Soil Survey as possessing low expansive (shrink-swell) potential.

Based on the laboratory classification test results, the shallow (upper 10 feet) CLAY (CL) soils possess Liquid Limits (LL) ranging from 19% to 36% and Plasticity Indices (PI) ranging from 8 to 21, generally indicative of possessing low shrink-swell potential and in agreement with the soil survey.

### 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 any topsoil, asphalt (deteriorated or otherwise), gravel, aggregate base material, unsuitable FILL material, and any other unsuitable materials from within the limits of construction. It is recommended that the clearing operations extend laterally at least 5 feet beyond the perimeter of the proposed construction area. It is estimated that a cut of up to 6 inches in depth will be required to remove the surficial materials; however, the removal of unsuitable FILL material noted at boring locations BMP-2, CBR-1 and CBR-3 may require cuts extending as deep as 24 inches below existing grades. These cuts may be expected to extend deeper in isolated areas to remove deeper deposits of organic or otherwise unsuitable soils, which may become evident during the clearing operation. It may be feasible for some the aggregate base material to remain within the footprints of the proposed construction if these areas are found to be stable and suitable for support of the at-grade structures during the field observations for subgrade approval (refer to Section 4.2).

The results of our field exploration program indicated that the soils below the surficial materials were generally comprised of Sandy CLAY (CL) to Clayey SAND (SC). 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 GET 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 12 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.

Backfill material in utility trenches within the construction areas should consist of structural fill (as described above), and should be compacted to at least 98% of Standard Proctor maximum dry density (ASTM D 698). This fill should be placed in 4 to 6 inch loose lifts when hand compaction equipment is used.

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 CLAY (CL) and Clayey SAND (SC) soils encountered at the boring locations do not appear to meet the criteria recommended in this report for reuse as fill. As such, 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 isolated spread footings bearing upon firm natural soil or well-compacted structural fill material. These footings can be designed using a net allowable soil pressure of 2,000 pounds per square foot (psf). In using net pressures, the weight of the footings and backfill over the footings, including the weight of the floor slab, need not be considered. Hence, only loads applied at or above the finished floor need to be used for dimensioning the footings.

In order to develop the recommended bearing capacity of 2,000 pounds per square foot (psf), the base of the footings should have a minimum embedment of 24 inches beneath finished grades and should have a minimum width of 24 inches. In addition, isolated square column footings (if deemed necessary) are recommended to be a minimum of 3 feet by 3 feet in area for bearing capacity consideration. The recommended 24-inch footing embedment is considered sufficient to provide adequate cover against frost penetration to the bearing soils.

4.6 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.

4.7 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 for each foundation structure. 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 advance hand auger borings or use a hand penetration device in the bases of the foundation excavations to verify that the recovered soils are consistent with those documented in this report. The necessary depth of penetration will be established during the subgrade observations.

If pockets of unsuitable 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 a suitable structural fill material compacted to a dry density of at least 98% of the Standard Proctor maximum dry density (ASTM D 698), as described in Section 4.3 of this report, prior to concrete placement. This construction procedure will provide for a net allowable bearing capacity of 2,000 psf.
Immediately prior to reinforcing steel placement, it is suggested that the bearing surfaces of all footing and floor slab areas be compacted using hand operated mechanical tampers, to a dry density of at least 98% of the Standard Proctor maximum dry density (ASTM D 698) as tested to a depth of 12 inches, for bearing capacity considerations. In this manner, any localized areas, which have been loosened by excavation operations, should be adequately re-compacted. The compaction testing in the base of the footings may be waived by the Geotechnical Engineer, where firm bearing soils are observed during the footing 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.

4.8 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. A subgrade modulus of 125 pounds per square inch per inch (psi/in) should be used when analyzing the slabs under this construction procedure. Alternately, the concrete slabs may be directly supported by a 6 to 8-inch layer of well-compacted aggregate base stone (VDOT 21A or 21B). Furthermore, a subgrade modulus of 150 pounds per square inch per inch (psi/in) should be used when analyzing the slabs under this construction procedure.

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.

4.9 Pavement Design Recommendations

Based on the results of the laboratory test program, the collected bulk soil samples in the footprint of the proposed new pavement have an average soaked CBR value of 10.9. 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 since the specified time for soaking may not be long enough to give the minimum CBR strength of some soils, to compensate for any non-uniformity of the soil, and to account for any low test results not considered when computing the average. Therefore, a CBR value of 7.2 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 125 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 VI.

### Table VI – Typical Minimum Pavement Sections (Parking Lot)

<table>
<thead>
<tr>
<th>Section</th>
<th>Hot Mix Asphalt</th>
<th>Concrete</th>
<th>Aggregate Base</th>
<th>Subgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
<td>Base</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>(SM-12.5A)</td>
<td>(BM-25.0A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Duty Flexible (Parking Bays)</td>
<td>2”</td>
<td>-</td>
<td>-</td>
<td>8”</td>
</tr>
<tr>
<td>Heavy Duty Flexible (Drive Aisles)</td>
<td>2”</td>
<td>3”</td>
<td>-</td>
<td>8”</td>
</tr>
<tr>
<td>Light Duty Rigid (Dumpster Pads)</td>
<td>-</td>
<td>-</td>
<td>6”</td>
<td>6”</td>
</tr>
<tr>
<td>Heavy Duty Rigid (Drive Aisles/Parking Bays)</td>
<td>-</td>
<td>-</td>
<td>8”</td>
<td>6”</td>
</tr>
</tbody>
</table>

Note(s): (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 100% 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.
4.10 On-site Shrink/Swell Properties

Based on the laboratory classification results, the shallow subsurface sandy soils encountered within the upper 10 feet at the boring locations are not considered to be expansive in accordance with 1803.5.3 of the 2015 International Building Code. As such, subsurface soil improvements do not appear necessary for shrink/swell considerations.

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. Based on these characteristics it is anticipated that some of the shallow subsurface materials encountered within the project alignment may be reusable as backfill. Soils containing appreciable amounts of deleterious debris should be discarded; however, an effort should be made during excavation to segregate potentially suitable in-situ soils for reuse. Information pertaining to backfill criteria was provided previously in Section 4.3.

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

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**

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 feet or shallower). Dewatering above the groundwater level could probably be accomplished by pumping from sumps. Dewatering at depths below the groundwater level will require well pointing and possibly shoring. Since temporary dewatering will impact construction and be dependent on construction methods and scheduling, we recommend the Contractor be solely responsible for the design, installation, maintenance, and performance of all temporary dewatering systems. Where 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.
5.4 Site Utility Installation

The base of the utility trenches should be observed by a qualified inspector prior to the pipe placement to verify the suitability of the bearing soils. It is expected that the utilities will be located above or near the groundwater level (at the time of this reporting 4 feet below current grades), bearing in moist to wet granular soils. In these instances, the bearing soils may require some stabilization to provide suitable bedding. This stabilization is commonly accomplished by adding 12 inches or more of bedding stone (Type VDOT No. 57). The resulting excavations should be backfilled with structural fill, as described in Section 4.3 of this report. As mentioned previously, some of the shallow subsurface materials encountered within the project site may be suitable for reuse as backfill. Soils containing appreciable amounts of fines or deleterious debris should be discarded. Imported fill should be included in the construction budget for backfilling the utility excavations within the construction areas.

