ECS Southeast, LLP

Geotechnical Engineering Report

Knoxville Head Start Western Heights

McSpadden Street
Knoxville, Tennessee

ECS Project No. 26:4588

January 15, 2021

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Mr. John Thurman
McCarty Holsaple McCarty
550 W Main Street
Suite 300
Knoxville, TN 37902

ECS Project No. 26:4588

Reference: Geotechnical Engineering Report
Knoxville Head Start Western Heights
McSpadden Street
Knoxville, Tennessee

Dear Mr. Thurman:

ECS Southeast, LLP (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our agreed to scope of work. This report presents our understanding of the geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations.

It has been our pleasure to be of service to McCarty Holsaple McCarty during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify subsurface conditions assumed for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Southeast, LLP

MARK D. LUSKIN REGISTERED ENGINEER AGRICULTURE COMMERCE No. 111668 STATE OF TENNESSEE 1-15-21

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EXECUTIVE SUMMARY

ECS Southeast, LLP (ECS) has completed the subsurface exploration for the proposed construction of a new 2-story Head Start childcare facility with associated parking/drive lanes on McSpadden Street in Knoxville, Tennessee. The project information summarized below is based exclusively on the information made available to us by the client at the time of this report and the results of our subsurface exploration. Our findings, conclusions, and recommendations are summarized below.

PROJECT INFORMATION:

- Site Location : McSpadden Street, Knoxville, Tennessee
- Building Scope: 2-story building, partial below-grade
- Assumed Loads: Max. column loads = 150 kips, Max. wall loads = 5 klf
- Earthwork: Less than 10 feet of cut and fill anticipated
- Sitework: Parking lot, drive lanes, SWM facility and underground utilities

SUBSURFACE CONDITIONS:

- Field Exploration: 8 SPT borings in the proposed construction area
- Surface Material: Topsoil = approximately 2- to 4-inches
- Existing Fill: Encountered to depths ranging from approximately 2 to 4 feet
- Native Material: SILT (ML) with varying amounts of sand
- Refusal Materials: Not encountered in our boring locations
- Groundwater: Not encountered in our boring locations

GEOTECHNICAL CONCERNS:

- Presence of undocumented fill
- Presence of low consistency soils

DESIGN & CONSTRUCTION RECOMMENDATIONS:

- Foundations: 2,500 psf on approved fill/native soils
- Slabs-on-Grade: Modulus of Subgrade Reaction, k = 120 pci
- Seismic Design: Seismic Site Class "D"

This summary should not be considered apart from the entire text of the report with all the qualifications and considerations mentioned herein. Details of our conclusions and recommendations are discussed in the report text.

1.0 INTRODUCTION

Our services were provided in accordance with our Proposal No. 26:7831, dated November 11, 2020, as authorized by McCarty Holsaple McCarty on December 3, 2020, which includes our terms and conditions.

This report contains the procedures and results of our subsurface exploration and laboratory testing programs, review of existing site conditions, engineering analyses, and recommendations for the design and construction of the project.

The report includes the following items.

- Observations from our site reconnaissance including current site conditions, surface drainage features, and surface topographic conditions.
- A subsurface characterization and a description of the field exploration and laboratory tests were performed. Groundwater concerns relative to the planned construction, if any, are summarized. Expected geological or seismic hazards are also addressed.
- Final logs of the soil borings and records of the field exploration prepared in accordance with the standard practice for geotechnical engineering. A boring location plan is included, and the results of the laboratory tests were plotted on the final boring logs and included on a separate test report sheet. Existing approximate elevation were recorded for each top of boring, based on interpolation of approximate locations and contour information.
- Recommendations for allowable soil bearing pressure for conventional shallow foundation systems and recommendations for intermediate foundations including estimates of predicted total and differential foundation settlement. This includes specific project information and design loads provided by the project structural engineer, if provided.
- Recommendations for floor slab and pavement construction, including recommendations for subgrade modulus and subgrade improvements.
- Recommendations for lateral earth pressures for below grade walls. We have not included Global Stability Analysis or retaining wall design in our scope; however, ECS can provide these services, if required, for additional cost once the final retaining wall designs have been completed.
- Recommended flexible asphalt and rigid concrete pavement sections (light duty and heavy duty) based on assumed loading conditions and assumed CBR values.
- Evaluation of the on-site soil characteristics encountered in the soil borings. Specifically, we discuss the suitability of the on-site materials for re-use as engineered fill to support slabs and pavements. We also included compaction requirements and suitable material guidelines.
- Recommended seismic site class in accordance with IBC 2012, based on Standard Penetration Testing and our knowledge of the site geology.
- Recommendations for additional testing and/or consultation that might be required to complete the geotechnical assessment and related engineering for this project (supplemental reports and evaluations can be performed as requested; supplemental reports and evaluations will be considered additional scope and will be billed in accordance with our standard fee schedule unless otherwise negotiated).

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION/CURRENT SITE USE

The project site is located on McSpadden Street in Knoxville, Tennessee. The site is currently surrounded by undeveloped land to the north and west, McSpadden Street to the east, and W Oldham Avenue to the south. Based on elevations (±3 ft) obtained from Google Earth, the site appears to undergo approximately 50 feet of topographic relief from 980 ft to 1,030 ft MSL.

Figure 2.1.1. Site Location

Based on our review of historical Google Earth satellite imagery, it appears that demolition of the existing apartment buildings occurred at this site between October 2010 and April 2012.

Figure 2.1.2. October 2010 Historical Satellite Imagery

2.2 PROPOSED CONSTRUCTION

The following information explains our understanding of the planned development including proposed buildings and related infrastructure.

Table 2.2.1 Design Information

SUBJECT	DESIGN INFORMATION / ASSUMPTIONS
Building Footprint	Approximately 10,000 square feet in plan view
# of Stories	2-story, partial below-grade
Usage	Institutional
Column Loads	150 kips
Wall Loads	5 kips per linear foot (klf) maximum
Lowest Finish Floor Elevation	Approx. 1002 feet on North side and approx. 988 feet on South side

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms to assist in developing geotechnical recommendations for the project.

3.1.1 Test Borings

The subsurface conditions were explored by drilling eight (8) soil test borings within the proposed construction areas. A truck-mounted drill rig was utilized to drill the soil test borings. Borings were advanced to a depth of 10 to 25 feet below the ground surface (the approximate depth of boring termination).

Boring locations were identified in the field by drilling personnel at the time of the mobilization of our drilling equipment. The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A. Ground surface elevations noted on our boring logs were obtained from Google Earth, and should be considered approximate.

Standard penetration tests (SPT's) were conducted in the borings at regular intervals in general accordance with ASTM D 1586. Small representative samples were obtained during these tests and were used to classify the soils encountered. The standard penetration resistances obtained provide a general indication of soil shear strength and compressibility.

3.1.2 Laboratory Testing Program

A geotechnical engineer classified each SPT soil sample on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS, ASTM D 2487). The group symbols for each soil type are indicated in parentheses following the soil descriptions on each boring log. A brief explanation of the USCS is included in the Appendix. The engineer grouped the various soil types into the major zones noted on the boring logs. The stratification lines designating the interfaces between materials on the exploration records should be considered approximate; in situ, the transitions may be gradual.

Representative soil samples were selected and tested in our laboratory to check field classifications and to determine pertinent index properties. The laboratory testing program included:

- Natural moisture content determinations (ASTM D 2216)
- Atterberg Limits tests (ASTM D 4318)

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition.

3.2 REGIONAL/SITE GEOLOGY

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil and rock strata. Please refer to the boring logs in Appendix B.

The USGS Geologic Map of the Knoxville Quadrangle (1958) indicates this particular site is underlain by the Chepultepec Dolomite Formation. The Chepultepec dolomite of Early Ordovician age is mainly light-colored dolomite. Several sandstone beds (2 inches to 4 feet thick) and brown, saccharoidal, silty dolomite beds are interlayered in the lower part of the formation. The contact between the underlying Copper Ridge dolomite and the Chepultepec is placed at the base of one of the sandstones that is differentiated from others in the Chepultepec and Copper Ridge in that the sandstone bed is generally the thickest (2 to 6 feet), and is the demarcation between the dark, coarse, oolitic chert of the Copper Ridge and the chert of the Chepultepec. Chert in the Chepultepec is light colored, generally finely porous, and somewhat oolitic. The oolites are small and light colored, however, in contrast to the coarse, dark oolites of the Copper Ridge.

Figure 3.1.1 - USGS Topographic Map of the Knoxville Quadrangle
(approximate site location shown)

3.3 SUBSURFACE CHARACTERIZATION

The site subsurface conditions were evaluated with eight (8) SPT borings at the approximate locations shown on the Boring Location Diagram in the Appendix. The quantity of borings, boring locations, and drilling depths were discussed with the project team prior to completing this subsurface exploration. The following is a table presenting a summary of the subsurface conditions encountered at the test boring locations.

Table 3.3.1 - Summary of Subsurface Conditions

Boring No.	Surface Material	Fill Material		Native Material		End of Boring Depth
		Depth	N-Values (bpf)	Depth	N-Values (bpf)	
B-1	Topsoil – 2 In.	1/6 – 2 ft	7	2 – 25 ft	5 – 18	25 ft
B-2	Topsoil – 4 In.	1/3 – 2 ft	8	2 – 20 ft	8 – 17	20 ft
B-3	Topsoil – 4 In.	1/3 – 4 ft	4	4 – 25 ft	6 – 12	25 ft
B-4	Topsoil – 4 In.	1/3 – 2 ½ ft	6	2 ½ – 25 ft	4 – 18	25 ft
B-5	Topsoil – 4 In.	1/3 – 2 ft	6	2 – 20 ft	8 – 21	20 ft
B-6	Topsoil – 2 In.	1/6 – 2 ½ ft	7	2 ½ – 20 ft	2 – 8	20 ft
B-7	Topsoil – 4 In.	1/3 – 2 ft	10	2 – 10 ft	8 – 16	10 ft
B-8	Topsoil – 4 In.	1/3 – 2 ft	6	2 – 10 ft	15 – 20	10 ft

The subsurface conditions presented in Table 3.3.1 and shown on the Boring Logs should be considered approximate, based on interpretation of the exploration data using normally accepted geotechnical engineering judgments. It should be noted that transitions between different soil strata are typically less distinct than that shown on the exploration records. Subsurface conditions between the actual boring locations will vary. In addition, surficial material depths may also vary significantly across the site from those we encountered.

3.4 GROUNDWATER OBSERVATIONS

During drilling operations, groundwater was not encountered. It should be noted that it is possible for perched water to exist within the depths explored at the borings during other times of the year depending upon climatic and rainfall conditions. Additionally, discontinuous zones of perched water may exist within the native materials.

Variations in the location of the long-term water table may occur as a result of change in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

3.5 LABORATORY TESTING

Laboratory index test results indicate the in-situ moisture contents of the tested samples ranged from approximately 17 to 33 percent.

Atterberg Limits test performed on select soil samples from Borings B-1 and B-4 indicated SILT (ML) with a Liquid Limits of 38 and 43 and Plasticity Indices of 12 and 6, respectively. These results have been included on the boring logs and Laboratory Testing Summary in the Appendix.

