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GEOTECHNICAL ENGINEERING REPORT

ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

100 NE ST. LUKE'S BLVD.
LEE'S SUMMIT, MISSOURI
(AOG 22-353E)(REVISED)

Date: October 6, 2022

Submitted to: ACI Boland Architects
Samuel Beckman AIA
1710 Wyandotte St.
Kansas City, MO 64108

STATE OF MISSOURI
GARIC L.
ABENDROTH
NUMBER
PE-2009023262
PROFESSIONAL ENGINEER

Submitted by: ALPHA-OMEGA GEOTECH, INC.

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Samuel,

Alpha Omega Geotech, Inc. (AOG) has completed its geotechnical engineering investigation for the above-referenced project.

Attached are the following items that were utilized in the analysis and evaluation of the subsurface conditions at this site: a sketch giving the approximate location of the eleven (11) auger borings completed during this investigation with reference to the existing site features; detailed laboratory results of sixteen (16) moisture contents (ASTM D2216), sixteen (16) dry density (ASTM D7263); eight (8) sets of Atterberg limits (ASTM D4318), and sixteen (16) unconfined compression - soil (ASTM D2166) tests; thirty (30) calibrated pocket penetrometer readings; and eleven (11) auger boring (ASTM D1452) logs that describe the materials encountered, their approximate thicknesses, and the sampling depths where Shelby tube, thin-walled steel, samplers (ASTM D1587) and Standard Penetration (ASTM D1586) tests were performed.

Representatives of AOG located each of the selected borings by measuring from the existing site features, and these measurements should be considered accurate only to the extent implied by the method of measurement. Surface elevations were not determined. Each of the borings was completed by AOG using a track-mounted CME 55 high-torque drill rig.

1.0 PROJECT DESCRIPTION

The expansion has a footprint of approximately 17,000 square feet and initially will be 3-stories above-grade with the possibility of expanding vertical to 5-stories. It is anticipated to be founded on deep foundations. The expansion will be attached to the existing building and match the finished floor elevation. The expansion may be steel or concrete construction. Actual foundation loads were not provided at this time, AOG assumes the addition will be heavily loaded. The existing parking in the area just east & south will have a grade change and be repaved. The existing parking will be expanded as indicated on the imbedded boring plan

ACI Boland has provided a diagram with boring locations: seven (7) borings will be performed inside of the new addition footprint. These borings will be advanced to refusal. At refusal, 3 borings were selected to be advanced into the bedrock a minimum of 5 feet. One (1) boring was located in the new pavement area and was advanced to 15 or refusal. Three (3) borings for proposed new parking were advanced to 10 ft or refusal.

2.0 SUBSURFACE INVESTIGATION

Based on the information provided, as well as, discussions with design team, AOG drilled eleven (11) auger borings at the proposed site. Each of building borings were advanced to auger refusal which was met at a depth of approximately 14.5 feet to 24.8 feet beneath existing grade (fbeg) then cored to depths of about 29.9 to about 30.3 fbeg.

The following table summarizes the depth of auger refusal in each of these test borings:

Table #1: Auger Refusal Depth (FT)

Boring	Location	Top of Weathered Rock (FT)	Depth of Refusal (FT)(*)	Depth of Core (FT)
B1	NWC	~ 23.2	~ 23.5	N/A
B2	W BLDG	~ 24.0	~ 24.8	N/A
B3A	SWC	~ 21.4	~ 21.8	~ 30.3
B4	NEC	~ 12.9	14.5	N/A
B5	MID BLDG	~ 21.4	21.8	~ 30.3
B6	MID BLDG	~ 17.8	22.4	~ 29.9
B7A	SEC	~ 19.0	20.6	N/A
B8	E BLDG ENTRY	N/A	NONE (15.0)	N/A
B9	E PARKING	N/A	NONE (10.0)	N/A
B10	MID PARKING	~ 12.0	~ 13.6 (Practical Refusal)	N/A
B11	W PARKING	~ 9.5	~ 9.7 (Practical Refusal)	N/A
(*) Very hard, weathered shale that was penetrable using our high-torque drilling equipment was encountered above the auger refusal depths shown above (see the boring logs enclosed in Appendix).				

Once auger refusal was encountered in each boring, a rock core was taken to help characterize the consistency and continuity of the underlying bedrock strata. The rock quality designation (RQD) of the recovered rock cores was determined by one of our engineering geologists. The RQD of a rock core is defined as the sum of the length of individual intact rock segments 4 inches in length, or greater, divided by the total length of the core advance in that rock unit expressed as a percentage. In similar fashion, the recovery ratio is calculated by dividing the length of recovered rock core by the total length of core advance for each particular rock unit. The RQD measurements, which are an indication of the amount of discontinuities in the rock and can be empirically correlated to its bearing capacity, are included on the boring logs.

A summary of the RQD and recovery ratio measurements on the recovered rock cores from the boring is summarized in the following table:

Table #2: Rock Core Quality

ROCK CORE QUALITY				
Boring	~ Depth (ft)	Bedrock Material	RQD	Recovery Ratio
B3A	21.8-25.3	LIMESTONE TURNING TO SHALE AT 22.4'	5	99
	25.3-30.3	LIMESTONE	96	100
B5	21.8-25.3	LIMESTONE	91	100
	25.3-30.3	LIMESTONE	100	100
B6	22.4-24.9	LIMESTONE W/ SHALE SEAMS	90	89
	24.9-29.9	LIMESTONE		100

It should be understood that the depth of boring, split-spoon refusal or auger refusal reported herein applies to the type of drilling equipment that was used. As such, it might be possible to extend some of these borings deeper using different drilling equipment and/or techniques. Conversely, residual sandstone, shale and limestone materials through which AOG's drill rig penetrated, without achieving refusal, may be difficult to excavate depending upon the equipment being used. As such, Alpha-Omega Geotech, Inc. shall not be responsible, for the determination of Others, regarding the rippability, or ease of excavation, of the in-situ subgrade, bedrock and/or geo-intermediate materials.

Above the depth, at which, boring termination occurred, predominantly lean and fat clays, were encountered in the borings. The overburden soil was underlain by interbedded shale and limestone bedrock. The uppermost portions of the bedrock were generally highly weathered to weathered. The highly weathered to weathered portions were variable in thickness, ranging from approximately a few feet to about twenty-five feet thick.

