PRELIMINARY REPORT OF
SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING ANALYSIS
TRANQUILITY AT THE LAKES
5827 BURTON STATION ROAD
VIRGINIA BEACH, VIRGINIA

ECS PROJECT NO. 04:9974

For

Community Housing Partners
c/o Mr. Lee S. Alford
4915 Radford Avenue, Suite 300
Richmond, Virginia 23230

September 8, 2014
September 8, 2014

Community Housing Partners
c/o Mr. Lee S. Alford
4915 Radford Avenue, Suite 300
Richmond, VA

ECS Job No. 04:9974

Reference: Preliminary Report of Subsurface Exploration and Geotechnical Engineering Analysis
Tranquility at the Lakes
5827 Burton Station Road
Virginia Beach, Virginia

Dear Mr. Alford:

ECS Mid-Atlantic, LLC (ECS) is pleased to provide you with this preliminary report of subsurface exploration and geotechnical engineering analysis for the proposed housing development to be located at 5827 Burton Station Road in the City of Virginia Beach, Virginia. This study has been completed in general accordance with our proposal No. 04:15086 dated August 7, 2014. Submitted herein are the results of our soil test borings, laboratory analysis and recommendations for geotechnical related design aspects for the proposed project.

We appreciate providing consulting services to Community Housing Partners during the design phase of this project. If you should have any questions regarding the information and recommendations contained in the accompanying report or if we can be of further assistance, please do not hesitate to contact us.

Respectfully,

ECS MID-ATLANTIC, LLC

David M. Anderson, E.I.T.
Geotechnical Project Manager

Michael J. Galli, P.E.
VP, Principal Engineer

Distribution: (1) Client via email
Preliminary Report of Subsurface Exploration and Geotechnical Engineering Analysis
Tranquility at the Lakes
5827 Burton Station Road
Virginia Beach, Virginia

Community Housing Partners
c/o Mr. Lee S. Alford
4915 Radford Avenue, Suite 300
Richmond, VA

PROJECT 04:9974

DATE September 8, 2014
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EXECUTIVE SUMMARY

This report contains the results of our preliminary subsurface exploration and geotechnical engineering analysis for the proposed housing development, to be located at 5827 Burton Station Road in the City of Virginia Beach, Virginia.

At the time of the preliminary subsurface exploration, the site appeared to be undeveloped with limited trees and surface cover generally included grassy vegetation with limited overgrowth to the rear of the site. The site was relatively level with minimal elevation changes.

A total of five (5) soil test borings were performed to evaluate subsurface conditions for the proposed housing development, drive lanes, and parking areas. Soil test borings indicated a surface cover consisting of 5 to 7 inches of topsoil. Underlying soils generally consisted of Clayey SANDs (SC) overlying Poorly Graded SANDs, with Silt (SP-SM) to depths explored of 20 feet below ground surface. We also encountered a deposit of Sandy Lean CLAY (CL) interbedded with these coarse-grained soils at one boring location.

The ground water table was encountered at depths of approximately 9 to 12 feet bgs in all borings. Soils below the level of the ground water table consist of relatively porous Sands. Excavations extending below the ground water table will likely require well pointing to achieve dewatering and temporary shoring systems to ensure excavation stability.

Provided the subgrades are prepared as recommended herein and in the field during construction, the proposed structure can be supported on a shallow spread foundation system bearing on suitable undisturbed natural soils or on newly compacted Engineered Fill. The foundations can be dimensioned for a net allowable bearing pressure of 2,000 psf for column and wall loads up to 75 kips and 4 klf, respectively. The floor slabs may be designed as slabs on grade. Based on our experience with seismic testing in this geologic environment, we estimate the subsurface profile of this site to have Site-Class E.

Further information regarding the subsurface exploration procedures used; soil conditions encountered; foundation, floor slab, and pavement design; earthwork operations; and construction considerations are included in the text of this report. This report should be reviewed in its entirety by the appropriate design/construction professional before making any assumptions relating to geotechnical conditions.
1.0 PROJECT OVERVIEW

Our professional services for this project were performed in general accordance with ECS Proposal No. 04:15086, dated August 7, 2014, and formally authorized by Mr. Lee Alford of Community Housing Partners. The site information was obtained from a Concept Site Plan provided by Community Housing Partners on August 5, 2014.

1.1 Project Characteristics

The proposed project site is located at 5829 Burton Station Road in the City of Virginia Beach, Virginia. The proposed development consists of the construction of a housing development having 40 units and three stories with associated entrance drives and parking spaces. It is anticipated that the proposed building footprint will have an area of approximately 13,000 SF. We have assumed that the building structure will consist of wood framing with concrete slab-on-grade floors. The exterior of the building is anticipated to be finished with brick veneer. Based on our experience with similar structures, it is anticipated that the foundations will be designed for maximum wall loads of about 4.0 kips/foot with exterior and interior column loads no greater than 75 kips. Maximum floor slab loads are anticipated to be 150 psf. Final site grades are assumed to be within 2 feet of existing surface grades.

The site pavements are anticipated to be subjected to maximum loading of 60,000 ESALs with an equivalent single axle loading of 18,000 pounds and a design life of 20 years.

1.2 Scope of Work

The conclusions and recommendations contained in this report are based upon the results of our field exploration and laboratory testing program. Our preliminary exploration consisted of a site visit by a geotechnical engineer and drilling of five (5) soil test borings to depths up to 20 feet below the existing ground surface (bgs) at locations across the site. Laboratory testing performed on several representative samples obtained during the field exploration aided in the evaluation of the field data.

The borings were located in the field by ECS personnel by measuring distances and estimating angles from existing sites features and based on the site plans provided. The approximate locations are shown on the Boring Location Diagram included in Appendix I. Laboratory testing was performed on representative samples obtained during the field exploration to aid in ascertaining pertinent soil properties.