6.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by GET 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, GET Solutions, Inc. should be notified immediately to determine if changes in the foundation recommendations are required. If GET Solutions, Inc. is not retained to perform these functions, GET 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 Suffolk Parks and Recreation Operations Facility project in Suffolk, Virginia.
APPENDICES

APPENDIX I  BORING LOCATION PLAN
APPENDIX II  CLASSIFICATION SYSTEM FOR SOIL EXPLORATION
APPENDIX III  SUMMARY OF LABORATORY CLASSIFICATION RESULTS
APPENDIX IV  BORING LOGS
APPENDIX V  GENERALIZED SOIL PROFILES
APPENDIX VI  SHELBY TUBE CLASSIFICATION SHEET
APPENDIX VII  CONSOLIDATION TEST DATA
APPENDIX VIII  CBR TEST RESULTS
APPENDIX IX  HYDRAULIC CONDUCTIVITY WORKSHEET
APPENDIX X  DCP TEST DATA
Boring Location Plan (boring location is approximate)

PROJECT: Suffolk Parks & Rec Operations Facility
LOCATION: Suffolk, VA
PROJECT NO: VB19-141G
DATE: April 5, 2019
CLIENT: City of Suffolk
APPENDIX II

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)

<table>
<thead>
<tr>
<th>Relative Density</th>
<th>Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td>4 blows/ft. or less</td>
</tr>
<tr>
<td>Loose</td>
<td>5 to 10 blows/ft.</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>11 to 30 blows/ft.</td>
</tr>
<tr>
<td>Dense</td>
<td>31 to 50 blows/ft.</td>
</tr>
<tr>
<td>Very Dense</td>
<td>51 blows/ft. or more</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Particle Size Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders</td>
</tr>
<tr>
<td>Cobbles 3 to 8 inch diameter</td>
</tr>
<tr>
<td>Gravel Coarse 1 to 3 inch diameter</td>
</tr>
<tr>
<td>Medium 1/2 to 1 inch diameter</td>
</tr>
<tr>
<td>Fine 1/4 to 1/2 inch diameter</td>
</tr>
<tr>
<td>Sand Coarse 2.00 mm to 1/4 inch (diameter of pencil lead)</td>
</tr>
<tr>
<td>Medium 0.42 to 2.00 mm (diameter of broom straw)</td>
</tr>
<tr>
<td>Fine 0.074 to 0.42 mm (diameter of human hair)</td>
</tr>
<tr>
<td>Silt 0.002 to 0.074 mm (cannot see particles)</td>
</tr>
</tbody>
</table>

COHESIVE SOILS
(CLAY, SILT and Combinations)

<table>
<thead>
<tr>
<th>Consistency</th>
<th>Relative Proportions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft</td>
<td>2 blows/ft. or less</td>
</tr>
<tr>
<td>Soft</td>
<td>3 to 4 blows/ft.</td>
</tr>
<tr>
<td>Medium Stiff</td>
<td>5 to 8 blows/ft.</td>
</tr>
<tr>
<td>Stiff</td>
<td>9 to 15 blows/ft.</td>
</tr>
<tr>
<td>Very Stiff</td>
<td>16 to 30 blows/ft.</td>
</tr>
<tr>
<td>Hard</td>
<td>31 blows/ft. or more</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Descriptive Term</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace</td>
<td>0-5</td>
</tr>
<tr>
<td>Few</td>
<td>5-10</td>
</tr>
<tr>
<td>Little</td>
<td>15-25</td>
</tr>
<tr>
<td>Some</td>
<td>30-45</td>
</tr>
<tr>
<td>Mostly</td>
<td>50-100</td>
</tr>
</tbody>
</table>

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, sidewalks, etc.). Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

<table>
<thead>
<tr>
<th>Highly Organic Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT - Peat</td>
</tr>
</tbody>
</table>

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

Borderline cases requiring dual symbols
Less than 5 percent GW, GP, SW,SP
More than 12 percent GM, GC, SM, SC
5 to 12 percent
### SUMMARY OF LABORATORY RESULTS

<table>
<thead>
<tr>
<th>Borehole</th>
<th>Depth</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>Maximum Size (mm)</th>
<th>%&lt;#200 Sieve</th>
<th>Classification</th>
<th>Water Content (%)</th>
<th>Dry Density (pcf)</th>
<th>Saturated (%)</th>
<th>Void Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>3.0</td>
<td>36</td>
<td>15</td>
<td>21</td>
<td>0.075</td>
<td>42</td>
<td>SC</td>
<td>17.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-1</td>
<td>14.0</td>
<td>37</td>
<td>16</td>
<td>21</td>
<td>0.075</td>
<td>46</td>
<td>SC</td>
<td>31.2</td>
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</tr>
<tr>
<td>B-1</td>
<td>19.0</td>
<td>20</td>
<td>11</td>
<td>9</td>
<td>0.075</td>
<td>28</td>
<td>SC</td>
<td>24.3</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>B-1</td>
<td>24.0</td>
<td>28</td>
<td>14</td>
<td>14</td>
<td>0.075</td>
<td>46</td>
<td>SC</td>
<td>25.2</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>B-2</td>
<td>5.0</td>
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<td></td>
<td></td>
<td>0.075</td>
<td>55</td>
<td></td>
<td>21.5</td>
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</tr>
<tr>
<td>B-2</td>
<td>11.0</td>
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<td></td>
<td></td>
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<tr>
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<td>19</td>
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<td>0.075</td>
<td>93</td>
<td>CH</td>
<td>39.4</td>
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<tr>
<td>B-2</td>
<td>24.0</td>
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<td></td>
<td>0.075</td>
<td>27</td>
<td></td>
<td>34.0</td>
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<tr>
<td>B-3</td>
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<td>19</td>
<td>11</td>
<td>8</td>
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<td>58</td>
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<tr>
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<td>14.0</td>
<td>26</td>
<td>16</td>
<td>10</td>
<td>0.075</td>
<td>20</td>
<td>SC</td>
<td>26.9</td>
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<td>31</td>
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<td>B-3</td>
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<td>60</td>
<td>CL</td>
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<tr>
<td>BMP-1</td>
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<td></td>
<td></td>
<td>0.075</td>
<td>61</td>
<td></td>
<td>22.6</td>
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<tr>
<td>BMP-1</td>
<td>9.0</td>
<td></td>
<td></td>
<td></td>
<td>0.075</td>
<td>28</td>
<td></td>
<td>19.0</td>
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<tr>
<td>BMP-2</td>
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<td>0.075</td>
<td>41</td>
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<td>11.2</td>
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<td>BMP-2</td>
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<td></td>
<td>0.075</td>
<td>70</td>
<td></td>
<td>20.1</td>
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<tr>
<td>CBR-1</td>
<td>3.0</td>
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<td></td>
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<td>0.075</td>
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<td></td>
<td>18.7</td>
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<td>CBR-3</td>
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<td></td>
<td></td>
<td>0.075</td>
<td>24</td>
<td></td>
<td>17.6</td>
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</table>
APPENDIX IV

