March 28, 2023

Knoxville's Community & Development Corporation
Redevelopment Department
901 North Broadway Street
Knoxville, Tennessee

ATTENTION: Mr. James Hatfield
jhatfield@kcdc.org

Subject: **REPORT OF GEOTECHNICAL EXPLORATION**
Vermont Avenue Multi-Family Development
1800 & 1900 Vermont Avenue
Knoxville, Tennessee
GEOServices Project No. 21-23276

Dear Mr. Hatfield:

We are submitting the results of the geotechnical exploration performed for the subject project. The geotechnical exploration was performed, in accordance with our Proposal No. 11-23173, dated February 1, 2023, and as authorized by you. The following report presents our findings and recommendations for the proposed project. Should you have any questions regarding this report, or if we can be of any further assistance, please contact us at your convenience.

Sincerely,

GEOServices, LLC

Michael D. Kelso, P.E.
Geotechnical Project Manager
TN 122,250

Ibrahim M. Aklouk, E.I.
Geotechnical Staff Professional

REPORT OF

GEOTECHNICAL EXPLORATION

Vermont Avenue Multi-Family Development

1800 & 1900 Vermont Avenue

Knoxville, Tennessee

GEOServices Project No. 21-23276

Submitted to:

Knoxville's Community & Development Corporation
Redevelopment Department
901 North Broadway Street
Knoxville, Tennessee

Submitted by:

GEOServices, LLC
2561 Willow Point Way
Knoxville, TN 37931

Phone (865) 539-8242
Fax (865) 539-8252

GEOServices, LLC-Geotechnical and Materials Engineers
A UES COMPANY

TABLE OF CONTENTS

Contents **Page**

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of our geotechnical exploration was to explore the subsurface conditions for the proposed multi-family development to be located off Vermont Avenue in Knoxville, Tennessee in effort to provide geotechnical recommendations for site preparation, grading, and for design and construction of the foundation system. Additionally, recommendations for light and heavy-duty pavements are included.

1.2 PROJECT INFORMATION AND SITE DESCRIPTION

Project information was provided via email correspondence between Mr. James Hatfield of KCDC and Mr. Stephen Martin of GEOServices, LLC on February 17, 2023. We were provided with a Concept Site Plan dated February 10, 2023, as prepared by Smith Gee Studio, which included twenty-eight (28) proposed boring locations.

Based on the provided information, it is our understanding that the proposed project is to consist of the construction of several three-story multi-family housing structures, concrete retaining walls, associated pavement, and landscaping areas. Provided loading information indicates that maximum column and continuous foundation loads will be less than 75 kips and 6 kips per linear foot, respectively. Based on our experience with similar projects we anticipate the buildings will be wood-framed and supported on a system of conventional shallow foundations with concrete slabs-on-grade.

Available topographic information (KGIS) indicates existing site elevations range from approximately 1070 to 965 feet MSL (Mean Sea Level), generally slopping downwards from north to south. We have not been provided with a final grading plan at this time; however, we anticipate the site will require cuts/fills of approximately 20 to 30 feet.

The proposed development is generally bordered by Vermont Avenue to the northwest, Virginia Avenue to the southeast, and residential properties on the remaining sides. At this time, the site consists of short grass and a few mature trees. In addition, a retaining wall along with a pavement section exist on the southwestern corner of the site. Based on historical aerial imagery (Google Earth and KGIS), it appears

that a series of residential structures existed on site sometime between 1935 and 2012 when they were demolished. The site has remained relatively unchanged since then.

1.3 SCOPE OF STUDY

This geotechnical exploration involved a site reconnaissance, field drilling, laboratory testing, and engineering analysis. The following sections of this report present discussions of the field exploration, site conditions, and conclusions and recommendations. Following the text of this report, Appendix A presents figures and test boring records.

The scope of our geotechnical engineering services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air, on, or below, or around this site. Statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2.0 EXPLORATION AND TESTING PROGRAMS

2.1 FIELD EXPLORATION

The site subsurface conditions were explored by drilling twenty-eight (28) soil test borings, as specified in the provided concept plan. Fourteen borings were drilled in proposed buildings, while the remaining fourteen borings were drilled in the pavement and landscape areas. The borings were located in the field by GEOServices (GEOS) personnel using the provided site plan and a hand-held GPS unit. The soil test borings were drilled between March 8 and 10, 2023 and advanced using 3¼-inch hollow stem augers and a track mounted drill rig.

The approximate locations of the soil test borings are shown on Figure 2 of Appendix A of this report. The depths in this report reference the ground surface that existed at the time of this exploration. The elevations for the borings were obtained from the available topographic map (KGIS) and should be considered approximate. Detailed logs for soil test borings can also be found in Appendix A.

Within each boring, Standard Penetration Testing (SPT) and split-spoon sampling were performed on 2½-foot intervals in the upper 10 feet and on 5-foot centers thereafter. SPT and split-spoon sampling were performed in accordance with ASTM D1586. In split–spoon sampling, a standard 2-inch O.D. split-spoon sampler is driven into the bottom of the boring with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the last 12 inches of the standard 18 inches of total penetration is recorded as the SPT (N-value). These N-values are indicated on the boring logs at the testing depth and provide an indication of the consistency of the cohesive soils.

2.2 LABORATORY TEST PROGRAM

After completion of the field drilling and sampling phase of this project, the soil samples were returned to our laboratory where they were visually-manually classified in general accordance with the Unified Soil Classification System (USCS – ASTM D2487) by a GEOServices geotechnical professional. Select samples were then tested for moisture content (ASTM D2216) and Atterberg Limits testing (ASTM D4318). The laboratory testing was ongoing, and the results will be provided under transmittal cover letter once completed.

3.0 SUBSURFACE CONDITIONS

3.1 GEOLOGIC CONDITIONS

The project site lies within the Appalachian Valley and Ridge Physiographic Province of East Tennessee. This Province is characterized by elongated, northeasterly-trending ridges formed on highly resistant sandstone and shale. Between ridges, broad valleys and rolling hills are formed primarily on less resistant limestone, dolomite, and shale.

Published geologic information indicates the project site is underlain by bedrock of the Copper Ridge Dolomite formation of the Knox Group. This formation is generally composed of gray, coarse to medium-grained, knotty dolomite in the upper zone and dark-gray crystalline dolomite in the lower zone. This formation typically weathers to produce a thick silty clay residual soil with dark iron stains. Silica in the form of chert is resistant to weathering and scattered in various quantities throughout the residuum.

Since the bedrock underlying this site contains carbonate rock (i.e., limestone/dolomite), it is susceptible to the hazards of irregular weathering, cave and cavern conditions, and overburden sinkholes. Carbonate rock, while appearing very hard and resistant, is soluble in slightly acidic water. This characteristic, plus differential weathering of the bedrock mass is responsible for these hazards. Of these hazards, the occurrence of sinkholes is potentially the most damaging to overlying soil-supported structures. Sinkholes occur primarily due to differential weathering of the bedrock and *flushing* or *raveling* of overburden soil into the cavities within the bedrock. This loss of solids creates a cavity, or *dome*, in the overburden. Growth of the cavity over time, or excavation over the *dome*, can create a condition in which rapid subsidence, or collapse, of the roof of the dome occurs.

A certain degree of risk with respect to sinkhole formation and subsidence should be considered with any site located within geologic areas underlain by potentially soluble rock units. While a rigorous effort to assess the potential for sinkhole formation on this site was beyond the scope of this evaluation, our borings did not encounter obvious indications of sinkhole development. In addition, we did not observe surface signs of sinkhole activity at the site. However, some closed depressions, which denote past sinkhole activity, are shown on the United States Geological Survey (USGS) topographic map in the area of the site.

Based the results of this exploration, it is our opinion that the risk of sinkhole development at this site is no greater than at other sites located within similar geologic settings which have been developed successfully. However, the owner must be willing to accept the moderate risk of sinkhole development at this site. The risk of sinkhole development can be reduced by following the recommendations provided in the *Sinkhole Corrective Actions* (Section 5.6) section of this report.

3.2 SOIL STRATIGRAPHY

The following subsurface description is of a generalized nature to highlight the subsurface stratification features and material characteristics at the boring locations. The boring logs included in Appendix A of this report should be reviewed for specific information at each boring location. Information on actual subsurface conditions exists only at the specific boring locations and is relevant only to the time that this exploration was performed. Variations may occur and should be expected at the site.

Surficial Materials

Initially, the majority of the boring locations encountered a surficial layer, generally consisting of 1 to 10 inches of topsoil. While the thickness of the surficial materials were similar, we anticipate the actual depths of surficial materials will likely vary significantly across the site, as the site has been previously developed. Therefore, we recommend the contractor evaluate the surficial material depth at the start of construction for bidding purposes.

Fill Materials

Each of the borings, with the exception to boring B-16 encountered apparent fill materials, consisting of reddish brown, orangish brown, tan, dark brown, dark gray, and black fat (high plasticity) and lean (low plasticity) clayey soils with varying amounts of gravel, organics, organic odor, topsoil, silt, and sand. We note five borings (B-5, B-11, B-20, B-22, and B-25) encountered deleterious materials in their clay matrices, which include plastic, concrete, asphalt, glass, wood, and brick fragments. In addition, two borings (B-9 and B-27) encountered a gray, dark gray, and orangish brown gravel layer with varying amounts of concrete and clay. Lastly, a dark gray and orangish brown concrete layer with clay was encountered in boring B-24.

The fill materials extended to depths ranging from approximately 3 to 20 feet below existing grade. We note B-20 was terminated in fill materials. Therefore, the fill may extend to a greater depth in that area. The SPT N-values within the fill materials generally ranged from 3 blows per foot (bpf) to 50/2” (50 blows per 2 inch of penetration), indicating soft to very stiff consistencies in the fine-grained materials and medium dense to very dense relative densities within the coarse-grained materials. We note the SPT N-values were likely inflated by dense fill or encountered deleterious materials.

Residuum

Each of the borings, with the exception of B-20 encountered apparent residual materials. The residual generally consisting of reddish brown, tan, light gray, and orangish brown fat and lean clayey soils with varying amounts of sand, silt, black manganese nodulus, and chert fragments.

The SPT N-values within the residual materials generally ranged from 5 bpf to 50/4”, indicating firm to hard consistencies in the fine-grained materials. The exceptions were isolated samples in five locations (B-3, B-11, B-14, B-22, and B-27) at depths ranging from the 5 to 25 feet, which had N-values between 1

and 4 bpf, indicating very soft to soft consistencies in the fine-grained materials. We SPT N-values greater than 20 bpf were likely influenced by denser materials, such as chert fragments in the soil matrix.