4.0 DESIGN RECOMMENDATIONS

4.1 GENERAL

The primary purpose of this geotechnical exploration was to help identify and evaluate the general subsurface conditions relative to the proposed construction. Our recommendations have been developed on the basis of the previously described project information and subsurface conditions identified during this study.

4.1.1 Soft Soils: Based on the results of SPT borings, soft soils (material with a N-Value less than or equal to 5 bpf) were encountered in the upper 5 feet in Borings B-3, B-4, and B-6. Based on our experience in the area, soils with blow counts less than or equal to 5 bpf typically are not able to pass a proofroll and additional undercutting or ground improvement techniques will likely be required as discussed in Section 4.2.5 of this report.

4.1.2 Undocumented Fill: Existing undocumented fill materials were encountered during our exploration at our boring locations. The samples obtained appeared relatively free of organic and deleterious material. Additionally, information pertaining to the age, placement and compaction of the fill was not available; however, based on historical aerials, it appears it would have likely been placed prior to 1992 during construction of the previously existed apartment buildings. As is the case with fill placed without technical observations, the possibility exists that the fill may contain concentrated amounts of deleterious material and soft compressible zones not disclosed by our borings.

Accordingly, there are certain risks associated with construction on these types of fill. The risk primarily consists of excessive and/or non-uniform settlement caused by extensive zones or pockets of soft, loose, or uncompacted material. The risk could be reduced with documentation supporting acceptable fill placement methods and compaction.

It is our opinion that if the existing fill materials can pass a proofroll, the fill material may remain in place.

4.1.3 Construction Monitoring: ECS should be on-site full-time during earthwork and foundation construction activities to document that our recommendations are followed and to provide recommendations for remedial activities, where necessary. If we are not retained for this critical geotechnical consulting and during earthwork construction and foundation construction, ECS cannot be responsible for long-term performance of the respective subgrade-supported construction.

4.2 SUBGRADE PREPARATION

The following sections describe our general recommendations for preparing the site subgrade prior to fill placement operations.

4.2.1 Stripping and Grubbing

The subgrade preparation should consist of stripping the vegetation, rootmat, topsoil, existing fill, and soft or unsuitable materials from the 10-foot expanded building and 5-foot expanded pavement limits, and 5 feet beyond the toe of structural fills. Borings performed contained an observed approximately 2 to 5 inches of surficial material. ECS should be retained to verify that topsoil and unsuitable surficial materials have been removed prior to the placement of structural fill or construction of structures.

4.2.2 Existing Man-Placed Fill

Fill Content: Based on the visual assessment of soil samples collected during drilling, apparent fill was observed in the boring locations to depths of approximately 2 to 4 feet below the ground surface. Based on the results of the N-values recorded in the undocumented fill, it does appear that consistent compactive effort was applied during the placement of the undocumented fill.

Test Pits: In regard to the undocumented fill material, it is possible for deleterious materials to exist in areas where we did not explore. Furthermore, ECS recommends that test pits are completed at the site to further evaluate the existing undocumented fill. The test pits can be completed during the site stripping phase.

Re-Use of Fill: Based on the results of our laboratory testing, it does appear that the majority of this fill can be re-used as engineered fill at the site pending it is relatively free of organic material, large rock fragments, and meets the general fill requirements as outlined in Section 4.3.1 of this report.

4.2.3 Excavation Considerations

The soil encountered within the borings should generally be excavatable with conventional earth moving equipment such as pans/scrapers, loaders, bulldozers, rubber tired backhoes, etc. Areas of mass excavation, trenches and pits should meet the requirements of the most current Occupational Safety and Health Administration (OSHA) 29 CFR Part 1926, “Occupational Safety and Health Standards-Excavations”. Site excavation safety should be solely the responsibility of the contractor and his subcontractors.

4.2.4 Proofrolling

Prior to fill placement or other construction on subgrades, the subgrades should be evaluated by an ECS field technician. The exposed subgrade should be thoroughly proofrolled with construction equipment having a minimum axle load of 10 tons [e.g. fully loaded tandem-axle dump truck]. Proofrolling should be traversed in two perpendicular directions with overlapping passes of the vehicle under the observation of an ECS technician. This procedure is intended to assist in identifying localized yielding materials. Based on the results of our SPT borings, Borings B-3, B-4 and B-6 encountered material that may not pass a proofroll and undercutting in these areas may be required.

Where proofrolling identifies areas that are unstable or “pumping” subgrade those areas should be repaired prior to the placement of subsequent structural fill or other construction materials. Undercut areas may be backfilled with compacted shotrock fill, engineered fill, compacted dense-grade aggregate base, or flowable fill once stable subgrade soils have been encountered. If stable subgrade soils are not encountered after the initial 3 to 6 feet of undercut in pavement or slab-on-grade areas, the backfill recommendations in Table 4.2.4.1 may be utilized.

Table 4.2.4.1 – Maximum Undercut Remediation Recommendations

Maximum Undercut Depth	Backfill Requirements
No Undercut	Cement treat upper 12 inches of subgrade
3 feet	Layer of Tensar TX 140 grid or equivalent and 3 feet of granular stone or shotrock fill
4 feet	4 feet of granular or shotrock fill

4.3 EARTHWORK OPERATIONS

4.3.1 Structural Fill

Prior to placement of structural fill, representative bulk samples (about 50 pounds) of on-site and/or off-site borrow should be submitted to ECS for laboratory testing, which will typically include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships (i.e., Proctors) for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications. Alternatively, Proctor data from other accredited laboratories can be submitted if the test results are within the last 90 days.

Satisfactory Structural Fill Materials: Materials satisfactory for use as structural fill should consist of inorganic soils with the following engineering properties and compaction requirements.

Table 4.3.1.1 – Structural Fill Recommendations

Material Type	Subject	Property
Soil Fill	Building and Pavement Areas	LL < 60, PI<35
	Building and Pavement Areas Below upper 2 feet	LL < 60, PI<35
	Max. Particle Size	4 inches
	Max. organic content	5% by dry weight
Shotrock Fill	Max. Amount of Fines (Pass No. 4 sieve)	20% by weight
	Max. Particle Size	18 inch

Table 4.3.1.2 – Structural Fill Compaction Recommendations

Subject	Requirement
Compaction Standard	Standard Proctor, ASTM D698
Required Compaction	95% of Max. Dry Density
Moisture Content	-2 to +3 % points of the soil's optimum value
Loose Thickness	8 inches prior to compaction (18-inch for shotrock fill)

Soil/Rock Mix: A soil/rock mix can be classified as a fill material that contains large boulder fill, similar to a shotrock fill mix, but has more than 20% material passing a #4 sieve. It should be emphasized that this material should NOT be considered as appropriate engineered fill. If fill material contains more that 20% of material that passes a #4 sieve, it should be considered a soil engineered fill and should follow the requirements outlined previously.

On-Site Borrow Suitability: The existing on-site native materials that meet the definition of satisfactory structural fill are present on the site. These occur mostly at relatively shallow depth below the surface.

Fill Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement. Grade controls should be maintained throughout the filling operations. Filling operations should be observed on a full-time basis by ECS to document that the minimum compaction requirements are being achieved. Field density testing of fills should be performed at the frequencies shown in Table 4.3.1.3, but not less than 2 tests per lift.

Table 4.3.1.3 Frequency of Compaction Tests in Fill Areas

Location	Frequency of Tests
Expanded Building Limits	1 test per 2,500 sq. ft. per lift
Pavement Areas	1 test per 10,000 sq. ft. per lift
Utility Trenches	1 test per 200 linear ft. per lift

Fill Placement: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and frozen or frost-heaved soils should be removed prior to placement of structural fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

At the end of each work day, fill areas should be graded to facilitate drainage of precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of 4 inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

Drying and compaction of wet soils is typically difficult during the cold, winter months. Accordingly, earthwork should be performed during the warmer, drier times of the year, if practical. Proper drainage should be maintained during the earthwork phases of construction to prevent ponding of water which has a tendency to degrade subgrade soils.

Where fill materials will be placed to widen existing embankment fills, or placed up against sloping ground, the soil subgrade should be scarified and the new fill benched or keyed into the existing material. Fill material should be placed in horizontal lifts. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 inches to 4 inches may be required to achieve specified degrees of compaction.

We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. We do not anticipate significant problems in controlling moisture within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain. The control of moisture content of higher plasticity soils is difficult when these soils become wet. Further, such soils are easily degraded by construction traffic when the moisture content is elevated.

4.4 FOUNDATIONS

Provided subgrades and structural fills are prepared as recommended in this report and the undocumented fill is remediated as discussed in Section 4.2.2, the proposed structure can be supported by shallow foundations including column footings and continuous wall footings. We recommend the foundation design use the following parameters.

Table 4.4.1 Foundation Recommendations

Design Parameter	Column Footing	Wall Footing
Net Allowable Bearing Pressure[1]	2,500 psf	2,500 psf
Acceptable Bearing Soil Material	Approved Undocumented Fill/Native Soils	Approved Undocumented Fill/Native Soils
Minimum Width	24 inches	18 inches
Minimum Exterior Frost Depth (below final exterior grade)	18 inches	18 inches
Sliding Friction Coefficient	0.3	0.3
Coefficient of Passive Soil Resistance	295	295
Estimated Total Settlement [3]	Less than 1 inch	Less than 1 inch
Estimated Differential Settlement [4]	Less than ½ inch between columns	Less than ½ inch between columns

Notes:

(1) Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.
(2) Based on assumed structural loads. If final loads are different, ECS must be contacted to review foundation recommendations and settlement calculations.
(3) Based on maximum column/wall loads and variability in borings. Differential settlement can be re-evaluated once the foundation plans are more complete.

Footing Subgrade Observations: Most of the soils at the foundation bearing elevation are not anticipated to be suitable for support of the proposed structure. ECS should evaluate the existing undocumented fill materials, if allowed to remain, encountered at the foundation subgrade. It is important to have ECS observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated.

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1- to 3-inch thick "mud mat" of "lean" concrete should be placed on the bearing soils before the placement of reinforcing steel.

4.5 SLABS ON GRADE

Assuming the undocumented fill can pass a proof-roll, the on-site soils are considered suitable for support of the lowest floor slabs. The following graphic depicts our soil-supported slab recommendations:

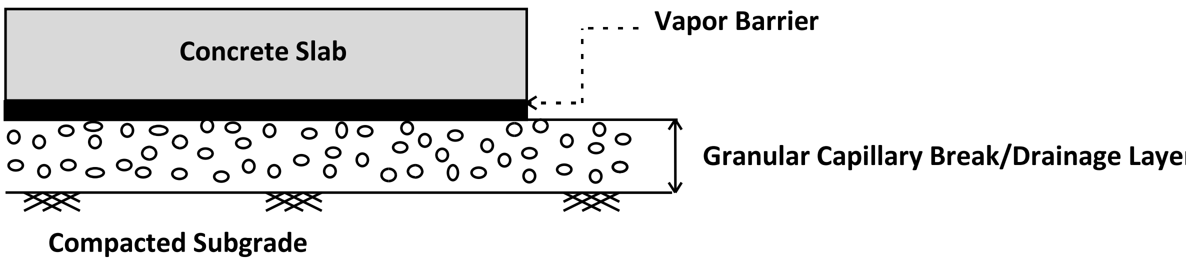


Figure 4.5.1

1. Drainage Layer Thickness: 4 inches
2. Drainage Layer Material: GRAVEL (GP, GW), SAND (SP, SW)

Slab Subgrade Verification: Prior to placement of a drainage layer, the subgrade should be prepared in accordance with the recommendations found in Section 4.2.2 of this report.