BORING LOGS
### Record of Subsurface Exploration

**Project Name:** Suffolk Parks & Rec Operations Facility  
**Client:** City of Suffolk  
**Project Location:** Suffolk Virginia  
**Boring Coordinates:**  
- **East:** -76.5999806  
- **North:** 36.6960194  
**Drilling Method(s):** Rotary wash "mud"  
**Groundwater:** Initial (ft): 8.5  
**Notes:** See GET Solutions Inc. Boring Location Plan

#### Strata Description

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Sample Type(s)</th>
<th>Sample ID</th>
<th>Strata Legend</th>
<th>Sample Recovery (in.)</th>
<th>Blow Counts (N-Values)</th>
<th>%&lt;#200</th>
<th>Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td>0</td>
<td>SS - Split Spoon</td>
<td>18</td>
<td>5-Inches Aggregate Base Material</td>
<td>Tan, moist, Sandy Lean CLAY (CL), stiff</td>
<td>11-6-3-4 (9)</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>2</td>
<td></td>
<td>24</td>
<td>Mottled Gray-Tan, moist, Clayey fine to medium SAND (SC), medium dense</td>
<td>2-4-6-8 (12)</td>
<td>7-8-8-8 (16)</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>5</td>
<td></td>
<td>24</td>
<td>Tan, moist to wet, Silty fine to medium SAND (SM) trace clay, very loose</td>
<td>2-3-2-1 (4)</td>
<td>1-1-1-1 (2)</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td>8</td>
<td></td>
<td>24</td>
<td>Gray, wet, Clayey fine to medium SAND (SC), very loose to loose</td>
<td>1-1-1-1 (2)</td>
<td>0-0-0-0 (0)</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>14.0</td>
<td>14</td>
<td></td>
<td>24</td>
<td>Gray, wet, Poorly graded fine to medium SAND (SP), loose</td>
<td>2-2-3-3 (5)</td>
<td>2-3-4-5 (7)</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>26.5</td>
<td></td>
<td></td>
<td>20</td>
<td>Boring terminated at 30 feet below existing grade.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Test Results**  
- Plastic Limit  
- Liquid Limit  
- Water Content

**Driller:** GET Solutions, Inc.

**Date Started:** 2/19/2019  
**Logged By:** J. Moran  
**Date Completed:** 2/19/2019  
**Project Number:** VB19-141G  
**Surface Elevation (NAVD88) (ft):**
### PROJECT NAME: Suffolk Parks & Rec Operations Facility

### CLIENT: City of Suffolk

### PROJECT LOCATION: Suffolk Virginia

### BORING COORDINATES: EAST: -76.5994972 NORTH: 36.6959278

### DRILLING METHOD(S): Rotary wash "mud"

### GROUNDWATER*: INITIAL (ft) 6 AFTER ___ HOURS (ft) ___ CAVE-IN (ft) ___

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

### STRATA DESCRIPTION

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>Sample ID</th>
<th>Strata Legend</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td></td>
<td></td>
<td>1</td>
<td>24</td>
<td>4.4-5.3</td>
<td>(9)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>2</td>
<td>24</td>
<td>4.4-6.6</td>
<td>(10)</td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td></td>
<td>3</td>
<td>24</td>
<td>4.6-6.8</td>
<td>(14)</td>
</tr>
<tr>
<td>10</td>
<td>24</td>
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<td>4</td>
<td>24</td>
<td>8.8-9.8</td>
<td>(17)</td>
</tr>
<tr>
<td>10.0</td>
<td>24</td>
<td></td>
<td>5</td>
<td>24</td>
<td>2.4-5.5</td>
<td>(9)</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
<td></td>
<td>6</td>
<td>23</td>
<td>3.3-1.1</td>
<td>(4)</td>
</tr>
<tr>
<td>16.5</td>
<td>24</td>
<td></td>
<td>7</td>
<td>23</td>
<td>1.1-1.1</td>
<td>(2)</td>
</tr>
<tr>
<td>20</td>
<td>24</td>
<td></td>
<td>8</td>
<td>24</td>
<td>0.0-2.1</td>
<td>(2)</td>
</tr>
<tr>
<td>21.5</td>
<td>24</td>
<td></td>
<td>9</td>
<td>24</td>
<td>2.2-3.2</td>
<td>(5)</td>
</tr>
<tr>
<td>25</td>
<td>24</td>
<td></td>
<td>10</td>
<td>16</td>
<td>3.8-5.9</td>
<td>(13)</td>
</tr>
<tr>
<td>30</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Notes:** See GET Solutions Inc. Boring Location Plan

---

**Test Results**

**Penetration:**
- 10
- 20
- 30
- 40
- 50
- 60
- 70

**Elevation (ft)**
- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70

**Sample Type(s):** SS - Split Spoon

---

**Virginia Beach:** 5465 Greenwich Road, Virginia Beach, VA 23462, 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
**RECORD OF SUBSURFACE EXPLORATION**

**BORING ID**
B-3

**PROJECT NAME:** Suffolk Parks & Rec Operations Facility

**CLIENT:** City of Suffolk

**PROJECT LOCATION:** Suffolk Virginia

**BORING COORDINATES:**

<table>
<thead>
<tr>
<th>EAST</th>
<th>NORTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>-76.5998417</td>
<td>36.6956083</td>
</tr>
</tbody>
</table>

**DRILLING METHOD(S):** Rotary wash "mud"

**GROUNDWATER:**
- **INITIAL (ft)**: 10
- **AFTER ___ HOURS (ft)**: __
- **CAVE-IN (ft)**: __

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

**GROUNDWATER:**
- **INITIAL (ft)**: 10
- **AFTER ___ HOURS (ft)**: __
- **CAVE-IN (ft)**: __

**RECORD OF SUBSURFACE EXPLORATION**

**BORING ID**
B-3

**PROJECT NUMBER:** VB19-141G

**SURFACE ELEVATION (NAVD88) (ft):**

**LOGGED BY:** J. Moran

**DATE STARTED:** 2/18/2019

**DATE COMPLETED:** 2/18/2019

**DRILLER:** GET Solutions, Inc.

**TEST RESULTS**

<table>
<thead>
<tr>
<th>Penetration</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>STRATA DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>0.3</td>
<td>3</td>
<td>3-Inches Aggregate Base Material</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tan, moist, Sandy Lean CLAY (CL), stiff</td>
</tr>
<tr>
<td>4.0</td>
<td></td>
<td>Mottled Orange-Tan-Gray to tan, moist to wet, Clayey SAND (SC), very loose to medium dense</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Dark Gray-Brown, wet, Fat CLAY (CH), with trace fiberous organics, very soft</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Dark Gray, wet, Lean CLAY (CL), very soft to medium stiff</td>
</tr>
<tr>
<td>16.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.5</td>
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</tbody>
</table>