Auger Refusal

Auger refusal was not encountered in any of the boring at the time of our drilling activities. Each of the borings were extended to the predetermined depths, ranging between 10 and 30 feet below existing grade without encountering refusal materials. Auger refusal is a designation applied to any material that cannot be readily penetrated by the drill auger and is normally indicative of a very hard or very dense material, such as large boulders or the upper surface of bedrock.

Ground Water

Groundwater was encountered in one location (B-7) at approximately 6 feet below existing grade. The remaining twenty-seven locations did not encounter apparent groundwater during or upon completion of drilling activities. Extended water levels were not obtained because the borings were backfilled upon completion as a safety precaution. Groundwater levels may fluctuate due to seasonal changes in precipitation amounts, construction activities in the area, and/or other factors. In addition, we note that stabilized water levels can sometimes be difficult to obtain as the encountered soils are known to be relatively impermeable.

It is possible for groundwater to exist within the depths explored during other times of the year depending upon climatic and rainfall conditions. Additionally, discontinuous zones of perched water may exist within the overburden materials. The groundwater information presented in this report is the information that was collected at the time of our field activities.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 SITE ASSESSMENT

Based on the results of our geotechnical exploration, it is our opinion that the site is generally adaptable for the proposed construction. However, certain challenges are present and will affect development of the site, which we have outlined in the following sections.

4.1.1 Existing Fill Materials and Existing Structures

Based on historical aerial imagery (Google Earth and KGIS), residential structures previously occupied the site sometime between 1935 and 2012. In addition, a retaining wall along with a pavement section currently exists on the southwestern corner of the site. Prior to construction, we recommend existing structures, pavements, and deleterious materials be completely removed and replaced with adequately compacted structural fill.

During our exploration, apparent fill materials were encountered in each of the borings, with the exception to boring B-16. The fill materials consisted of clayey soils with varying amounts of gravel, organics, silt, sand, plastic, concrete, asphalt, glass, wood, and brick fragments. In addition, two borings (B-9 and B-27) encountered a gravel layer with varying amounts of concrete and clay, while boring B-24 encountered a concrete layer with clay. The fill materials generally extended to depths ranging from approximately 3 to 8 feet below existing grade. However, we note B-20 was terminated in fill materials at a depth of 20 feet below existing grade. Therefore, the fill may extend to a greater depth in that area. It is possible that deeper zones or pockets of fill materials may be encountered between our widely spaced borings, as the site has been previously developed.

There is an inherent risk of excessive total or differential settlement of foundations constructed on undocumented fill materials. Given that the fill contained deleterious materials and contained soft zones, it is not likely the fill was placed in a controlled (engineered) manner. Accordingly, there are certain risks associated with construction on these types of fill materials. The risk primarily consists of excessive and/or non-uniform settlement caused by extensive zones or pockets of soft, loose, or uncompacted material or extensive zones of deleterious materials. We do not recommend the uncontrolled fill be relied upon for direct shallow foundation support of the structures given these risks.

Where encountered in the building area, the fill should be completely undercut to the underlying residual soils within the area extending at least 5 feet beyond the proposed footprint of the structure. The undercut excavation may be brought back to grade using structural soil fill.

Removing the existing fill in its entirety may not be economical or practical given the depth of fill encountered in portions of the site. Suppose the owner wants to reduce the risk for differential settlements associated with leaving much of the fill in place. In that case, we recommend the client

consider rammed aggregate piers as an intermediate foundation system. A discussion about rammed aggregate pier is presented later within this report. At a minimum, debris-laden fill, deleterious, or soft materials encountered during grading or construction and/or between our boring locations should be undercut entirely and disposed of off-site. A budget contingency for undercutting and replacement of unsuitable materials encountered during construction should be included.

4.1.2 Lower Consistency and High Plasticity Materials

While we anticipate the existing residual materials appear to be suitable for re-use as structural soil fill, firm consistency materials were encountered in 14 out of 28 locations at depths ranging from beneath the fill layer surface to termination depth. In addition, isolated zones of very soft to soft materials were noted in five locations (B-3, B-11, B-14, B-22, and B-27) at depths ranging from approximately 5 to 25 feet below existing grade. While some remediation of the subgrade will likely be necessary, the amount will be dependent on final grades and time of year of construction.

We recommend performing close construction observations during earthwork and foundation excavations activities to observe the consistency and suitability to support the proposed construction. Any areas observed to be unsuitable for use as foundation or subgrade support should be remediated accordingly. Generally, remediation of these types of soils consists of undercutting and replacing a minimum of 2 feet below foundation bearing elevation with properly compacted structural soil fill or compacted dense graded aggregate.

The depth of undercutting should be determined based upon observations and tests performed at the time of construction. It may be of added benefit to the client to consider an additional exploration with test pits at the onset of construction to better assess the quality and composition of the subsurface materials present. During this additional exploration, bulk sampling of the soils may be performed for additional classification testing for their potential reuse as Engineered Fill and will allow for better visual assessment as to the character and consistency of potential fill across the site. This excavation of test pits can be performed with a trackhoe or similar piece of heavy construction equipment which will also allow for confirmation of auger refusal within structural areas.

Subgrades for lightly loaded slabs and/or pavement areas can typically be supported on materials which proofroll successfully. Proofrolling should be observed by a geotechnical engineer or by a qualified

representative in order to help identify areas requiring subgrade support correction. Where the subgrade does not pass proofrolling, remediation should be anticipated.

In addition, the majority of the boring locations encountered materials which were classified as high plasticity (fat) clays at depths ranging from the existing surface to boring termination depths. Therefore, these materials will likely be encountered during grading activities, especially in cut areas. Typically, these materials are marginally suitable for foundation, slab or pavement support and will likely impede site grading activities as they are susceptible to moisture changes. We have provided recommendations pertaining to the fat clayey soils in this report.

Based on our exploration, we anticipate the residual soils classified as lean clays may be suitable for reuse; however, the client should understand that some variation should be expected between our widely spaced borings. The existing onsite residual fat clays may also be mixed with lower plasticity materials during earthwork grading to produce a material which meets the recommended criteria. In addition, this may include the lower consistency materials, free of deleterious materials, if the soils are scarified (or undercut) and recompacted in areas where minimal grading is necessary.

4.1.3 Site Grading

Based on our anticipation of cuts/fills between 20 and 30 feet, retaining walls and/or below grade walls will likely be required to facilitate grade changes throughout the site. We anticipate sloping may be considered along the perimeter and between the upper and lower parking lots depending on site constraints. The following recommendations are provided for consideration during development of the site design and are generally applicable for dry slopes of up to 20 feet in maximum height.

Our experience suggests that excavation side slopes through the residual soil overburden at the site may be laid back at a 2.0H:1V (Horizontal: Vertical) slope. Permanent fill slopes placed on a suitable foundation should be constructed at 2.0H:1V, or flatter. Before final grading of a fill slope, the edge of the compacted fill should extend at least 10 feet horizontally beyond the outside edge of the building foundations and at least 5 feet beyond paved areas. Fill slopes should be adequately compacted. Cut and fill slope surfaces should be protected from erosion by grassing or other means. Permanent slopes of 3H:1V or flatter may be desirable for mowing.

We strongly encourage the client to confer with the design team and a contractor with regard to the recommendations contained in this report, in an effort to assess potential costs and schedule. Additional onsite testing during construction can further classify the fill materials suitability for reuse as structural soil fill.

4.2 SITE PREPARATION RECOMMENDATIONS

4.2.1 Subgrade

Site stripping within the proposed construction areas (building and pavement) should include the removal of construction debris, vegetation, topsoil, unsuitable fill, rock fragments greater than 6 inches, and gravel. While observed construction debris was limited to seven borings (B-6, B-9, B-11, B-12, B-24, and B-27), the previous development and grading may have buried pockets of these materials in unexplored locations across the site, which should be completely undercut and removed. The stripping operations should extend a minimum of 5 feet beyond the limits of proposed pavement areas and 10 feet beyond building footprints. These areas should be observed by a geotechnical engineer upon grading to confirm the recommendations in this report are followed.

The site also contains large, mature trees. Along with the tree, the respective root system should also be removed. Removal of trees and their root system upturns and loosens the surrounding soils. If the disturbed soils are suitable and are to remain, then they will require additional compactive effort and testing prior to proof-roll testing and fill placement. The client should budget for additional removal of these root systems and replacement with structural soil fill.

After the completion of stripping operations and excavation to reach the planned subgrade elevation, we recommend that the subgrade be proofrolled with a fully-loaded, tandem-axle dump truck or other pneumatic-tired construction equipment of similar weight. The geotechnical engineer or his representative should observe proofrolling. Areas judged to perform unsatisfactorily (e.g., pumping and/or rutting) by the engineer should be undercut and replaced with structural soil fill or remediated at the geotechnical engineer's recommendation. Areas to receive structural soil fill should also be proofrolled prior to the placement of new fill. Proofrolling operations should extend a minimum distance of 10 feet beyond the building perimeter and 5 feet beyond pavement areas.

4.2.2 Structural Soil Fill

Material considered suitable for use as structural fill should be clean soil free of organics and other deleterious material, containing no rock fragments greater than 6 inches in dimension. Preferably, structural soil fill material should have a standard Proctor maximum dry density of 90 pounds per cubic foot (pcf), or greater, and a PI value of 35 percent, or less. The material to be used as structural fill should be tested by the geotechnical engineer to confirm that it meets the project requirements before being placed.

Based on our exploration, the soils classified as low plasticity (lean) clay and free of deleterious materials may be suitable for re-use as structural soil fill. Further assessment of the onsite materials can be made during observation of the undercut and earthwork activities performed on site or prior to construction using test pits. The higher plasticity materials may be mixed with lower plasticity materials during earthwork grading to produce a material which meets the recommended criteria, or the material treated using lime or cement to lower the soil plasticity.

Structural fill should be placed in loose, horizontal lifts not exceeding 8 inches in thickness. Each lift should be compacted to at least 98 percent of the soil's maximum dry density per the standard Proctor method (ASTM D 698) and within the range of minus (-) 2 percent to plus (+) 3 percent of the optimum moisture content. Each lift should be tested by geotechnical personnel to confirm that the contractors' method is capable of achieving the project requirements before placing subsequent lifts. Areas which have become soft or frozen should be removed before additional structural fill is placed.