Thin-walled, steel, Shelby tube samplers (ASTM D1587) were used to collect relatively undisturbed samples from these borings for laboratory analysis. Standard Penetration tests (SPT) (ASTM D1586) were also used to sample and evaluate the consistency of the in-situ subgrade materials encountered in these test borings. Standard Penetration Tests are conducted by advancing a hollow, split spoon sampler into the base of the auger hole by means of dropping a 140-pound hammer a distance of 30 inches onto the drill rods. Each drop of the hammer is one blow, and these blow counts are recorded for each of three, 6-inch advances of the sampler. The first 6-inch advance is the seating drive, and the summation of the blow counts of the final two, 6-inch advances is taken as the standard penetration resistance. The standard penetration resistance, or N-value, as it is known, along with the soil classification, can be used to estimate the density, shear strength and other engineering properties of the materials encountered.

The N-values obtained from each of the SPT's completed in these borings using a CME automatic hammer are included on the boring logs and summarized in the Summary of Laboratory Testing sheet found in Appendix B. Samples retrieved during drilling efforts were returned to AOG's laboratory for testing and evaluation.

3.0 LABORATORY TESTING PROGRAM

Laboratory testing on materials collected during drilling was performed on samples selected by AOG. Results from these tests can be found in Appendix B and on the boring logs in Appendix C. The following laboratory tests were performed by qualified AOG personnel in accordance with ASTM specifications to determine pertinent engineering properties of the soils:

- Visual classification (ASTM D2488)
- Moisture content tests (ASTM D2216)
- Atterberg limits tests (ASTM D4318)
- Dry Unit Weight (ASTM D7263)
- Unconfined compression tests on soil (ASTM D2166)

The dry unit weights of specimens cut from the Shelby tube samples were found to be medium at 91.6 to 106.1 pounds per cubic foot (pcf). Depending upon the material composition and depth below existing grade, the moisture content of the specimens cut from these tube samples ranged from 14.3 to 31.8 percent. The unconfined compressive strength of the specimen cut from the Shelby tube sample ranged from 1668 to 7889 pounds per square foot (psf). It should be noted that some of the maximum unconfined compressive strength values were obtained at high strain rates nearing and exceeding 10 percent. As a result, given the onsite soil types, these high strain rates typically indicate that larger settlements could occur unless a lower allowable bearing capacity value is used than otherwise indicated by the unconfined compressive strength test results. Calibrated pocket penetrometer readings ranging from 0.75 tons per square foot (tsf) (1500 psf) to >4.50 tsf (>9000 psf) were obtained on the recovered Shelby tube samples. However, it should be noted that the pocket penetrometer values tend to over-estimate the strength of in-situ subgrade materials relative to the actual unconfined compressive strength test

The Atterberg consistency limits were determined for eight (8), generally, representative sample taken at relatively shallow to intermediate depths from within the proposed structures' footprints. Based on the Atterberg limits, the samples were classified in accordance with the Unified Soil Classification System (USCS) as Lean Clay (CL) and Fat Clay (CH) classification materials. The results of these laboratory analyses are presented in the following table:

Table #3: Atterberg Limits Results

ATTERBERG LIMITS TESTS					
Sample	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Classification
B1 ST-2	3.0-5.0	53	24	29	Fat Clay (CH)
B2 ST-4	8.0-10.0	64	24	40	Fat Clay (CH)
B3A ST-4	8.0-10.0	60	25	35	Fat Clay (CH)
B4 ST-2	3.0-5.0	56	23	33	Fat Clay (CH)
B5 ST-2	3.0-15.0	48	25	23	Lean Clay (CL)
B6 ST-4	8.0-10.0	63	24	39	Fat Clay (CH)
B7A ST-2	3.0-5.0	56	24	32	Fat Clay (CH)
B8 ST-4	8.0-10.0	62	24	38	Fat Clay (CH)

Based on the Atterberg limits, it is anticipated that onsite soil materials generally possess a moderate to high swelling potential. The swelling potential of a clay soil is an indication of the volume changes that may take place with variations in the soil moisture content.

Except for the samples for which the Atterberg limits were determined, all of the other soil classifications given throughout the laboratory test data, as well as, the boring logs, were made using the visual and tactile techniques described in ASTM D2488. As a result, additional analyses could reveal other soil types of different classification and potentially higher plasticity and swelling potential both onsite and within the nearby vicinity.

4.0 GROUNDWATER

Free water was encountered in boring B1 at a depth of 2.5 (fbeg), boring B6 at 17.9 (fbeg), boring B7A at 20.0 (fbeg) and boring B10 at 10.5 (fbeg) at the time of drilling (see boring logs). However, a twenty-four-hour water level was not established in these borings due to time restrictions, as well as, potential safety hazards associated with open bore holes.

Although the ground water levels given on the boring logs reflect the conditions observed at the time the borings were made, they should not be construed to represent an accurate or permanent condition. There is uncertainty involved with short-term water level observations in bore holes especially in clay soils of relatively low permeability. The groundwater level should be expected to fluctuate with variations in precipitation, site grading and drainage conditions. In addition, it is also possible that seasonal perched ground water may be encountered within these soil deposits and bedrock formations at different depths during other times of the year based on drainage conditions, seasonal snowmelt and rainwater infiltration.

5.0 GEOTECHNICAL CONSIDERATIONS

The following considerations are given based on observations made by AOG at the time of drilling, during reconnaissance trips, and based on the project requirements and description as stated above:

1) *Undocumented Fill:* Undocumented fill, in general, consists of foreign materials with unknown densities and consistencies. Undocumented fill is unsuitable beneath structures and pavements unless measures are taken to stabilize the materials prior to loading. Undocumented fill beneath foundations and slabs should be addressed in accordance with Section 6.0, "SITE DEVELOPMENT" and 7.0, "FOUNDATIONS," of this report.
2) *Expansive Materials:* Expansive clays were encountered during this exploration. Expansive clays are known to experience significant volume changes with changed in moisture. Expansive clays located beneath any slabs on grade should be removed in accordance with Section 8.0, "SLABS ON GRADE," of this report.
3) *Settlement between the Existing Structure and the Proposed Addition:* Differential settlement is likely to occur when a new addition is rigidly attached to an existing structure. Design considerations to help mitigate differential settlement between structures should be taken. Reference Section 7.0 FOUNDATIONS of this report.

6.0 SITE DEVELOPMENT

6.1 Site Preparation

Appropriate erosion control measures, such as proper site contouring during grading activities, as well as, silt fences, should be maintained to help keep any eroded materials onsite.

Within the footprint of the proposed new structures, it is recommended that any topsoil, vegetation, utility backfill, and other deleterious material (i.e. concrete slabs, relic foundations, utilities, etc.) or pavements should be stripped and removed prior to the placement of any fill required to achieve the finished floor elevation. In accordance with the local building code, this should be verified by a representative of Alpha-Omega Geotech, Inc. prior to the placement of fill.