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

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

The purpose of this exploration was to explore the soil and groundwater conditions at the site in order to develop preliminary geotechnical engineering recommendations to aid in the design and construction of the project and help develop earthwork specifications. This purpose was accomplished by:

- Advancing borings to explore the subsurface soil conditions and ascertain the depth of ground water.
- Performing laboratory tests on representative soil samples obtained from the borings to evaluate pertinent engineering properties.
- Analyzing the field and laboratory data to develop appropriate preliminary geotechnical engineering recommendations to support the design of foundations, floor slabs, pavements, and develop earthwork specifications for the project.
2.0 EXPLORATION PROCEDURES

This section described the methods by which information was obtained during the subsurface exploration for the preparation of this report.

2.1 Subsurface Exploration Procedures

Soil test borings were performed with an ATV-Mounted drill rig which utilized auger drilling techniques to advance the boreholes. Drilling services were provided by EarthCon Site Services of Williamsburg, Virginia.

Representative samples were obtained from the soil borings by means of the split-barrel sampling procedure in accordance with ASTM Specification D 1586-99, (Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils). Samples were taken continuously to a depth of 10 feet, and at 5-foot intervals thereafter. In this procedure, a 2.25 inch O.D., split barrel sampler is driven into a soil a distance of 24 inches by a 140-pound hammer falling 30 inches. The first 6-inch depth increment is considered the seating interval. The number of blows required to drive the sampler through the next two 6-inch intervals is designated the standard penetration test or the “SPT N” value and is indicated for each sample on the boring logs. Individual Soil Boring Logs can be found in Appendix II, of this report. Copies of the “Unified Soil Classification System” and “Reference Notes for Boring Logs” are included in Appendix III of this report.

After recovery, representative portions of each sample were removed from the sampler and placed in sealed glass jars. The samples were taken to our laboratory for classification in accordance with ASTM D 2487 (United Soil Classification System) and laboratory testing.

2.2 Laboratory Testing Program

Representative soil samples were selected and tested in our laboratory to determine pertinent engineering properties. The laboratory testing program included visual classifications, moisture content, grain size analysis, and Atterberg Limits tests. All data obtained from the laboratory tests are included on the laboratory test summary in Appendix IV.

An experienced Geotechnical Engineer classified each soil sample on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS). The group symbol for each soil type is indicated in parentheses following the soil description on the boring logs. A brief explanation of the USCS is included with this report. The geotechnical engineer grouped the various soil types into the major zones noted on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs and profile are approximate; in situ, the transitions may be gradual.
3.0 EXPLORATION RESULTS

This section incorporates the site and subsurface conditions observed during our site reconnaissance and field exploration.

3.1 Site Conditions

At the time of the preliminary subsurface exploration, the site appeared to be undeveloped with limited trees and surface cover generally included grassy vegetation with limited overgrowth to the rear of the site. The site was relatively level with minimal elevation changes.

3.2 Regional Geology

The subject property is located on the eastern margin of the Coastal Plain Physiographic Province. The Coastal Plain Physiographic Province extends from the Fall Zone at the eastern edge of the Piedmont Province eastward to the Atlantic Ocean. The topography of the Coastal Plain is a terraced landscape that stair-steps down to the coast and to the major rivers. The terrace risers (scarps) are former shorelines and the treads are emergent bay and river bottoms. The higher, older plains in the western part of the Coastal Plain are more dissected by stream erosion than the lower, younger terrace treads. This landscape was formed over the last few million years as sea level rose and fell in response to the repeated melting and growth of large continental glaciers and as the Coastal Plain slowly uplifted.

The Coastal Plain is underlain by a thick wedge of sediments that increases in thickness from a featheredge near the Fall Zone to more than 4,000 meters under the continental shelf. These sediments rest on an eroded surface of Precambrian to early Mesozoic Era rock. Two-thirds of this wedge are comprised of late Jurassic and Cretaceous clay, sand, and gravel, which were stripped from the Appalachian mountains, carried eastward by rivers, sorted by shoreline, bay, and estuary hydraulics, and deposited primarily in submerged environments. A sequence of deeply bedded, fossiliferous marine sands and Clays of Tertiary period (late Miocene and Pliocene Epochs) overlies similar older strata. These formed at the bottom of shallow seas and are pre-consolidated deposits, having once been buried hundreds of feet below the surface but now being nearly exposed by erosion. Later Tertiary and Quaternary Period sand, silt, and clay, which cover much of the Coastal Plain surface, were deposited during subsequent interglacial highstands of the sea over the past 1.5 million years under shallow water conditions similar to those that exist in the modern Chesapeake Bay and its tidal tributaries.

The shallowest fossiliferous marine sands and clays are known as the Yorktown Formation. The Yorktown Formation soils are a marine deposit that is generally considered to be of late Miocene and early Pliocene age. The surface of the Yorktown in the tidewater area is about El 20 near the Suffolk Scarp (which extends north-south through Suffolk) but can be as high as El 60 further inland. The formation surface, excluding deep eroded zones, slopes gently eastward to about El -20 near the present ocean front. The Yorktown formation is 150 to 200 ft thick in the vicinity of the Suffolk Scarp and over 500 ft thick in eastern tidewater. Since deposition, the Yorktown Formation has experienced numerous cycles of erosion, desiccation, and additional deposition. The ocean level has varied from about El 125 during deposition of the Yorktown Formation to as low as El -180 during the Wisconsin Glacial period which peaked about 20,000 years ago. The effect of this extended period of low ocean level was non-uniform erosion and
desiccation of the Yorktown surface. Yorktown soils are thus consolidated in excess of existing overburden pressure. ("Coastal Plain Province: The geology of Virginia", by Chad Roberts).