4.2.3 Dense Graded Aggregate

Dense graded aggregate (DGA) fill may be used as backfill in undercut excavations and in utility trench excavations. The DGA used for this section should be Type A and Grading D or E in accordance with Section 903.05 of the Tennessee Department of Transportation (TDOT) specifications. The DGA fill should be placed in loose, horizontal lifts not exceeding 8 inches in loose thickness. Each lift should be compacted to at least 98 percent of maximum dry density per the standard Proctor method (ASTM D 698). Each lift should be compacted, tested by geotechnical personnel, and approved before placing subsequent lifts.

4.3 FOUNDATION RECOMMENDATIONS

4.3.1 Shallow Foundations

Upon completion of site preparation, as previously recommended, our opinion is that the proposed building can be supported on conventional spread footing foundations bearing on approved properly compacted structural soil fill or suitable residual materials following the recommendations of this report. We recommend that if lower consistency soils are encountered during footing excavations, they be undercut and backfilled with compacted structural soil fill in the building area. Spread and continuous footings supported on adequately placed and compacted structural soil fill or suitable residual soils can be designed for an allowable soil bearing pressure of 2,000 psf.

We anticipate the majority of the additional undercut will be in areas of minimal grading where these materials will not be removed. Areas to receive more than 5 feet of structural soil fill should be stripped and proof-rolled to determine if additional undercutting may be necessary. The undercut areas should be backfilled using structural soil fill and extend at least 10 feet laterally beyond the building footprint in areas where the overexcavation is necessary. Where undercut and replacement is performed, we recommend excavations be backfilled the same day to reduce the risk of sidewall collapse.

We recommend that continuous foundations be a minimum of 18 inches wide and isolated spread footings be a minimum of 24 inches wide to reduce the possibility of a localized punching shear failure. Exterior foundations should be designed to bear at least 18 inches below finished exterior grade to develop the design bearing pressure and to protect against frost heave.

The available lateral capacity of shallow foundations includes a soil lateral pressure and coefficient of friction as described in the IBC, Section 1806. Footings will be embedded in material similar to those described as Class 5 in Table 1806.2. Where footings are cast neat against the sides of excavations, an allowable lateral bearing pressure of 100 psf per foot depth below natural grade may be used in computations. Resistance to lateral sliding represented by a value of adhesion of 130 psf may be used for clays similar to those described as soil Class 5. An increase of one-third in the allowable lateral capacity may be considered for transient load combinations, including wind or earthquake, unless otherwise restricted by design code provisions.

A geotechnical representative should be retained to perform foundation subgrade tests to confirm that the recommendations provided in this report are consistent with the site conditions encountered. Some undercutting of lower consistency fill soils where encountered in foundation excavations should be anticipated. A dynamic cone penetrometer (DCP) is commonly utilized to provide information that is compared to the data obtained in the geotechnical report. Where unacceptable materials are encountered, the material should be excavated to stiff, suitable soils or remediated at the geotechnical engineer's direction.

Based on the known subsurface conditions, geology, and past experience, we estimate foundations supported on the recommended structural soil fill or other approved soils should experience maximum total and differential settlements of less than 1 inch and ½ of an inch, respectively. The settlement information provided was with maximum column and continuous foundation loads on the order of 75 kips and 6 kips per linear foot (kpf), respectively, and an allowable bearing pressure of 2,000 psf. Additionally, this information assumes that the site is prepared in accordance with our recommendations provided in this report including allowing the proposed fill time to consolidate under its own weight. If these parameters are determined to be incorrect, we should be notified to reevaluate the settlements for the building.

4.3.2 Intermediate Foundations (Rammed Aggregate Pier Alternative)

Due to the amount and quality of fill materials encountered, it may be impractical to remove the materials in their entirety. Instead, the client may elect to utilize an intermediate foundation system, such as rammed aggregate piers, to improve the existing fill and residual soils to allow shallow foundation support of structures. Rammed aggregate piers are constructed by initially drilling a hole of predetermined diameter to a predetermined depth. The rammed aggregate pier designer will determine these depths. Once the required hole depth is achieved, the excavation is backfilled in lifts generally 18 to 24 inches thick with dense graded aggregate stone or approved alternative.

Upon completion of backfilling, dynamic cone penetrometer (DCP) testing is often performed to confirm adequate compaction of the backfill material. GEOServices should review the rammed aggregate pier design to confirm that the appropriate design parameters are used. Additionally, at least one modulus test on a sacrificial pier should be performed to confirm that the designed piers will perform satisfactorily. GEOServices should observe the modulus test.

The presence of buried impenetrable materials at this site could present some difficulties during rammed aggregate pier installation. Therefore, it will be required that the hard material which impedes rammed aggregate pier installation be removed by the project grading contractor and the excavation backfilled as recommended by the rammed aggregate pier designer.

The recommended allowable soil bearing capacity for the design of the foundations is 4,000 psf, where the rammed aggregate piers are used. Where rammed aggregate piers are installed, we recommend a friction coefficient of 0.45 be utilized. The values for allowable bearing pressure and frictional resistance should be confirmed and approved by the selected rammed aggregate pier designer.

4.3.3 Slabs-on-Grade

Following the recommended site preparation activities, it is our opinion that the floor slab can be grade supported on structural soil fill materials or suitable residual soils. Observing proofrolling of the subgrade, as discussed earlier in this report, should be accomplished to identify soft or unstable soils which should be removed from the floor slab area prior to fill placement and/or floor slab construction. Based on our exploration, the client should anticipate and budget for some remediation of the existing materials at foundation subgrade.

We recommend that a minimum 4-inch-thick granular mat be placed beneath the floor slab to enhance drainage and provide a capillary break. The subgrade should be proofrolled and approved prior to the placement of the crushed stone. Based on the conditions encountered on this site, we recommend that the floor slabs be designed using a subgrade modulus of 100 pounds per cubic inch (pci). This modulus is appropriate for small diameter loads (i.e. a 1ft x 1ft plate) and should be adjusted for wider loads.

4.4 SEISMIC DESIGN CRITERIA

In accordance with the International Building Code (IBC), 2018 and ASCE 7-22, we are providing the following seismic design information. After evaluating the SPT N-value data from the soil test borings and considering the changes to the site and foundation types, it was determined that the subsurface conditions at the site most closely matched the description for “Seismic Site Class D” or “Stiff Soil”. Table 1 provides the spectral response accelerations for both short and 1-second periods, which may be used for design.

Table 1 – Seismic Design Parameters – ASCE 7-22

Structure	S_s g	S_1 g	S_{DS} g	S_{D1} g
Vermont Avenue Multi-Family Development – Knoxville, TN	0.56	0.12	0.38	0.17

The short and 1-second period values indicate the structure should be assigned a Seismic Design Category "C" using the published information. The provided values are based on the results of our field exploration and the assumption that the structure will be designed utilizing a Risk Category I, II or III. If these assumptions are incorrect, we should be contacted to reevaluate the seismic design information.

In accordance with IBC 2018 sections 1803.5.11 and 1803.5.12, we have provided a discussion on the following geologic and seismic hazards: slope instability, liquefaction, total/differential settlement, and surface displacement due to faulting or seismically induced lateral spread or lateral flow.

Liquefaction occurs when soil, primarily saturated cohesionless soils, undergo a loss in strength due to monotonic, transient, or repeated disturbance that commonly occurs during a seismic event (Kramer 1996). This loss of strength occurs due to increased pore water pressures caused by an undrained condition. The increase in pore water pressure decreases the effective stress in the soil, thus reducing the soil's ability to support any applied loads. For liquefaction to occur, there must be an increase in pore pressure meaning the soil must be saturated and be able to behave in an undrained condition. According to the NHI 2011 Reference Manual on LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations, if any of the following criteria are satisfied then a significant liquefaction hazard does not exist:

- The geologic materials underlying the site are either bedrock or have very low liquefaction susceptibility according to the relative susceptibility ratings shown in the Estimated Susceptibility of Sedimentary Deposits to Liquefaction During Strong Ground Motion table presented by Youd and Perkins in 1978.
- The soils below the groundwater table at the site are one of the following:
    - Clayey soils which have a clay content greater than 15%, liquid limit greater than 35%, or natural water content less than 90% of the liquid limit.
    - Sand with a minimum corrected SPT $(N_1)_{60}$ value of 30 blows/foot.
    - The water table is deeper than 50 feet below the ground surface or proposed finished grade at the site.

We note that the borings encountered plastic soils having clay contents likely above 15 percent. Additionally, based on experience in this geologic region and immediate vicinity of the site, it is our opinion that a liquefaction hazard does not exist for the subject development. As such, we do not expect significant additional total and differential settlement, lateral soil movement, reduction in bearing capacity or lateral soil reaction, permanent increase in soil lateral pressure, or flotation of buried structures in accordance with Sections 1803.5.11 and 1803.5.12 of the 2018 IBC.

We also noted mapped faults on the geologic maps we reviewed for this project vicinity of the site. However, the known faults within the East Tennessee valley are generally ancient, with no known active faults reaching the surface. Therefore, it is our opinion that surface displacement due to faulting or seismically induced lateral spreading or lateral flow, is not a seismic hazard that will affect the subject development. In addition, seismically induced slope instability is also not expected to be a seismic hazard that will affect the subject development.

4.5 PAVEMENT DESIGN RECOMMENDATIONS

Following site preparation as previously recommended, the pavements can be grade supported on suitable residual soils or properly placed structural soil fill. We recommend that if the client elects to utilize the existing materials for support of the proposed pavements, proof-rolling of the subgrade be accomplished to identify any soft or unstable soils which should be removed from the pavement area prior to fill placement and/or pavement construction. Unsuitable soils will likely pump and deflect during proofrolling and will likely need to be removed and replaced prior to placement of the structural soil fill or the design pavement section.

4.5.1 Flexible Pavement Design

AASHTO flexible pavement design methods have been utilized for pavement recommendations. Our recommendations are based on the assumptions that the subgrade has been properly prepared as described previously which will require subgrade stabilization to improve support conditions at this site. Based on our experience with similar developments, we recommend the following light and heavy-duty flexible pavement sections:

Table 2 - Flexible Pavement Recommendations

Pavement Materials	Light-Duty (inches)	Heavy-Duty (inches)
Bituminous Asphalt Surface Mix	1.5	1.5
Bituminous Asphalt Base Mix	2.0	3.0
Compacted Crushed Aggregate Base	6.0	8.0

We recommend a base stone equivalent to a Type A and Grading D in accordance with Section 903.05 of the TDOT specifications. The bituminous asphalt pavement should be Grading "E" as per Section 411 for the surface mix and Grading “BM” as per section 307 for the binder mix. Compaction requirements for the crushed aggregate base and the bituminous asphalt pavement should generally follow TDOT specifications.

