REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING SERVICES

5th Bay Ocean View
Norfolk, Virginia
GET Project No: VB15-342G
January 6, 2016

PREPARED FOR:

Pennoni
PENNONI ASSOCIATES INC.
CONSULTING ENGINEERS
TO:  Pennoni Associates, Inc.
349 Southport Circle Suite 100
Virginia Beach, Virginia 23462

Attn: Mr. Scott Chewning, PE, LEED AP

RE:  Report of Subsurface Exploration and Geotechnical Engineering Services

5th Bay Ocean View
Norfolk, Virginia
GET Project No: VB15-342G

Dear Mr. Chewning:

In compliance with your instructions, we have completed our Geotechnical Engineering Services for the 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. GET Solutions, Inc. would be pleased to continue its role as Geotechnical Engineer during the project implementation.

Thank you for 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,
GET Solutions, Inc.

Edward Setnicky.
Project Geologist

Bruce R. Spiro, P.E.
Principal Engineer
VA Lic. # 015791

Copies: (1) Client
1.0 PROJECT INFORMATION

1.1 Project Authorization

G E T Solutions, Inc. has completed our subsurface exploration and geotechnical engineering services for the proposed 5th Bay Ocean View project, located in Norfolk, Virginia. The geotechnical engineering services were conducted in general accordance with G E T Proposal No. PVB15-488G. Authorization to proceed with our services was obtained from Mr. Scott Chewning in the form of electronic mail dated December 7, 2015.

1.2 Project and Site Description

The project site is located on 5th Bay Street in the Ocean View section of the City of Norfolk, Virginia and is only slightly developed with 4 residences throughout the specified area. Elevations for the site area range from 4 to 9 MSL based on provided topographic plans. The proposed construction at this site will consist of building several single-family structures. Project specifications are unknown at this time but the structures are expected to be of CMU and structural steel construction. The maximum wall and column loads are not expected to exceed 1-1.5 klf and 50 kips, respectively. The finish grades are expected to coincide with current grades, thus cuts and fills are not expected to exceed 1 to 2 feet. New roadways, BMP facilities, 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.

1.3 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 foundation excavations.

4. Evaluation of the on-site soils for re-use as structural fill.
5. Feasibility of a slab-on-grade design utilizing turn-down edges for foundation support. Design parameters required for the foundation system, including foundation sizes, allowable bearing pressures, foundation levels and expected total and differential settlements.

6. Pavement design based on the field exploration activities (1 boring and 1 CBR test) and our experience with similar soil conditions.

7. Determine pertinent information regarding groundwater and subsurface permeability conditions. (Installation of temporary groundwater monitoring wells and infiltration testing).

8. Seismic Site Class definition in accordance with the IBC 2012 requirements, available soil data, and our local experience.

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

2.0 FIELD AND LABORATORY PROCEDURES

2.1 Field Exploration

In order to explore the general subsurface soil types and to aid in developing associated construction design parameters, the following field exploration program was performed at the site:

- Four (4) 20-foot deep SPT borings (designated as B-1 through B-4) were drilled within the footprints of the proposed structures.
- One (1) bulk soil samples were collected from the approximate subgrade level of the test location. In addition, one (1) 10-foot deep boring was drilled at the CBR test location.
- A temporary groundwater monitoring well was installed at the B-1 and B-2 boring locations for groundwater level readings.
- Two (2) infiltration tests were performed adjacent to the groundwater monitoring wells within the proposed BMP areas.
The SPT borings were performed with the use of rotary wash “mud” and hollow stem auger drilling procedures in general accordance with ASTM D 1586. The tests were performed continuously from the existing ground surface to depths of 12-feet, and at 5-foot intervals thereafter. The soil samples were obtained with a standard 1.4” I.D., 2” O.D., 30” long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches, using an automatic hammer. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value (uncorrected for automatic hammer and overburden pressure). A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a glass jar, sealed, labeled, and returned to our laboratory for review.

Upon completion of the borings, two (2) monitoring wells were installed using 5.25 I.D. hollow stem augers to facilitate groundwater sampling. The monitoring wells were constructed of 2-inch I.D., Schedule 40 PVC materials. Sections of 0.010-inch slotted screen were placed in the boreholes with casing threaded to the top. The top of the screen was positioned above the water level. An appropriately graded sand/gravel pack was placed around the screen and extended one to two feet above the top of the screen. A 1-to 2- foot bentonite seal was then placed above the sand/gravel pack and hydrated with potable water. The remainder of the borehole annular space was pumped full of a neat cement grout. The well was then fitted with a PVC slip cap.

Two (2) infiltration tests were performed adjacent to the groundwater monitoring wells within the BMP footprint. A hand-auger was performed to a depth of 1 foot above the measured groundwater level. Infiltration testing was then conducted within the vadose zone utilizing a Precision Permeameter.