### 3.3 Subsurface Conditions

Each soil sample obtained from the test borings was classified on the basis of texture and plasticity in accordance with the USCS. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. A brief explanation of the USCS is included in Appendix III of this report. The various soil types were grouped into the major zones noted on the boring logs. The stratification lines designating the interfaces between subsurface materials on the boring logs and profiles are approximate; in-situ, the transitions may be gradual.

Borings indicated 5 to 7 inches of topsoil. Underlying the surface cover, we generally encountered two (2) distinct soil strata:

**Stratum I:** The near surface soils from the bottom of the surface cover to depths of approximately 6 feet below ground surface (bgs) consisted of natural deposits of brown to gray, loose to medium dense density Clayey SAND (SC) and stiff consistency Sandy Lean CLAY (CL). The N-values of the Sandy soil deposit varied from 9 to 15 bpf, with an approximate average value of 11 bpf within 0 to 6 feet bgs.

**Stratum II:** Underlying the Clayey Sands and extending to boring termination depths of approximately 20 feet bgs, we encountered tan to gray, medium dense density SAND WITH SILT (SP-SM). The N-values of the Sandy soil deposit varied from 15 to 4 bpf, with an approximate average value of 9 bpf within 6 to 20 feet bgs.

### 3.4 Groundwater Observations

The groundwater table (GWT) was encountered at depths of approximately 9 to 12 feet bgs in all borings. It is not expected that the GWT will be encountered by foundation excavations for the building. However, if the GWT is encountered in utility or other deeper excavations, well-pointing will likely be required to achieve dewatering as well as an excavation plan.

The location of the groundwater table can vary as a result of seasonal fluctuations in precipitation, evaporation, surface water runoff, local topography, and other factors not immediately apparent at the time of this exploration. Normally, the highest groundwater levels occur in the late winter and spring and lowest levels occur in the late summer and fall. The contractor should determine actual groundwater conditions prior to construction to evaluate their impact on the work. Seasonal high groundwater elevations are generally anticipated to be 2 feet higher than currently reported groundwater elevations.
4.0 ANALYSIS AND RECOMMENDATIONS

The data developed during this study indicate that the subsoil and groundwater conditions at the site are generally adaptable for the construction of the proposed building and parking areas provided the preliminary recommendations in this report are followed. Shallow foundations are considered suitable for support of the proposed structure.

4.1 Site Preparation and Earthwork Operations

Prior to the start of construction, the site should be cleared of unsuitable materials such as: surface vegetation, topsoil materials, and concrete/asphalt/demolition debris, if encountered. It is recommended that the clearing operations extend laterally at least five (5) feet beyond the proposed building limits and two (2) feet beyond the proposed pavement limits and toe of fill slopes.

After stripping and removal of all unsuitable materials and cutting to the desired grade, and prior to Engineered Fill placement, subgrades should be observed by the Geotechnical Engineer. Proofrolling using a 10-ton drum roller or a loaded tandem axle dump truck having an axle weight of at least 10 tons should be used at this time to aid in identifying localized soft or unsuitable material. Any soft or unsuitable materials encountered during proofrolling should be removed and replaced with an approved backfill (Engineered Fill material) or scarified and recompacted as recommended by the Geotechnical Engineer.

After stripping and prior to Engineered Fill placement, all subgrades to a depth of at least 8 inches should be moisture conditioned to within +/- 2 percentage points of the soil’s optimum moisture content and be compacted to a dry density of at least 95% of maximum dry density as determined by the Standard Proctor (ASTM D-698). Engineered Fill should be placed and compacted in loose lifts not exceeding 8 inches to a dry density of at least 95% of the maximum dry density as determined by the Standard Proctor (ASTM D-698). Compaction should be accomplished with a large sheepsfoot roller for predominately Clayey soil materials and/or a heavy vibratory drum roller for Sandy soil materials (or equivalent compacting equipment). Field density testing of all subgrades and subsequent lifts of Engineered Fill should be performed at a rate of no less than one (1) test per 2,000 square feet in the building areas and one (1) test per 5,000 square feet in the pavement areas, but not less than one (1) test per lift.

The Engineered Fill should extend at least 5 feet beyond the building limits and 2 feet beyond the edges of the pavement before being sloped. Fill and cut slopes should not be constructed steeper than 3H:1V.

On-site soils which are free of organic material and deleterious debris and which meet the criteria for On-Site Borrow Engineered Fill provided below may be considered suitable for use as Engineered Fill for building and pavement support provided these soils are tested to verify their suitability prior to use and are moisture conditioned, as required. If off-site borrow soils are needed, they should consist of material satisfying the criteria for Imported Engineered Fill, as described below.
The ease by which on-site soils can be reused as Engineered Fill will depend upon their moisture content at the time of construction. At the time this report was prepared, some natural moistures, determined through laboratory testing, indicated that the on-site soils could potentially possess higher than optimum moistures. Therefore, scarifying and drying of the on-site soils may be required before recommended compaction can be achieved. Drying and compaction of wet soils is typically difficult during the cold, winter months. Accordingly, we recommend earthwork be performed during the warmer, drier times of the year. Proper drainage should be maintained during the earthwork phases of construction to prevent prolonged periods of standing water which has a tendency to degrade soil subgrades. Materials identified as “unsuitable” should be limited to landscaped areas and other areas without any significant loading.

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

**On-Site Borrow Engineered Fill:** Granular soil material classified as Sand (SM, SC, SP, SW or better) which is free of organics, debris, rubble greater than 4 inches in diameter, and other unsuitable material. Soils classified as Clay (CL and CH) or Silt (ML and MH) or soils containing excessive organic materials are not suitable for reuse as Engineered Fill below the building or within 2 vertical feet of pavement subgrades.

**Imported Engineered Fill:** Granular soil material classified as Sand (SM, SP, SW or better) with a maximum 20% passing the No. 200 Sieve (Silt or Clay) and free of organics, debris, rubble, and other unsuitable material. Imported Engineered Fill shall possess a minimum CBR quality of 15.