4.5.2 Rigid Pavement Design

AASHTO rigid pavement design methods have been utilized for the rigid pavement recommendations. In areas of trash dumpster pads or areas where large trucks will traverse, we recommend the use of a concrete pavement section. Our recommendations are based on the assumptions that the subgrade has been properly prepared. Based on our experience with similar developments, we recommend the following rigid pavement section:

Table 3 - Rigid Pavement Recommendations

Pavement Materials	Light-Duty (inches)	Heavy-Duty (inches)
4,000 psi Type I Concrete	6.0	8.0
Compacted Crushed Aggregate Base	4.0	6.0

Concrete should be reinforced with welded wire fabric or reinforcing bars to assist in controlling cracking from drying shrinkage and thermal changes. Sawed or formed control joints should be included for each 144 square feet of area or less (12 feet by 12 feet). Saw cuts should not cut through the welded wire fabric or reinforcing steel and dowels should be utilized at formed and/or cold joints.

4.5.3 General

Our recommendations are based upon the assumption that the subgrade has been properly prepared as described in previous sections and that if used, off-site soil borrow to be used to backfill to the final

subgrade meets the requirements of the structural fill section. The paved areas should be constructed with positive drainage to direct water off-site and to minimize surface water seeping into the pavement subgrade. The subgrade should have a minimum slope of 1 percent. In down grade areas, the basestone should extend through the slope to allow water entering the basestone to exit. For rigid pavements, water-tight seals should also be provided at formed construction and expansion joints.

We understand that budgetary considerations sometimes warrant thinner pavement sections than those presented. However, the client, owner, and project designers should be aware that thinner pavement sections may result in increased maintenance costs and lower than anticipated pavement life. If thinner pavement sections are warranted, alternate reinforced pavement sections can be considered, including the use of geogrid reinforcement.

4.6 LATERAL EARTH PRESSURES

For the design of cast-in-place concrete retaining walls, we have provided equivalent fluid pressures for two backfill conditions for cantilever-type walls. These are 1) active earth pressure for granular backfill (clean sand or gravel) and 2) at-rest earth pressure for granular backfill. The equivalent fluid pressures provided have assumed a level backfill and a wall with a vertical face. The designer should confirm other aspects of retaining wall design, including an evaluation of local and global stability, with respect to the proposed walls and site design.

The provided parameters should not be used for the design of other wall types, such as walls that will retain in-situ materials. Alternative wall types such as mechanically stabilized earth (MSE), soldier pile or others should be designed by a specialty contractor or proprietary wall manufacturer. No other information has been provided at this time regarding the use of retaining walls.

Condition 1 - The active earth pressure for granular backfill will result in an equivalent fluid pressure of 35 pounds per cubic foot (pcf). If the granular backfill is to develop active earth pressure conditions, walls must be flexible and/or free to rotate or translate at the top approximately one inch laterally for every 20 feet of wall height.

Condition 2 - The at-rest earth pressure for granular backfill will result in an equivalent fluid pressure of 55 pcf. For retaining walls that will not rotate or translate, such as building walls or other walls rigidly connected to structures, at-rest conditions will develop.

In each case, forces from surcharge loading including sloping backfill should be added to the equivalent fluid pressures. The walls should be properly drained to remove water or hydrostatic pressure should be added to the design pressure.

The wedge of clean aggregate backfill should have a minimum width of 1 foot at the base of the wall or the width of the footing heel, whichever is greater, and increase in width a minimum of 0.6 feet per foot of wall height. The aggregate should be fully encapsulated with a properly designed geotextile (filter fabric) to prevent migration of the adjacent soils into the aggregate. Aggregate placed behind the retaining wall should be placed in accordance with the compaction recommendations of this report. However, we caution that operating compaction equipment directly behind the wall can create lateral earth pressures far in excess of those recommended for design. Therefore, we recommend using hand operated, smaller compaction equipment in non-vibratory modes within 5 feet of the front of the wall.

For rigid, cast-in-place concrete walls, an ultimate friction factor of 0.35 between foundation concrete and the bearing soils may be used when evaluating friction. Also, an ultimate passive earth pressure resistance of well-compacted soil fill can be approximated by a uniformly acting resistance of 1,000 psf. However, to limit deformation when relying on passive strength, we recommend using a minimum safety factor of 3.0 applied to the ultimate passive resistance value.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 FOUNDATION CONSTRUCTION

Foundation excavations should be opened, the subgrade evaluated, remedial work performed (if required), and concrete placed in an expeditious manner. Exposure to weather often reduces foundation support capabilities, thus necessitating remedial measures prior to concrete placement. It is also important that proper surface drainage be maintained both during construction (especially in terms of maintaining dry

footing trenches) and after construction. Soil backfill for footings should be placed in accordance with the recommendations for structural fill presented herein.

5.2 EXCAVATIONS

Auger refusal was not encountered prior to reaching the predetermined termination depths ranging from approximately 10 to 30 feet below existing grade at each location. Auger refusal conditions generally correspond to materials which require difficult excavation methods such as ripping, chipping (by track-mounted hydraulic hammers) or blasting for removal. However, excavation equipment varies, and field refusal conditions may vary. Generally, the weathering process is erratic and variations in the rock profile can occur in small lateral distances.

Based on our understanding of the project and assumption of cuts/fills between 20 to 30 feet, we do not anticipate that difficult excavation techniques will be necessary for most construction activities. However, we anticipate that if a shallow rock (or chert layers) is encountered, it can be removed with hydraulic hammers or other conventional construction equipment methods. Once grading plans are available, GEOServices should be allowed to review and revise recommendations, as necessary.

Excavations should be sloped or shored in accordance with local, state, and federal regulations, including OSHA (29 CFR Part 1926) excavation trench safety standards. The contractor is usually solely responsible for site safety. This information is provided only as a service, and under no circumstances should GEOServices be assumed responsible for construction site safety.

5.3 HIGH PLASTICITY SOIL CONSIDERATIONS

Based on our experience in the East Tennessee area, soils with plasticity indices (PI) less than 30 percent have a slight potential for volume changes with changes in moisture content, and soils with a PI greater than 50 percent are highly susceptible to volume changes. Between these values, we consider the soils to be moderately susceptible to volume changes.

Plastic soils have the potential to shrink or swell with significant changes in moisture content. Unlike other areas of the country where high plasticity soils cause considerable foundation problems, East Tennessee does

not typically endure long periods of severe drought or wet weather. However, in recent years drought conditions have been sufficient to cause soil shrinkage and related structural distress of buildings, floor slabs and pavements at sites underlain by high plasticity soils.

At sites that have high plasticity soils, certain precautions should be considered to minimize or eliminate the potential for volume changes. The most effective way to eliminate the potential for volume changes is to remove highly plastic soils and replace them with compacted fill of non-expansive material. Testing and recommendations for the required depth of removal can be provided, if needed. If removal of the highly plastic soils is not desirable, then measures should be taken to protect the soils from excessive amounts of wetting or drying. In addition, modification of the soils by lime or cement treatment can be utilized to reduce the soil plasticity.

Several construction considerations may reduce the potential for volume changes in the subgrade soils. Foundations should be excavated, checked, and concreted in the same day to prevent excessive wetting or drying of the foundation soils. The floor subgrade should be protected from excessive drying and wetting by covering the subgrade prior to slab construction. The site should be graded in order to drain surface water away from the building both during and after construction.

Installing moisture barriers around the perimeter of the slab will help limit the moisture variation of the soil and reduce the potential for shrinking or swelling. In addition, roof drains should discharge water away from the building area and foundations. Heat sources should be isolated from foundation soils to minimize drying of the foundation soils. Trees and large shrubs can draw large amounts of moisture from the soil during dry weather and should be kept well away from the building to prevent excessive drying of the foundation soils. Watering of lawns or landscaped areas should be performed to maintain moisture levels during dry weather.

Structural details to make the building flexible should be considered to accommodate potential volume changes in the subgrade. Floor slabs should be liberally jointed to control cracking, and the floor slab should not be structurally connected to the walls. Walls should incorporate sufficient expansion/contraction joints to allow for differential movement.

5.4 MOISTURE SENSITIVE SOILS

The plastic fine-grained soils encountered at this site will be sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. Construction traffic patterns should be varied to prevent the degradation of previously stable subgrade. In addition, the soils at this site which become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. We caution if site grading is performed during the wet weather season; increases in the undercut volumes should be expected.

Further for site fills, methods such as discing and allowing the material to dry will be required to meet the required compaction recommendations. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather. However, November through March is typically the difficult grading period due to the limited drying conditions which exist.

5.5 DRAINAGE AND SURFACE WATER CONCERNS

To reduce the potential for additional undercut and construction induced sinkholes, water should not be allowed to collect in the foundation excavations, on floor slab areas, or on prepared subgrades of the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, subsurface water, or surface runoff. Positive site surface drainage should be provided to reduce infiltration of surface water around the perimeter of the building and beneath the floor slab. The grades should be sloped away from the building and surface drainage should be collected and discharged such that water is not permitted to infiltrate the backfill and floor slab areas of the building.

Significant construction dewatering is not anticipated for site grading based on our limited understanding of the proposed grading. However, seasonal fluctuations and runoff from adjacent properties may occur once construction begins. If seepage or runoff is encountered at shallow depths, it is anticipated that it can be controlled by simple means such as pumping from sumps or perimeter trenches to collect and discharge the water away from the work area. We recommend that all excavations where groundwater is encountered be observed individually to determine if interior drain systems are required.

5.6 SINKHOLE RISK REDUCTION AND CORRECTIVE ACTIONS

Based on our experience, corrective actions can be performed to reduce the potential for sinkhole development. These corrective actions would decrease but not eliminate the potential for sinkhole development. Much can be accomplished to decrease the potential of future sinkhole activity by proper grade selection and through the establishment of positive site drainage.