Subgrade Modulus: Provided the structural fill and granular drainage layer are constructed in accordance with our recommendations, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 120 pci (lbs./cu. inch). The modulus of subgrade reaction value is based on a 1 ft by 1 ft plate load test basis.

Vapor Barrier: Before the placement of concrete, a vapor barrier may be placed on top of the granular drainage layer to provide additional protection against moisture penetration through the floor slab. When a vapor barrier is used, special attention should be given to surface curing of the slab to reduce the potential for uneven drying, curling and/or cracking of the slab. Depending on proposed flooring material types, the structural engineer and/or the architect may choose to eliminate the vapor barrier.

Slab Isolation: Soil-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab such as in a drop down footing/monolithic slab configuration, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab.

4.6 PAVEMENTS

Subgrade Characteristics: Based on the results of our borings, it appears that the pavement subgrades in cuts will consist of SILT (ML). California Bearing Ratio (CBR) testing was not performed as part of this study. Therefore we have assumed a CBR value of 3 for preliminary design purposes.

We were not provided traffic loading information so we have assumed loadings typical of this type of project in the following table assuming a 20 year design life and 90% reliability:

Table 4.6.1: Pavement Loading Assumptions

Vehicle Description	Light Duty (15,000 ESAL)		Heavy Duty (100,000 ESAL)	
	Number of Trips per Day	Days Per Week	Number of Trips	Days Per Week
Passenger Car	250	7	250	7
Package Delivery Truck	1	2	2	5
Garbage Truck	1	2	1	2
School Bus	0	0	20	5

The preliminary pavement sections below are guidelines that may or may not comply with local jurisdictional minimums.

Table 4.6.2: Proposed Pavement Sections

MATERIAL	FLEXIBLE PAVEMENT		RIGID PAVEMENT	
	Heavy Duty	Light Duty	Heavy Duty	Light Duty
Portland Cement Concrete (f'_c = 4000 psi)	-	-	6 in.	6 in.
Asphaltic Surface Course	1 ½ in	1 in	-	-
Asphaltic Binder Course	2 ¼ in	2 in	-	-
Crushed Stone Base[1]	8 in	8 in	5 in	5 in

In general, heavy duty sections are areas that will be subjected to trucks, buses, or other similar vehicles including main drive lanes of the development. Light duty sections are appropriate for vehicular traffic and parking areas.

Large, front loading trash dumpsters frequently impose concentrated front wheel loads on pavements during loading. This type of loading typically results in rutting of asphalt pavement and ultimately pavement failures. For preliminary design purposes, we recommend that the pavement in trash pickup areas consist of a 6-inch thick, 4,000 psi, reinforced concrete slab over 6-inches of dense graded aggregate. When traffic loading becomes available ECS or the Civil Engineer can design the pavements.

Pavement Maintenance: Regular maintenance and occasional repairs should be implemented to keep pavements in a serviceable condition. In addition, to help reduce water infiltration to the pavement section and within the base course layer resulting in softening of the subgrade and deterioration of the pavement, we recommend the timely sealing of joints and cracks using proper sealants. We recommend exterior pavements be reviewed for distress/cracks twice a year, once in the spring and once in the fall.

Sound maintenance programs should help maintain and enhance the performance of pavements and attain the design service life. A preventative maintenance program should be implemented early in the pavement life to be effective. The "standard in the industry" supported by research indicates that preventative maintenance should begin within 2 to 5 years of the pavement construction. Failure to perform preventative maintenance will reduce the service life of the pavement and increase the costs for both corrective maintenance and full pavement rehabilitation.

4.7 SEISMIC DESIGN CONSIDERATIONS

Seismic Site Classification: The International Building Code (IBC) **2018** requires site classification for seismic design based on the upper 100 feet of a soil profile. At least two methods are utilized in classifying sites, namely the shear wave velocity (v_s) method and the Standard Penetration Resistance (N-value) method. The second method (N-Value) was used in classifying this site.

Table 4.7.1: Seismic Site Classification

Site Class	Soil Profile Name	Shear Wave VeloNashville, Vs, (ft./s)	N value (bpf)
A	Hard Rock	Vs > 5,000 fps	N/A
B	Rock	2,500 < Vs ≤ 5,000 fps	N/A
C	Very dense soil and soft rock	1,200 < Vs ≤ 2,500 fps	>50
D	Stiff Soil Profile	600 ≤ Vs ≤ 1,200 fps	15 to 60
E	Soft Soil Profile	Vs < 600 fps	<15

Based upon our interpretation of the subsurface conditions, the appropriate Seismic Site Classification is "D" as shown in the preceding table.

Ground Motion Parameters: In addition to the seismic site classification, ECS has determined the design spectral response acceleration parameters following the IBC methodology. The Mapped Reponses were estimated from the USGS website https://earthquake.usgs.gov/ws/designmaps/. The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are noted in bold at the far right end of the following table.

Table 4.7.2: Ground Motion Parameters "Class D" ***(IBC 2018 Method)***

Period (sec)	Mapped Spectral Response Accelerations (g)		Values of Site Coefficient for Site Class		Maximum Spectral Response Acceleration Adjusted for Site Class (g)		Design Spectral Response Acceleration (g)	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_S	0.609	F_a	1.313	$S_{MS}=F_aS_s$	0.8	$S_{DS}=2/3\ S_{MS}$	**0.533**
1.0	S_1	0.132	F_v	2.335	$S_{M1}=F_vS_1$	0.309	$S_{D1}=2/3\ S_{M1}$	**0.206**

The Site Class definition should not be confused with the Seismic Design Category designation which the Structural Engineer typically assesses. If a higher site classification is beneficial to the project, we can provide additional testing methods that may yield more favorable results.

4.8 SLOPE STABILITY

In general, compacted soil fill embankments on stiff undisturbed soils should be constructed no steeper than a ratio of 3.0 horizontal (H) to 1.0 vertical (V). We recommend cut slopes not be steeper than a ratio of 3.0 (H) to 1.0 (V).

Surface water runoff should be prevented from flowing over the slope face. For cut slopes, the area above the slope crest should be constructed with a reverse slope to prevent surface water runoff from flowing over the slope face. Additionally, we recommend a drainage swale or other provisions be constructed near the crest of each cut slope to divert water away from the cut face.

Material should not be stockpiled within 10 feet of the crest of cut or fill slopes. In addition, both cut and fill slope faces should be protected from erosion using a vegetative cover. Seed and mulch, or erosion matting with embedded seed, are options for developing a vegetative cover.

Special consideration must also be given to the stability to cut surfaces in natural soil and rock excavations. The evaluation of slope stability aspects of this site and the proposed development is beyond the scope of this exploration. Relatively detailed grading plans will have to be developed before meaningful evaluation of slope stability can be accomplished. Slope stability evaluation should be performed by qualified geotechnical engineering personnel prior to the initiation of significant grading activities at the site.

4.9 BELOW GRADE WALLS

We recommend that below grade walls be designed to withstand at-rest lateral earth pressures and surcharge loads from adjacent building foundations, and/or streets. These recommendations apply to a "drained" condition which is where there is drainage material behind below grade walls that prevents hydrostatic water pressures on the back of the below grade wall.

To accomplish a drained condition, drainage materials such as a free draining gravel, geocomposite drainage panels, weep holes, and an underslab drainage system should be used.

We recommend that walls that are restrained from movement at the top be designed for a linearly increasing lateral earth pressure. The following Figure depicts our recommended at-rest lateral earth pressure condition for a "drained below-grade wall" with restrained wall top:

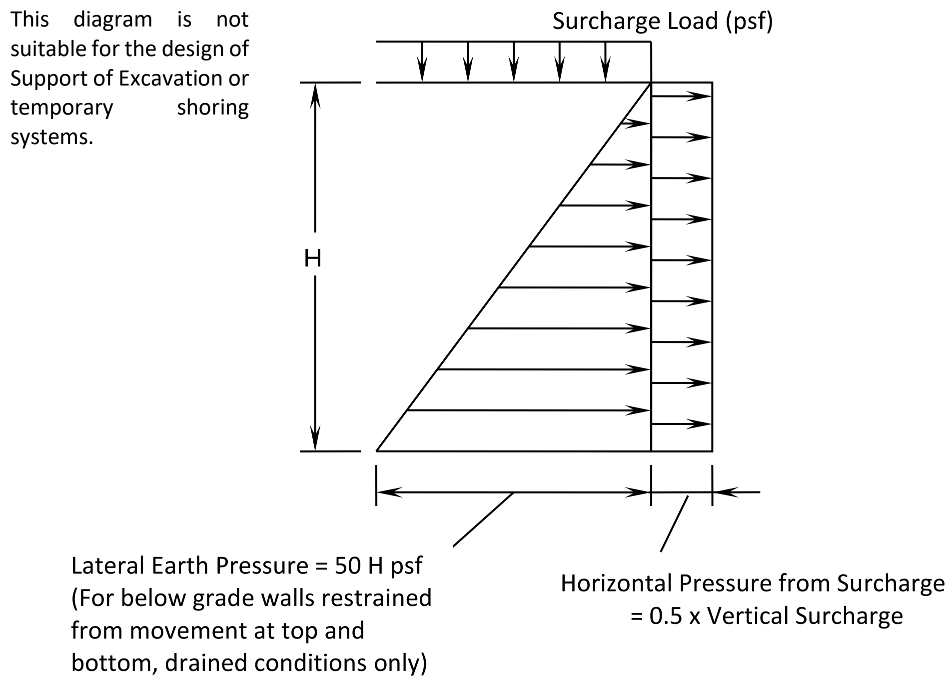


Figure 4.9.1

Surcharge loads imposed within a 45 degree slope from the base of the restrained wall should be considered in the below grade wall design. These surcharge loads should be based on an at-rest pressure coefficient, k_0, of 0.5. Care should be used to avoid the operation of heavy equipment to compact the wall backfill since it may overload and damage the wall; in addition, such loads are not typically considered in the design of below grade walls. The below grade wall foundation can be designed at 2,500 psf for bearing on native soils.

Lateral Earth Pressures: Below grade walls (permanent and temporary) should be designed to withstand the lateral earth pressures exerted by the backfill. The pressure diagram is triangular. For design of below grade retaining wall structures, the following soil parameters can be utilized. These parameters assume that SILT (ML) or granular soils meeting the requirements recommended herein for retaining wall backfill will comprise the backfill in the critical zone. The critical zone is defined as the area between the back of the retaining wall structure and an imaginary line projected upward and rearward from the bottom back edge of the wall footing at a 45-degree angle. For temporary shoring, the clay parameters should be utilized.