One (1) bulk soil sample (designated as CBR-1) was collected from the pavement area at its respective location. The bulk subgrade sample was collected at depths ranging from 0.5 to 3 feet below existing site grades and was returned to our laboratory and subjected to Proctor and CBR testing in accordance with ASTM standards.

The SPT boring locations were established by the client and staked in the field by a representative of GET Solutions, Inc. The approximate boring locations are shown on the attached “Boring Location Plan” (Appendix I)

2.2 Laboratory Testing

Representative portions of all soil samples collected during drilling were sealed in glass jars, labeled and transferred to our laboratory for classification and analysis. The soil classification was performed by a Project Geologist in accordance with ASTM D2488. A summary of the soil classification system is provided in Appendix II.
Three (3) representative soil samples were selected and subjected to natural moisture, #200 sieve wash, and Atterburg Limits in order to corroborate the visual classification. These test results are presented on the “Summary of Laboratory Results” sheet (Appendix III) and the “Boring Logs” sheets (Appendix IV).

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Geology

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

3.2 Subsurface Soil Conditions

The results of our soil test borings are summarized below in Table I.

<table>
<thead>
<tr>
<th>STRATUM</th>
<th>DESCRIPTION</th>
<th>RANGES OF UNCORRECTED SPT(^{(1)}) N-VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 0.42 - 0.58 Topsoil/Asphalt</td>
<td>➢ 1 to 5 inches of Topsoil, 4 inches of Asphalt <em>,CBR-1 only</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>➢ 3 inches of Aggregate Base <em>,CBR-1 only</em></td>
<td></td>
</tr>
<tr>
<td>0.42 – 0.58 to 0 - 2 IA</td>
<td>➢ FILL (SP, SM, SP-SM) with trace amounts of marine shell fragments and gravel.</td>
<td></td>
</tr>
<tr>
<td>0 - 2 to 20 I</td>
<td>➢ SAND (SP, SM, SC) <em>CLAY (CL) found at B-4 at depths of 16.5 to 20 ft</em></td>
<td>Granular 2 – 26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cohesive 3</td>
</tr>
</tbody>
</table>

Notes: (1) SPT = Standard Penetration Test, Uncorrected N-Values in Blows-per-foot.
The subsurface description is of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface exploration are included on the “Boring Logs” sheets (Appendix IV) and in the “Generalized Soil Profile” (Appendix V), which should be reviewed for specific information as to the individual borings. The stratifications shown on the records of the subsurface exploration represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual or occur between sample intervals.

### 3.3 Groundwater Information

The groundwater level was recorded at the boring locations and as observed through the relative wetness of the recovered soil samples during the drilling operations. The initial groundwater table was generally determined to occur at an approximate depth of 3.5 to 8 feet below current grades at the boring locations at the time of our site reconnaissance. The boreholes were backfilled upon completion for safety considerations. As such, the reported groundwater level may not be indicative of the static groundwater level.

In addition, groundwater readings were taken at the temporary groundwater monitoring well locations. At the time of this reporting the groundwater wells remained in place for future monitoring. The groundwater information associated with the wells is displayed below in Table II and Appendix IV.

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Initial Groundwater Reading (ft)*</th>
<th>24-hour Groundwater Reading (ft)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>6.0</td>
<td>6.2</td>
</tr>
<tr>
<td>B-2</td>
<td>4.0</td>
<td>2.4</td>
</tr>
</tbody>
</table>

* Depth below existing site grades

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

Our recommendations are based on the previously discussed project information, our interpretation of the soil test borings, our laboratory testing 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 Site preparation

The proposed construction areas should be cleared by means of removing all concrete, trees, root mat, topsoil, or any otherwise unsuitable materials. It is estimated that a cut of up to 1 to 5 inches in depth will be required to remove the topsoil. These cuts are expected to extend deeper in isolated areas to remove deeper deposits of unsuitable material, which become evident during the clearing. It is recommended that the clearing operations extend laterally at least 5 feet beyond the perimeter of the proposed construction area.

The results of our field exploration program indicated that the surface soils are generally comprised of FILL (SP, SM) and SAND (SP). 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. The extent of any undercut will be determined in the field during construction based on the outcome of the field testing procedures (subgrade proofroll).

Furthermore, inherently wet subgrade soils combined with potential poor site drainage make this site particularly susceptible to subgrade deterioration. Thus, grading should be performed during a dry season if at all possible. This should minimize these potential problems, although they likely will not be eliminated. The project’s budget should include an allowance for subgrade improvements (undercut and backfill with structural fill or aggregate base in the building and pavement areas).

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

4.2 Subgrade Preparation

Following clearing operations, 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 GET Solutions, Inc. for stability. Accordingly, the subgrade soils should be proof rolled 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, loaded dump truck or other heavy equipment 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 and unstable areas observed during proof rolling (beyond the initial cut) should be undercut and/or stabilized at the directions of the Geotechnical Engineer.