In general, the portions of a site that are excavated to achieve the desired grades will have a higher risk of sinkhole development than the areas that are filled, because of the exposure of relic fractures in the soil to rainfall and runoff. On the other hand, those portions of a site that receive a modest amount of fill (or that have been filled in the past) will have a decreased risk of sinkhole development caused by rainfall or runoff because the placement of a cohesive soil fill over these areas effectively caps the area with a relatively impervious "blanket" of remolded soil. Although it is our opinion that the risk of ground subsidence associated with sinkhole formation cannot be eliminated, however, we have found that several measures are useful in site design and development to reduce this potential risk. These measures include:

- Maintaining positive site drainage to route surface waters well away from structural areas both during construction and for the life of the structure.
- The scarification and re-compaction of the upper 6 to 10 inches of soil in earthwork cut areas.
- Verifying that subsurface piping is carefully constructed, and pressure tested prior to its placement in service. Maintain the subsurface piping and pool to identify leaks and correct them in a timely manner.

Considerations when building within a sinkhole prone area are to provide positive surface drainage both during and after construction. Backfill in utility trenches or other excavations should consist of compacted, well-graded material such as dense graded aggregate or compacted on site soils. The use of an open graded stone (such as No. 57 stone) is not recommended unless the stone backfill is provided an exit path and not allowed to pond. If sinkhole conditions are observed, the type of corrective action is most appropriately determined by a geotechnical engineer on a case-by-case basis.

6.0 LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. This report is for our geotechnical work only, and no environmental

assessment efforts have been performed. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

The analyses and recommendations submitted herein are based, in part, upon the data obtained from the exploration. The nature and extent of variations between the borings will not become evident until construction. We recommend that GEOServices be retained to observe the project construction in the field. GEOServices cannot accept responsibility for conditions which deviate from those described in this report if not retained to perform construction observation and testing. If variations appear evident, then we will re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed, and conclusions modified or verified in writing. Also, if the scope of the project should change significantly from that described herein, these recommendations may need to be re-evaluated.

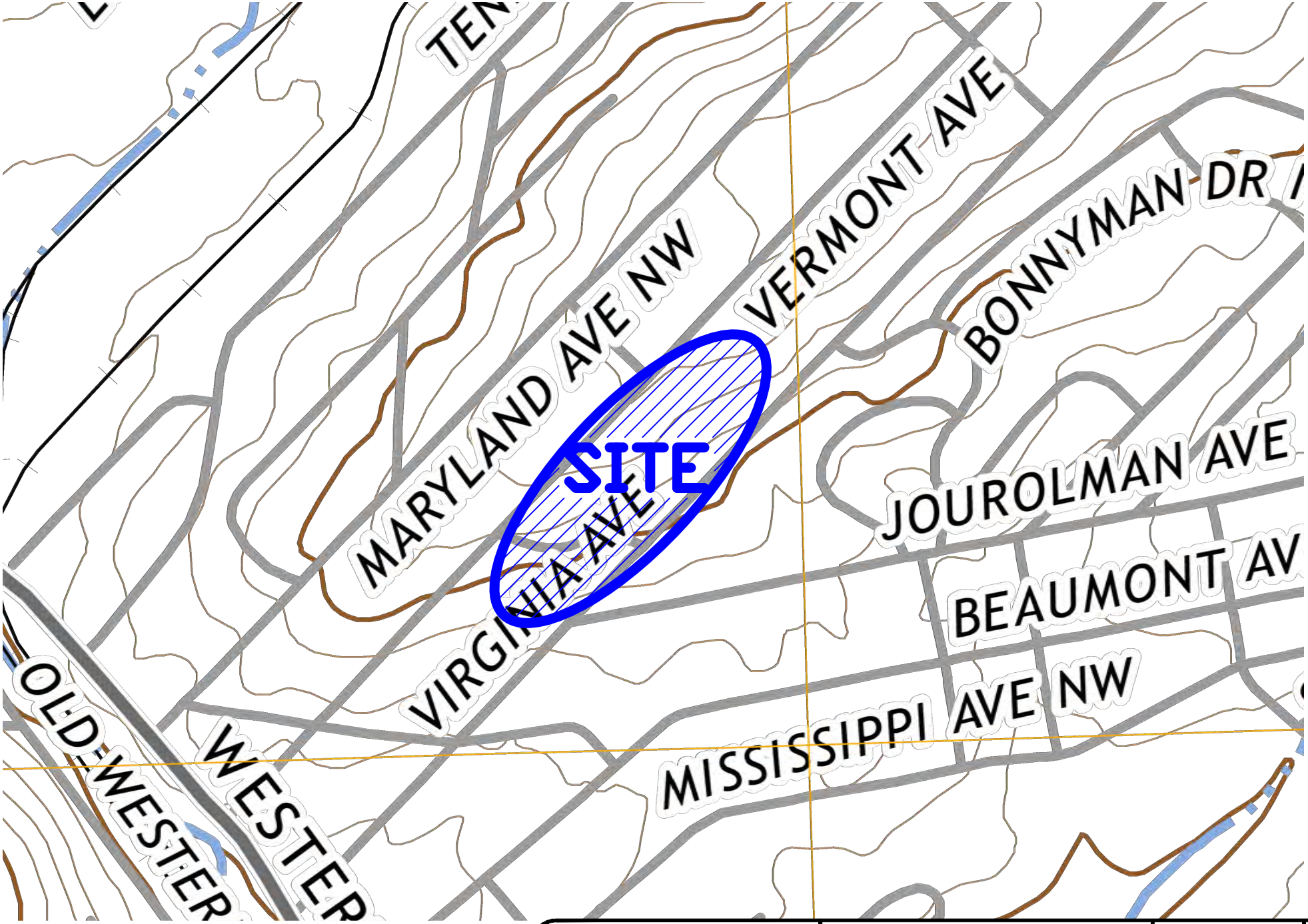
GEOServices, LLC, Geotechnical and Materials Engineers

ATTACHMENTS

GEOServices, LLC, Geotechnical and Materials Engineers

APPENDIX A

Figures, General Notes and Boring Logs



NOTES:

1.) BASE MAP: USGS QUADRANGLE (KNOXVILLE, TENNESSEE)

GEOS
GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company
2561 Willow Point Way
Knoxville, Tennessee 37931
Office: 865-539-8242
Fax: 865-539-8252

SITE VICINITY MAP

PROPOSED MULTI-FAMILY DEVELOPMENT

1800 & 1900 VERMONT AVENUE

KNOXVILLE, TENNESSEE 37921

DRAWN BY:	KSR
APPROVED BY:	MDK
SCALE:	N.T.S.
JOB NO.:	21-23276
DATE:	3/16/23

FIGURE 1

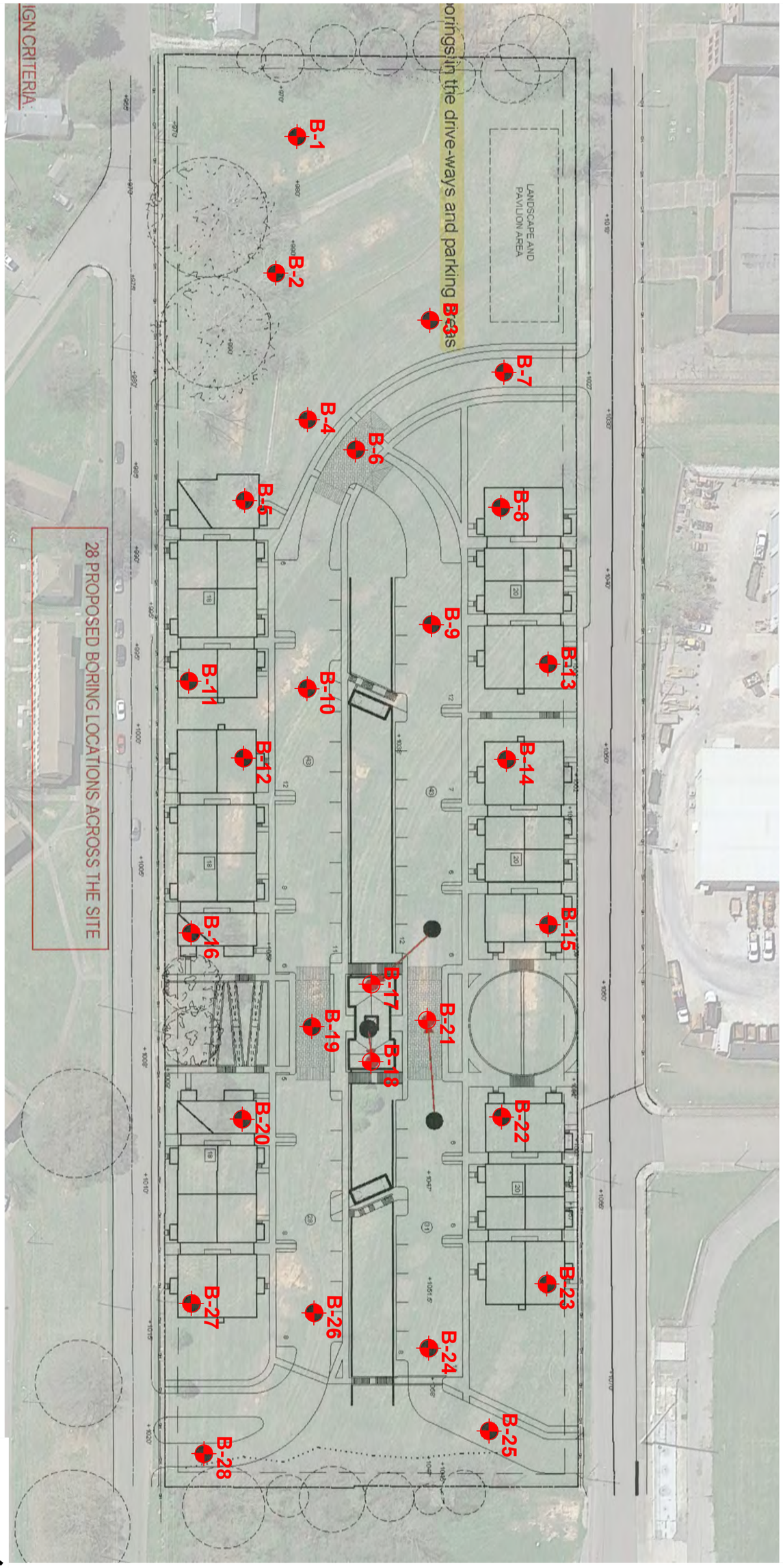


Figure 2

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company
2561 Willow Point Way
Knoxville, Tennessee 37931
Office: 865-539-8242
Fax: 865-539-8252