**Notes:** See GET Solutions Inc. Boring Location Plan

**Sample Type(s):**
- SS - Split Spoon

**Sample TypeSample ID Strata Legend Sample Recovery (in.) Blow Counts (N-values) %<200**

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Strata Type</th>
<th>Recovery (in.)</th>
<th>Blow Counts (N-values)</th>
<th>%&lt;200</th>
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<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>4-2-1-1 (4)</td>
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</tr>
<tr>
<td>2</td>
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<td>3-3-6-6 (9)</td>
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<td>3</td>
<td>20</td>
<td>3-4-5-5 (9)</td>
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<tr>
<td>4</td>
<td>24</td>
<td>7-8-8-7 (16)</td>
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<tr>
<td>5</td>
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<tr>
<td>11</td>
<td>24</td>
<td>4-3-2-2 (5)</td>
<td>68</td>
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**DRILLING METHOD(S):**
- Rotary wash "mud"

** Virgin Beach 5465 Greenwich Road Virginia Beach, VA 23462 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 252-335-7675 **
** Jacksonville 415-A Western Blvd Jacksonville, NC 28546 910-478-9915 **

**Suffolk Virginia**

**Dark Gray-Brown, wet, Fat CLAY (CH), with trace fiberous organics, very soft**

**Dark Gray, wet, Lean CLAY (CL), very soft to medium stiff**

**Notes:** See GET Solutions Inc. Boring Location Plan

**Sample Type(s):**
- SS - Split Spoon

**Sample TypeSample ID Strata Legend Sample Recovery (in.) Blow Counts (N-values) %<200**

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Strata Type</th>
<th>Recovery (in.)</th>
<th>Blow Counts (N-values)</th>
<th>%&lt;200</th>
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<tr>
<td>1</td>
<td>24</td>
<td>4-2-1-1 (4)</td>
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<tr>
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<td>3-3-6-6 (9)</td>
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<td>3-4-5-5 (9)</td>
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</tr>
<tr>
<td>4</td>
<td>24</td>
<td>7-8-8-7 (16)</td>
<td>68</td>
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<td>5</td>
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<td>3-5-6-3 (11)</td>
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<tr>
<td>6</td>
<td>24</td>
<td>1-1-1-1 (2)</td>
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<td></td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>1-1-1-1 (2)</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>24</td>
<td>0-0-0-1 (0)</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>24</td>
<td>0-0-0-1 (0)</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>18</td>
<td>3-3-3-3 (6)</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>24</td>
<td>4-3-2-2 (5)</td>
<td>68</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** See GET Solutions Inc. Boring Location Plan

**Sample Type(s):**
- SS - Split Spoon
### RECORD OF SUBSURFACE EXPLORATION

**BORING ID**: B-3

**PROJECT NUMBER**: VB19-141G

**SURFACE ELEVATION (NAVD88)**: (ft):__

**LOGGED BY**: J. Moran

**DATE STARTED**: 2/18/2019

**DATE COMPLETED**: 2/18/2019

**DRILLER**: GET Solutions, Inc.

---

**PROJECT NAME**: Suffolk Parks & Rec Operations Facility

**CLIENT**: City of Suffolk

**PROJECT LOCATION**: Suffolk Virginia

**BORING COORDINATES**: EAST: -76.5998417 NORTH: 36.6956083

**DRILLING METHOD(S)**: Rotary wash "mud"

**GROUNDWATER**: INITIAL (ft) 10 AFTER ____ HOURS (ft):__ CAVE-IN (ft):__

---

**STRATA DESCRIPTION**

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Strata Legend</th>
<th>Sample Type</th>
<th>Sample ID</th>
<th>Penetration (N-values)</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.5</td>
<td></td>
<td>Dark Gray, wet, Lean CLAY (CL), very soft to medium stiff (layer continued from previous page)</td>
<td>SS - Split Spoon</td>
<td>10</td>
<td>6-8:10-4 (18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Gray, wet, Poorly graded fine to medium SAND (SP-SM) with Silt, medium dense</td>
<td>SS - Split Spoon</td>
<td>13</td>
<td>5-8:6-4 (13)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Boring terminated at 45 feet below existing grade.

---

**Sample Type(s)**: SS - Split Spoon

**Notes**: See GET Solutions Inc. Boring Location Plan

---

PAGE 2 OF 2
**PROJECT NAME:** Suffolk Parks & Rec Operations Facility  
**CLIENT:** City of Suffolk  
**PROJECT LOCATION:** Suffolk Virginia  
**BORING COORDINATES:** EAST: -76.5999556 NORTH: 36.6965111  
**DRILLING METHOD(S):** Rotary wash "mud"  
**GROUNDWATER:** INITIAL (ft): 7 AFTER ___ HOURS (ft): 4.25 CAVE-IN (ft): ___  
*The initial groundwater readings are not intended to indicate the static groundwater level.*

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>STRATA DESCRIPTION</th>
<th>Strata Legend</th>
<th>Sample Type</th>
<th>Sample ID</th>
<th>Sample Recovery (in.)</th>
<th>Blow Count (N-Values)</th>
<th>%&lt;#200</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td></td>
<td>2-Inches Topsoil</td>
<td>1</td>
<td>24</td>
<td></td>
<td>2-3-3-3 (6)</td>
<td>61</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mottled Gray-Tan, moist to wet, Sandy Lean CLAY (CL), medium stiff to stiff</td>
<td>2</td>
<td>24</td>
<td></td>
<td>3-4-7-7 (11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>5</td>
<td>Gray-Tan, wet, Clayey fine to medium SAND (SC), medium dense</td>
<td>3</td>
<td>24</td>
<td></td>
<td>4-7-8-6 (15)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td>15.0</td>
<td>Tan, wet, Silty fine to medium SAND (SM), loose</td>
<td>7</td>
<td>24</td>
<td></td>
<td>2-3-2-2 (5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boring terminated at 15 feet below existing grade.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** See GET Solutions Inc. Boring Location Plan
**RECORD OF SUBSURFACE EXPLORATION**

**BORING ID**

**BMP-2**

**PROJECT NAME:** Suffolk Parks & Rec Operations Facility  
**CLIENT:** City of Suffolk  
**PROJECT LOCATION:** Suffolk Virginia  
**BORING COORDINATES:** EAST: -76.6004833 NORTH: 36.6962417  
**GROUNDWATER:** INITIAL (ft) 6 AFTER ___ HOURS (ft) 4.25 CAVE-IN (ft) ___