Once initial site stripping operations have been completed and prior to the placement of any engineered fill in this area, it is recommended that the exposed subgrade be moisture conditioned and recompacted, as needed, and be thoroughly evaluated by means of a proof-roll with a fully loaded, tandem-axle dump truck to locate any soft, compressible areas within the proposed project site. Any soft, compressible areas identified on the proposed project site must be corrected by over-excavation to a suitable subgrade and replaced with an acceptable material. Although it is not anticipated that any extensive removal and replacement would be necessary, it is possible that some effort may be required to develop a stable platform on which to place the necessary fill material and address any other existing site conditions that become known during construction. It is generally anticipated that the extent of these efforts would strongly depend upon the ground moisture conditions at the time the site work begins. In the event that the ground is generally dry, it is possible that only a minimal amount of stabilization would be required, which may be possible to accomplish by simple moisture conditioning and recompaction efforts. *Nevertheless, it is recommended that a representative of Alpha-Omega Geotech, Inc. should be onsite to witness this proof-rolling and offer recommendations, as needed, to correct any problem areas identified.*

6.2 Undocumented Fill

Undocumented fill is a foreign material, of which no records of testing or evaluation by a qualified professional during the time of placement exist. Undocumented fill is, generally, unsuitable beneath structures, and if encountered during development, should be removed or stabilized in accordance with this report. Undocumented fill beneath pavements should be undercut to a minimum depth of two (2) feet, and the exposed subgrade should be thoroughly evaluated by a registered professional engineer.

6.3 Engineered Fill Placement

It is assumed that any fill material needed will come from cut areas and, if necessary, on-site or nearby borrow sources of similar material. <u>It is recommended that unweathered shales should NOT be used to construct any of the necessary fill within either the new buildings or paved portions of the site.</u> Assuming they are properly moisture conditioned and compacted, it generally appears that the clean clay soils encountered in the borings that are free of rubble, trash, concrete, asphalt, and other debris would be acceptable for use as controlled fill. However, due to their swelling potential and for subgrade stability, detailed recommendations for the placement of a non-expansive subbase are provided in Section 9.0, SLABS ON GRADE of this report.

Any imported fill materials for use as structural fill should be tested by Alpha-Omega Geotech, Inc. to determine if they are acceptable for the intended use. Any ground water seeps that are encountered must be diverted prior to placing fill.

In addition, no compaction of soil fill material should be performed during freezing weather. Nevertheless, as weather conditions dictate, it may be possible to substitute crusher-run limestone in lieu of soil fill to allow placement of engineered controlled fill material to continue during the cold fall and winter months. However, any frozen fill material must be stripped prior to placing subsequent lifts.

All general fill within the area of the new building (except for the upper 24-inches, as discussed in Section 10.0, SLABS ON GRADE of this report, should be placed in lifts not exceeding 6 inches in thickness, and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content.

<u>As required by the local building code, the compaction of any structural fill beneath the new buildings, pavements, and any other areas where settlement control is necessary, as well as, any slopes that are steeper than 4:1 (H:V) should be tested lift-by-lift by a representative of Alpha-Omega Geotech, Inc.</u>

6.4 Drainage Considerations

Fluctuations of the ground water level can occur due to seasonal variations in the amount of rainfall and other climatic factors that were not evident at the time the borings were made. The possibility of ground water level fluctuations should be considered when developing the design and construction plans for the project. In spring and late fall, soil moisture contents may be abnormally high and drying of the soils that are exposed and/or undercutting may be required to develop a suitable base for the placement and compaction of engineered fill. Disking and aeration of the exposed soils may be sufficient to develop a stable base. However, if site grading begins during the summer or early fall, moisture contents may be abnormally low and the plastic clay soils encountered during this exploration may undergo significant volume changes with subsequent increases in their moisture content. Therefore, when these conditions exist, disking and moisture conditioning of the exposed subgrade soils may be required.

It is highly important to consider drainage and construction elements that will help to inhibit future slab on grade problems, foundation cracks, as well as, intolerable settlements due to volume changes of the onsite soils. The surface drainage must be designed to prevent ponding and effectively move water away from both the new and existing buildings, pavements and other structures. It is also very important to place all materials under carefully controlled conditions of moisture and density to inhibit significant soil volume changes. Shrubs and trees with deep root systems and requiring large quantities of water should not be planted within 20 feet of the building lines. Any planters located near the building should have impermeable bases with weep holes to discharge water away from the wall lines. Down spouts should be connected to subsurface drains to carry the water to safe exits beyond the building lines, retaining walls, pavements, slopes and other site features or structures that could be adversely affected by water seepage.

6.5 General

Permanent slopes should not be steeper than 3:1 (H:V) to help ensure their future stability and accommodate normal mowing equipment. The responsibility for excavation safety and stability of temporary construction slopes should lie solely with the contractor and should follow the OSHA regulations given in 29 CFR Part 1926.650 - .652, Subpart P. The stability of open excavations is dependent upon a number of factors including but not limited to the presence of gravel, sand and/or silt seams, ground water seepage, strength characteristics of the soil layers, slickensides and other unique geological features, the slope and height of the cut, surcharge loading and vibrations during construction, weather conditions, as well as, the length of time the excavation is left open. Alpha-Omega Geotech, Inc. does not assume any responsibility for construction site safety or the contractor's or other parties' compliance with all local, state and federal safety or other regulations including imprudent excavating practices that results in any damage to nearby structures, roadways, utilities, as well as, onsite or offsite improvements.

7.0 FOUNDATIONS

Based on the subsurface investigations/preliminary information for this structure, laboratory test data, the available subsurface information that has been obtained in this investigation, our understanding of the conceptual project requirements, planned foundation loads and to minimize differential settlements between the new addition and existing structure, it is our opinion that the proposed conceptual building foundations are well-suited for the use of deep foundations (drilled piers).

Based on the subsurface conditions that have been identified, Site Class C conditions (IBC 2018) may be assumed for seismic consideration.

7.1 Drilled Piers

Due to the anticipated foundation loads, it is AOG's opinion that a deep foundation system consisting of drilled piers founded in competent bedrock *(minimum estimated top of competent limestone rock to be encountered at an depth of about 22 to 25 fbeg based on borings)* should be used as economical foundation elements. The drilled piers will bear on competent limestone bedrock below the top of the weathered rock layers.

Based on the subsurface conditions that have been identified, it is recommended that all of the drilled piers be socketed (rock augered) into competent limestone bedrock strata a **minimum of 12-inches**. It is recommended that a representative from Alpha-Omega Geotech, Inc. should continuously monitor the excavation of the drilled piers to help ensure that competent and uniform bearing support is provided beneath all of the drilled piers. Assuming that the excavations of the drilled piers are continuously monitored, it is not anticipated that any probe holes would be needed in the base of the drilled piers during construction. *The recommendations given, herein, assume a representative from Alpha-Omega Geotech, Inc. will continuously monitor the excavation of the drilled piers to help ensure that adequate and proper bearing material has been reached.* Excavation for drilled shafts is not expected to be unusually difficult. Conventional drilling and coring equipment should be able to penetrate the soil or rock to the required depth for bearing. A significant amount of groundwater was not observed in the test borings. Temporary steel casing may not be needed to advance drilled shaft excavations but it should be installed if caving is experienced during drilling in the overburden.