Table 4.9.1 Retaining Wall Backfill in the Critical Zone

Soil Parameter	Estimated value (SILT (ML))	Estimated value Select Granular Fill	Estimated value 57 or 67 Stone
Coefficient of Earth Pressure at Rest (K_o)	0.56	0.47	0.35
Coefficient of Active Earth Pressure (K_a)	0.39	0.31	0.22
Coefficient of Passive Earth Pressure (K_p)	2.56	3.25	4.6
Retained Soil Moist Unit Weight (γ)	100 pcf	130 pcf	105 pcf
Cohesion (C)	500 psf	0 psf	0 psf
Angle of Internal Friction (ϕ)	26°	32°	40°
Friction Coefficient [Concrete on Soil] (μ)	0.30	0.30	0.30
At-rest Equivalent Fluid Pressure	56H (psf)	61H (psf)	37H (psf)
Active Equivalent Fluid Pressure	39H (psf)	40H (psf)	23H (psf)
Passive Equivalent Fluid Pressure	256H (psf)	420H (psf)	483H (psf)

<u>Retaining Wall Backfill</u>: Backfill of below-grade walls may consist of on-site low to moderate plasticity SILT (ML) or well-graded granular materials (SC, SM, SW, GC, GM or GW) may be used. Select granular backfill should consist of clean sands or gravel. ECS's geotechnical engineer should review the laboratory data for the proposed backfill material, prior to backfill placement, to determine whether the material is consistent with the recommended lateral earth pressures. The first layer of fill should be placed in a relatively uniform horizontal lift and be adequately keyed into the stripped and scarified subgrade soils. The backfill materials should be placed in 8-inch thick loose layers and compacted to at least 95 percent of the Standard Proctor maximum dry density. We recommend that backfill directly behind the walls be compacted with hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 5 to 10 feet of the wall during backfilling to avoid developing excessive temporary lateral soil pressures.

5.0 SITE CONSTRUCTION RECOMMENDATIONS

5.1 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrades should be observed and probed for stability by ECS. Loose or unsuitable materials encountered should be removed and replaced with suitable compacted structural fill, or pipe stone bedding material.

Utility Backfilling: The granular bedding material (often #57 stone) should be at least 4 inches thick, but not less than that specified by the civil engineer's project drawings and specifications. We recommend that the bedding materials be placed up to the springline of the pipe. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for structural fill and fill placement.

5.2 GENERAL CONSTRUCTION CONSIDERATIONS

Moisture Conditioning: During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction. Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to prevent construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to reduce the likelihood of the infiltration of surface water.

Excavation Safety: Cuts or excavations associated with utility excavations may require forming or bracing, slope flattening, or other physical measures to control sloughing and/or prevent slope failures. Contractors should be familiar with applicable OSHA codes to ensure that adequate protection of the excavations and trench walls is provided.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. Erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

6.0 CLOSING

ECS has prepared this report to guide the geotechnical-related design and construction aspects of the project. We performed these services in accordance with the standard of care expected of professionals in the industry performing similar services on projects of like size and complexity at this time in the region. No other representation, expressed or implied, and no warranty or guarantee is included or intended in this report.

The description of the proposed project is based on information provided to ECS by McCarty Holsaple McCarty. If any of this information is inaccurate or changes, either because of our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted so we can review our recommendations and provide additional or alternate recommendations that reflect the proposed construction.

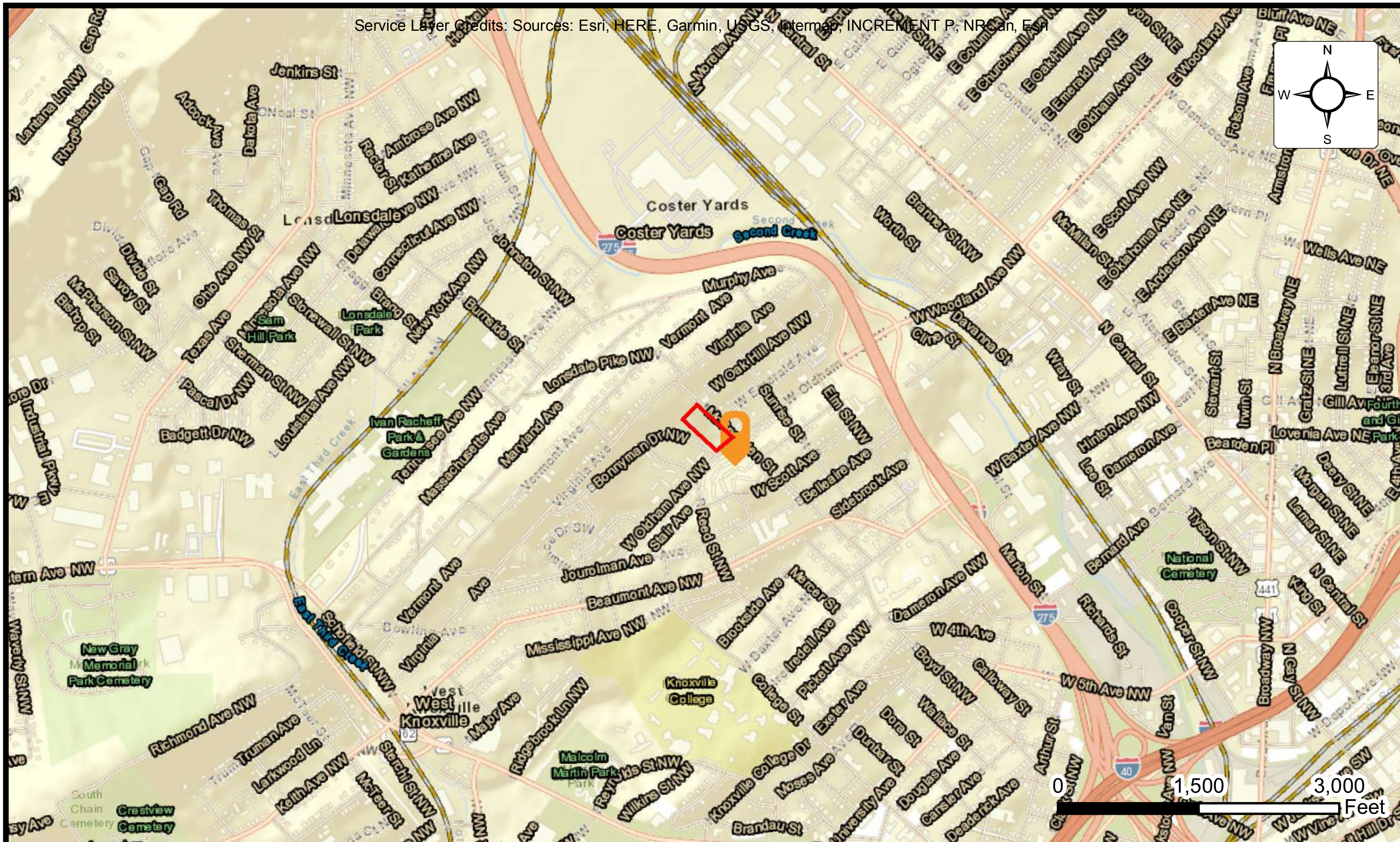
We recommend that ECS review the project plans and specifications so we can confirm that those plans/specifications are in accordance with the recommendations of this geotechnical report.

Field observations, and quality assurance testing during earthwork and foundation installation are an extension of, and integral to, the geotechnical design. We recommend that ECS be retained to apply our expertise throughout the geotechnical phases of construction, and to provide consultation and recommendation should issues arise.

ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Diagrams & Reports

Site Location Diagram
Boring Location Diagram
Subsurface Cross-Sections



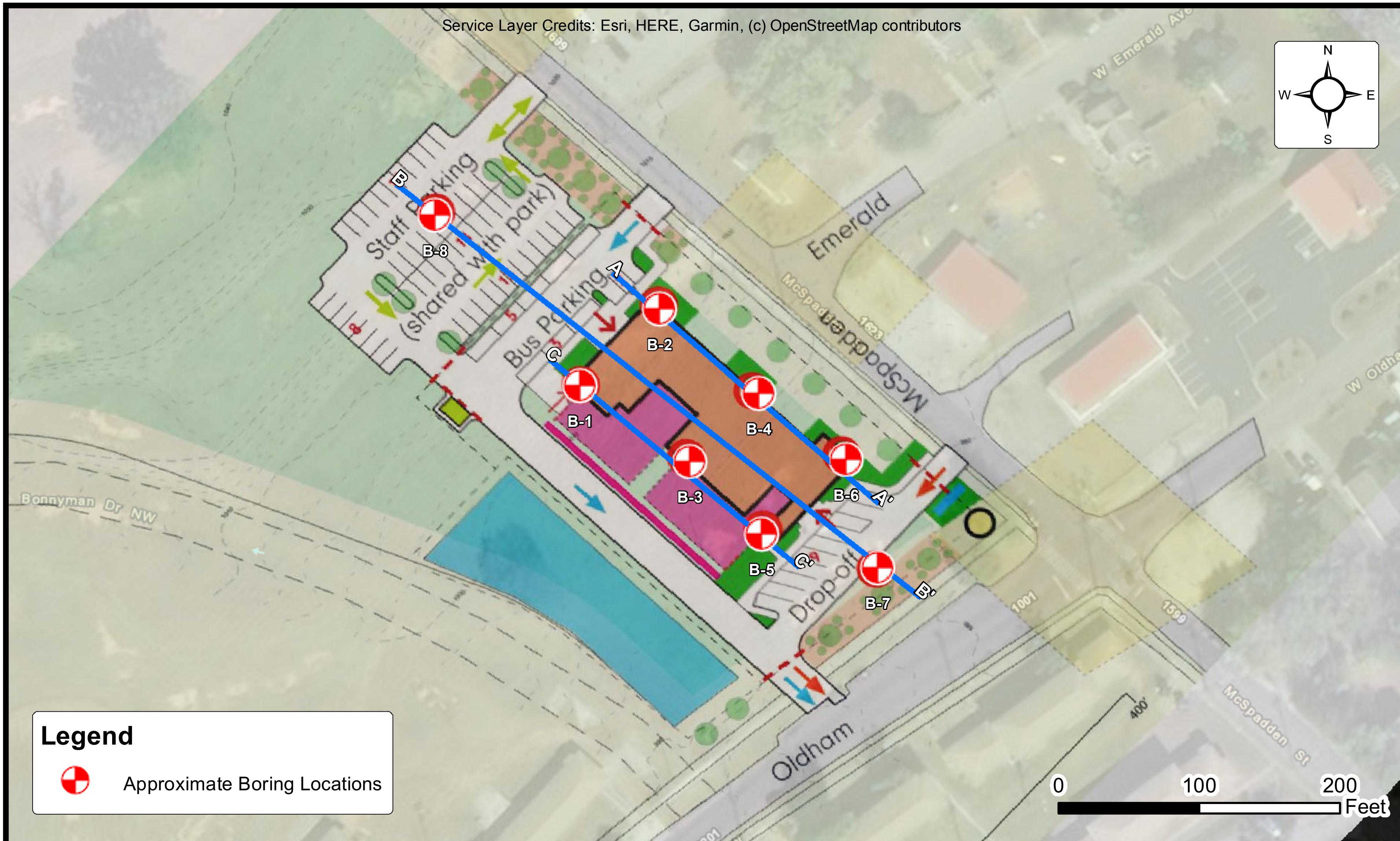
SITE LOCATION DIAGRAM

KNOXVILLE HEAD START WESTERN HEIGHTS

MCSPADDEN STREET, KNOXVILLE, TENNESSEE

MCCARTY HOLSAPLE MCCARTY, INC.