During the subgrade testing (proofrolling), isolated areas of unstable subgrade soils are likely, thus requiring ground improvements. Soil instabilities may be noted during the proofroll due to high soil moisture contents. In this case, drying the subgrade soils (to within +/- 2% of the optimum moisture) should be attempted prior to ground improvements. If drying the soils is not a feasible option the subgrade improvements can be performed by means of lime stabilization (cohesive soils) and/or cement stabilization (granular soils) of the shallow unstable soils.

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 GET 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 25% by weight of fines (SP, SM, SW, GP, GW), having a liquid limit less than 20 and plastic limit less than 6, and should be free of rubble, organics, clay, debris and other unsuitable material.

All structural fill should be compacted to a dry density of at least 98 percent of the Standard Proctor maximum dry density (ASTM D698). 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 GET Solutions, Inc. should perform field density tests on each lift as necessary to assure that adequate compaction is achieved.
All fill should be placed in horizontal lifts. Backfill material in utility trenches within the construction areas should consist of structural fill (as previously described), and should be compacted to at least 98 percent of ASTM D698. 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

The shallow subsurface FILL (SP, SM) soils encountered at the boring locations do appear to meet the criteria recommended in this report for reuse as structural fill; however, this would require all deleterious materials which initially led them to being classified as Uncontrolled FILL to be removed from the soils. Also, significant moisture manipulation is expected as these soils are located near or below the groundwater table. This manipulation will likely require stockpiling of wet soils and/or placing the material in thin layers. The goal of these methods is to dry the soils to within +/- 2% of their optimum moisture at the time of compaction which could prove time consuming and cost prohibitive. Again, it is important that during excavation, the deleterious materials are segregated from the suitable granular soils (SAND with less than 25% fines).

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

4.5 Foundation Design Recommendations

Provided that the construction procedures are properly performed, the proposed structure can be supported by shallow foundations bearing upon firm natural soil or well compacted structural fill material. The turn down edges of the foundation slab can be designed using a net allowable soil pressure of 2,000 pounds per square foot (psf).

In order to develop the recommended bearing capacity of 2,000 pounds per square foot (psf), the turned down edges should have an embedment of at least 24 inches beneath finished grades and wall footings should have a minimum width of 24 inches. In addition, isolated square column footings 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 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. All foundation excavations should be observed by a representative of G E T Solutions, Inc. 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 the footing observations, the Geotechnical Engineer will advance hand auger borings in the bases of the foundation excavations to verify that the bearing soils are consistent with those documented in this report. The necessary depth of penetration will be established during the subgrade observations.

When 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 percent of the Standard Proctor maximum dry density (ASTM D698), 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 foundation concrete placement, it is suggested that the bearing surfaces of all foundations be compacted using hand operated mechanical tampers. In this manner, any localized areas, which have been loosened by excavation operations, should be adequately re-compacted.

The compaction testing in the base of the foundation may be waived by the Geotechnical Engineer, where firm bearing soils are observed during the foundation inspections. Soils exposed in the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition such as from physical disturbance, rain or frost. Surface run-off water should be drained away from the excavations and not be allowed to pond. If possible, all footing concrete should be placed the same day the excavation is made. If this is not possible, the footing excavations should be adequately protected.
4.8 Turn Down Slab Design

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

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 Discussion

Based on the results of the laboratory test program, the collected bulk soil samples have a soaked CBR value of 28.7. In addition, the soaked CBR value was multiplied by a factor of two-thirds to determine a design CBR value. The two-thirds factor provides the necessary safety margins to compensate for some non-uniformity of the soil. This gives a design CBR value of 19.1. These test results are presented in Appendix VII.

The minimum pavement design recommendations for the proposed pavement areas are presented below in Table III.

**Table III-Typical Minimum Pavement Sections**

<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 (SM-12.5A)</td>
<td>Base (BM-25.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexible</td>
<td>2”</td>
<td>3”</td>
<td>-</td>
<td>8”</td>
</tr>
<tr>
<td>Rigid</td>
<td>-</td>
<td>-</td>
<td>6”</td>
<td>6”</td>
</tr>
</tbody>
</table>

* Concrete minimal flexural strength of 650 psi at 28 days.
** 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).
*** Compacted to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D 698).
Actual pavement section thickness should be provided by the design civil engineer based on traffic loads, volume, and the owners design life requirements. All pavement material and construction procedures should conform to Virginia Department of Transportation (VDOT) requirements.

Following pavement rough grading operations, the exposed subgrade should be observed under proofrolling. This proofrolling should be accomplished with a fully loaded dump truck or 7 to 10 ton drum roller to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed should be removed and replaced with a well-compacted material. The inspection of these phases should be performed by the Geotechnical Engineer or his representative. The project’s budget should include a contingency to accommodate the potential ground improvements.

Where excessively unstable subgrade soils are observed during proofrolling and/or fill placement, it is expected that these weak areas can be stabilized by means of thickening the base course layer. These alternatives are to be addressed by the Geotechnical Engineer during construction, if necessary, who will recommend the most economical approach at the time.