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

**GROUNDWATER**

**Drilling Method(s):** Rotary wash "mud"  
**Depth (ft):** 0.2 2.0 5.0 6.0 10.0 15.0 20.0 30.0 40.0 50.0 60.0 70.0

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Strata Legend</th>
<th>Sample Type(s)</th>
<th>Sample Recovery (in.)</th>
<th>Blow Counts (N-Values)</th>
<th>Water Content - %&lt;#200</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>2.0</td>
<td>2-Inches Aggregate Base Material</td>
<td>SS - Split Spoon</td>
<td>16</td>
<td>5-9-9-4 (18)</td>
<td>41</td>
<td>x</td>
<td>x</td>
<td>See GET Solutions Inc. Boring Location Plan</td>
</tr>
<tr>
<td>2.0</td>
<td>5.0</td>
<td>Brown-Tan, moist, Clayey fine to medium SAND (SC), trace gravel, medium dense - Fill</td>
<td></td>
<td>24</td>
<td>3-4-4-5 (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>6.0</td>
<td>Mottled Tan-Gray, moist to wet, Sandy Lean CLAY (CL), stiff to very stiff</td>
<td></td>
<td>20</td>
<td>4-5-6-5 (11)</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>10.0</td>
<td>Gray-Tan, wet, Clayey fine to medium SAND (SC), loose to medium dense</td>
<td></td>
<td>24</td>
<td>6-7-7-7 (14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>15.0</td>
<td>Boring terminated at 15 feet below existing grade.</td>
<td></td>
<td>24</td>
<td>5-6-4-3 (18)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sample Type(s):**

- SS - Split Spoon

**Notes:**

1. The initial groundwater readings are not intended to indicate the static groundwater level.
2. This information pertains only to this boring and should not be interpreted as being indicative of the site.

**Test Results**

<table>
<thead>
<tr>
<th>Water Content - %&lt;#200</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>x</td>
<td>x</td>
<td>See GET Solutions Inc. Boring Location Plan</td>
</tr>
</tbody>
</table>

**SURFACE ELEVATION (NAVD88) (ft):**

- **DATE COMPLETED:** 2/18/2019
- **LOGGED BY:** J. Moran
- **DATE STARTED:** 2/18/2019
- **DRILLER:** GET Solutions, Inc.
### Record of Subsurface Exploration

#### Boring ID CBR-1

**Project Name:** Suffolk Parks & Rec Operations Facility  
**Client:** City of Suffolk  
**Project Location:** Suffolk Virginia  
**Boring Coordinates:** EAST: -76.6002583 NORTH: 36.6960361  
**Drilling Method(s):** Rotary wash "mud"  
**Groundwater: Initial (ft):** 7  
**After Hours (ft):** 0  
**Cave-in (ft):** 0  

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

#### Strata Description

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Sample Type(s)</th>
<th>Strata Legend</th>
<th>Sample ID</th>
<th>Sample Recovery (in.)</th>
<th>Blow Counts (N-values)</th>
<th>%&lt;#200</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>0.0</td>
<td>SS - Split Spoon</td>
<td>4-inches Aggregate Base Material</td>
<td>1</td>
<td>16</td>
<td>8-8-7-5 (15)</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>2.0</td>
<td></td>
<td>Tan and Gray, moist, Clayey fine to medium SAND (SC), loose -FILL</td>
<td>2</td>
<td>24</td>
<td>3-2-4-4 (6)</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>4.0</td>
<td></td>
<td>Mottled Gray-Tan, moist, fine Sandy Lean CLAY (CL), medium stiff</td>
<td>3</td>
<td>22</td>
<td>4-3-4-5 (7)</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>5.0</td>
<td></td>
<td>Mottled Gray-Tan to Gray, moist, Clayey fine to medium SAND (SC), loose to medium dense</td>
<td>4</td>
<td>24</td>
<td>6-7-6-8 (13)</td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>10.0</td>
<td></td>
<td></td>
<td>5</td>
<td>24</td>
<td>6-5-5-5 (10)</td>
<td></td>
</tr>
</tbody>
</table>

Boring terminated at 10 feet below existing grade.

#### Test Results

<table>
<thead>
<tr>
<th>Penetration</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 20 30 40 50 60 70</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sample Type(s):** SS - Split Spoon  
**Notes:** See GET Solutions Inc. Boring Location Plan

---

**Address:**
- Virginia Beach: 5465 Greenwich Road, Virginia Beach, VA 23462  
- Williamsburg: 1592-E Penniman Road, Williamsburg, VA 23185  
- Elizabeth City: 106 Capital Trace Unit E, Elizabeth City, NC 27809  
- Jacksonville: 415-A Western Blvd, Jacksonville, NC 28546

**Contact:**
- Virginia Beach: 757-518-1703  
- Williamsburg: 757-564-6452  
- Elizabeth City: 252-335-9768  
- Jacksonville: 910-478-9915

---

**Project Number:** VB19-141G  
**Surface Elevation (NAVD88) (ft):**  
**Logged By:** J. Moran  
**Date Started:** 2/18/2019  
**Date Completed:** 2/18/2019  
**Driller:** GET Solutions, Inc.
**PROJECT NAME:**  Suffolk Parks & Rec Operations Facility  
**CLIENT:** City of Suffolk  
**PROJECT LOCATION:** Suffolk Virginia  
**BORING COORDINATES:** EAST: -76.59935 NORTH: 36.6961583  
**DRILLING METHOD(S):** Rotary wash "mud"  
**GROUNDWATER:** INITIAL (ft) ⬆ 8 ➔ AFTER ___ HOURS (ft) ⬇ ___ CAVE-IN (ft) ⬇ ___  

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

**RECORD OF SUBSURFACE EXPLORATION**

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Strata Legend</th>
<th>Sample ID</th>
<th>Sample Type</th>
<th>Sample Recovery (in.)</th>
<th>Blow Counts (N-Values)</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Water Content - %&lt;#200</th>
<th>Penetration - %</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.0</td>
<td>1-Inch Aggregate Base Material</td>
<td>1</td>
<td>16</td>
<td>6-5-3-3-3(8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>Mottled Tan-Gray, moist, Sandy Lean CLAY (CL), medium stiff - Possible Fill</td>
<td>2</td>
<td>16</td>
<td>4-6-6-4(12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>Mottled Tan-Gray, moist to wet, Clayey fine to medium SAND (SC), medium dense</td>
<td>3</td>
<td>24</td>
<td>4-5-6-6(11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td></td>
<td>4</td>
<td>24</td>
<td>9-9-10-12(19)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td></td>
<td>5</td>
<td>24</td>
<td>6-5-6-4(11)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Boring terminated at 10 feet below existing grade.