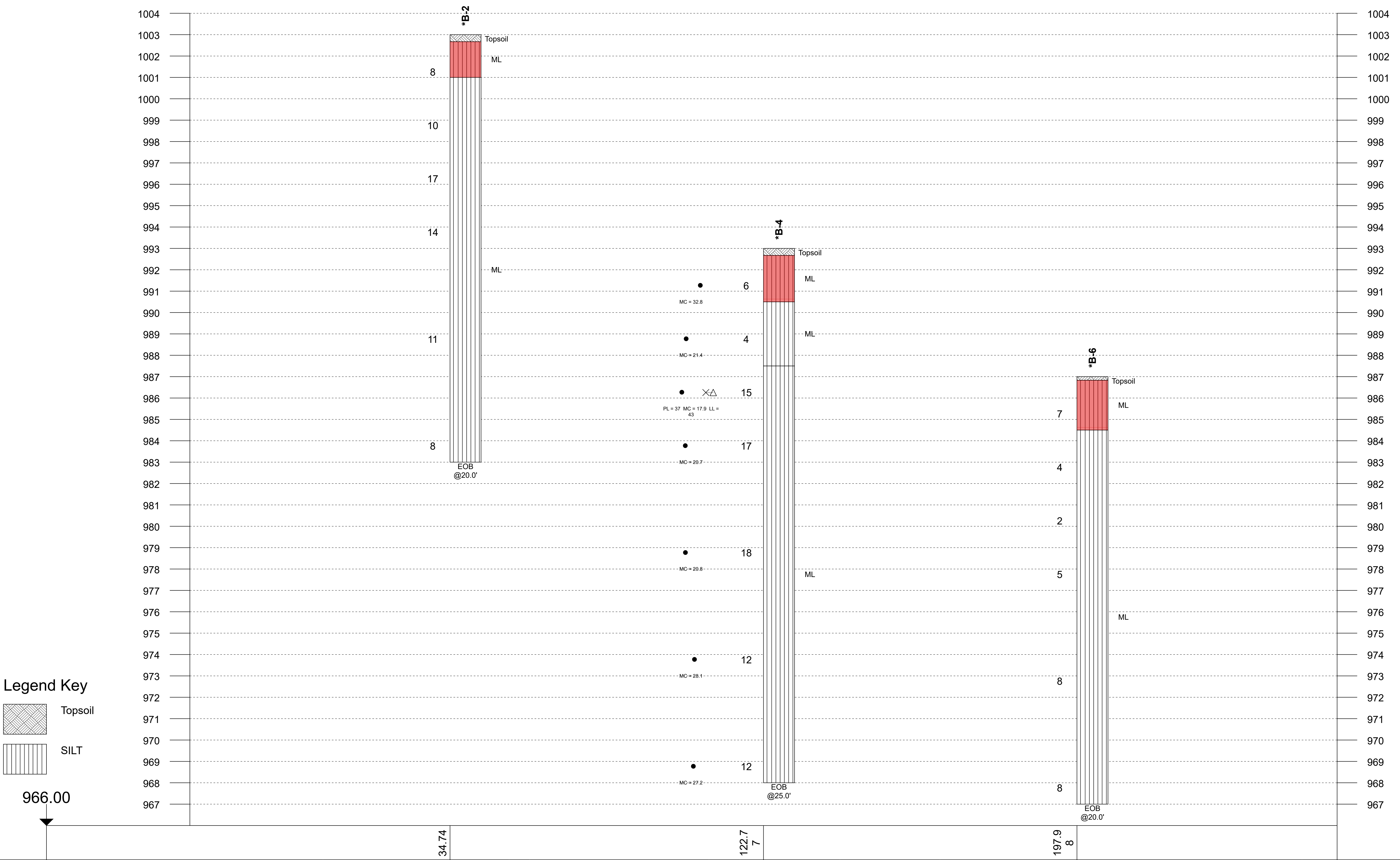
ENGINEER	JDG2
SCALE	AS NOTED
PROJECT NO.	26:4588
SHEET	1 OF 1
DATE	12/3/2020



Boring Location Diagram
KNOXVILLE HEAD START WESTERN HEIGHTS

MCSPADDEN STREET, KNOXVILLE, TENNESSEE
MCCARTY HOLSAPLE MCCARTY, INC.

ENGINEER	JDG2
SCALE	AS NOTED
PROJECT NO.	26:4588
SHEET	1 OF 1
DATE	1/13/2021



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit X———●———△		WL (First Encountered)	Fill
[FINES CONTENT%]		WL (Completion)	Possible Fill
BOTTOM OF CASING		WL (Seasonal High Water)	Probable Fill
LOSS OF CIRCULATION		WL (Stabilized)	Rock

ECS

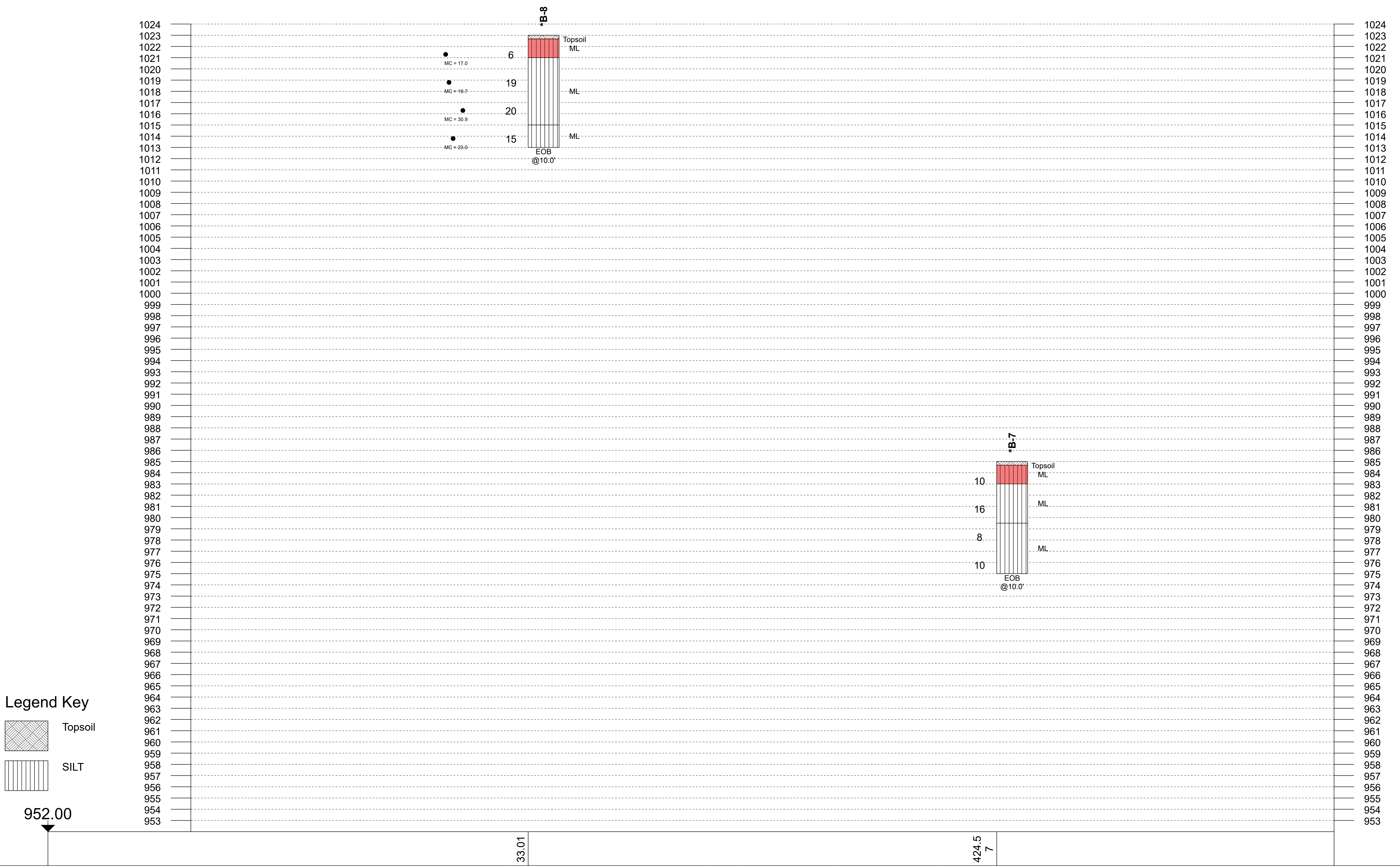
GENERALIZED SUBSURFACE SOIL PROFILE Section Line A - A'

Knoxville Head Start Western Heights

McCarty Holsaple McCarty, Inc.

McSpadden Street, Knoxville, Tennessee 37921

Project No:	26:4588	Date:	01/13/2021



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit X———●———△	WL (First Encountered)	Fill	
[FINES CONTENT%]	WL (Completion)	Possible Fill	
BOTTOM OF CASING	WL (Seasonal High Water)	Probable Fill	
LOSS OF CIRCULATION	WL (Stabilized)	Rock	

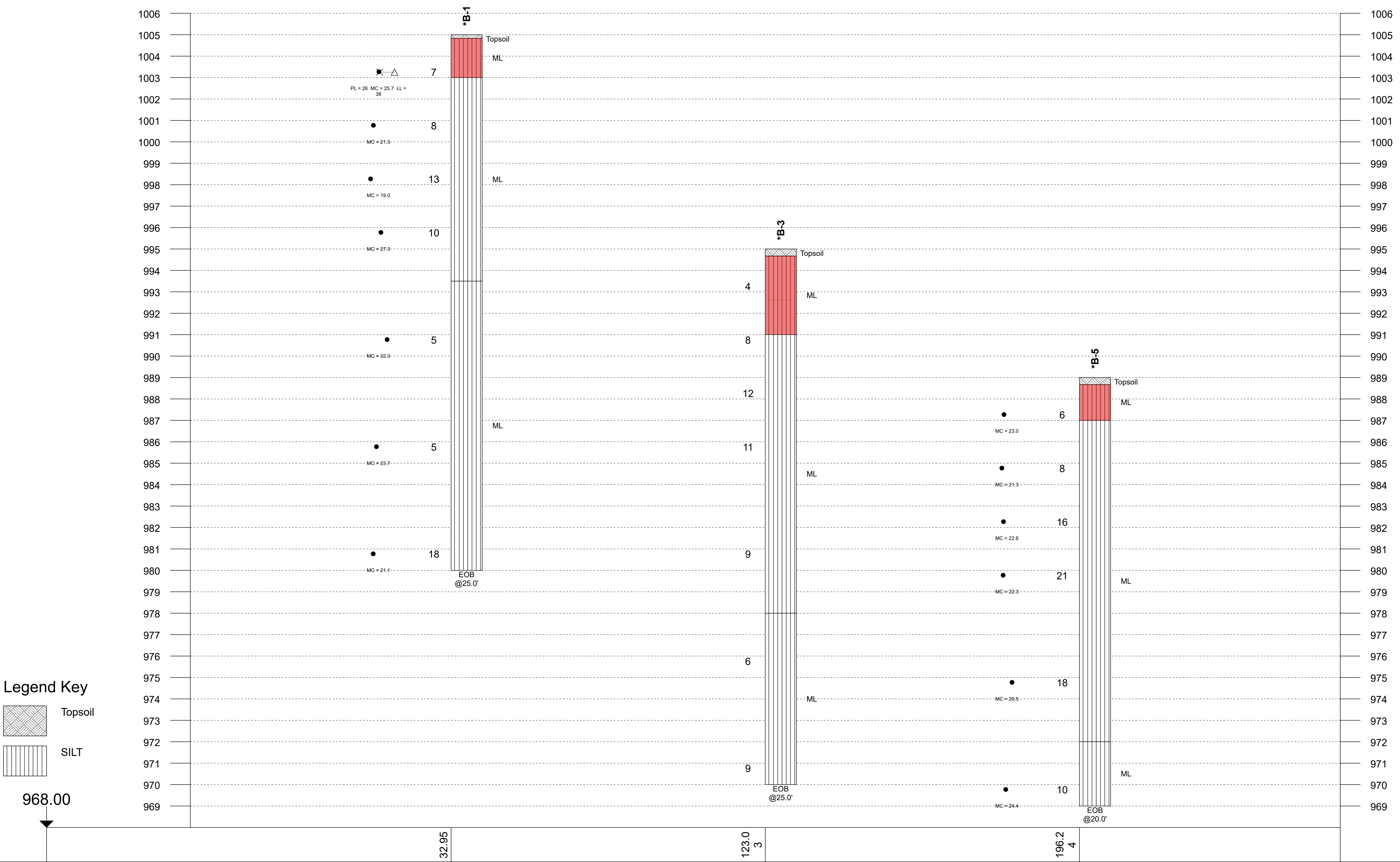
GENERALIZED SUBSURFACE SOIL PROFILE Section Line B - B'