It is recommended that the base of the grade beams and pier caps should be placed a minimum depth of 3 feet below final exterior grade to provide adequate protection from frost and volume changes associated with fluctuations in the soil-moisture environment.

Additionally, it is recommended that concrete be placed in all of the drilled pier excavations on the same day they are drilled. The base of the drilled pier and grade beam excavations should be free of water and loose soil prior to placing reinforcing steel and concrete.

7.2 Allowable Bearing Capacity

Provided all design and inspection recommendations as given in this report are closely followed and good construction practices are exercised, drilled piers bearing in limestone bedrock, with a 1-ft rock socket (rock augered), can be designed for a bearing capacity of 50 kips per square foot (ksf). This allowable bearing capacity values, which is based on shear strength alone and not on settlement, incorporate a factor of safety of 3.0. *The actual bearing capacity of all subgrade supporting the foundation elements must be confirmed by a representative of Alpha-Omega Geotech, Inc. as the excavations for the load-bearing wall and column footings are completed and prior to placement of reinforcing steel and concrete.*

Uplift loads on the drilled piers can be resisted using an allowable side resistance of 1,000 psf between the shaft and the surrounding competent bedrock (shale and limestone) material and 500 psf between the shaft and fat clay overburden. The allowable side resistance is based on a factor of safety of approximately 2.0.

7.3 Anticipated Settlement

Uniform bearing conditions should be provided beneath the drilled pier foundations to minimize differential settlements. All foundation elements should bear in a similar hard shale bedrock. *A representative of Alpha-Omega Geotech, Inc. should inspect all of the footing excavations to verify that uniform and competent bearing material is present beneath all of the foundation elements prior to the placement of any reinforcing steel and concrete.*

For drilled pier foundations designed and constructed in accordance with this report, it is anticipated that settlements should be less than 0.25 inches.

7.4 LPILE Soil Parameters

Recommended soil parameters for analyzing lateral deflection of piles foundations under design loading conditions using the computer program LPILE are provided in the following table. LPILE analyzes pile deflection as a function of the design loads and subsurface soils conditions. The values below are based on AOG's experience with similar soils and as identified in our soil borings. It should be understood that no additional lab testing was conducted to determine the values.

The following soil parameters are recommended based on our soil borings:

Table #4: LPILE Parameters

LPILE PARAMETERS					
Soil Description	Effective Unit Weight (pcf) (submerged)	Internal Angle of Friction, ϕ (degrees)	Undrained Shear Strength Su (psf)	Strain Factor, ε_{50} (Strain at 50%)	Static Horizontal Soil Modulus, k_s (pci)
CLAY/WEATHERED SHALE (soft clay)	60	26	500	.02	650
SHALE (soft rock)	70	26	500*	.004	--
LIMESTONE (hard rock)	82	38	1,000*	--	--

(*) unconfined compressive strength instead of shear strength

The lateral design parameters in Table 4 assume that no interaction of loading will occur between the drilled pier foundations. This condition can be achieved if the shafts are spaced at least 3 diameters apart (center-to-center spacing) in a direction perpendicular to the applied loading and at least 7 diameters apart (center-to-center spacing) in a direction parallel to the applied loading. If the piles or shafts are more closely spaced than this, then a reduction in the lateral design parameters provided in Table 4 would apply.

7.5 Lateral Capacity - Alternate

The lateral capacity of the drilled piers depends on the structural capacity of the pier and the materials surrounding the upper portion of the pier foundation. Since the maximum shear force has not been provided, the depth of influence to resist lateral loading cannot be accurately determined; however, it is anticipated the majority of the horizontal load will be dissipated within the upper 1/3 to 1/2 of the pier length. Using a simplified lateral capacity method, such as Brom's, and assuming a factor of safety of 3, an allowable lateral working load resistance value of 4,500 psf may be used to model the clay soils surrounding the top of these drilled pier foundations. This allows for a horizontal deflection of 1.5 percent of the pier diameter, or about ½-inch if 30-inch diameter piers (minimum) are used, as recommended. However, if a more detailed lateral capacity analysis is to be made, the methodology of Evans and Duncan (Simplified Analysis of Laterally Loaded Piles, Report No. UBC/GT82-04, Department of Civil

Engineering University of California Berkeley) presented in "Foundation Design Principles and Practices" by Donald P. Cuduto, Prentice Hall 1994, pg. 536-547 is recommended. Once the characteristic shear load, Vc, and the characteristic moment load, Mc, have been calculated, and the 50% strain value, ε_{50}, is known, given cohesive or cohesionless soils and knowing the head restraint conditions, the p-y charts that were compiled by Evans and Duncan can be used to estimate the shear forces and moments, as well as the lateral deflection of the drilled piers. In this case, the $\varepsilon_{50,}$ value can be taken as 0.015. The unit weight of the soil may be taken as 120 pcf. Assuming undrained loading conditions, i.e. $\phi = 0$, the undrained shear strength of these cohesive soils may be taken to be not more than 1,500 psf.

7.6 General

If possible, the foundation excavations should not be left open for more than 24 hours to help reduce excessive sloughing, softening or drying of the exposed subgrade material. The base of the foundation excavations should be free of water and loose soil prior to placing reinforcing steel and concrete. No groundwater is expected in the footing excavations since groundwater was not encountered in any of the borings made at the time of drilling. However, if groundwater is encountered within the expected depth of excavation for the footings, it is anticipated that it can be removed by the use of sumps and pumps.

8.0 FOUNDATIONS (ALTERNATIVE)

Based on the findings during this geotechnical exploration and AOG's understanding the proposed project, it is AOG's opinion that the proposed structure may need to be supported by a deep foundation system consisting of drilled piers to hard limestone bedrock. If drilled piers are undesirable, depending on the final foundation loads, a shallow foundation system consisting of earth formed trench or spread footings can be used, given the subgrade is stabilized by means of a soil improvement/reinforcement system, such as Geopiers®. Recommendations for drilled piers and possibly Geopier® Ground Improvement can be found below.

If the Geopier and shallow foundation alternative is viable, perimeter footings, and any footings in unheated areas, should be placed at least 3 feet below final exterior grade to provide adequate frost protection and place them in a more stable moisture environment. Under heated areas, the interior footings can be founded at shallower depths of at least 18 inches below the finished floor elevation. The footing excavations should be carried to undisturbed, inorganic soil or engineered fill.