**PROJECT NUMBER:** VB19-141G

**SURFACE ELEVATION (NAVD88) (ft):**

**LOGGED BY:** J. Moran

**DATE STARTED:** 2/18/2019  
**DATE COMPLETED:** 2/18/2019  
**DRILLER:** GET Solutions, Inc.

**Sample Type(s):**

- SS - Split Spoon

**Notes:** See GET Solutions Inc. Boring Location Plan
**RECORD OF SUBSURFACE EXPLORATION**

**BORING ID**
CBR-3

**PROJECT NAME:** Suffolk Parks & Rec Operations Facility

**CLIENT:** City of Suffolk

**PROJECT LOCATION:** Suffolk Virginia

**BORING COORDINATES:** EAST: -76.5998167 NORTH: 36.6953778

**DRILLING METHOD(S):** Rotary wash "mud"

**GROUNDWATER:**
INITIAL (ft) 7
AFTER __ HOURS (ft) __ CAVE-IN (ft) __

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

---

**STRATA DESCRIPTION**

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Strata Legend</th>
<th>Sample Type(s)</th>
<th>Sample ID</th>
<th>Sample Recovery (in.)</th>
<th>Blow Counts (N-Values)</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>0.0</td>
<td>2-Inches Topsoil</td>
<td>SS - Split Spoon</td>
<td>1</td>
<td>22</td>
<td>4.3-2.2 (5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dark Gray, moist, Poorly graded fine to medium SAND (SP-SM) with Silt, medium dense - FILL</td>
<td></td>
<td>2</td>
<td>24</td>
<td>2.3-5.4 (8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mottled Gray-Tan, moist Clayey fine to medium SAND (SC), loose to medium dense</td>
<td></td>
<td>3</td>
<td>16</td>
<td>2.4-4.3 (8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.0</td>
<td></td>
<td></td>
<td>4</td>
<td>24</td>
<td>8.8-7.9 (15)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>24</td>
<td>7.8-8.8 (16)</td>
<td></td>
<td></td>
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</table>

Boring terminated at 10 feet below existing grade.

---

**TEST RESULTS**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Water Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Sample Type(s):** SS - Split Spoon

**Notes:** See GET Solutions Inc. Boring Location Plan

---

**PROJECT NUMBER:** VB19-141G

**SURFACE ELEVATION (NAVD88) (ft):**

**LOGGED BY:** J. Moran

**DATE STARTED:** 2/18/2019

**DATE COMPLETED:** 2/18/2019

**DRILLER:** GET Solutions, Inc.
APPENDIX V

GENERALIZED SOIL PROFILES
<table>
<thead>
<tr>
<th>Length (in.)</th>
<th>Depth below Grade (ft.)</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.3</td>
<td>18-20</td>
<td>Brown Fat CLAY (CH)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Natural Moisture</th>
<th>-#200 Sieve</th>
<th>Atterberg Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>(%)</td>
<td>(%)</td>
<td>LL/Pl/PI</td>
</tr>
<tr>
<td>71.1</td>
<td>89.9</td>
<td>94/61/60</td>
</tr>
</tbody>
</table>
APPENDIX VII

CONSOLIDATION TEST DATA
CONSOLIDATION TEST REPORT

<table>
<thead>
<tr>
<th>Natural Saturation</th>
<th>Moisture</th>
<th>Dry Dens. (pcf)</th>
<th>LL</th>
<th>PI</th>
<th>Sp. Gr.</th>
<th>USCS</th>
<th>AASHTO</th>
<th>Initial Void Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>96.2 %</td>
<td>71.1 %</td>
<td>55.5</td>
<td>94</td>
<td>60</td>
<td>2.7</td>
<td>CH</td>
<td>A-7-5(63)</td>
<td>1.996</td>
</tr>
</tbody>
</table>

MATERIAL DESCRIPTION

Brown, Fat CLAY

Project No. VB19-141G  Client: City of Suffolk
Project: Suffolk ParkS & Rec Operation Facility

Location: B-3 (18-20 ft.)  Depth: 18-20 ft.  Sample Number: B-3

Remarks:
Passing #200 Sieve = 89.9%
Dial Reading vs. Time

Project No.: VB19-141G
Project: Suffolk Park S & Rec Operation Facility

Location: B-3 (18-20 ft.)  Depth: 18-20 ft.  Sample Number: B-3

Load No. = 5
Load = 2.00 tsf
D₀ = 0.9710
D₅₀ = 0.9402
D₁₀₀ = 0.9094
T₅₀ = 15.70 min.

Cᵥ @ T₅₀
0.028 ft.²/day
Cᵥ = 0.004

Load No. = 6
Load = 0.50 tsf
D₀ = 0.9079
D₅₀ = 0.9165
D₁₀₀ = 0.9252
T₅₀ = 4.20 min.

Cᵥ @ T₅₀
0.098 ft.²/day

Figure
Dial Reading vs. Time

Project No.: VB19-141G
Project: Suffolk Park S & Rec Operation Facility
Location: B-3 (18-20 ft.) Depth: 18-20 ft. Sample Number: B-3

Load No. = 7
Load = 0.13 tsf
D₀ = 0.9280
D₅₀ = 0.9377
D₁₀₀ = 0.9474
T₅₀ = 20.76 min.

Cᵥ @ T₅₀
0.021 ft²/day

Load No. = 9
Load = 0.50 tsf
D₀ = 0.9460
D₅₀ = 0.9429
D₁₀₀ = 0.9398
T₅₀ = 4.62 min.

Cᵥ @ T₅₀
0.095 ft²/day

Cᵥ = 0.001

---

GET Solutions, Inc.
Dial Reading vs. Time

Project No.: VB19-141G
Project: Suffolk Park S & Rec Operation Facility
Location: B-3 (18-20 ft.)  Depth: 18-20 ft.  Sample Number: B-3

Load No.= 10
Load= 1.00 tsf
  \( D_0 = 0.9389 \)
  \( D_{50} = 0.9321 \)
  \( D_{100} = 0.9253 \)
  \( T_{50} = 4.31 \text{ min.} \)

\( C_v @ T_{50} \)
\( 0.099 \text{ ft.}^2/\text{day} \)
\( C_\alpha = 0.001 \)

Load No.= 11
Load= 2.00 tsf
  \( D_0 = 0.9244 \)
  \( D_{50} = 0.9109 \)
  \( D_{100} = 0.8975 \)
  \( T_{50} = 4.42 \text{ min.} \)

\( C_v @ T_{50} \)
\( 0.092 \text{ ft.}^2/\text{day} \)
\( C_\alpha = 0.002 \)

GET Solutions, Inc.
Dial Reading vs. Time

Project No.: VB19-141G
Project: Suffolk Park S & Rec Operation Facility
Location: B-3 (18-20 ft.) Depth: 18-20 ft. Sample Number: B-3

Load No. 12
Load = 4.00 tsf
\[ D_0 = 0.8947 \]
\[ D_{50} = 0.8499 \]
\[ D_{100} = 0.8052 \]
\[ T_{50} = 21.98 \text{ min.} \]
\[ C_v @ T_{50} = 0.016 \text{ ft}^2 / \text{day} \]
\[ C_\alpha = 0.007 \]

Load No. 13
Load = 8.00 tsf
\[ D_0 = 0.8025 \]
\[ D_{50} = 0.7573 \]
\[ D_{100} = 0.7121 \]
\[ T_{50} = 15.04 \text{ min.} \]
\[ C_v @ T_{50} = 0.019 \text{ ft}^2 / \text{day} \]
\[ C_\alpha = 0.001 \]
Dial Reading vs. Time

Project No.: VB19-141G
Project: Suffolk Park S & Rec Operation Facility
Location: B-3 (18-20 ft.) Depth: 18-20 ft. Sample Number: B-3

Load No. = 14
Load = 16.00 tsf
D₀ = 0.7062
D₅₀ = 0.6709
D₁₀₀ = 0.6356
T₅₀ = 20.81 min.