DRAWN BY:	KSR
APPROVED BY:	MDK
SCALE:	N.T.S.
JOB NO.:	21-23276
DATE:	3/16/23

SOIL TEST BORING LOCATION PLAN

PROPOSED MULTI-FAMILY DEVELOPMENT
1800 & 1900 VERMONT AVENUE
KNOXVILLE, TENNESSEE 37921

NOTES:
1.) BORING LOCATIONS ARE SHOWN IN GENERAL ARRANGEMENT ONLY.
2.) DO NOT USE BORING LOCATIONS FOR DETERMINATIONS OF DISTANCES OR QUANTITIES.
3.) BASE MAP PROVIDED BY: Smith Gee Studio

LOCATION OF SOIL TEST BORINGS

GENERAL NOTES

FINE AND COARSE GRAINED SOIL PROPERTIES

PARTICLE SIZE

BOULDERS:	GREATER THAN 300 mm
COBBLES:	75 mm to 300 mm
GRAVEL:	4.74 mm to 75 mm
COARSE SAND:	2 mm to 4.74 mm
MEDIUM SAND:	0.425 mm to 2 mm
FINE SAND:	0.075 mm to 0.425 mm
SILTS & CLAYS:	LESS THAN 0.075 mm

COARSE GRAINED SOILS (SANDS & GRAVELS)

N-VALUE	RELATIVE DENSITY
0 - 4	VERY LOOSE
5 - 10	LOOSE
11 - 30	MEDIUM DENSE
31 - 50	DENSE
OVER 50	VERY DENSE

FINE GRAINED SOILS (SILTS & CLAYS)

N-VALUE	CONSISTENCY	Qu, PSF
0 - 2	VERY SOFT	0-500
3 - 4	SOFT	500 -1000
5 - 8	FIRM	1000 - 2000
9 - 15	STIFF	2000 - 4000
16 - 30	VERY STIFF	4000 - 8000
OVER 31	HARD	8000 +

STANDARD PENETRATION TEST (ASTM D1586)

THE STANDARD PENETRATION TEST AS DEFINED BY ASTM D1586 IS A METHOD TO OBTAIN A DISTURBED SOIL SAMPLE FOR EXAMINATION AND TESTING AND TO OBTAIN RELATIVE DENSITY AND CONSISTENCY INFORMATON. THE 1.4 INCH I.D./2.0 INCH O.D. SAMPLER IS DRIVEN 3-SIX INCH INCREMENTS WITH A 140-LB. HAMMER FALLING 30 INCHES. THE BLOW COUNTS REQUIRED TO DRIVE THE SAMPLER THE FINAL 2 INCREMENTS ARE ADDED TOGETHER AND DESIGNATED THE N-VALUE. AT TIMES, THE SAMPLER CAN NOT BE DRIVEN THE FULL 18 INCHES. THE FOLLOWING REPRESENTS OUR INTERPRETATION OF THE STANDARD PENETRATION TEST WITH VARIATIONS.

BLOWS/FOOT (N-VALUE)	DESCRIPTION
25	25 BLOWS DROVE SAMPLER 12" AFTER INITIAL 6" SEATING
75/10"	75 BLOWS DROVE SAMPLER 10" AFTER INITIAL 6" SEATING
50/PR	PENETRATION REFUSAL OF SAMPLER AFTER INITIAL 6" SEATING

SAMPLING SYMBOLS

ST:	UNDISTURBED SAMPLE
SS:	SPLIT SPOON SAMPLE
CORE:	ROCK CORE SAMPLE
AU:	AUGER OR BAG SAMPLE

SOIL PROPERTY SYMBOLS

N:	STANDARD PENETRATION, BPF
M:	MOISTURE CONTENT %
LL:	LIQUID LIMIT %
PI:	PLASTICITY INDEX%
Qp:	POCKET PENETROMETER VALUE, TSF
Qu:	UNCONFINED COMPRESSIVE STRENGTH, TSF
DUW:	DRY UNIT WEIGHT, PCF

ROCK PROPERTIES

ROCK QUALITY DESIGNATION (RQD)

PERCENT	QUALITY
90 TO 100	EXCELLENT
75 TO 90	GOOD
50 TO 75	FAIR
25 TO 50	POOR
O TO 25	VERY POOR

ROCK HARDNES

VERY SOFT:	ROCK DISINTEGRATES OR EASILY COMPRESSES TO TOUCH: CAN BE HARD TO VERY HARD SOIL.
SOFT:	ROCK IS COHERANT BUT BREAKS EASILY TO THUMB PRESSURE AT SHARP EDGES AND IT CRUMBLES WITH FIRM HAND PRESSURE.
MODERATELY HARD:	SMALL PIECES CAN BE BROKEN OFF ALONG SHARP EDGES BY CONSIDERABLE HARD THUMB PRESSURE: CAN BE BROKEN BY LIGHT HAMMER BLOWS.
HARD:	ROCK CAN NOT BE BROKEN BY THUMB PRESSURE, BUT CAN BE BROKEN BY MODERATE HAMMER BLOWS.
VERY HARD:	ROCK CAN BE BROKEN BY HEAVY HAMMER BLOWS.

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

KEY TO SYMBOLS

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

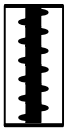
- ASPHALT: Asphalt
- CH: USCS High Plasticity Clay
- CL: USCS Low Plasticity Clay
- CL-ML: USCS Low Plasticity Silty Clay
- CONCRETE: Concrete
- DOLOMITE: Dolomite
- GRAVEL: Gravel / Basestone
- LIMESTONE: Limestone
- ML: USCS Silt
- SANDSTONE: Sandstone
- SC: USCS Clayey Sand
- SC-SM: USCS Silty Clayey Sand
- SHALE: Shale
- SLATE: Slate
- SM: USCS Silty Sand
- SW: USCS Well-graded Sand
- SP: USCS Poorly-graded Sand
- TOPSOIL: Topsoil
- WEATHERED ROCK: Weathered Bedrock
- WOOD: Wood / Mulch

SAMPLE SYMBOLS


Grab Sample


No Recovery


Rock Core


AUGER: Auger Probe


Shelby Tube


Split Spoon

COLOR CODES FOR LITHOLOGIC SYMBOLS

- RED: Fill
- GREEN: Cultivated
- BLUE: Residuum
- MAGENTA: Alluvium
- PINK: Colluvium
- LIGHT GRAY: Weathered Rock
- ORANGE: Loess
- DARK GRAY: Rock Core
- YELLOW: Void
- TEAL: Glacial Outwash / Glacial Till
- PURPLE: Marine

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)

▽ Water Level at Time Drilling, or as Shown
▼ Water Level at End of Drilling, or as Shown
▼ Water Level After 24 Hours, or as Shown

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION

BORING NUMBER B-1

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/10/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 979 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 969.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	979.0		Topsoil (1 Inch)						
			(CH) **Fat CLAY** - with gravel and trace organics - reddish brown, dark brown, tan and dark gray - moist (FILL)	SS 1		4-2-3 (5)			
			(CH) **Fat CLAY** - with trace chert fragments and sand at depth - reddish brown, orangish brown and tan - moist - stiff to firm (RESIDUUM)	SS 2		4-5-9 (14)			
5	974.0			SS 3		4-6-7 (13)			
				SS 4		3-4-4 (8)			
10	969.0		Bottom of borehole at 10.0 feet.						

NOTES:

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-2

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/10/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 992 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 982.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	992.0		Topsoil (1 Inch)						
			(CH) **Fat CLAY** - with sand, large gravel and trace organics - orangish brown, dark brown, tan and dark gray - moist (FILL)	SS 1		5-4-6 (10)			
			(CH) **Fat CLAY** - with silt - reddish brown, orangish brown and tan - moist - firm to very stiff (RESIDUUM)	SS 2		2-3-5 (8)			
5	987.0			SS 3		4-5-7 (12)			
				SS 4		6-10-13 (23)			
10	982.0		Bottom of borehole at 10.0 feet.						

NOTES:

BORING NUMBER B-3

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1012 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 1002.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1012.0		Topsoil (1 Inch)						
			(CL) **Lean CLAY** - with gravel, silt, trace organics and strong organic odor - tan and dark gray - dry (FILL)	SS 1		1-2-3 (5)			
			(CH) **Fat CLAY** - with large gravel and organic odor - reddish brown, orangish brown, dark brown and dark gray - moist (FILL)	SS 2		2-3-4 (7)			
5	1007.0		(CL) **Sandy Lean CLAY** - with silt - light gray and tan - moist - very soft (RESIDUUM)	SS 3		0-1-1 (2)			
			(CH) **Fat CLAY** - with sand and chert fragments - reddish brown and orangish brown - moist - very stiff (RESIDUUM)	SS 4		5-9-12 (21)			
10	1002.0		Bottom of borehole at 10.0 feet.						

NOTES: 0 = Weight of Hammer

BORING NUMBER B-4

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/10/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1004 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 994.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1004.0		Topsoil (3 Inches)						
			(CH) **Fat CLAY** - with gravel, trace organics and strong organic odor - reddish brown, dark brown, tan and dark gray - moist (FILL)	SS 1		4-3-2 (5)			
			(CH) **Fat CLAY** - with silt and trace chert fragments - orangish brown and tan - moist - very stiff to stiff (RESIDUUM)	SS 2		4-5-7 (12)			
5	999.0			SS 3		4-7-9 (16)			
				SS 4		6-6-9 (15)			
10	994.0								

Bottom of borehole at 10.0 feet.

NOTES:

BORING NUMBER B-5

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/10/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 993 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 973.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	993.0		Topsoil (4 Inches)						
			(CL) **Lean CLAY** - with trace gravel, trace plastic fragments and strong organic odor - orangish brown, black and dark gray - moist (FILL)	SS 1		5-4-5 (9)			
			(CH) **Fat CLAY** - with silt and sand at depth - orangish brown and tan - moist to very moist - firm (RESIDUUM)	SS 2		3-2-3 (5)			
5	988.0			SS 3		3-3-3 (6)			
				SS 4		3-2-3 (5)			
10	983.0								
				SS 5		2-3-2 (5)			
15	978.0								
				SS 6		1-2-4 (6)			
20	973.0								

NOTES: Bottom of borehole at 20.0 feet.