Knoxville Head Start Western Heights

McCarty Holsaple McCarty, Inc.

McSpadden Street, Knoxville, Tennessee 37921

Project No: 26:4588 Date: 01/13/2021



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit X——●——△	▽ WL (First Encountered)	Fill	
[FINES CONTENT%]	▼ WL (Completion)	Possible Fill	
BOTTOM OF CASING	▽ WL (Seasonal High Water)	Probable Fill	
LOSS OF CIRCULATION	▽ WL (Stabilized)	Rock	

GENERALIZED SUBSURFACE SOIL PROFILE Section Line C - C'

Knoxville Head Start Western Heights

McCarty Holsaple McCarty, Inc.

McSpadden Street, Knoxville, Tennessee 37921

Project No: 26:4588 Date: 01/13/2021

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Boring Logs B-1 through B-8

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]

	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
GW	**WELL-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GP	**POORLY-GRADED GRAVEL** gravel-sand mixtures, little or no fines
GM	**SILTY GRAVEL** gravel-sand-silt mixtures
GC	**CLAYEY GRAVEL** gravel-sand-clay mixtures
SW	**WELL-GRADED SAND** gravelly sand, little or no fines
SP	**POORLY-GRADED SAND** gravelly sand, little or no fines
SM	**SM SILTY SAND** sand-silt mixtures
SC	**CLAYEY SAND** sand-clay mixtures
ML	**SILT** non-plastic to medium plasticity
MH	**ELASTIC SILT** high plasticity
CL	**LEAN CLAY** low to medium plasticity
CH	**FAT CLAY** high plasticity
OL	**ORGANIC SILT or CLAY** non-plastic to low plasticity
OH	**ORGANIC SILT or CLAY** high plasticity
PT	**PEAT** highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, QP[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
With	10 - 20	10 - 25
Adjective *(ex: "Silty")*	25 - 45	30 - 45

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS[6]

- WL (First Encountered)
- WL (Completion)
- WL (Seasonal High Water)
- WL (Stabilized)

FILL AND ROCK

FILL | POSSIBLE FILL | PROBABLE FILL | ROCK

[1]Classifications and symbols per ASTM D 2488-17 (Visual-Manual Procedure) unless noted otherwise.

[2]To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3]Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4]Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5]Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6]The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7]Minor deviation from ASTM D 2488-17 Note 14.

[8]Percentages are estimated to the nearest 5% per ASTM D 2488-17.

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
McCarty Holsaple McCarty, Inc.	**26:4588**	**B-1**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Knoxville Head Start Western Heights	**Master Drillers, Inc.**

SITE LOCATION:	
McSpadden Street, Knoxville, Tennessee 37921	LOSS OF CIRCULATION 100%

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:	
605453.6	**2576762.3**		**1005.0**	BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

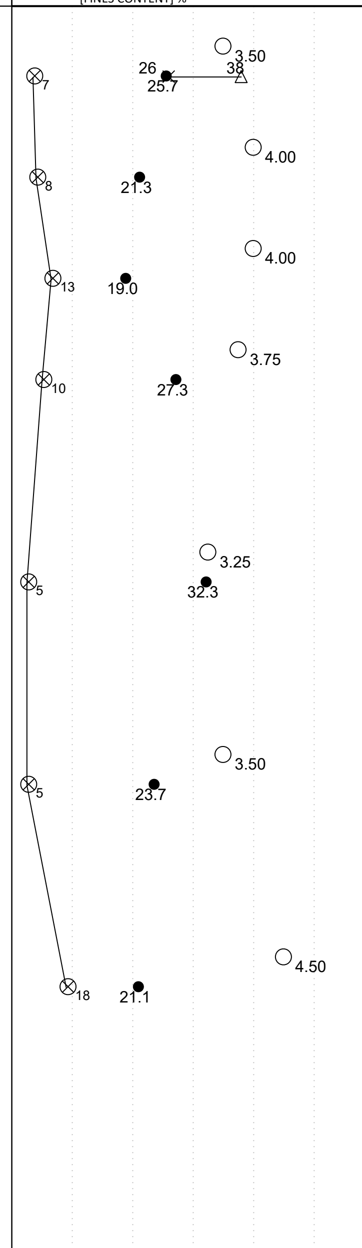
RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [2"]		1005	
	S-1	SS	18	18	(ML FILL) FILL, SILT, brown, moist			4-4-3 (7)
					(ML) SILT, reddish brown, moist, firm to stiff			
	S-2	SS	18	18				1-3-5 (8)
5							1000	
	S-3	SS	18	18				4-5-8 (13)
	S-4	SS	18	18				3-5-5 (10)
10							995	
					(ML) SILT, reddish brown, moist, soft to very stiff			
	S-5	SS	18	18				2-2-3 (5)
15							990	
	S-6	SS	18	18				2-2-3 (5)
20							985	
	S-7	SS	18	18				7-8-10 (18)
25					**END OF DRILLING AT 25.0 FT**		980	
30							975	



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

WL (First Encountered)	BORING STARTED: **Jan 04 2021**		CAVE IN DEPTH:
WL (Completion)	BORING COMPLETED: **Jan 04 2021**		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **ATV**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
McCarty Holsaple McCarty, Inc.	**26:4588**	**B-2**	**1 of 1**

PROJECT NAME: **Knoxville Head Start Western Heights**

DRILLER/CONTRACTOR: **Master Drillers, Inc.**

SITE LOCATION: **McSpadden Street, Knoxville, Tennessee 37921**

LOSS OF CIRCULATION

BOTTOM OF CASING

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
605507.2	**2576815.9**		**1003.0**

Plastic Limit X, Water Content ●, Liquid Limit △

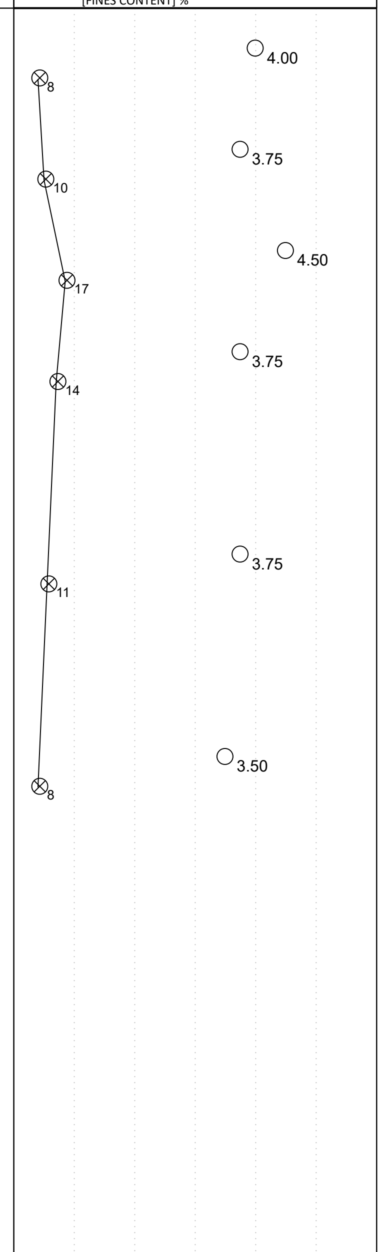
⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY: RQD, REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness [4"]			
	S-1	SS	18	18	(ML FILL) FILL, SILT, brown, moist			6-4-4 (8)
	S-2	SS	18	18	(ML) SILT, reddish brown, moist, stiff to very stiff			3-4-6 (10)
5							998	
	S-3	SS	18	18				3-8-9 (17)
	S-4	SS	18	18				3-6-8 (14)
10							993	
	S-5	SS	18	18				3-5-6 (11)
15							988	
	S-6	SS	18	18				3-4-4 (8)
20					**END OF DRILLING AT 20.0 FT**		983	
25							978	
30							973	



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

WL (First Encountered)	BORING STARTED: **Jan 04 2021**	CAVE IN DEPTH:
WL (Completion)	BORING COMPLETED: **Jan 04 2021**	HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **ATV** / LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)		

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
McCarty Holsaple McCarty, Inc.	**26:4588**	**B-3**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Knoxville Head Start Western Heights	**Master Drillers, Inc.**

SITE LOCATION:
McSpadden Street, Knoxville, Tennessee 37921

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
605399.1	**2576834.1**		**995.0**

LOSS OF CIRCULATION
BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit
STANDARD PENETRATION BLOWS/FT
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
CALIBRATED PENETROMETER TON/SF
[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	SPT BLOWS/FT	CALIBRATED PENETROMETER TON/SF
					Topsoil Thickness [4"]					
	S-1	SS	18	18	(ML FILL) FILL, SILT, brown, moist			3-2-2 (4)	4	3.00
5	S-2	SS	18	18	(ML) SILT, reddish brown, moist, soft to stiff		990	2-4-4 (8)	8	3.50
	S-3	SS	18	18				4-6-6 (12)	12	3.50
10	S-4	SS	18	18			985	4-5-6 (11)	11	4.00
15	S-5	SS	18	18			980	2-4-5 (9)	9	4.00
20	S-6	SS	18	18	(ML) SILT, reddish brown, moist, firm to stiff		975	2-3-3 (6)	6	3.25
25	S-7	SS	18	18			970	4-4-5 (9)	9	4.00
					END OF DRILLING AT 25.0 FT					
30							965			

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

WL (First Encountered)	BORING STARTED: **Jan 04 2021**		CAVE IN DEPTH:
WL (Completion)	BORING COMPLETED: **Jan 04 2021**		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **ATV**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
McCarty Holsaple McCarty, Inc.	26:4588	B-4	1 of 1

PROJECT NAME:	DRILLER/CONTRACTOR:
Knoxville Head Start Western Heights	Master Drillers, Inc.