**Porous Fill:** Clean, crushed Gravel (such as No. 57 stone) with a maximum aggregate size of 1.5 inches or Clean, Poorly Graded Sand (SP) with no more than 12% passing the No. 200 Sieve.

**Foundation Undercut Backfill:** VDOT Size No. 57 Stone or Flowable Fill with a minimum compressive strength of 200 psi at 28 days. No. 57 Stone should be used for backfilling foundation excavations under wet or submerged conditions.

It is recommended that all materials to be used for Engineered Fill be analyzed and approved by ECS prior to their use on the site.

### 4.2 Foundations

Based on the results of our exploration and considering the maximum anticipated foundation loads previously described, we recommend that the proposed building be supported on shallow spread foundation systems. Foundations should be supported on suitable undisturbed natural soils or on properly compacted Engineered Fill. Foundations can be designed for a net allowable bearing pressure of 2,000 psf. The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. This bearing pressure provides a factor of safety of at least 3.0 against general shear failure.

Minimum foundation widths of 24 and 36 inches should be maintained for wall and column foundations, respectively, for general shear considerations. The bottoms of all foundations
should be placed at a depth of at least 18 inches below finished ground surface in order to develop the allowable bearing pressure and provide the necessary frost protection.

The foundations should be designed as structurally independent of the floor slabs-on-grade. This is to allow for some differential movement between the slabs and the foundations and walls and columns supported by the foundations. In addition, all continuous (strip type) foundations should be adequately reinforced with steel reinforcement in order to better distribute the foundation structural loading and to span soft zones or other inconsistencies in the subgrade bearing soils. New foundations should be positioned so as to avoid bearing above or in close proximity to any deep utilities or storm drains.

The bearing capacity at the final foundation elevation should be verified in the field by the Geotechnical Engineer or their qualified representative to assure that the in-situ bearing capacity at the bottom of each foundation excavation is adequate for support of the design loads. Where foundation excavations are undercut, the bottom of foundation elevation should be reestablished by backfilling with Foundation Undercut Backfill.

Provided our recommendations outlined herein are followed, total foundation settlement is expected to be less than 1.0 inch. Differential settlement between similarly loaded foundations is not expected to exceed ½ inch. These settlements will occur more or less immediately during construction. The structural design and specification of architectural finishes should consider the potential aesthetic impact of these settlements. This evaluation is based on our engineering experience of the soil conditions and the anticipated structural loading and is to guide the structural engineer with the design.

4.3 Seismic Classification

The 2012 Edition of the International Building Code (IBC) requires that a seismic Site Class be assigned for new structures. The Seismic Site Class may be determined by calculating a weighted average of the N-values of subsurface materials encountered through a depth of 100 feet or to a depth of consistent values as determined by Standard Penetration Test methods. Alternatively, engineering judgment based on local experience may be applied.

We have evaluated the seismic site coefficient in accordance with the IBC. Based on our experience with seismic testing in this geologic environment, we estimate the subsurface profile of this site to have Site-Class E.

4.4 Floor Slab Design

Floor slabs may be supported on suitable natural soils and/or properly placed and compacted Engineered Fill, or approved subgrade material. Slab subgrades should be re-worked to a depth of 8 inches and re-compacted to a dry density of at least 95% the maximum dry density as determined by the Standard Proctor Method (ASTM D 698), as previously discussed.

An effective modulus of subgrade reaction, \( k_s \), of 200 pci may be used to design the floor slab. Floor slab subgrades should be proofrolled by the Geotechnical Engineer or their qualified representative during the time of construction to aid in locating any soft or unsuitable materials. Fill placed for support of floor slabs should satisfy the criteria outlined in this report.
We recommend that the floor slab be isolated from the shallow foundations so differential settlement of the structure will not induce shear stresses in the floor slab. Also, in order to minimize the crack width of any shrinkage cracks that may develop near the surface of the slab, we recommend mesh reinforcement be included in the design of the floor slab. The mesh should be within the top half of the slab to be effective.

The floor slab should be directly supported by a Porous Fill layer consisting of a minimum of 4 inches Clean SAND (SP). This Porous Fill layer will facilitate the fine grading of the building pad, provide more uniform bearing conditions and help prevent the rise of water to the bottom of the slab (capillary action). As an alternate to protect slab subgrades during adverse seasonal conditions, a 6-inch layer of Aggregate Base Material, VDOT Type I, Size 21A can be employed beneath the slabs. A suitable vapor barrier consisting of at least a 6 mil polyethylene sheet should be placed on top of the Porous Fill prior to the placement of concrete, with an overlap of at least 6 inches. Seams and penetrations in the vapor barrier should be taped. Floor slab subgrades should be recompacted immediately before placing the Porous Fill to repair any disturbance that may have occurred due to construction operations.

4.5 Site Drainage

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

To reduce contractor costs associated with unnecessary undercutting of soft, wet soils during construction, it is essential that positive drainage be maintained. Building and pavement subgrades frequently require undercutting as a result of wet surficial soils, standing water, and poor drainage. Temporary construction roads can be employed to minimize subgrade deterioration during wet seasonal conditions.

In order to enhance pavement performance and help protect subgrades, we recommend that ditches and/or subdrains be employed around the perimeter of pavements as discussed in Section 4.6. We do not anticipate the groundwater table will be encountered during general earthwork operations. However, seasonally perched water may be encountered. Temporary dewatering measures such as trenching and/or pumping from sumps should be sufficient to control perched water.