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-6

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1008 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 998.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1008.0		Topsoil (5 Inches)						
			(CH) **Gravelly Fat CLAY** - orangish brown and dark gray - dry (FILL)	SS 1		12-11-6 (17)			
			(CH) **Fat CLAY** - reddish brown and orangish brown - moist - stiff (RESIDUUM)	SS 2		5-5-8 (13)			
5	1003.0		(CL) **Sandy Lean CLAY** - with significant chert fragments - orangish brown, reddish brown and tan - moist - very stiff (RESIDUUM)	SS 3		3-12-15 (27)			
			(CH) **Fat CLAY** - with trace chert fragments - reddish brown and orangish brown - moist - stiff (RESIDUUM)	SS 4		2-4-6 (10)			
10	998.0		Bottom of borehole at 10.0 feet.						

NOTES:

BORING NUMBER B-7

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1021 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
▽ **AT END OF DRILLING** 6.00 ft / Elev 1015.00 ft
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 1011.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1021.0		(CH) **Fat CLAY** - with gravel and strong organic odor - black, dark brown, reddish brown and dark gray - moist (FILL)	SS 1		3-3-2 (5)			
				NR 2		1-1-2 (3)			
5	1016.0		▽ (CL) **Lean CLAY** - with large gravel and strong organic odor - dark brown, reddish brown, dark gray and tan - very moist (FILL)	SS 3		0-2-3 (5)			
			(CH) **Fat CLAY** - with significant chert fragments - reddish brown and tan - moist - very stiff (RESIDUUM)	SS 4		18-13-15 (28)			
10	1011.0								

Bottom of borehole at 10.0 feet.

NOTES: 0 = Weight of Hammer

BORING NUMBER B-8

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1030 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1010.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1030.0		Topsoil (1 Inch)						
			(CL) **Lean CLAY** - with gravel, trace organics and strong organic odor - tan, dark brown, reddish brown and dark gray - moist (FILL)	SS 1		4-4-3 (7)			
				SS 2		2-2-2 (4)			
5	1025.0		(CH) **Fat CLAY** - with sand - reddish brown and orangish brown - moist to very moist - stiff (RESIDUUM)	SS 3		3-5-7 (12)			
				SS 4		3-4-7 (11)			
10	1020.0		(CH) **Fat CLAY** - with significant chert fragments and sand - tan, reddish brown and orangish brown - moist - very stiff to stiff (RESIDUUM)	SS 5		8-11-11 (22)			
15	1015.0			SS 6		4-5-7 (12)			
20	1010.0		Bottom of borehole at 20.0 feet.						

NOTES:

BORING NUMBER B-9

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1027 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 1017.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1027.0		Topsoil (1 Inch)						
			GRAVEL and CONCRETE - with trace clay - gray - dry (FILL)	SS 1		50/2"			
			(CH) **Fat CLAY** - with sand and trace chert fragments - reddish brown, tan and orangish brown - moist - very stiff (RESIDUUM)	SS 2		6-10-11 (21)			
5	1022.0			SS 3		8-12-15 (27)			
				NR 4		8-10-12 (22)			
10	1017.0		Bottom of borehole at 10.0 feet.						

NOTES:

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-10

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1014 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 1004.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1014.0		(CH) **Fat CLAY** - with sand, gravel, organics and strong organic odor - dark brown and reddish brown - moist (FILL)	SS 1		4-5-6 (11)			
5	1009.0		(CH) **Fat CLAY** - with significant chert fragments and sand - tan, reddish brown and orangish brown - moist to dry - very stiff (RESIDUUM)	SS 2		7-10-14 (24)			
				SS 3		10-15-15 (30)			
10	1004.0		(CH) **Fat CLAY** - with silt and trace chert fragments - tan and reddish brown - moist - very stiff (RESIDUUM)	SS 4		6-6-10 (16)			

Bottom of borehole at 10.0 feet.

NOTES:

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-11

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1000 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 30.0 ft / Elev 970.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1000.0		(CL) **Lean CLAY** - with large concrete fragments, silt, trace gravel and organic odor - dark brown and dark gray - dry (FILL)	SS 1		6-12-8 (20)			
			(CH) **Fat CLAY** - tan, reddish brown and orangish brown - moist - stiff to very stiff (RESIDUUM)	SS 2		3-3-7 (10)			
5	995.0			SS 3		5-7-10 (17)			
				SS 4		6-7-12 (19)			
10	990.0								
			(CL) **Lean CLAY** - with silt - reddish brown, orangish brown and tan - moist - stiff to soft (RESIDUUM)	SS 5		3-3-6 (9)			
15	985.0								
				SS 6		1-2-3 (5)			
20	980.0								

NOTES:

(Continued Next Page)

BORING NUMBER B-11

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1000 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 30.0 ft / Elev 970.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
20	980.0		(CL) **Lean CLAY** - with silt - reddish brown, orangish brown and tan - moist - stiff to soft (RESIDUUM) *(continued)*						
				SS 7		1-1-2 (3)			
25	975.0								
			(CH) **Fat CLAY** - with trace sand and trace chert fragments - tan and orangish brown - moist - stiff (RESIDUUM)						
				SS 8		4-6-6 (12)			
30	970.0								

Bottom of borehole at 30.0 feet.

NOTES:

BORING NUMBER B-12

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1014 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 994.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1014.0		(CL) **Lean CLAY** - with gravel, sand, organics and organic odor - dark brown, reddish brown and dark gray - dry (FILL)	SS 1		5-6-6 (12)			
5	1009.0		(CH) **Fat CLAY** - with trace chert fragments - tan, reddish brown and orangish brown - moist - very stiff to stiff (RESIDUUM)	SS 2		2-4-7 (11)			
				SS 3		6-7-13 (20)			
10	1004.0			SS 4		5-7-8 (15)			
15	999.0		(CL) **Lean CLAY** - with silt - orangish brown and tan - moist - stiff (RESIDUUM)	SS 5		4-4-6 (10)			
20	994.0			SS 6		2-6-7 (13)			

NOTES: Bottom of borehole at 20.0 feet.

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-13

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1042 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1022.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1042.0		(CL) **Gravelly Lean CLAY** - with silt, trace organics and strong organic odor - black, tan and dark gray - dry (FILL)	SS 1		4-4-5 (9)			
5	1037.0		(CL) **Lean CLAY** - with trace gravel - tan, reddish brown and dark gray - moist (FILL)	SS 2		1-1-3 (4)			
			(CL) **Gravelly Lean CLAY** - with organic odor - black, tan, dark brown, reddish brown and dark gray - very moist (FILL)	SS 3		1-2-1 (3)			
10	1032.0		(CL) **Lean CLAY** - with silt, black manganese nodules and trace chert fragments - orangish brown, reddish brown, light gray and tan - moist to very moist - stiff (RESIDUUM)	SS 4		3-3-7 (10)			
15	1027.0			SS 5		3-4-5 (9)			
20	1022.0		(CH) **Fat CLAY** - with significant chert fragments and silt - tan, reddish brown and orangish brown - moist - very stiff (RESIDUUM)	SS 6		8-14-14 (28)			

Bottom of borehole at 20.0 feet.

NOTES:

BORING NUMBER B-14

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1046 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1026.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1046.0		(CL) **Lean CLAY** - with gravel, trace asphalt fragments at depth and strong organic odor - tan, dark brown, black and dark gray - moist to very moist (FILL)	SS 1		4-5-6 (11)			
				SS 2		3-3-2 (5)			
5	1041.0		(CL) **Lean CLAY** - with black manganese nodules and silt - brown, light gray and tan - very moist to moist - very soft to stiff (RESIDUUM)	SS 3		0-0-1 (1)			
				SS 4		5-5-7 (12)			
10	1036.0								
			(CL) **Lean CLAY** - with silt and trace chert fragments - orangish brown, reddish brown and tan - moist - firm (RESIDUUM)	SS 5		3-3-4 (7)			
15	1031.0								
				SS 6		3-3-4 (7)			
20	1026.0		Bottom of borehole at 20.0 feet.						

NOTES: 0 = Weight of Hammer

BORING NUMBER B-15

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1053 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1033.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1053.0		(CH) **Fat CLAY** - with organics, trace gravel and strong organic odor - dark brown and reddish brown - moist (FILL)	SS 1		4-5-4 (9)			
5	1048.0		(CH) **Fat CLAY** - with significant chert fragments and trace sand - reddish brown, orangish brown, light gray and tan - moist - stiff to very stiff (RESIDUUM)	SS 2		3-6-9 (15)			
				SS 3		4-8-13 (21)			
10	1043.0			SS 4		7-8-9 (17)			
			(CL) **Lean CLAY** - with silt - orangish brown, reddish brown and tan - moist - stiff (RESIDUUM)						
15	1038.0			SS 5		5-5-6 (11)			
20	1033.0			SS 6		5-5-5 (10)			

Bottom of borehole at 20.0 feet.

NOTES:

BORING NUMBER B-16

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1008 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 988.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1008.0		Topsoil (3 Inches)						
			(CH) **Fat CLAY** - with trace chert fragments in the upper 3.0 feet - reddish brown, orangish brown and tan - moist - stiff (RESIDUUM)	SS 1		4-5-5 (10)			
				SS 2		4-4-7 (11)			
5	1003.0			SS 3		3-4-6 (10)			
			(CL) **Lean CLAY** - with silt and sand - light gray, orangish brown and tan - moist - stiff (RESIDUUM)	SS 4		4-5-7 (12)			
10	998.0								
			(CL) **Lean CLAY** - with sand and chert fragments - orangish brown and tan - moist - stiff to very stiff (RESIDUUM)	SS 5		10-7-8 (15)			
15	993.0								
				SS 6		8-8-12 (20)			
20	988.0		Bottom of borehole at 20.0 feet.						

NOTES:

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-17

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1034 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1014.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1034.0		(CH) **Fat CLAY** - with gravel, topsoil, trace organics and strong organic odor - dark brown, dark gray and reddish brown - moist (FILL)						
				SS 1		2-2-3 (5)			
				SS 2		3-3-4 (7)			
5	1029.0		(CH) **Fat CLAY** - with chert fragments and sand - reddish brown, orangish brown and tan - moist - very stiff to hard (RESIDUUM)						
				SS 3		6-9-9 (18)			
				SS 4		7-9-13 (22)			
10	1024.0								
				SS 5		12-50/4"			
15	1019.0		(CH) **Fat CLAY** - with significant chert fragments and silt - orangish brown, reddish brown and tan - moist - very stiff (RESIDUUM)						
				SS 6		6-6-12 (18)			
20	1014.0								

NOTES: Bottom of borehole at 20.0 feet.