Cᵥ @ T₅₀
0.011 ft.²/day

Cᵥα = 0.003

Load No. = 15
Load = 4.00 tsf
D₀ = 0.6391
D₅₀ = 0.6483
D₁₀₀ = 0.6574
T₅₀ = 13.41 min.

Cᵥ @ T₅₀
0.015 ft.²/day

GET Solutions, Inc.
**Dial Reading vs. Time**

**Project No.:** VB19-141G  
**Project:** Suffolk ParkS & Rec Operation Facility  
**Location:** B-3 (18-20 ft.)  
**Depth:** 18-20 ft.  
**Sample Number:** B-3

---

**Load No.= 16**  
**Load= 1.00 tsf**  
- $D_0 = 0.6616$  
- $D_{50} = 0.6788$  
- $D_{100} = 0.6961$  
- $T_{50} = 33.32$ min.

**$C_v @ T_{50}$**  
- $0.007$ ft.$^2$/day

---

**Load No.= 17**  
**Load= 0.25 tsf**  
- $D_0 = 0.6962$  
- $D_{50} = 0.7160$  
- $D_{100} = 0.7359$  
- $T_{50} = 42.18$ min.

**$C_v @ T_{50}$**  
- $0.006$ ft.$^2$/day

---

*Figure: GET Solutions, Inc.*
The test results show:

- Maximum dry density = 123.9 pcf
- Optimum moisture = 10.4 %

**Test Specification:** ASTM D 698-12 Method A Standard

**Classification Table:**

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
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</thead>
<tbody>
<tr>
<td>1-2 ft.</td>
<td>SC</td>
<td>A-6(3)</td>
<td>15</td>
<td>25</td>
<td>13</td>
<td>2.2</td>
<td>49.0</td>
</tr>
</tbody>
</table>

**Test Results:**

- Maximum dry density = 123.9 pcf
- Optimum moisture = 10.4 %

**Material Description:**

- Tan, Clayey SAND

**Remarks:**

Sample Obtained 2/18/19

---

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

---

**Figure 1**
**Soil Description**

Tan, Clayey SAND

**Atterberg Limits**

- **PL** = 12
- **LL** = 25
- **Pl** = 13

**Coefficients**

- **D_90** = 0.4221
- **D_85** = 0.3332
- **D_50** = 0.1659
- **D_10** = 0.0828

**Classification**

- **USCS** = SC
- **AASHTO** = A-6(3)

**Remarks**

Sample Obtained 2/18/19

---

**Particle Size Distribution Report**

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<th>SIEVE SIZE</th>
<th>PERCENT FINER</th>
<th>SPEC.* PERCENT</th>
<th>PASS? (X=NO)</th>
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<td>.75</td>
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<td>.375</td>
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<td>#10</td>
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<td>63.7</td>
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<td>#100</td>
<td>55.8</td>
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</tr>
<tr>
<td>#200</td>
<td>49.0</td>
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<td></td>
</tr>
</tbody>
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**Location:** CBR-1  
**Sample Number:** CBR-1  
**Depth:** 1-2 ft.  
**Date:** 2/18/19

---

**Client:** City of Suffolk  
**Project:** Suffolk ParkS & Rec Operation Facility

**Project No:** VB19-141G  
**Figure:** 1A
MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)

Test specification: ASTM D 698-12 Method A Standard

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 ft.</td>
<td>CL</td>
<td>A-6(5)</td>
<td></td>
<td></td>
<td>27</td>
<td>15</td>
<td>2.8</td>
</tr>
</tbody>
</table>

TEST RESULTS

Maximum dry density = 118.0 pcf
Optimum moisture = 11.8 %

PROJECT:
- **Project No.:** VB19-141G
- **Client:** City of Suffolk
- **Project:** Suffolk ParkS & Rec Operation Facility
- **Location:** CBR-2
- **Sample Number:** CBR-2
- **Remarks:** Sample Obtained 2/18/19

MATERIAL DESCRIPTION

Tan, Sandy Lean CLAY

GET SOLUTIONS, INC.
**Project No:** VB19-141G  
**Project:** Suffolk ParkS & Rec Operation Facility  
**Location:** CBR-1  
**Sample Number:** CBR-1  
**Depth:** 1-2 ft.  
**Date:** 2/18/19

Test Description/Remarks:

Resiliency Factor = 2.5

---

**Material Description**

<table>
<thead>
<tr>
<th>USCS</th>
<th>Max. Dens. (pcf)</th>
<th>Optimum Moisture (%)</th>
<th>LL</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC</td>
<td>123.9</td>
<td>10.4</td>
<td>25</td>
<td>13</td>
</tr>
</tbody>
</table>

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**Penetration Resistance (psi)**

<table>
<thead>
<tr>
<th>Penetration Depth (in.)</th>
<th>0</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration Resistance (psi)</td>
<td>0</td>
<td>70</td>
<td>140</td>
<td>210</td>
<td>280</td>
<td>350</td>
</tr>
</tbody>
</table>

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**Penetration Depth (in.)**

<table>
<thead>
<tr>
<th>Penetration Depth (in.)</th>
<th>0</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration Resistance (psi)</td>
<td>0</td>
<td>70</td>
<td>140</td>
<td>210</td>
</tr>
</tbody>
</table>

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**Table:**

<table>
<thead>
<tr>
<th>Molded</th>
<th>Soaked</th>
<th>CBR (%)</th>
<th>Linearity Correction (in.)</th>
<th>Surcharge (lbs.)</th>
<th>Max. Swell (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (pcf)</td>
<td>Percent of Max. Dens.</td>
<td>Moisture (%)</td>
<td>Density (pcf)</td>
<td>Percent of Max. Dens.</td>
<td>Moisture (%)</td>
</tr>
<tr>
<td>1</td>
<td>124.0</td>
<td>100.1</td>
<td>10.3</td>
<td>123.7</td>
<td>99.9</td>
</tr>
<tr>
<td>2</td>
<td>△</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>□</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Test Description/Remarks:**

Resiliency Factor = 2.5
### Soil Description
Tan, Sandy Lean CLAY

### Atterberg Limits
- **PL**: 12
- **LL**: 27
- **PI**: 15

### Coefficients
- \( D_{90} = 0.3340 \)
- \( D_{85} = 0.2727 \)
- \( D_{50} = 0.1423 \)
- \( D_{10} = C_u = C_c = \)

### Classification
- USCS: CL
- AASHTO: A-6(5)

### Remarks
Sample Obtained 2/18/19

---

**Location:** CBR-2  
**Sample Number:** CBR-2  
**Depth:** 1-2 ft.  
**Date:** 2/18/19

---

**GET SOLUTIONS, INC.**  
**Client:** City of Suffolk  
**Project:** Suffolk ParkS & Rec Operation Facility  
**Project No:** VB19-141G  
**Figure:** 2A
**BEARING RATIO TEST REPORT**

**VTM-8 (2013)**

**GET SOLUTIONS, INC.**

**Project No:** VB19-141G  
**Project:** Suffolk ParkS & Rec Operation Facility  
**Location:** CBR-2  
**Sample Number:** CBR-2  
**Depth:** 1-2 ft.  
**Date:** 2/18/19