The groundwater table was encountered as shallow as about 9 feet below the surface. Soils at and below the level of the groundwater table consist of Sands with relatively high permeability. Excavation below the groundwater table will result in cave-in. Such excavations will likely require well pointing to achieve dewatering.
4.6 Pavements

For the construction of new pavements, we recommend that any soft, unstable and/or unsuitable materials be removed from design subgrade elevations in the pavement areas. The exposed surface should be proofrolled and carefully observed at the time of construction in order to aid in identifying any localized soft or unsuitable materials. This material where encountered, should be closely evaluated during construction and should be removed from below the pavement or moisture conditioned and compacted as required and/or considered necessary by the Geotechnical Engineer. Subgrades to a depth of 8 inches should be scarified, moisture conditioned, and compacted as recommended herein. In the event that large areas of unstable and unsuitable subgrade are encountered, stabilization utilizing geotextile, geogrid, moderate undercutting or a combination of these remedial type measures, could be considered under the advisement of the Geotechnical Engineer.

Soils expected to be exposed at design pavement subgrade elevations consist of Clayey SAND (SC). CBR test was not conducted as part of the scope of this preliminary report. The following pavement profiles are for planning purposes and are based on assumed traffic volumes and a CBR value of 10. The following preliminary pavement sections are provided for planning purposes only:

**LIGHT DUTY PAVEMENT**  
(Parking Stalls)

- Asphalt Surface: 2.0 inches Asphalt Surface Material Type SM-9.5A
- Aggregate Base: 8.0 inches Aggregate Base Material Type I Size 21A
- Subgrade: Stable and compacted to a dry density of at least 95% of the soil's Standard Proctor maximum dry density (ASTM D698) to a depth of at least 8 inches.

**HEAVY DUTY PAVEMENT**  
(Entrance Drives and Drive Lanes)

- Asphalt Surface: 1.5 inches Asphalt Surface Material Type SM-9.5A
- Asphalt Base Course: 3.0 inches Asphalt Base Material Type BM-25.0
- Aggregate Base: 8.0 inches Aggregate Base Material Type I Size 21A
- Subgrade: Stable and compacted to a dry density of at least 95% of the soil's Standard Proctor maximum dry density (ASTM D698) to a depth of at least 8 inches.

The above pavement profiles are for planning purposes only and final Geotechnical Report should be conducted in order to verify CBR values and finalize a pavement profile.

A rigid pavement should be used beneath dumpster pads (including the area the collection truck will be on while emptying the dumpster). These concrete pads should be comprised of a minimum of 6 inches of Portland Cement concrete with a minimum flexural strength of 650 psi and minimum 28-day compressive strength of 4,000 psi. The concrete should be air entrained and should be reinforced with welded wire mesh-type reinforcement. Construction joints or sawcut joints should be provided at a maximum spacing of 12 feet. Six (6) inches of untreated aggregate base material, Type I - Size 21A, is recommended beneath exterior concrete pavements.
An important consideration with regard to the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should minimize the possibility of the subgrade materials becoming saturated over a long period of time. Based upon the results of the soil test borings, groundwater should not significantly affect the performance of pavements; however, surface runoff water that is trapped during construction on the exposed subgrade soils could create localized deterioration of the soil's bearing capacity. Standing water that may develop on the surface of the pavement may be controlled by adequate design (surface graded to control runoff to desired locations - catch basins, drain inlets, gutters, etc.), adequate compaction of each lift of pavement section component material (to reduce localized settlements that result in ponding) and accurate grading of each lift of pavement section component material (to achieve the desired design grades). Standing water that may develop within the base course layer may be removed by installing temporary weep holes in drainage structures, construction of drainage swales and diversion ditches, and proper backfill and grading behind curbs to minimize water intrusion from behind the curbs.

Pavement subdrains or drainage ditches should be provided behind curbs in cut areas where the grades slope down towards the pavements. The invert grade of swales should be at least 1 ft below the pavement subgrade level. Pavement subdrains should be daylighted or connected to a storm sewer.

### 4.7 Construction Considerations

It has been our experience that newly exposed subgrades will deteriorate more rapidly upon demolition of overlying asphalt/concrete pavements or previously existing structures. The shallow soil materials on this site consist of Clayey Sands that are expected to be sensitive to moisture and disturbance once they are exposed. Because of this, care should be taken by the contractor to protect the existing subgrades once they are exposed. These materials should be carefully observed and tested to verify that they are suitable for supporting pavements, floor slabs, and building foundations in accordance with the report recommendations.

Exposure to the environment may weaken the soils at the foundation bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete.

All Engineered Fill materials should be placed, compacted and tested in accordance with the recommendations contained in this report. We recommend that all cut and fill operations be observed on a full-time basis by the Geotechnical Engineer or their qualified representative to determine if minimum earthwork and compaction requirements are being met.

In a dry and undisturbed state, the subgrade soils at the site should provide suitable subgrade support for Engineered Fill placement and construction operations. However, when wet, soils will degrade quickly either with or without disturbance from contractor operations. Therefore, positive site drainage should be maintained during earthwork operations so as to help maintain the stability of the soil. We recommend that the design depths of stone be placed in the pavement areas early in the construction so as to help protect these subgrades. Any subgrades...
left exposed to precipitation will quickly degrade, regardless of the construction traffic exposure. Attempting site work during adverse seasonal conditions will have significant effect on the site work budget as substantially more undercutting will be required. Ideally, earthwork should be performed during the summer or early fall (typically drier and warmer months).

Control of groundwater may become difficult in excavations that extend below about 9.0 feet. If shallow perched water is encountered, we expect that dewatering in shallow trenches could be accomplished by pumping from sumps adjacent to the construction excavations. However, for deeper excavations below the groundwater table, additional measures may require temporary dewatering systems such as well-pointing to permit stable excavations to be made. The specifications should alert the contractor to the potential presence of subsurface water, and it should be incumbent on the contractor to provide the means by which to satisfactorily dewater the site.
5.0 CLOSING

This preliminary report is provided for the exclusive use of Community Housing Partners. This preliminary report is not intended to be used or relied upon in connection with other projects or by other unidentified third parties. The use of this report by any undesignated third party or parties will be at the sole risk of the third party or parties and ECS Mid-Atlantic, LLC disclaims liability for any such third party use or reliance. Our conclusions and recommendations have been rendered in a manner consistent with the level and skill ordinarily exercised by members of the geotechnical engineering profession in the Commonwealth of Virginia.