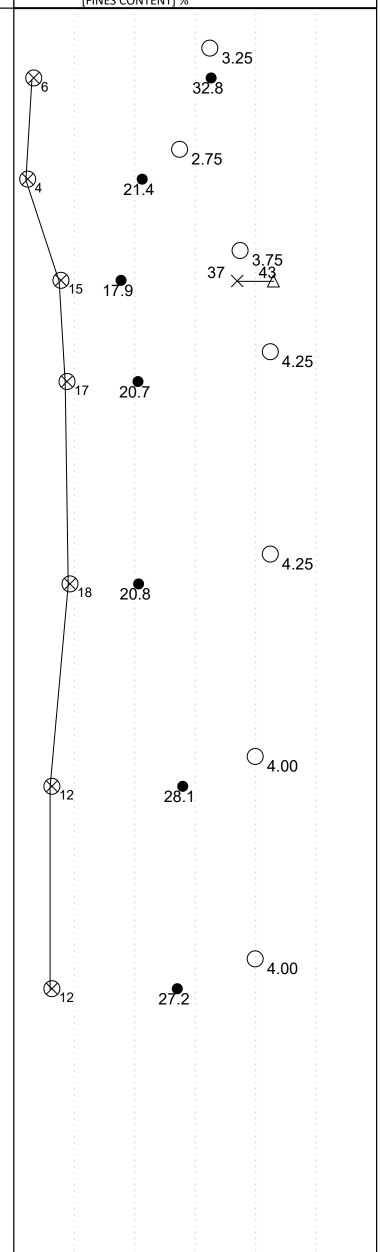
SITE LOCATION:
McSpadden Street, Knoxville, Tennessee 37921

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
605447.4	2576880.5		993.0

LOSS OF CIRCULATION 100%
BOTTOM OF CASING

Plastic Limit X — Water Content ● — Liquid Limit △
⊗ STANDARD PENETRATION BLOWS/FT
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
○ CALIBRATED PENETROMETER TON/SF
[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [4"]		993	
	S-1	SS	18	18	(ML FILL) FILL, SILT, brown, moist			3-3-3 (6)
	S-2	SS	18	18	(ML) SILT, reddish brown, moist, firm to soft			1-1-3 (4)
5							988	
	S-3	SS	18	18	(ML) SILT, reddish brown, moist, stiff to very stiff			3-6-9 (15)
	S-4	SS	18	18				4-7-10 (17)
10							983	
	S-5	SS	18	18				4-8-10 (18)
15							978	
	S-6	SS	18	18				4-5-7 (12)
20							973	
	S-7	SS	18	18				4-6-6 (12)
25					**END OF DRILLING AT 25.0 FT**		968	
30							963	



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

WL (First Encountered)	BORING STARTED: Jan 04 2021		CAVE IN DEPTH:
WL (Completion)	BORING COMPLETED: Jan 04 2021		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: ATV	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
McCarty Holsaple McCarty, Inc.	26:4588	B-5	1 of 1

PROJECT NAME:	DRILLER/CONTRACTOR:
Knoxville Head Start Western Heights	Master Drillers, Inc.

SITE LOCATION:	LOSS OF CIRCULATION
McSpadden Street, Knoxville, Tennessee 37921	BOTTOM OF CASING

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
605349.6	2576888.2		989.0

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness [4"]			
	S-1	SS	18	18	(ML FILL) FILL, SILT, brown, moist			2-3-3 (6)
	S-2	SS	18	18	(ML) SILT, reddish brown, moist, firm to very stiff			3-4-4 (8)
5							984	
	S-3	SS	18	18				4-7-9 (16)
	S-4	SS	18	18				4-12-9 (21)
10							979	
	S-5	SS	18	18				4-8-10 (18)
15							974	
	S-6	SS	18	18	(ML) SILT, reddish brown, moist, stiff			4-5-5 (10)
20					**END OF DRILLING AT 20.0 FT**		969	
25							964	
30							959	

Plastic Limit Water Content Liquid Limit

X——●——△

⊗ STANDARD PENETRATION BLOWS/FT

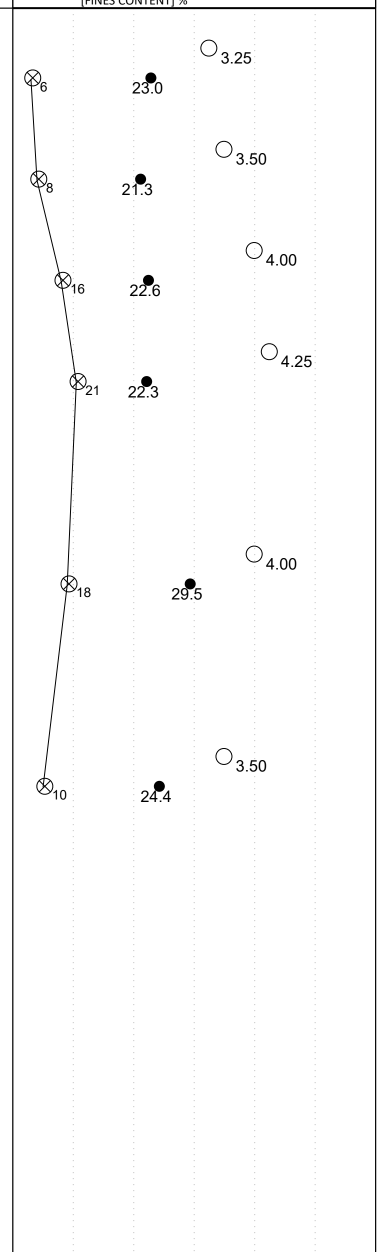
ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



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

▽ WL (First Encountered)	BORING STARTED:	Jan 04 2021	CAVE IN DEPTH:	
▼ WL (Completion)	BORING COMPLETED:	Jan 04 2021	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)	EQUIPMENT: ATV	LOGGED BY:	DRILLING METHOD:	**HSA/SPT**
WL (Stabilized)				

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
McCarty Holsaple McCarty, Inc.	**26:4588**	**B-6**	**1 of 1**
PROJECT NAME:	DRILLER/CONTRACTOR:		
Knoxville Head Start Western Heights	**Master Drillers, Inc.**		

SITE LOCATION:
McSpadden Street, Knoxville, Tennessee 37921

LOSS OF CIRCULATION (100%)

BOTTOM OF CASING

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
605402.0	**2576940.9**		**987.0**

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

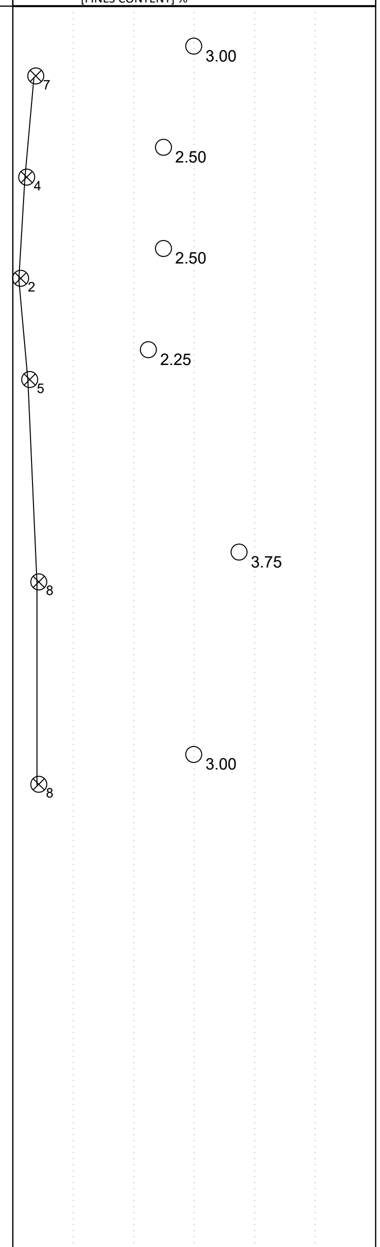
RQD

REC

CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Topsoil Thickness [2"]			
	S-1	SS	18	18	(ML FILL) FILL, SILT, brown, moist			2-3-4 (7)
	S-2	SS	18	18	(ML) SILT, reddish brown, moist, firm to soft			1-2-2 (4)
5							982	
	S-3	SS	18	18				1-1-1 (2)
	S-4	SS	18	18				1-2-3 (5)
10							977	
	S-5	SS	18	18				3-4-4 (8)
15							972	
	S-6	SS	18	18				3-3-5 (8)
20					**END OF DRILLING AT 20.0 FT**		967	
25							962	
30							957	



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

WL (First Encountered)	BORING STARTED: **Jan 04 2021**		CAVE IN DEPTH:
WL (Completion)	BORING COMPLETED: **Jan 04 2021**		HAMMER TYPE: **Auto**
WL (Seasonal High Water)	EQUIPMENT: **ATV**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
McCarty Holsaple McCarty, Inc.	**26:4588**	**B-7**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
Knoxville Head Start Western Heights	**Master Drillers, Inc.**

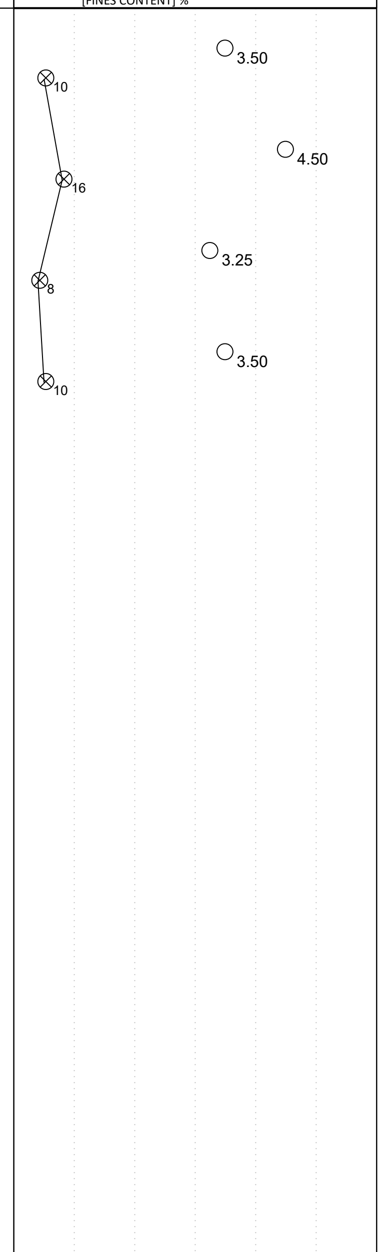
SITE LOCATION:
McSpadden Street, Knoxville, Tennessee 37921