4.10 Soil Permeability

Two (2) infiltration tests were performed within vicinity of the temporary monitoring well locations. A hand-auger was performed adjacent to each well to a depth of 1 foot above the measured 24-hour groundwater level. The boreholes were prepared utilizing an auger to remove soil clippings from the base. Infiltration testing was then conducted within the vadose zone utilizing a Precision Permeameter and the following testing procedures.

A support stand was assembled and placed adjacent to the borehole. This stand holds a calibrated reservoir (130 ml) and a cable used to raise and lower the water control unit (WCU). The WCU establishes a constant water head within the borehole during testing by use of a precision valve and float assembly. The WCU was attached to the flow reservoir with a 2-meter (6.6 foot) braided PVC hose and then lowered by cable into the borehole to the test depth elevation. As required by the Glover solution, the WCU was suspended above the bottom of the borehole at an elevation of approximately 5 times the borehole diameter. The shut-off valve was then opened allowing water to pass through the WCU to fill the borehole to the constant water level elevation. The absorption rate slowed as the soil voids became filled and an equilibrium developed as a wetting bulb developed around the borehole. Water was continuously added until the flow rate stabilized. The reservoir was then re-filled in order to begin testing. During testing, as the water drained into the borehole and surrounding soils, the water level within the calibrated reservoir was recorded as well as the elapsed time during each interval. The test was continued until 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 and corroborated with laboratory testing results (published values compared to classification results), the hydraulic conductivity of the soils is listed below in Table IV and is presented on the “Hydraulic Conductivity Worksheets” (Appendix VI), included with this report.

Table IV - Infiltration Test Results

<table>
<thead>
<tr>
<th>Boring ID</th>
<th>Boring depth (ft)*</th>
<th>Water depth (ft)*</th>
<th>Ksat Value (cm/sec)</th>
<th>Ksat Class</th>
<th>USCS Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>5.2</td>
<td>6.2</td>
<td>3.93 x 10^-4</td>
<td>Moderately High</td>
<td>SP</td>
</tr>
<tr>
<td>B-2</td>
<td>1.4</td>
<td>2.4</td>
<td>7.49 x 10^-4</td>
<td>Moderately High</td>
<td>SP</td>
</tr>
</tbody>
</table>

*Depth below existing site grades

The infiltration test results provided in this report are the result of infiltration testing at the locations and elevations indicated in Table IV. Varying site conditions, including soil composition, soil density, stratum depth, and stratum thickness should be expected throughout the site. As such, the infiltration test results indicated in Table IV should not be assumed for all locations and depths across the project site.

4.11 Seismic Evaluation

Based on the information obtained at the boring locations and our experience within the vicinity of the project site, the upper 25 feet of the recovered soils (maximum explored depth) are indicative of a Site Class “D” in accordance with Table 1613.5.2 of the 2012 International Building Code; however, the seismic evaluation requires soils information associated with the upper 100 feet. If the site classification is critical to the structural design it will be necessary to perform a 100-foot deep CPT boring with shear wave velocity testing to substantiate the site classification.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Drainage and Groundwater Concerns

It is expected that dewatering may be required for excavations that extend below the groundwater table level. Dewatering from excavations above the groundwater level is expected to be accomplished by pumping from sumps. Dewatering at depths below the groundwater level may require well pointing and/or shoring.

It would be advantageous to construct all fills early in the construction. If this is not accomplished, disturbance of the existing site drainage could result in collection of surface water in some areas, thus rendering these areas wet and very loose. Temporary drainage ditches should be employed by the contractor to accentuate drainage during construction. We recommend that the contractor determine the actual groundwater levels at the time of construction to determine groundwater impact on this project.
5.2 Excavations

In Federal Register, Volume 54, No. 209 (October, 1959), 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 excavation or footing excavations, be constructed in accordance with the new (OSHA) guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor’s responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor’s safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. G E T Solutions, Inc. is not assuming responsibility for construction site safety or the contractor’s activities; such responsibility is not being implied and should not be inferred.
6.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by GET Solutions, Inc. and the information supplied by the client, and their consultants for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, 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 assure our engineering recommendations have been properly incorporated into the design documents, in order that the earthwork and foundation recommendations may be properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of the client and their designated agents for the specific application to the 5th Bay Ocean View project in Norfolk, Virginia.
APPENDICES

I. BORING LOCATION PLAN
II. SOIL CLASSIFICATION SYSTEM
III. LABORATORY TEST RESULTS
IV. BORING LOGS
V. GENERALIZED SOIL PROFILE
VI. HYDRAULIC CONDUCTIVITY WORKSHEETS
VII. CBR TEST DATA
APPENDIX I