**Material Description USCS**

<table>
<thead>
<tr>
<th></th>
<th>Density (pcf)</th>
<th>Moisture (%)</th>
<th>Density (pcf)</th>
<th>Moisture (%)</th>
<th>CBR (%)</th>
<th>Linearity Correction (in.)</th>
<th>Surcharge (lbs.)</th>
<th>Max. Swell (%)</th>
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<tr>
<td>1</td>
<td>117.9</td>
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<td>117.7</td>
<td>99.7</td>
<td>4.5</td>
<td>4.3</td>
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<td>10</td>
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<tr>
<td>2</td>
<td>△</td>
<td></td>
<td></td>
<td></td>
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<td>3</td>
<td>□</td>
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<td></td>
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</tbody>
</table>

**Test Description/Remarks:**

- Resiliency Factor = 2.5
MOISTURE DENSITY RELATIONSHIP (PROCTOR CURVE)

Test specification: ASTM D 698-12 Method A Standard

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 FT.</td>
<td>SC</td>
<td>A-4(1)</td>
<td>15</td>
<td>22</td>
<td>10</td>
<td>0.7</td>
<td>40.1</td>
</tr>
</tbody>
</table>

TEST RESULTS

Maximum dry density = 121.6 pcf
Optimum moisture = 10.8%

Project No.  VB19-141G  Client: City of Suffolk
Project: Suffolk Park & Rec Operation Facility

Location: CBR-3  Sample Number: CBR-3

Remarks:
Sample Obtained 2/18/19

GET SOLUTIONS, INC.
Particle Size Distribution Report

Location: CBR-3
Sample Number: CBR-3
Depth: 1-2 FT.

Client: City of Suffolk
Project: Suffolk ParkS & Rec Operation Facility
Project No: VB19-141G
Date: 2/18/19

Soil Description
Tan, Clayey SAND

Atterberg Limits
PL= 12
LL= 22
Pl= 10

Coefficients
D90= 0.5687
D85= 0.4323
D50= 0.1987
D30= 0.1601
D10= 
Cu= 
Cc= 

Classification
USCS= SC
AASHTO= A-4(1)

Remarks
Sample Obtained 2/18/19
**BEARING RATIO TEST REPORT**

**VTM-8 (2013)**

**GET SOLUTIONS, INC.**

**Project No:** VB19-141G

**Project:** Suffolk Parks & Rec Operation Facility

**Location:** CBR-3

**Sample Number:** CBR-3  **Depth:** 1-2 FT.

**Date:** 2/18/19

**Test Description/Remarks:**

Resiliency Factor = 2.5

---

### Material Description

<table>
<thead>
<tr>
<th>USCS</th>
<th>Max. Dens. (pcf)</th>
<th>Optimum Moisture (%)</th>
<th>LL</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC</td>
<td>121.6</td>
<td>10.8</td>
<td>22</td>
<td>10</td>
</tr>
</tbody>
</table>

---

### Test Results

<table>
<thead>
<tr>
<th></th>
<th>Molded</th>
<th>Soaked</th>
<th>CBR (%)</th>
<th>Linearity Correction (in.)</th>
<th>Surcharge (lbs.)</th>
<th>Max. Swell (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (pcf)</td>
<td>121.8</td>
<td>121.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Max. Dens. (%)</td>
<td>100.2</td>
<td>100</td>
<td>11.9</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>10.8</td>
<td>11.9</td>
<td>11.0</td>
<td>13.3</td>
<td>0.000</td>
<td>10</td>
</tr>
<tr>
<td>CBR (%)</td>
<td>0.10 in.</td>
<td>0.20 in.</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration Depth (in.)</td>
<td>0.10</td>
<td>0.20</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penetration Resistance (psi)</td>
<td>0</td>
<td>70</td>
<td>140</td>
<td>210</td>
<td>280</td>
<td>350</td>
</tr>
</tbody>
</table>

---

Figure 3B
Project Number: VB19-141G
Test Location: BMP-2
Time interval: 0.5 minutes
Ksat Method: Glover Solution

Steady Flow Rate achieved when Water Consumption Rate changes less than +/- 88% for 8 consecutive readings

Steady Flow Rate: 0.114 ml/min
Tmp Adj Flow Rate: 0.114 ml/min
Percolation Rate: 454.647 min/cm
Ksat: 1.47E-06 cm/sec

Site GPS Position
Longitude: 76 degrees 41 minutes 2 seconds West
Latitude: 36 degrees 41 minutes 46 seconds North

Site Details:

Notes:

Site Texture Structure Category:
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
# DCP TEST DATA

**Project:** Suffolk Parks and Rec Operations Facility  
**Location:** C-1  
**Equipment Used:** Kesler K-100  
**ASTM Test Method:** ASTM D6951  
**Surficial Composition:** 1.0” Asphalt, 8.0” Agg. Base  
**Soil Type(s):** Type in the soil type

## Test Identification:
IRHS-1

### No. of Blows vs Accumulative Penetration (mm) vs Type of Hammer

<table>
<thead>
<tr>
<th>No. of Blows</th>
<th>Accumulative Penetration (mm)</th>
<th>Type of Hammer</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>4</td>
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<td>4</td>
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<tr>
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</tbody>
</table>

### CBR vs Depth

#### CBR vs Depth, in.

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<thead>
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<th>CBR</th>
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<tr>
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<td>1.0</td>
</tr>
<tr>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### Bearing Capacity (psf) vs Depth

#### Bearing Capacity (psf) vs Depth, in.

<table>
<thead>
<tr>
<th>Depth, in.</th>
<th>Bearing Capacity, psf</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>4000</td>
<td>4000</td>
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<tr>
<td>6000</td>
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<td>8000</td>
<td>8000</td>
</tr>
<tr>
<td>10000</td>
<td>10000</td>
</tr>
<tr>
<td>12000</td>
<td>12000</td>
</tr>
</tbody>
</table>

Based on approximate interrelationships of CBR and Bearing values (Design of Concrete Airport Pavement, Portland Cement Association, page 8, 1955)
DCP TEST DATA

Project: Suffolk Parks and Rec Operations Facility
Date: 2/19/2019
Location: C-2
G E T Project No.: VB18-141G
Equipment Used: Kesler K-100
ASTM Test Method: ASTM D6951
Surficial Composition: 1.0” Asphalt, 15.0” Stone
(Concrete, Asphalt, Stone, Topsoil, etc.)

Test Identification:
IRHS-1

| No. of Blows | Accumulative Penetration (mm) | Type of Hammer
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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</tr>
<tr>
<td>5</td>
<td>188</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>239</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>290</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>340</td>
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![CBR Graph](chart1.png)

![BEARING CAPACITY, psf Graph](chart2.png)

Soil Type(s): Type in the soil type

- CH
- CL
- All other soils

Based on approximate interrelationships of CBR and Bearing values (Design of Concrete Airport Pavement, Portland Cement Association, page 8, 1955)