8.1 Geopier® Alternative Foundation

Due to the soft subgrade soils and both overall and differential settlement concerns at the proposed site, it appears that the subsurface conditions at this site are well-suited for the use of Geopier® Ground Improvement.

The Geopier soil reinforcement system is a design-build soil reinforcement system that is commonly used to support structures as a potential cost-saving alternative to soil correction and deep foundations including auger-cast piling. The Geopier system allows the use of conventional spread footings and floor slabs cast on-grade, and typically provides settlement control to within 1-inch or less.

The Geopier elements are installed by excavating a cylindrical cavity (typically about 30-inches in diameter) and ramming thin lifts of well-graded aggregate within the holes to form very stiff, high-density aggregate piers. The drilled holes typically extend from about 10 to 20 feet below grade and 7 to 16 feet below footing bottoms. The first lift of aggregate forms a bulb below the bottoms of the piers, thereby pre-stressing and pre-straining the soils to a depth equal to at least one pier diameter below drill depths. Subsequent lifts are typically about 12 inches in loose thickness.

Ramming takes place with a high-energy beveled tamper that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in surrounding soil; thereby further stiffening the stabilized composites soil mass. The result of Geopier installation is a significant strengthening and stiffening of subsurface soils that then support floor slabs and high-capacity footings.

After reinforcement with the Geopier system, the foundations for the new structures may be designed as conventional spread footings, sized for an allowable bearing pressure of approximately 5,000 to 7,000+ pounds per square foot (to be designed and verified by Geopier). In addition, it should be noted that the use of Geopiers may be used to allow floor slabs to be designed as a conventional concrete slabs-on-grade.

The Geopier soil reinforcement system is a design-build system and Geopier Foundation Company should be contacted to provide engineering analyses and project specific design information. It should be noted that the soft ground conditions as well as the presence of shallow ground water will have to be taken into consideration by the design and construction procedures developed by Geopier. In addition, if the Geopier system is selected, Quality Assurance testing should be performed during installation, including documentation of the soil conditions encountered, the shaft lengths, amount of aggregate used, verification of the modulus test readings, and tests on the compacted aggregate lifts.

To provide continuity from design through construction, it is recommended that Alpha-Omega Geotech, Inc. should be retained to provide these Quality Assurance testing services as well as the other construction observation, monitoring and testing services required for this project.

It is recommended that the Geopier Foundation Company should be allowed the opportunity to review the subsurface information obtained during this preliminary investigation and provide recommendations for any supplemental information needed to prepare the most cost effective Geopier soil reinforcement design to meet the structural and project requirements.

8.1.1 General

If possible, the over-dug footing excavations should not be left open for more than 24 hours to help reduce excessive sloughing, softening or drying of the exposed subgrade material. The base of the footing excavations should be free of water and loose soil prior to placing reinforcing steel and concrete. No groundwater is expected in the footing excavations since groundwater was not encountered in any of the borings that were made at the time of drilling. However, if groundwater is encountered within the expected depth of excavation for the footings, it is anticipated that it can be removed by the use of sumps and pumps. Based on the subsurface conditions that have been identified, it is anticipated that earth-formed trench footing excavations may be used effectively on this project. A minimum width of 12 inches should be used for trenched wall footings to allow for steel placement and inspection. Minimum widths of 16 and 24 inches should be used for formed wall and column footings, respectively.

9.0 SLABS ON GRADE

9.1 Slab Thicknesses

Slabs on grade that will be subjected to repeated wheel loads, such as passenger vehicles, should be at least 6 inches in thickness. Slabs that are **not** exposed to repeated wheel loads, should be at least 4 inches in thickness. Slabs in storage areas may need to be thicker due to shelving post and other concentrated floor loads. Actual slab thicknesses should be determined by the project structural engineer.

9.2 Low Volume Change (LVC)

The following recommendations provided to help protect the slabs from damage caused by volume changes within the underlying subgrade, and should be implemented in conjunction with Section 7.0 and Section 8.0 of this report:

1) Cut the subgrade a minimum of 28-inches beneath the base of slab elevation to allow placement of a 24-inch subbase and a 4-inch base course beneath the slab-on-grade.

2) Scarify and recompact the upper 9 inches of exposed subgrade to within 95 to 100 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content wet of the optimum moisture content 0 to 3 percent.

3) For the 24-inch granular subbase, place crusher-run limestone or rock dust in 6-inch lifts and compact to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density. The moisture content of this material at the time of placement must be sufficient to achieve the specified level of compaction.

4) Place a 4-inch base course of clean, open-graded crushed limestone. This granular base course should be compacted with a suitable vibratory steel wheel roller.

9.3 General

It is strongly recommended that under-slab utility trenches should be backfilled with impermeable clay soil (*), flowable fill or lean concrete to help reduce the potential of these trenches acting as aqueducts transmitting groundwater beneath the new building, pavements, retaining walls and other structures.

(*) If impermeable clay soil is used as backfill, it should be placed in lifts not exceeding 6 inches in thickness and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content, which should be verified lift-by-lift during placement by a representative of Alpha-Omega Geotech, Inc. Although clay soil may be less costly than flowable fill or lean concrete, the OSHA excavation safety regulations given in 29 CFR Part 1926.650 - .652, Subpart P must be followed in the event that clay soil is used to backfill any utility trenches.

Finally, it should be noted that the recommendations given, herein, regarding placement of low-volume change fill to help protect the slabs on grade from volume changes associated with fluctuations within the moisture content of the underlying subgrade materials, would still apply.

Plumbing lines and other water leaks occurring beneath the structure's slab-on-grade floor can induce volume changes within the underlying subgrade materials. Therefore, it is recommended that all water supply and waste water lines should be tested for leaks prior to backfilling the utility trenches. In addition, it is also recommended that every effort should be made to maintain the plumbing in good working order and prevent or minimize water leaks and discharges.

It is assumed the concrete will be reinforced with properly placed steel reinforcement, such as #4 bars, and control joints will be cut during or shortly after finishing (to be designed by the project structural engineer). Properly placed wire mesh may be used as secondary reinforcement. Fiber reinforcement may also be considered to help control shrinkage cracking and the use of other admixtures may be considered to enhance the workability and performance of the concrete. Suitable construction and sawed joints should be used to control cracking of the slab. In addition, it is recommended that the slump and temperature of the concrete at the time of placement should be limited to standard American Concrete Institute (ACI) guidelines. Furthermore, it is also recommended that proper concrete curing techniques should be utilized and the addition of jobsite water to the concrete be avoided or very closely controlled to within acceptable parameters. Nevertheless, it should be noted that cracking of concrete used for slabs on grade is a normal occurrence and should be expected.