BORING LOCATION PLAN
Boring Location Plan

PROJECT: 5th Bay Ocean View
PROJECT LOCATION: Norfolk, Virginia
PROJECT NO: VB15-342G
CLIENT: Pennoni Associates
DATE: 12/17/2015
PLOT BY: E.Setnicky
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>Very Soft</td>
</tr>
<tr>
<td>Loose</td>
<td>Soft</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>Medium Stiff</td>
</tr>
<tr>
<td>Dense</td>
<td>Stiff</td>
</tr>
<tr>
<td>Very Dense</td>
<td>Very Stiff</td>
</tr>
<tr>
<td></td>
<td>Hard</td>
</tr>
</tbody>
</table>

4 blows/ft. or less
5 to 10 blows/ft.
11 to 30 blows/ft.
31 to 50 blows/ft.
51 blows/ft. or more
2 blows/ft. or less
3 to 4 blows/ft.
5 to 8 blows/ft.
9 to 15 blows/ft.
16 to 30 blows/ft.
31 blows/ft. or more

Particle Size Identification

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

Relative Proportions

<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, side walks, etc.).

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

Less than 5 percent: GW, GP, SW, SP
More than 12 percent: GM, GC, SM, SC
5 to 12 percent: Borderline cases requiring dual symbols

CLASSIFICATION SYMBOLS (ASTM D 2487 and D 2488)

Coarse Grained Soils

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

CL - Lean Clay
CL-ML - Silty Clay
ML - Silt
OL - Organic Clay/Silt
Liquid Limit 50% or greater
CH - Fat Clay
MH - Elastic Silt
OH - Organic Clay/Silt

Highly Organic Soils

PT - Peat

Plasticity Chart
APPENDIX III

LABORATORY TEST DATA
<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>Saturation (%)</th>
<th>Void Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-3</td>
<td>9.0</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>4.75</td>
<td>7</td>
<td>SP-SM</td>
<td>19.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-4</td>
<td>19.0</td>
<td>22</td>
<td>13</td>
<td>9</td>
<td>0.075</td>
<td>57</td>
<td>CL</td>
<td>25.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBR-1</td>
<td>9.0</td>
<td>51</td>
<td>23</td>
<td>28</td>
<td>0.075</td>
<td>41</td>
<td>SC</td>
<td>52.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX IV
BORING LOGS
RECORD OF SUBSURFACE EXPLORATION

PROJECT NAME: 5th Bay Ocean View
CLIENT: Pennoni Associates
PROJECT LOCATION: Norfolk, Virginia
BORING LOCATION: See boring location plan
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.

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

GROUNDWATER*: INITIAL (ft) : 6

GROUNDWATER*:

PROJECT NUMBER: VB15-342G
SURFACE ELEVATION (MSL) (ft): ___
LOGGED BY: E.Setnicky
DATE STARTED: 12/14/2015
DATE COMPLETED: 12/14/2015
DRILLER: GET Solutions, Inc.

Boring terminated at 20 feet below existing grade.

STRATA DESCRIPTION

Elevation (ft)        Depth (ft)
0.3                   4-in. Topsoil
                      Brown to Tan, moist, Poorly Graded fine to medium SAND (SP), trace clay, loose, FILL
                      2.0
                      Tan, moist to wet, Poorly Graded fine to coarse SAND (SP), loose
                      8.0
                      Gray, wet, Poorly Graded fine to coarse SAND (SP), very loose to medium dense
                      20.0
                      Boring terminated at 20 feet below existing grade.

Elevation (ft)        Depth (ft)
0.3                   4-in. Topsoil
                      Brown to Tan, moist, Poorly Graded fine to medium SAND (SP), trace clay, loose, FILL
                      2.0
                      Tan, moist to wet, Poorly Graded fine to coarse SAND (SP), loose
                      8.0
                      Gray, wet, Poorly Graded fine to coarse SAND (SP), very loose to medium dense
                      20.0
                      Boring terminated at 20 feet below existing grade.

Sample Type(s):

SS - Split Spoon

Notes:

This information pertains only to this boring and should not be interpreted as being indicative of the site.
<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>STRATA DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td></td>
<td>5-in. Topsoil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tan, moist, Poorly Graded fine to medium SAND (SP), very loose to loose</td>
</tr>
<tr>
<td>4.0</td>
<td></td>
<td>Gray, wet, Poorly Graded fine to coarse SAND (SP), loose</td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td>Gray, wet, Poorly Graded fine to coarse SAND (SP), trace clay, very loose</td>
</tr>
<tr>
<td>8.0</td>
<td></td>
<td>Dark Gray, wet, Poorly Graded fine to coarse SAND (SP), loose to medium dense</td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td>Boring terminated at 20 feet below existing grade.</td>
</tr>
</tbody>
</table>

**TEST RESULTS**

- **Plastic Limit**: X
- **Liquid Limit**: X
- **Water Content**: ●
- **Penetration**: 