LOSS OF CIRCULATION: 100%
BOTTOM OF CASING

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
605319.5	**2576962.5**		**985.0**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Thickness [4"]		985	
	S-1	SS	18	18	(ML FILL) FILL, SILT, brown, moist			3-5-5 (10)
	S-2	SS	18	18	(ML) SILT, reddish brown, moist, stiff to very stiff			4-6-10 (16)
5							980	
	S-3	SS	18	18	(ML) SILT, reddish brown, moist, firm to stiff			3-4-4 (8)
	S-4	SS	18	18				4-5-5 (10)
10					**END OF DRILLING AT 10.0 FT**		975	
15							970	
20							965	
25							960	
30							955	

Plastic Limit X — Water Content ● — Liquid Limit △
⊗ STANDARD PENETRATION BLOWS/FT
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
○ CALIBRATED PENETROMETER TON/SF
[FINES CONTENT] %



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

▽ WL (First Encountered)	BORING STARTED:	**Jan 04 2021**	CAVE IN DEPTH:
▼ WL (Completion)	BORING COMPLETED:	**Jan 04 2021**	HAMMER TYPE: **Auto**
▽ WL (Seasonal High Water)	EQUIPMENT: **ATV**	LOGGED BY:	DRILLING METHOD: **HSA/SPT**
▽ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT: McCarty Holsaple McCarty, Inc.	PROJECT NO.: 26:4588	BORING NO.: B-8	SHEET: 1 of 1
PROJECT NAME: Knoxville Head Start Western Heights	DRILLER/CONTRACTOR: Master Drillers, Inc.		
SITE LOCATION: McSpadden Street, Knoxville, Tennessee 37921			
NORTHING: 605576.1	EASTING: 2576666.8	STATION:	SURFACE ELEVATION: 1023.0

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit

STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	SPT (BLOWS/FT)	WATER CONTENT (%)	PENETROMETER (TON/SF)
					Topsoil Thickness [4"]						
	S-1	SS	18	18	(ML FILL) FILL, SILT, brown, moist			3-3-3 (6)	6	17.0	2.75
	S-2	SS	18	18	(ML) SILT, reddish brown, moist, firm to very stiff			5-8-11 (19)	19	19.7	3.50
5							1018				
	S-3	SS	18	18				5-8-12 (20)	20	30.9	4.25
	S-4	SS	18	18	(ML) SILT, reddish brown, moist, stiff			4-7-8 (15)	15	23.0	3.50
10					**END OF DRILLING AT 10.0 FT**		1013				
15							1008				
20							1003				
25							998				
30							993				

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

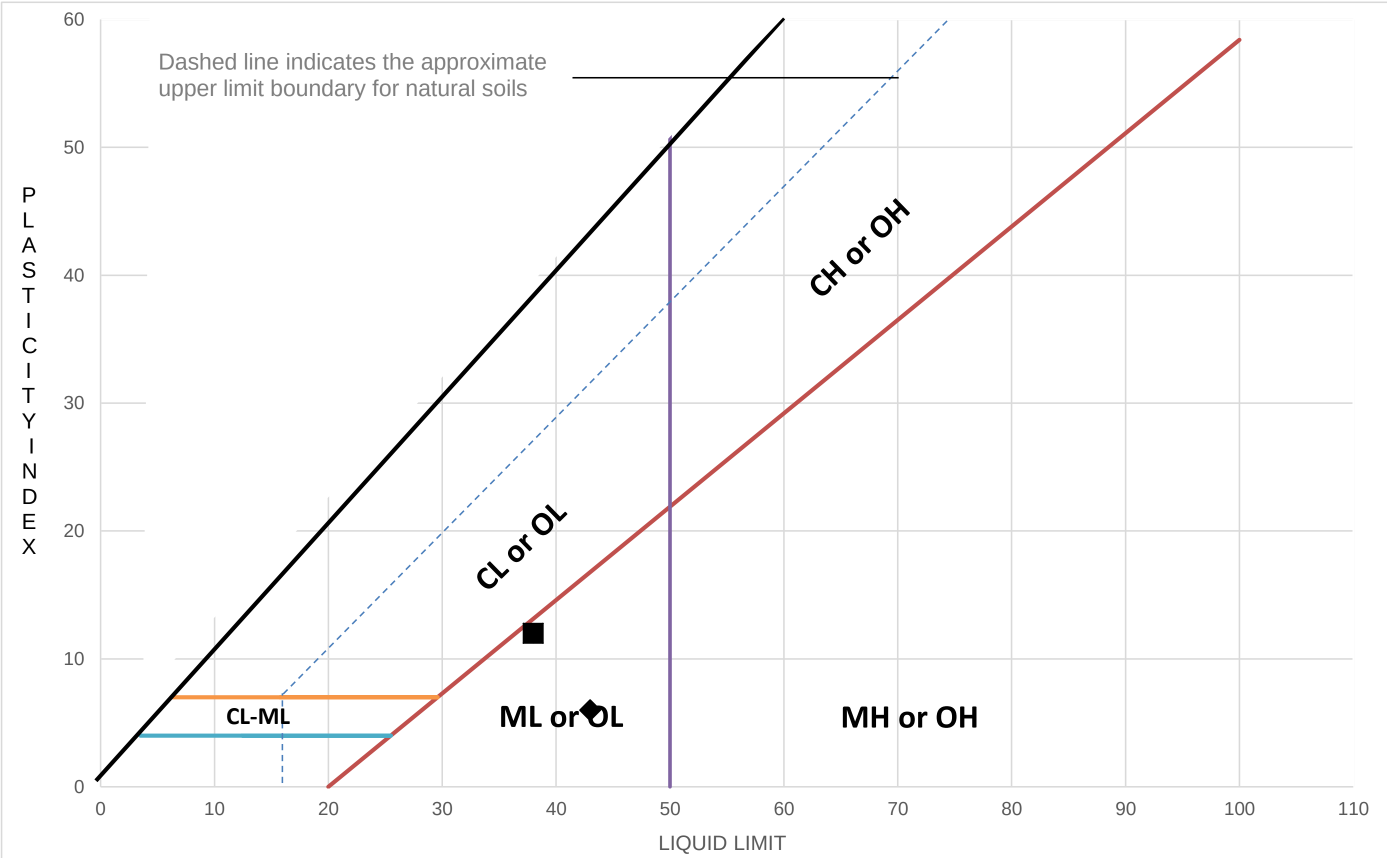
WL (First Encountered)	BORING STARTED: Jan 04 2021	CAVE IN DEPTH:
WL (Completion)	BORING COMPLETED: Jan 04 2021	HAMMER TYPE: Auto
WL (Seasonal High Water)	EQUIPMENT: ATV / LOGGED BY:	DRILLING METHOD: HSA/SPT
WL (Stabilized)		

GEOTECHNICAL BOREHOLE LOG

APPENDIX C – Laboratory Testing

Liquid and Plastic Limits Test Results
Laboratory Test Results Summary

LIQUID AND PLASTIC LIMITS TEST REPORT



TEST RESULTS (ASTM D4318-10 (MULTIPOINT TEST))

	Sample Location	Sample Number	Sample Depth (ft)	LL	PL	PI	%<#40	%<#200	AASHTO	USCS	Material Description
■	B-1	S-1	1-2.5	38	26	12					(ML) SILT, reddish brown, moist, firm
◆	B-4	S-3	6-7.5	43	37	6					(ML) SILT, reddish brown, moist, stiff

Project: Knoxville Head Start Western Heights
Client: McCarty Holsaple McCarty, Inc.

Project No.: 26:4588
Date Reported: 1/13/2021

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Knoxville	4708 Middlecreek Lane Knoxville, TN 37921	(865)281-1840

Tested by	Checked by	Approved by	Date Received
adusheck	rbanner	rbanner	1/8/2021

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)	0.1 in.	0.2 in.	
B-1	S-1	1-2.5	25.7		38	26	12						
B-1	S-2	3.5-5	21.3										
B-1	S-3	6-7.5	19										
B-1	S-4	8.5-10	27.3										
B-1	S-5	13.5-15	32.3										
B-1	S-6	18.5-20	23.7										
B-1	S-7	23.5-25	21.1										
B-4	S-1	1-2.5	32.8										
B-4	S-2	3.5-5	21.4										
B-4	S-3	6-7.5	17.9		43	37	6						

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: Knoxville Head Start Western Heights
Client: McCarty Holsaple McCarty, Inc.
Project No.: 26:4588
Date Reported: 1/13/2021

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Knoxville	4708 Middlecreek Lane Knoxville, TN 37921	(865)281-1840

Tested by	Checked by	Approved by	Date Received
adusheck	rbanner	rbanner	1/8/2021

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)	0.1 in.	0.2 in.	
B-4	S-4	8.5-10	20.7										
B-4	S-5	13.5-15	20.8										
B-4	S-6	18.5-20	28.1										
B-4	S-7	23.5-25	27.2										
B-5	S-1	1-2.5	23										
B-5	S-2	3.5-5	21.3										
B-5	S-3	6-7.5	22.6										
B-5	S-4	8.5-10	22.3										
B-5	S-5	13.5-15	29.5										
B-5	S-6	18.5-20	24.4										

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: Knoxville Head Start Western Heights
Client: McCarty Holsaple McCarty, Inc.
Project No.: 26:4588
Date Reported: 1/13/2021

Office / Lab: ECS Southeast LLP - Knoxville
Address: 4708 Middlecreek Lane Knoxville, TN 37921
Office Number / Fax: (865)281-1840

Tested by	Checked by	Approved by	Date Received
adusheck	rbanner	rbanner	1/8/2021

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	^MC (%)	Soil Type	Atterberg Limits			**Percent Passing No. 200 Sieve	Moisture - Density		CBR (%)		#Organic Content (%)
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)	0.1 in.	0.2 in.	
B-8	S-1	1-2.5	17										
B-8	S-2	3.5-5	19.7										
B-8	S-3	6-7.5	30.9										
B-8	S-4	8.5-10	23										

Notes: See test reports for test method, ^ASTM D2216-19, *ASTM D2488, **ASTM D1140-17, #ASTM D2974-20e1

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content

Project: Knoxville Head Start Western Heights
Client: McCarty Holsaple McCarty, Inc.

Project No.: 26:4588
Date Reported: 1/13/2021

Office / Lab	Address	Office Number / Fax
ECS Southeast LLP - Knoxville	4708 Middlecreek Lane Knoxville, TN 37921	(865)281-1840

Tested by	Checked by	Approved by	Date Received
adusheck	rbanner	rbanner	1/8/2021

APPENDIX D – Supplemental Report Documents

USGS Design Maps Detailed Report
Important Information

Knoxville Head Start Western Heights

Latitude, Longitude: 35.97879337, -83.94358621

Date	1/13/2021, 8:54:11 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	0.609	MCE_R ground motion. (for 0.2 second period)
S_1	0.132	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.8	Site-modified spectral acceleration value
S_{M1}	0.309	Site-modified spectral acceleration value
S_{DS}	0.533	Numeric seismic design value at 0.2 second SA
S_{D1}	0.206	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.313	Site amplification factor at 0.2 second
F_v	2.335	Site amplification factor at 1.0 second
PGA	0.412	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.494	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	0.609	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.677	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.132	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.142	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.9	Mapped value of the risk coefficient at short periods
C_{R1}	0.934	Mapped value of the risk coefficient at a period of 1 s

DISCLAIMER

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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