If an 24-inch thick subbase layer of crusher-run limestone (AB-3) or rock dust is used, as recommended, a modulus of subgrade reaction of 150 pounds per cubic inch (pci) may be assumed for reinforcement and thickness design to support surface loads. If a higher modulus of subgrade reaction were desired, we would be pleased to work with the project's structural engineer to develop recommendations for alternate bases and/or subbases to achieve a higher modulus of subgrade reaction.
infiltration of surface water.

10.0 EARTH PRESSURE COEFICIENTS

A coefficient of sliding friction over the in-situ clay soils at this site may be taken as 0.32. A minimum factor of safety of 1.5 should be used when considering sliding resistance.

Active, passive and at-rest earth pressure coefficients of 0.25, 4.2 and 0.4 may be assumed for backfills of clean, open-graded crushed limestone.

Active, passive and at-rest earth pressure coefficients of 0.5, 1.9 and 1.0 may be assumed for the in-situ clay soils at this site.

If deflection of extended foundation walls or retaining walls is not tolerable, as rest earth pressures should be assumed.

These earth pressure coefficients do not include the effect of surcharge loads, hydrostatic loading or a sloping backfill nor do they incorporate a factor of safety. Also, these earth pressure coefficients do not account for high lateral pressures that may result from volume changes when expansive clay soils are used as backfill behind walls with unbalanced fill depths. In addition, any disturbed soils that are relied upon to provide some level of passive resistance should be placed in lifts not exceeding 6 inches in thickness and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content. It is recommended that a representative of Alpha-Omega Geotech, Inc. should verify the compaction of any such materials relied upon to provide passive pressure lift-by-lift during placement.

11.0 MSE WALLS

It is understood that MSE walls will be utilized for this site. Established design methods for modular block walls address local and internal stability issues; global stability of the wall system should also be included in the design analyses. Design of this type of wall is beyond the scope of our present agreement for geotechnical services. It is understood that BHC will prepare designs for these walls.

We recommend the following general considerations be included in the project specifications for each wall design. Internal and local stability analyses for each wall design should consider both drained and undrained strength parameters to evaluate the long-term (drained) and end of construction (undrained) conditions. The designer should include in their design documents the material strength parameters assumed for the analysis and design. In addition, global stability of the wall system should be analyzed considering slopes adjacent to the wall and the loading conditions above and below the proposed walls. Analyses using both drained and undrained strength parameters should be performed to evaluate long-term (drained) and end of construction (undrained) conditions. The designer should be required to provide these analyses, based on the planned final cross sections, including the adjacent topography above and below the wall system, utilizing the generalized subsurface stratigraphy discussed in this report.

Provided all design and inspection recommendations as given in this report are closely followed and good construction practices are exercised, it is recommended an allowable bearing value of 1,500 psf may be used for design purposes to proportion the wall footings bearing on native clays or engineered fill. These allowable bearing capacity values, which are based on shear strength alone and not on settlement, incorporate a factor of safety of 3.0. *The actual bearing capacity of all subgrade supporting the foundation elements must be confirmed by a representative of Alpha-Omega Geotech, Inc. as the excavations for the wall footings are completed and prior to placement of any leveling pad or reinforcing steel and concrete, or wall blocks.*

We recommend the following parameters be utilized for design:

Table #5: Soil Parameters - Walls

GLOBAL STABILITY EFFECTIVE STRESS (DRAINED CONDITION)			
SOIL TYPE	UNIT WEIGHT (PCF)	FRICTION ANGLE (ϕ)	COHESION (PSF)
ONSITE CLAYS (LEAN/FAT CLAYS) (CL-CH)	120	26°	50
KDOT AB-3/MoDOT TYPE 5	130	34°	0

GLOBAL STABILITY TOTAL STRESS (UNDRAINED CONDITION)			
DESCRIPTION	UNIT WEIGHT (PCF)	FRICTION ANGLE (ϕ)	COHESION (PSF)
ONSITE CLAYS (LEAN/FAT CLAYS) (CL-CH)	120	0°	1000
KDOT AB-3/MoDOT TYPE 5	130	34°	0

If any MSE walls are planned with close proximity to any structures/pavements or other areas that cannot undergo settlement, except for a drainage layer directly behind the face blocks, it is recommended that crusher-run limestone such as AB-3 should be used within the entire reinforced zone. The geogrid reinforcement should be placed and overlapped as needed in accordance with the manufacturer's recommendations, which should be verified by a representative of Alpha-Omega Geotech, Inc. In addition, it is recommended that the geogrid layers should be carefully stretched and staked firmly into position prior to placement of the crusher-run limestone.

During the construction of any critical retaining walls that will directly or indirectly support any structures/pavements or other areas where settlement behind the top of the wall cannot to tolerated, it is recommended that full-time construction observation, monitoring and testing should be implemented. This would include subgrade preparation beneath the wall alignment, proper installation of the geogrid layers, verification of lift thickness and the compaction of the fill within the reinforced zone.

12.0 PAVEMENTS

12.1 Subgrade Preparation

Please note, a formal pavement design is beyond AOG's scope of service. Standard asphaltic concrete and concrete pavement designs for a given service life requires evaluation of the soil by means of a California Bearing Ratio (CBR) test or other methods, estimates of traffic volumes and axle weights, drainage requirements, and the desired level of maintenance. As such, some standard pavement design options based on assumptions made for materials of this nature are included in this section.

Without stabilization or treatment, the subgrade soils at this site are considered to be poor subgrade materials for the support of pavements. California Bearing Ratio (CBR) values we have obtained rarely exceed 5, soaked, for these materials. Pavements, either total strength flexible or rigid, do not usually perform well when they are placed directly on highly expansive, poor soil subgrades. Soft areas can develop during wet periods and differential shrinkage can occur during dry periods. As a result, no pavement can avoid damage from wheel loads under these circumstances.

Unless the subgrade is stabilized with Class C flyash, the subgrade for all pavements should consist of at least 9 inches of properly compacted soil, which will require tilling and recompacting in cut sections. It is recommended that any untreated aggregate base or flyash stabilized subgrade layers should extend at least 2 feet beyond the pavement and curb lines. The subgrade should be compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content. Any additional fill that is required to develop the paved areas should also be placed in loose lifts not exceeding 8 inches in thickness and compacted in accordance with these recommendations. The subgrade should be proof-rolled with a loaded tandem-axle dump truck after the final subgrade elevation has been established throughout the paved area. A representative of Alpha-Omega Geotech, Inc. should witness this proof-rolling.

Please note, if asphaltic pavements are used, annual maintenance including, but not limited to, crack sealing, fog sealing, and possible patch with overlay should be anticipated. In addition, the quality of the aggregates and overall composition of the asphalt or concrete mix, as well as, drainage conditions can have a profound effect upon the durability of the pavement section.