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-18

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1034 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1014.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1034.0		Topsoil (5 Inches)						
			(CH) **Fat CLAY** - with gravel, topsoil and strong organic odor - reddish brown, dark brown, tan and dark gray - moist (FILL)	SS 1		3-3-3 (6)			
			(CH) **Fat CLAY** - with trace chert fragments - reddish brown, orangish brown and tan - moist - firm to very stiff (RESIDUUM)	SS 2		2-2-3 (5)			
5	1029.0			SS 3		2-2-3 (5)			
				SS 4		5-5-9 (14)			
10	1024.0								
				SS 5		9-9-12 (21)			
15	1019.0								
				SS 6		4-4-6 (10)			
20	1014.0		Bottom of borehole at 20.0 feet.						

NOTES:

BORING NUMBER B-19

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1026 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1006.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1026.0		Topsoil (4 Inches)						
			(CL) **Lean CLAY** - with topsoil and strong organic odor - dark brown and reddish brown - moist (FILL)	SS 1		2-2-2 (4)			
			(CH) **Fat CLAY** - with sand and trace chert fragments - reddish brown, brown and tan - moist - firm (RESIDUUM)	SS 2		2-2-4 (6)			
5	1021.0			SS 3		4-3-4 (7)			
			(CH) **Fat CLAY** - with chert fragments at depth - reddish brown, orangish brown and tan - moist - stiff to very stiff (RESIDUUM)	SS 4		7-8-10 (18)			
10	1016.0								
				SS 5		6-7-8 (15)			
15	1011.0								
				SS 6		13-15-12 (27)			
20	1006.0		Bottom of borehole at 20.0 feet.						

NOTES:

BORING NUMBER B-20

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1020 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1000.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1020.0		Topsoil (10 Inches)						
			(CH) **Fat CLAY** - with gravel - dark brown and reddish brown - moist (FILL)	SS 1		3-4-5 (9)			
5	1015.0		(CL) **Lean CLAY** - with trace gravel and organic odor - dark brown, dark gray and tan - moist (FILL)	SS 2		3-3-3 (6)			
			(CL) **Lean CLAY** - with gravel, glass fragments, trace organics and strong organic odor - dark brown, dark gray and reddish brown - moist (FILL)	SS 3		4-3-2 (5)			
10	1010.0		(CL) **Lean CLAY** - with large wood fragments at depth and strong organic odor - black and dark gray - moist (FILL)	NR 4		3-2-2 (4)			
15	1005.0			SS 5		3-2-2 (4)			
			(CL) **Sandy Lean CLAY** - with trace gravel and strong organic odor - dark gray, light gray, tan and black - moist (FILL)						
20	1000.0			SS 6		8-7-4 (11)			

NOTES: Bottom of borehole at 20.0 feet.

BORING NUMBER B-21

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1043 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1023.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1043.0		Topsoil (1 Inch)						
			(CL) **Lean CLAY** - with topsoil, gravel and strong organic odor - dark brown, dark gray and reddish brown - moist (FILL)	SS 1		3-2-3 (5)			
			(CH) **Fat CLAY** - with significant chert fragments and sand - reddish brown and orangish brown - moist - very stiff (RESIDUUM)	SS 2		4-9-11 (20)			
5	1038.0			SS 3		10-9-20 (29)			
			(CL) **Sandy Lean CLAY** - with significant chert fragments and silt - reddish brown and tan - moist - very stiff (RESIDUUM)	SS 4		4-8-9 (17)			
10	1033.0								
				SS 5		10-13-15 (28)			
15	1028.0								
			(CH) **Fat CLAY** - with silt - reddish brown and tan - moist - stiff (RESIDUUM)						
				SS 6		4-4-6 (10)			
20	1023.0								

Bottom of borehole at 20.0 feet.

NOTES:

BORING NUMBER B-22

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1052 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1032.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1052.0		Topsoil (1 Inch)						
			(CL) **Lean CLAY** - with sand, gravel, trace organics, brick fragments at depth and strong organic odor - dark brown, dark gray, black and reddish brown - moist (FILL)	SS 1		6-4-4 (8)			
				SS 2		3-3-2 (5)			
5	1047.0			SS 3		1-1-2 (3)			
			(CL) **Lean CLAY** - with black manganese nodules, silt and trace chert fragments - light gray, brown and tan - very moist - soft (RESIDUUM)	SS 4		1-1-3 (4)			
10	1042.0								
			(CL) **Lean CLAY** - with silt and trace chert fragments - light gray, orangish brown and tan - moist - stiff (RESIDUUM)	SS 5		4-6-7 (13)			
15	1037.0								
				SS 6		3-5-7 (12)			
20	1032.0		Bottom of borehole at 20.0 feet.						

NOTES:

BORING NUMBER B-23

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1059 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 1039.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1059.0		(CL) **Lean CLAY** - with topsoil, trace gravel and strong organic odor - dark brown and orangish brown - moist (FILL)	SS 1		4-2-4 (6)			
			(CL) **Lean CLAY** - with significant chert fragments and silt - reddish brown, orangish brown, light gray and tan - moist - very stiff to stiff (RESIDUUM)	SS 2		5-7-10 (17)			
5	1054.0			SS 3		3-4-6 (10)			
10	1049.0			SS 4		3-5-7 (12)			
			(CH) **Fat CLAY** - with chert fragments - orangish brown and reddish brown - moist - very stiff (RESIDUUM)	SS 5		6-7-11 (18)			
15	1044.0								
				SS 6		5-7-11 (18)			
20	1039.0		Bottom of borehole at 20.0 feet.						

NOTES:

BORING NUMBER B-24

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1051 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 1041.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1051.0		Topsoil (1 Inch)						
			CONCRETE - with clay - dark gray and orangish brown - dry (FILL)	SS 1		5-10-14 (24)			
			(CL) **Lean CLAY** - with silt and trace chert fragments - reddish brown, orangish brown and tan - moist - stiff (RESIDUUM)	SS 2		3-6-3 (9)			
5	1046.0		(CH) **Fat CLAY** - with chert fragments and sand - orangish brown and reddish brown - moist - very stiff to hard (RESIDUUM)	SS 3		10-13-15 (28)			
				SS 4		13-50/4"			
10	1041.0		Bottom of borehole at 10.0 feet.						

NOTES:

BORING NUMBER B-25

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1063 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 1053.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1063.0		Topsoil (2 Inches)						
			(CL) **Lean CLAY** - with trace gravel, trace asphalt fragments and organic odor - dark gray and dark brown - moist (FILL)	SS 1		3-2-3 (5)			
			(CL) **Lean CLAY** - with black manganese nodules, silt and trace chert fragments - light gray and tan - very moist to moist - firm to stiff (RESIDUUM)	SS 2		1-2-3 (5)			
5	1058.0			SS 3		2-4-9 (13)			
			(CH) **Fat CLAY** - with silt and trace chert fragments - tan and reddish brown - moist - stiff (RESIDUUM)	SS 4		5-7-8 (15)			
10	1053.0		Bottom of borehole at 10.0 feet.						

NOTES:

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-26

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1034 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 1024.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1034.0		(CL) **Gravelly Lean CLAY** - reddish brown - dry (FILL)	SS 1		11-16-8 (24)			
5	1029.0		(CH) **Fat CLAY** - with significant chert fragments and silt - tan and reddish brown - dry - very stiff (RESIDUUM)	SS 2		7-9-14 (23)			
			(CH) **Fat CLAY** - with trace chert fragments - tan, orangish brown and reddish brown - moist - very stiff (RESIDUUM)	SS 3		6-7-11 (18)			
10	1024.0			SS 4		6-7-9 (16)			

Bottom of borehole at 10.0 feet.

NOTES:

BORING NUMBER B-27

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/8/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1016 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 20.0 ft / Elev 996.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1016.0		Topsoil (4 Inches)						
			GRAVEL - with clay - dark gray and orangish brown - dry (FILL)	SS 1		4-10-6 (16)			
			(CL) **Lean CLAY** - with black manganese nodules, silt, chert fragments and organic odor - light gray, dark brown, orangish brown and tan - moist - very soft (RESIDUUM)	SS 2		2-1-1 (2)			
5	1011.0		(CH) **Fat CLAY** - with significant chert fragments and sand - tan, orangish brown and reddish brown - moist - stiff (RESIDUUM)	SS 3		4-6-6 (12)			
			(CH) **Fat CLAY** - tan and orangish brown - moist - stiff to firm (RESIDUUM)	SS 4		4-7-8 (15)			
10	1006.0								
				SS 5		4-4-5 (9)			
15	1001.0								
				SS 6		2-3-3 (6)			
20	996.0		Bottom of borehole at 20.0 feet.						

NOTES:

GEOServices, LLC-Geotechnical and Materials Engineers
A Universal Engineering Sciences Company

BORING NUMBER B-28

PROJECT NAME Proposed Multi-Family Development
GEOServices PROJECT# 21-23276
DATE 3/9/23
PROJECT LOCATION 1800 & 1900 Vermont Ave., Knoxville, TN 37921
DRILLING CONTRACTOR M&W Drilling
LOGGED BY KSR **ON-SITE REP.** ---
DRILLING METHOD Geoprobe 7822
LATITUDE / LONGITUDE ---
GROUND ELEVATION 1030 ft **PROPOSED FFE** ---
NORTHING / EASTING ---
REFUSAL ---
TOP OF ROCK ---
GROUND WATER LEVELS:
BEGAN CORING ---
AT END OF DRILLING --- Dry
FOOTAGE CORED (LF) ---
AFTER 1 HOUR --- Backfilled
BOTTOM OF HOLE Depth 10.0 ft / Elev 1020.0 ft
AFTER 24 HOURS --- Backfilled

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	1030.0		Topsoil (4 Inches)						
			(CL) **Lean CLAY** - with sand, trace gravel, trace organics and strong organic odor - reddish brown, dark gray and dark brown - moist (FILL)	SS 1		2-2-3 (5)			
			(CL) **Sandy Lean CLAY** - with trace gravel and organic odor - dark gray, dark brown, black and tan - very moist to moist (FILL)	SS 2		1-1-2 (3)			
5	1025.0								
			(CH) **Fat CLAY** - with significant chert fragments - orangish brown and reddish brown - moist - firm to very stiff (RESIDUUM)	SS 3		0-2-4 (6)			
				SS 4		10-9-10 (19)			
10	1020.0								

Bottom of borehole at 10.0 feet.

NOTES: 0 = Weight of Hammer