<table>
<thead>
<tr>
<th>Sample Type</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>SS - Split Spoon</td>
<td>1</td>
<td>16</td>
<td>2-2-3-2 (5)</td>
<td></td>
</tr>
<tr>
<td>SS - Split Spoon</td>
<td>2</td>
<td>14</td>
<td>1-2-2-4 (4)</td>
<td></td>
</tr>
<tr>
<td>SS - Split Spoon</td>
<td>3</td>
<td>24</td>
<td>2-3-4-3 (7)</td>
<td></td>
</tr>
<tr>
<td>SS - Split Spoon</td>
<td>4</td>
<td>24</td>
<td>1-1-1-2 (2)</td>
<td></td>
</tr>
<tr>
<td>SS - Split Spoon</td>
<td>5</td>
<td>16</td>
<td>8-3-5-6 (8)</td>
<td></td>
</tr>
<tr>
<td>SS - Split Spoon</td>
<td>6</td>
<td>22</td>
<td>4-5-8-8 (13)</td>
<td></td>
</tr>
<tr>
<td>SS - Split Spoon</td>
<td>7</td>
<td>20</td>
<td>5-6-6-7 (12)</td>
<td></td>
</tr>
<tr>
<td>SS - Split Spoon</td>
<td>8</td>
<td>20</td>
<td>7-8-9-11 (17)</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

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

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Strata Description</th>
<th>Sample ID</th>
<th>Sample Type(s)</th>
<th>Sample Recovery (in.)</th>
<th>Blow Counts (N-Values)</th>
<th>%&lt;#200</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td></td>
<td>1-in. Topsoil</td>
<td>1</td>
<td>SS - Split Spoon</td>
<td>16</td>
<td>3-7-3-3 (10)</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td>Tan, moist, Poorly Graded fine to medium SAND (SP), trace marine shell fragments, loose, FILL</td>
<td>2</td>
<td>SS - Split Spoon</td>
<td>20</td>
<td>3-3-4-5 (7)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Tan, moist to wet, Poorly Graded fine to medium SAND (SP), loose</td>
<td>3</td>
<td>SS - Split Spoon</td>
<td>24</td>
<td>4-4-4-5 (8)</td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td></td>
<td>Tan-Gray, wet, Poorly Graded fine to coarse SAND with Silt (SP-SM), loose</td>
<td>4</td>
<td>SS - Split Spoon</td>
<td>24</td>
<td>3-3-4-3 (7)</td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td>Tan, wet, Poorly Graded fine to coarse SAND (SP), loose</td>
<td>5</td>
<td>SS - Split Spoon</td>
<td>16</td>
<td>2-2-3-4 (5)</td>
<td>7</td>
</tr>
<tr>
<td>12.5</td>
<td></td>
<td>Dark Gray, wet, Poorly Graded fine to coarse SAND (SP), medium dense</td>
<td>6</td>
<td>SS - Split Spoon</td>
<td>14</td>
<td>2-2-3-4 (5)</td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td>7</td>
<td>SS - Split Spoon</td>
<td>13</td>
<td>5-7-8-10 (16)</td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td>Boring terminated at 20 feet below existing grade.</td>
<td>8</td>
<td>SS - Split Spoon</td>
<td>11</td>
<td>5-7-7-9 (14)</td>
<td></td>
</tr>
</tbody>
</table>
**Strata Description**

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Strata Legend</th>
<th>Sample ID</th>
<th>Sample Type(s)</th>
<th>Sample Recovery (in.)</th>
<th>Blow Counts (N-Values)</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Water Content</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td>5-in. Topsoil</td>
<td>Tan, moist, Poorly Graded fine to medium SAND (SP), trace marine shell fragments and clay, medium dense, FILL</td>
<td>1</td>
<td>17</td>
<td>2-8-5-4  (13)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td>Tan, moist, Poorly Graded fine to medium SAND (SP), loose to medium dense</td>
<td>2</td>
<td>22</td>
<td>4-4-5-6  (9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td>3</td>
<td>16</td>
<td>5-6-5-7  (11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td></td>
<td>Dark Gray, wet, Poorly Graded fine to medium SAND (SP), loose to medium dense</td>
<td>4</td>
<td>24</td>
<td>3-3-4-5  (7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td>5</td>
<td>12</td>
<td>3-3-4-4  (7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td>6</td>
<td>10</td>
<td>2-2-5-6  (7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.5</td>
<td></td>
<td>Mottled Orange-Tan, wet, Lean CLAY (CL), medium stiff</td>
<td>7</td>
<td>15</td>
<td>3-5-6-9  (11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td>Boring terminated at 20 feet below existing grade.</td>
<td>8</td>
<td>15</td>
<td>2-3-2-3  (5)</td>
<td>57</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

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

**Project Information:**

- **Project Name:** 5th Bay Ocean View
- **Client:** Pennoni Associates
- **Project Location:** Norfolk, Virginia
- **Boring Location:** See boring location plan
- **Drilling Method(s):** Rotary wash "mud"
- **Groundwater:** Initial (ft) 8, After ___ Hours (ft) ___, Cave-In (ft) ___
- **Date Started:** 12/14/2015
- **Date Completed:** 12/14/2015
- **Driller:** GET Solutions, Inc.
## Record of Subsurface Exploration