Our preliminary conclusions and recommendations are based on design information furnished to us and our experience. They do not necessarily reflect variations in the subsurface conditions, which likely exist intermediate of our borings and in unexplored areas of the site due to inherent variability of the subsurface conditions in this geologic region, as well as past land use. Should such variations become apparent during construction, it will be necessary to reevaluate our conclusions and recommendations based upon on-site observations of the conditions.

If changes are made in the overall design or location of the building and other structures or if our assumptions differ significantly from the actual design, the recommendations presented in this report must not be considered valid unless the changes are reviewed by ECS Mid-Atlantic, LLC and our recommendations are modified or verified in writing. We request the opportunity to review the foundation plan, grading plan and applicable portions of the project specifications when the design is finalized. This review will allow us to check whether these documents are consistent with the intent of our recommendations.

Field observations, monitoring and quality assurance testing during earthwork and foundation installation are an extension of the geotechnical design. We recommend that the owner retain these services and we be allowed to continue our involvement throughout these phases of construction. ECS Mid-Atlantic, LLC is not responsible for the conclusions, opinions or recommendations of others based on the data in this report.
APPENDICES

APPENDIX I
Site Location Map
Boring Location Diagram

APPENDIX II
Profile & Soil Boring Logs

APPENDIX III
Unified Soil Classification System and Reference Notes for Boring Logs

APPENDIX IV
Laboratory Test Summary
APPENDIX I

Site Location Map
Boring Location Diagram
PROJECT: TRANQUILITY AT THE LAKES
5827 BURTON STATION ROAD
VIRGINIA BEACH, VIRGINIA

PROJECT NUMBER: 04:9974
DATE: SEPTEMBER 2014

BORING LOCATION DIAGRAM
APPENDIX II

Profile & Soil Boring Logs
NOTES:

1 SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
2 PENETRATION TEST RESISTANCE IN BLOWS PER FOOT (ASTM D1586).
3 HORIZONTAL DISTANCES ARE NOT TO SCALE.

GENERALIZED SUBSURFACE SOIL PROFILE

Tranquility at the Lakes
Community Housing Partners
5827 Burton Station Road, Virginia Beach, VA

PROJECT NO.: 9974 DATE: 9/5/2014 VERTICAL SCALE: 1"=5'
## Tranquility at the Lakes

**5827 Burton Station Road, Virginia Beach, VA**

**SITE LOCATION**

**CLIENT**
Community Housing Partners

**JOB #**
9974

**BORING #**
B-1

**PROJECT NAME**
Tranquility at the Lakes

**ARCHITECT-ENGINEER**

**SITE LOCATION**

5827 Burton Station Road, Virginia Beach, VA

**NORTHING**  
EASTING  
STATION

---

### Depth (ft) | Sample No. | Sample Type | Sample Dist. (in) | Recovery (in) | Description of Material |
--- | --- | --- | --- | --- | --- |
0 | S-1 | SS | 24 | 15 | Topsoil Depth [6"] (SC) CLAYEY SAND, Gray, Moist, Loose |
5 | S-2 | SS | 24 | 19 | |
10 | S-3 | SS | 24 | 20 | (SP-SM) SAND WITH SILT, Tan, Moist to Wet, Medium Dense to Loose |
15 | S-4 | SS | 24 | 20 | |
20 | S-5 | SS | 24 | 22 | |
25 | S-6 | SS | 24 | 24 | |
30 | S-7 | SS | 24 | 24 | END OF BORING @ 20.00’

---

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

---

**WL** 10.00  
**WS**  
**WD**  
Boring Started 08/21/14

**WL(BCR)**  
**WL(ACR)**  
Boring Completed 08/21/14  
Cave in Depth

**WL**  
RIG 45B ATV  
Foreman EarthCon  
Drilling Method HSA
### Tranquility at the Lakes

5827 Burton Station Road, Virginia Beach, VA

**NORTHING** | **EASTING** | **STATION**
---|---|---

<table>
<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SAMPLE NO.</th>
<th>SAMPLE TYPE</th>
<th>SAMPLE DIST. (IN)</th>
<th>RECOVERY (IN)</th>
<th>DESCRIPTION OF MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>S-1</td>
<td>SS</td>
<td>24</td>
<td>24</td>
<td>Topsoil Depth [5”] (SC) CLAYEY SAND, Brown to Gray, Moist, Medium Dense to Loose</td>
</tr>
<tr>
<td>5</td>
<td>S-2</td>
<td>SS</td>
<td>24</td>
<td>24</td>
<td>(CL) SANDY LEAN CLAY, Gray-Orange, Moist to Wet, Stiff</td>
</tr>
<tr>
<td>10</td>
<td>S-3</td>
<td>SS</td>
<td>24</td>
<td>19</td>
<td>(SP-SM) SAND WITH SILT, Tan, Wet, Medium Dense to Loose</td>
</tr>
<tr>
<td>15</td>
<td>S-4</td>
<td>SS</td>
<td>24</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>S-5</td>
<td>SS</td>
<td>24</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>S-6</td>
<td>SS</td>
<td>24</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>S-7</td>
<td>SS</td>
<td>24</td>
<td>22</td>
<td>END OF BORING @ 20.00’</td>
</tr>
</tbody>
</table>