12.2 Pavement Sections

<u>Table 6:</u> Recommended Thicknesses with Flyash/Cement Subgrade Stabilization

FLYASH/CEMENT SUBGRADE STABILIZATION SECTIONS (INCHES)			
PAVEMENT MATERIALS	**CAR PARKING**	**DRIVE LANES**	**HEAVY DUTY AREAS (i.e. Dumpster pads, approach lanes, etc.)**
Asphaltic Surface Course	2	2	NA
Asphaltic Base Course	2	4	NA
Flyash/Cement Stabilization	12	12	NA
Portland Cement Concrete	4	6	7
Crushed Stone (3/4-inch minus)	4	4	4
Flyash/Cement Stabilization	12	12	12

*Reference Section 11.3, "Subgrade Stabilization Sections"

<u>Table 7:</u> Recommended Thicknesses with Geogrid Reinforcement & Baserock

GEOGRID REINFORCEMENT AND BASEROCK SUBGRADE STABILIZATION SECTIONS (INCHES)			
PAVEMENT MATERIALS	**CAR PARKING**	**DRIVE LANES**	**HEAVY DUTY AREAS (i.e. Dumpster pads, approach lanes, etc.)**
Asphaltic Surface Course	2	2	NA
Asphaltic Base Course	2	4	NA
Crushed Stone (3/4-inch minus)	6	6	NA
Portland Cement Concrete	4	6	7
Crushed Stone (3/4-inch minus)	6	6	6

*Reference Section 11.3, "Subgrade Stabilization Sections"

12.3 Subgrade Stabilization Sections

Alternate pavement sections utilizing flyash, geogrids, granular base and/or subbase courses should be considered. Treating the subgrade with Class C flyash or Portland cement or using a geogrid reinforced base course can provide a pavement section having a much longer service life.

If specific pavement performance standards are to be met, AOG would be pleased to be of further assistance once the actual design loading conditions, service-life and maintenance expectations have been defined.

12.3.1 Flyash/Cement

The use of flyash/cement is usually not effective during cold winter months. Notwithstanding this weather limitation, assuming the flyash is thoroughly and uniformly mixed with the subgrade, flyash stabilization can greatly reduce the swelling potential and improve the strength of the subgrade soil.

If the subgrade is stabilized with Class C flyash or Portland cement to a depth of 12 inches, full depth asphalt pavements with thicknesses of 4.0 and 6.0 inches for parking and drive lanes, respectively, can be used. Likewise, if the subgrade is stabilized with flyash, the Portland cement concrete pavement sections over a 4-inch thick base course of crushed limestone may also be reduced to 4.0 and 6.0 inches, respectively. The crushed limestone base course should be compacted to the specifications given in Section 10.3, "Rigid Pavement Sections," of this report.

Based on experience with similar projects, adding more flyash does not always increase the stiffness of the subgrade. In fact, too much flyash in the subgrade may cause excessive brittleness, which may result in reflective cracking problems to develop. It is usually cost effective to determine the optimum amount of flyash necessary by laboratory testing; however, it usually ranges from about 12 to 15 percent by weight (5% for Portland Cement). The Class C flyash should be thoroughly mixed with the subgrade soil by means of a Bomag tiller or other similar equipment specifically designed for such procedures and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within ± 3 percent of the optimum moisture content.

12.3.2 Geogrid Reinforcement & Base Rock

Soft areas can develop even when the subgrade is stabilized with Class C flyash/Portland cement. An even better pavement section can be developed by the use of a tri-axial geogrid over a properly compacted subgrade, as discussed in this report, and a layer of untreated crushed limestone base rock under either flexible or rigid pavements. The purpose of the geogrid is to help span soft spots that will inevitably develop in the subgrade. The geogrid helps to confine the base rock and acts as a "snowshoe," distributing the loads over the subgrade in a tri-axial direction. The layer of base rock, which is placed over the geogrid, must be thick enough to support construction traffic and paving equipment so the geogrid does not become exposed. In general, the crushed limestone base rock should not be less than approximately 6 inches in thickness. If this option is chosen, it is recommended that Tensar TX-140, which is a tri-axial polypropylene geogrid, be used. The geogrid reinforcement should be placed and overlapped as needed in accordance with the manufacturer's recommendations, which should be verified by a representative of Alpha-Omega Geotech, Inc.

Asphaltic concrete thicknesses of 4.0 and 6.0 inches for parking areas and drive lanes, respectively, can be used if geogrid and base rock stabilization are used. Similarly, the Portland cement concrete sections can be reduced to 4.0 and 6.0 inches for the respective areas. Although these thicknesses are the same as given if the subgrade is treated with Class C flyash, the use of a tri-axial geogrid and base rock usually represents the most effective, reasonable pavement section.

12.4 General

If asphaltic pavements are used, periodic maintenance including, but not limited to, crack sealing, fog sealing, and possible patch with overlay should be anticipated. In addition, the quality of the aggregates and overall composition of the asphalt or concrete mix, as well as, drainage conditions can have a profound effect upon the durability of the pavement section.

Where engineered controlled fill is placed beneath paved areas, it is recommended the compacted fill should extend a minimum distance of two (2) feet beyond the pavement edge or curb line, or a distance equal to the depth of the fill, whichever is greater.

Asphalt mixes meeting KDOT BM-2 and BM-2B specifications may be used for surface and base mixes, respectively. Compaction testing of each pavement layer is recommended to help ensure compliance with the mix design specifications.

For areas where heavy truck loads/concentrations are anticipated, Portland Cement concrete is should be used. It is recommended that load-transfer devices should be installed where construction joints are required. For dumpster stations, the concrete slabs should be large enough to accommodate the dumpster and at least the rear wheels of the disposal vehicle. Rigid pavements should have No. 4 bars on at least 2-foot centers and positioned in the upper third of the slab. Joints should be tooled or cut within 4 hours of hardening to a depth of at least one fourth of the thickness.

The subgrade should be moistened prior to placement of concrete. Fresh concrete should be properly cured as recommended by the American Concrete Institute (ACI). To help provide resistance to damage caused by alternating cycles of freezing and thawing, it is recommended that any exposed concrete should be properly air entrained; typically at 5 to 7 percent. In addition, it is also recommended the outer edges of pavement slabs should be thickened to help resist cracking associated with heavy wheel loads near these unrestrained areas.

If full-depth pavement is used, it is important the moisture content of the subgrade should be kept as constant as possible from the time of recompacting until the pavement is laid. However, if the subgrade becomes dry, it should be moistened for at least 72 hours prior to paving, but it should not be saturated. In all cases, pavements should be sloped to inhibit ponding and provide rapid surface drainage. If water is allowed to pond on or adjacent to the pavement, the subgrade could become saturated and lose its bearing capacity which would contribute to premature pavement deterioration under a single cycle of heavy wheel loads or a number of cycles of lighter wheel loads.