**Boring ID:** CBR-1

**Project Name:** 5th Bay Ocean View

**Client:** Pennoni Associates

**Project Location:** Norfolk, Virginia

**Boring Location:** See boring location plan

**Drilling Method(s):** Rotary wash "mud"

**Groundwater:**
- Initial (ft): 3.5
- After ___ Hours (ft): ___
- Cave-in (ft): ___

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

**Test Results**

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Depth (ft)</th>
<th>Strata Description</th>
<th>Sample ID</th>
<th>Sample Type</th>
<th>Sample Recovery (in.)</th>
<th>Blow Counts (N-Values)</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Water Content</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>3-in. Asphalt</td>
<td>4-in. Asphalt</td>
<td>1</td>
<td>12</td>
<td>0-6-8-9 (14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td>3-in. Aggregate Base</td>
<td>Tan, moist, Poorly Graded fine to medium SAND with Silt (SP-SM), trace fine gravel, medium dense, FILL</td>
<td>1</td>
<td>12</td>
<td>0-6-8-9 (14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Tan-Gray, moist to wet, Poorly Graded fine to medium SAND with Silt (SP-SM), trace fine gravel, medium dense, Possible FILL</td>
<td>2</td>
<td>15</td>
<td>4-5-6-5 (11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Tan, wet, Poorly Graded fine to coarse SAND (SP), loose</td>
<td>3</td>
<td>22</td>
<td>4-4-4-4 (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gray, wet, Poorly Graded fine to coarse SAND (SP), loose</td>
<td>4</td>
<td>24</td>
<td>3-3-2-2 (5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Dark Gray, wet, Clayey fine SAND (SC), trace organic matter, soft</td>
<td>5</td>
<td>6</td>
<td>1-1-2-8 (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Boring terminated at 10 feet below existing grade.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**Notes:**

---

**Surface Elevation (MSL) (ft):**

**Logged By:** E.Setnicky

**Date Started:** 12/14/2015

**Date Completed:** 12/14/2015

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

GENERALIZED SOIL PROFILE
APPENDIX VI

HYDRAULIC CONDUCTIVITY WORKSHEETS
<table>
<thead>
<tr>
<th>VOLUME (ml)</th>
<th>Volume Out (ml)</th>
<th>TIME (h:mm:ss A/P)</th>
<th>Flow Rate Q (cm/min)</th>
<th>Flow Rate Q (cm/sec)</th>
<th>Flow Rate Q (cm/day)</th>
<th>Flow Rate Q (in/hr)</th>
<th>Flow Rate Q (ft/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td></td>
<td>1:25:00 PM</td>
<td>0.024</td>
<td>3.93E-04</td>
<td>33.932</td>
<td>0.557</td>
<td>1.113</td>
</tr>
<tr>
<td>120</td>
<td>10</td>
<td>1:25:10 PM</td>
<td>0.024</td>
<td>3.93E-04</td>
<td>33.932</td>
<td>0.557</td>
<td>1.113</td>
</tr>
<tr>
<td>110</td>
<td>10</td>
<td>1:25:20 PM</td>
<td>0.024</td>
<td>3.93E-04</td>
<td>33.932</td>
<td>0.557</td>
<td>1.113</td>
</tr>
<tr>
<td>90</td>
<td>10</td>
<td>1:25:30 PM</td>
<td>0.024</td>
<td>3.93E-04</td>
<td>33.932</td>
<td>0.557</td>
<td>1.113</td>
</tr>
<tr>
<td>80</td>
<td>10</td>
<td>1:25:40 PM</td>
<td>0.024</td>
<td>3.93E-04</td>
<td>33.932</td>
<td>0.557</td>
<td>1.113</td>
</tr>
<tr>
<td>70</td>
<td>10</td>
<td>1:25:50 PM</td>
<td>0.024</td>
<td>3.93E-04</td>
<td>33.932</td>
<td>0.557</td>
<td>1.113</td>
</tr>
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<td>33.932</td>
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<td>33.932</td>
<td>0.557</td>
<td>1.113</td>
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**Natural Moisture:** -  
**Consistency:** loose  
**USDA Txt./USCS Class:** SP  
**Water Table Depth:** 6.2  
**Struct./% Pass. #200:** -  
**Init. Saturation Time:** 1:05:00 PM  

Field-Estimated Ksat: 0.024 3.93E-04 33.932 0.557 1.113

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

Glover, R. E. 1953. Flow from a test-hole located above groundwater level, pp. 69-71. In: Theory and Problems of Water Percolation. (C. N. Zanger, ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. H/r > 5 to > 10  Johnson Permeameter, LLC Revised 11/29/13
### Constant-Head Borehole Permeameter Test

#### Project Name: 5th Bay Ocean View
#### Project No.: VB15-342G
#### Boring No.: B-2
#### Proj. Location: Norfolk, Virginia
#### Investigators: Anthony Baker, Zach Baker
#### Date: 12/29/2015