---

**WATER LEVELS**

| DEPTH (FT) | SURFACE ELEVATION | WATER LEVELS ELEVATION (FT) | BLOWS/6” | 10 | 20 | 30 | 40 | 50+ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | |
| 5 | | | | | | | | | |
| 10 | | | | | | | | | |
| 15 | | | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |

---

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

---

**RIG** 45B ATV

**FOREMAN** EarthCon

**DRILLING METHOD** HSA
## Tranquility at the Lakes

### Site Location
5827 Burton Station Road, Virginia Beach, VA

### Boring # B-3

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Sample Type</th>
<th>Sample Dist. (in)</th>
<th>Recovery (in)</th>
<th>Description of Material</th>
<th>Water Levels</th>
<th>Bottom of Casing</th>
<th>Loss of Circulation</th>
<th>Water Levels Elevation (ft)</th>
<th>Blow/sf</th>
<th>Plastic Limit %</th>
<th>Water Content %</th>
<th>Liquid Limit %</th>
<th>Rock Quality Designation &amp; Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>SS</td>
<td>24</td>
<td>16</td>
<td>Topsoil Depth [7&quot;]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-2</td>
<td>SS</td>
<td>24</td>
<td>24</td>
<td>(SC) CLAYEY SAND, Gray, Dry to Moist, Medium Dense to Loose</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-3</td>
<td>SS</td>
<td>24</td>
<td>18</td>
<td>(SP-SM) SAND WITH SILT, Tan, Moist to Wet, Medium Dense to Loose</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-4</td>
<td>SS</td>
<td>24</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-5</td>
<td>SS</td>
<td>24</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-6</td>
<td>SS</td>
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<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-7</td>
<td>SS</td>
<td>24</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### End of Boring @ 20.00'

---

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

---

**WL** 9.00  **WS**  **WD**  **BORING STARTED** 08/21/14

**WL(BCR)**  **WL(ACR)**  **BORING COMPLETED** 08/21/14  **CAVE IN DEPTH**

**WL**  **RIG** 45B ATV  **FOREMAN** EarthCon  **DRILLING METHOD** HSA
### Client
Community Housing Partners

### Project Name
Tranquility at the Lakes

### Site Location
5827 Burton Station Road, Virginia Beach, VA

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Sample Type</th>
<th>Sample Dist (in)</th>
<th>Recovery (in)</th>
<th>Description of Material</th>
<th>Water Levels</th>
<th>Surface Elevation</th>
<th>Depth (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>SS</td>
<td>24</td>
<td>11</td>
<td>Topsoil Depth [7&quot;]</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>S-2</td>
<td>SS</td>
<td>24</td>
<td>16</td>
<td>(SC) CLAYEY SAND, Tan to Gray, Moist, Loose</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>S-3</td>
<td>SS</td>
<td>24</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>S-4</td>
<td>SS</td>
<td>24</td>
<td>19</td>
<td>(SP-SM) SAND WITH SILT, Tan, Moist to Wet, Medium Dense to Loose</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>S-5</td>
<td>SS</td>
<td>24</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>S-6</td>
<td>SS</td>
<td>24</td>
<td>22</td>
<td></td>
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<td>15</td>
</tr>
<tr>
<td>S-7</td>
<td>SS</td>
<td>24</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

**End of Boring @ 20.00'**

---

### Notes
- THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.
- WL 9.00 W L 08/21/14 BORING STARTED
- WL(BCR) 08/21/14 BORING COMPLETED
- 45B ATV RIG, EarthCon FOREMAN
- HSA DRILLING METHOD
### Tranquility at the Lakes

**SITE LOCATION**
5827 Burton Station Road, Virginia Beach, VA

**PROJECT NAME**
Tranquility at the Lakes

**ARCHITECT-ENGINEER**

**CLIENT**
Community Housing Partners

**JOB #**
9974

**BORING #**
B-5

**SHEET**
1 OF 1

---

#### Depth (ft) | Sample No. | Sample Type | Sample Dist. (in) | Recovery (in) | Description of Material | Water Levels Elevation (ft) | Blows/6" | 10 20 30 40 50+
--- | --- | --- | --- | --- | --- | --- | --- | ---
0 | S-1 | SS | 24 | 13 | Topsoil Depth [6”] (SC) CLAYEY SAND, Tan to Gray, Dry to Moist, Medium Dense | | |
5 | S-2 | SS | 24 | 14 | |
10 | S-3 | SS | 24 | 18 | (SP-SM) SAND WITH SILT, Tan, Moist to Wet, Medium Dense to Loose | |
15 | S-4 | SS | 24 | 20 | |
20 | S-5 | SS | 24 | 20 | |
25 | S-6 | SS | 24 | 21 | |
30 | S-7 | SS | 24 | 24 | |

**END OF BORING @ 20.00'**

---

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

**WL** 10.50  | **WS**  | **WD**  | BORING STARTED 08/21/14
--- | --- | --- | ---
**WL**(BCR) | **WL**(ACR)  | BORING COMPLETED 08/21/14  | CAVE IN DEPTH
**WL** | **RIG** 45B ATV  | **FOREMAN** EarthCon  | **DRILLING METHOD** HSA
APPENDIX III

Unified Soil Classification System and Reference Notes for Boring Logs
## UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

<table>
<thead>
<tr>
<th>Major Divisions</th>
<th>Group Symbols</th>
<th>Typical Names</th>
<th>Laboratory Classification Criteria</th>
</tr>
</thead>
</table>
| Coarse-grained soils | GW | Well-graded gravels, gravel-sand mixtures, little or no fines | \( C_u = D_{60}/D_{10} \) greater than 4
\( C_c = (D_{30})^2/(D_{10}D_{60}) \) between 1 and 3
Not meeting all gradation requirements for GW |
| | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines | Atterberg limits below "A" line or P.I. less than 4 Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| | GM | Silty gravels, gravel-sand mixtures | Atterberg limits below "A" line or P.I. less than 7 |
| | GC | Clayey gravels, gravel-sand-clay mixtures | Limits plotting in CL-ML zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| | SW | Well-graded sands, gravelly sands, little or no fines | Atterberg limits above "A" line or P.I. less than 4 |
| | SP | Poorly graded sands, gravelly sands, little or no fines | GM, GC, SM, SC Border 4 line cases requiring dual symbols |
| | SM | Silty sands, sand-silt mixtures | SC Clayey sands, sand-clay mixtures |

<table>
<thead>
<tr>
<th>Fine-grained soils</th>
<th>ML</th>
<th>Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity</th>
<th>D.L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CL</td>
<td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays</td>
<td>CH Inorganic clays of high plasticity, fat clays</td>
</tr>
<tr>
<td></td>
<td>OL</td>
<td>Organic silts and organic silty clays of low plasticity</td>
<td>MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts</td>
</tr>
<tr>
<td></td>
<td>MH</td>
<td>Inorganic clays of high plasticity, fat clays</td>
<td>CH Organic clays of medium to high plasticity, organic silts</td>
</tr>
<tr>
<td></td>
<td>OH</td>
<td>Organic clays of high plasticity, fat clays</td>
<td>CL-ML Organic clays of medium to high plasticity, organic silts</td>
</tr>
<tr>
<td></td>
<td>Pt</td>
<td>Peat and other highly organic soils</td>
<td>OL Organic clays of high plasticity, fat clays</td>
</tr>
</tbody>
</table>

* Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.
* Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder. (From Winterkorn and Fang, 1975)
REFERENCE NOTES FOR BORING LOGS

I. Drilling Sampling Symbols:

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

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

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

<table>
<thead>
<tr>
<th>Density</th>
<th>Relative Properties</th>
<th>Adjective Form</th>
<th>Under 4 blows/ft</th>
<th>4 to 10 blows/ft</th>
<th>11 to 30 blows/ft</th>
<th>31 to 50 blows/ft</th>
<th>Over 51 blows/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td>Adjective Form</td>
<td>12% to 49%</td>
<td>Very Loose</td>
<td>Loose</td>
<td>Medium Dense</td>
<td>Dense</td>
<td>Very Dense</td>
</tr>
<tr>
<td>Loose</td>
<td>5% to 12%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Particle Size Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders</td>
</tr>
<tr>
<td>Cobbles</td>
</tr>
<tr>
<td>Gravel</td>
</tr>
<tr>
<td>Coarse</td>
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<tr>
<td>Medium</td>
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<td>Fine</td>
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<td>Sand</td>
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<td>Coarse</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>Fine</td>
</tr>
<tr>
<td>Silt and Clay</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Blows/ft</th>
<th>Consistency</th>
<th>Unconfined Comp. Strength $Q_p$ (tsf)</th>
<th>Degree of Plasticity</th>
<th>Plasticity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 2</td>
<td>Very Soft</td>
<td>Under 0.25</td>
<td>None to slight</td>
<td>0 – 4</td>
</tr>
<tr>
<td>2 to 4</td>
<td>Soft</td>
<td>0.25-0.49</td>
<td>Slight</td>
<td>5 – 7</td>
</tr>
<tr>
<td>5 to 8</td>
<td>Medium Stiff</td>
<td>0.50-0.99</td>
<td>Medium</td>
<td>8 – 22</td>
</tr>
<tr>
<td>9 to 15</td>
<td>Stiff</td>
<td>1.00-1.99</td>
<td>High to Very High</td>
<td>Over 22</td>
</tr>
<tr>
<td>16 to 30</td>
<td>Very Stiff</td>
<td>2.00-3.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 30</td>
<td>Hard</td>
<td>Over 4.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

III. Water Level Measurement Symbols:

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

The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clay and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.
APPENDIX IV

Laboratory Test Summary
<table>
<thead>
<tr>
<th>Sample Source</th>
<th>Sample Number</th>
<th>Depth (feet)</th>
<th>MC1 (%)</th>
<th>Soil Type2</th>
<th>Atterberg Limits3</th>
<th>Percent Passing No. 200 Sieve4</th>
<th>Moisture - Density (Corr.)5</th>
<th>CBR Value6</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S-2</td>
<td>2.00 - 4.00</td>
<td>13.8</td>
<td>SC</td>
<td></td>
<td>45.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-5</td>
<td>S-3</td>
<td>4.00 - 6.00</td>
<td>9.2</td>
<td>SC</td>
<td></td>
<td>35.7</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

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

Particle Size Distribution Report

MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>GRAIN SIZE - mm.</th>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coarse</td>
<td>Fine</td>
<td>Coarse</td>
<td>Medium</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>1.1</td>
<td>3.8</td>
</tr>
<tr>
<td>○</td>
<td>0.0</td>
<td>0.0</td>
<td>2.0</td>
<td>6.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LL</th>
<th>PL</th>
<th>D85</th>
<th>D60</th>
<th>D50</th>
<th>D30</th>
<th>D15</th>
<th>D10</th>
<th>Cc</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>0.9376</td>
<td>0.4974</td>
<td>0.2973</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>○</td>
<td>1.5248</td>
<td>0.7754</td>
<td>0.6096</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Client</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>9974</td>
<td>Community Housing Partners</td>
<td></td>
</tr>
<tr>
<td>Project:</td>
<td>Tranquility at the Lakes</td>
<td></td>
</tr>
<tr>
<td>○ Source of Sample: B-4</td>
<td>Depth: 2.00-4.00</td>
<td>Sample Number: S-2</td>
</tr>
<tr>
<td>○ Source of Sample: B-5</td>
<td>Depth: 4.00-6.00</td>
<td>Sample Number: S-3</td>
</tr>
</tbody>
</table>

Tested By: rjw
Checked By: rjw