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<tr>
<th>Boring Depth</th>
<th>1.4 (m, cm, ft, in)</th>
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<tr>
<td>Boring Radius r</td>
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<td>Soil/Water Temp. T:</td>
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<tr>
<td>Dyn. Visc. @ T °C:</td>
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<table>
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<tr>
<th>VOLUME (ml)</th>
<th>Volume Out (ml)</th>
<th>TIME (h:mm:ss A/P)</th>
<th>Interval Elapsed Time (min)</th>
<th>Flow Rate Q (ml/min)</th>
<th>(cm/min)</th>
<th>(cm/sec)</th>
<th>(cm/day)</th>
<th>(in/hr)</th>
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<td>0.045</td>
<td>7.55E-04</td>
<td>65.254</td>
<td>1.070</td>
</tr>
</tbody>
</table>

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

**Field-Estimated Ksat:** 0.045 7.49E-04 64.724 1.062 2.124

**USDA Txt./USCS Class:** SP

**Water Table Depth:** 2.4

**Struct./% Pass. #200:** -

**Init. Saturation Time:** 12:30:00 PM

**Analytical Method:** Glover Solution

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

\[
K_{sat, B} = \frac{Q V \left[ \sinh^{-1}(H/r) - \left(\frac{r^2}{H^2} + 1\right)^{1/2}\right] + r/H}{2\pi H^2} \quad [\text{Basic Glover Solu.}]
\]

Where:
- \(Q\): Rate of flow of water from the borehole
- \(V\): Dynamic Visc. of water @ Temp. \(T\) °C
- \(H\): Constant height of water in the borehole
- \(r\): Radius of the cylindrical borehole
- \(H/r\): Ratio of the height of water to the radius of the borehole

Glover, R. E. 1953. Flow from a test-hole located above groundwater level, pp. 69-71. in: Theory and Problems of Water Percolation. (C. N. Zanger, ed.). USBR. The condition for this solution exists when the distance from the bottom of the borehole to the water table or an impervious layer is at least twice the depth of the water in the well. \(H/r > 5\) to >10 Johnson Permeameter, LLC Revised 11/29/13
APPENDIX VII

CBR TEST DATA
Test specification: ASTM D 698 Method A Standard

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<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>USCS</th>
<th>AASHTO</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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<td>A-3</td>
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<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>3.8</td>
<td>6.8</td>
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TEST RESULTS

Maximum dry density = 109.1 pcf
Optimum moisture = 11.6%

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<tr>
<th>Project No.</th>
<th>Client: Pennoni Associates</th>
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<tbody>
<tr>
<td>Project</td>
<td>5th Bay Ocean View</td>
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</table>

Remarks:
Sample Obtained 12/14/15
CBR-1

GET SOLUTIONS, INC.
Particle Size Distribution Report

Material Description
Brown, Poorly Graded SAND with Silt

Atterberg Limits
PL = NP
LL = NP
Pl = NP

Coefficients
D90 = 3.0048
D85 = 2.2488
D60 = 0.5002
D50 = 0.3971
D30 = 0.2746
D10 = 0.1552
CU = 3.22
CC = 0.97

Classification
USCS = SP-SM
AASHTO = A-3

Remarks
Sample Obtained 12/14/15
CBR-1

Sieve Size | Percent Finer | Spec.* Percent | Pass? (X=No)
---|---|---|---
1 | 100.0 | | |
.75 | 98.7 | | |
.375 | 96.7 | | |
#4 | 96.2 | | |
#10 | 83.2 | | |
#40 | 53.3 | | |
#80 | 12.4 | | |
#100 | 9.6 | | |
#200 | 6.8 | | |

* (no specification provided)

Location: CBR-1
Sample Number: CBR-1
Depth: 7-48 in.

Date: 12/14/15

Client: Pennoni Associates
Project: 5th Bay Ocean View
Project No: VB15-342G
Figure: 1A
BEARING RATIO TEST REPORT
ASTM D 1883-07

Brown, Poorly Graded SAND with Silt

<table>
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<th>Penetration Depth (in.)</th>
<th>Penetration Resistance (psi)</th>
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<td>50</td>
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<td>0.4</td>
<td>70</td>
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<tr>
<td>0.5</td>
<td>90</td>
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<table>
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<tr>
<th>Molded</th>
<th>Soaked</th>
<th>CBR (%)</th>
<th>Linearity Correction (in.)</th>
<th>Surcharge (lbs.)</th>
<th>Max. Swell (%)</th>
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<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>
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<tr>
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<td>100.6</td>
<td>11.5</td>
<td>109.8</td>
<td>100.6</td>
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Material Description

Brown, Poorly Graded SAND with Silt

Test Description/Remarks:

CBR-1
Resiliency Factor = 3.0

Project No: VB15-342G
Project: 5th Bay Ocean View
Location: CBR-1
Sample Number: CBR-1  Depth: 7-48 in.
Date: 12/14/15

BEARING RATIO TEST REPORT
GET SOLUTIONS, INC.