13.0 TESTING AND INSPECTION RECOMMENDATIONS

Unless Alpha-Omega Geotech, Inc. is retained to provide the construction observation, monitoring and testing services for this project, we cannot accept any responsibility for any conditions that deviate from those identified in this subsurface investigation nor for the performance of the foundations, pavements and other structures including any retaining walls that are a part of this project. Alpha-Omega Geotech, Inc. is highly experienced in construction quality control and have a fully-equipped soil, concrete, aggregate, rock and asphalt testing laboratory, as well as, qualified field technicians to provide these field services.

It is not economically practical to perform enough exploratory borings on any site to identify all subsurface conditions. Some conditions affecting the design and/or construction may not become known until the project is underway. The boring logs, field SPT and laboratory test results depict subsurface conditions only at the specified locations and depths at the site. The boundaries between soil and rock layers indicated on the boring logs are based on observations made during drilling and an interpretation of the laboratory testing results. The exact depths of these boundaries are approximate and the transitions between soil and rock types may be gradual rather than being clearly defined. Also, due to the prior development at this site, as well as, the natural conditions of the formation of soils and rock, it is possible that unanticipated subsurface conditions may be encountered during construction. Monitoring of the subsurface conditions that are revealed during construction is needed to verify that subsurface conditions are consistent with those conditions identified in this preliminary geotechnical investigation. If variations in subsurface conditions are encountered, it will be necessary for Alpha-Omega Geotech, Inc. to re-evaluate the recommendations that have been made in this report.

Special Inspections should be performed in accordance with the local building code under which the project is designed, as adopted by Lee's Summit, Missouri.

Prior to filling, it is recommended that a representative of Alpha-Omega Geotech, Inc. should verify that the site has been properly stripped of all topsoil and other deleterious material, benched as needed and prepared for the placement of fill. The compaction of any structural fill beneath the new building, pavements, and any other areas where settlement control is necessary should be tested lift-by-lift by a representative of Alpha-Omega Geotech, Inc. as it is being placed. This should include the prepared subgrade layers beneath the building's slab-on-grade, as well as, any other fill material relied upon to provide passive resistance. Also, in accordance with the local building code, any fill that is used to construct slopes steeper than 4:1 (H:V) must be placed as engineered controlled fill and the compaction tested lift-by-lift during placement.

Assuming that uniform fill material is used, nuclear density gauges (ASTM D2922/D3017) should be used to test compaction wherever necessary. However, if fill material of non-uniform consistency is used, other evaluation methods may be required. Such methods may include, but not be limited to, the use of a GeoGauge Stiffness meter, Dynamic Cone Penetrometer (DCP), proof-rolling or other visual inspection techniques.

Any geotextile fabric and geogrid reinforcement that is utilized should be placed and overlapped as needed in accordance with the manufacturer's recommendations, which should be verified by a representative of Alpha-Omega Geotech, Inc. Proper placement of the reinforcing steel for drilled piers, grade beams, pier caps, foundation walls and other structural elements including any necessary wing walls and retaining walls should be verified prior to the placement of concrete. The subgrade under the slabs on grade and pavements should be checked to verify they are in compliance with the density and moisture requirements. Wherever possible, in addition to compaction testing, cut and fill areas should be proof-rolled with a loaded tandem-axle dump truck to identify soft areas that will need to be corrected. A representative of Alpha-Omega Geotech, Inc. should observe this proof-rolling. Checks should also be made of the subbases, concrete and any pavement materials.

Finally, the inspection and testing services listed herein are given as a minimum and it should be understood that additional inspection and testing services might also be required or otherwise beneficial.

14.0 LIMITATIONS

This report is presented in broad terms to provide a comprehensive assessment of the interpreted subsurface conditions and their potential effect on the adequate design and economical construction of the proposed St. Luke's East Hospital Renovation and Addition project located in Lee's Summit, Missouri, as discussed herein. This report has been prepared for the exclusive use of our client for specific application to the project discussed herein and has been prepared within our client's directive and budgetary constraints and in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

It should be noted that the concept of risk is an important aspect of the geotechnical engineering evaluation and report since the recommendations given in this report are not based on exact science but rather analytical tools and empirical methods in conjunction with engineering judgment and experience. Therefore, the recommendations given herein should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soil materials and the proposed structures will perform as planned. Nevertheless, the geotechnical engineering recommendations presented herein are Alpha-Omega Geotech, Inc.'s professional opinion of those measures that are necessary for the proposed structures to perform according to the proposed design based on the information provided to Alpha-Omega Geotech, Inc., the referenced information gathered during the course of this investigation and our experience with these conditions.

Any significant structural changes to the proposed new structure or its location on this site relative to where these test borings were completed shall be assumed to invalidate the conclusions and recommendations given in this report until we have had the opportunity to review these changes and, if necessary, modify our conclusions and recommendations accordingly. It is also strongly suggested that Alpha-Omega Geotech, Inc. should review your plans and specifications dealing with the earthwork, foundations, as well as, any pavements prior to construction to confirm compliance with the recommendations given herein. Particular details of foundation design, construction specifications or quality control may develop, and we would be pleased to respond to any questions regarding these details.

If Alpha-Omega Geotech, Inc. is not retained to review the project plans and specifications, address to the proposed building its location on the site relative to where these test borings were completed, provide the recommended construction phase observation, monitoring and testing services and respond to any subsurface conditions that are identified during construction to evaluate whether or not changes in the recommendations given in this report are needed, we cannot be held responsible for the impact of those conditions on the project or the future performance of the buildings, pavements and/or structures that may be involved.

The scope of our services did not include any environmental assessment or investigation for the presence of hazardous or toxic materials in the soil, surface water, ground water or air, either on, below or adjacent to this site. In addition, no determination regarding the presence or absence of wetlands was made. Furthermore, it should be understood that the scope of geotechnical services for this project does not include either specifically or by implication any biological (i.e. mold, fungi or bacteria) assessment of the site or the proposed construction. Any statements in this report or included on the boring logs regarding odors, colors and unusual or suspicious items or conditions are strictly for informational purposes only.

We appreciate the opportunity to be of service to ACI Boland Architects, as well as, the project developers and look forward to working with you throughout the construction process. We are prepared to provide the Special Inspection services that will be required by the local building code under which this project is designed, as adopted by the City of Lee's Summit, Missouri, as well as, the other necessary construction observation, monitoring and testing services discussed in this report. If you have any questions concerning this report, or if we may be of further assistance, please call us at (913) 371-0000.

Sincerely,
ALPHA-OMEGA GEOTECH, INC.

Garic Abendroth, P.E.
Engineering Director

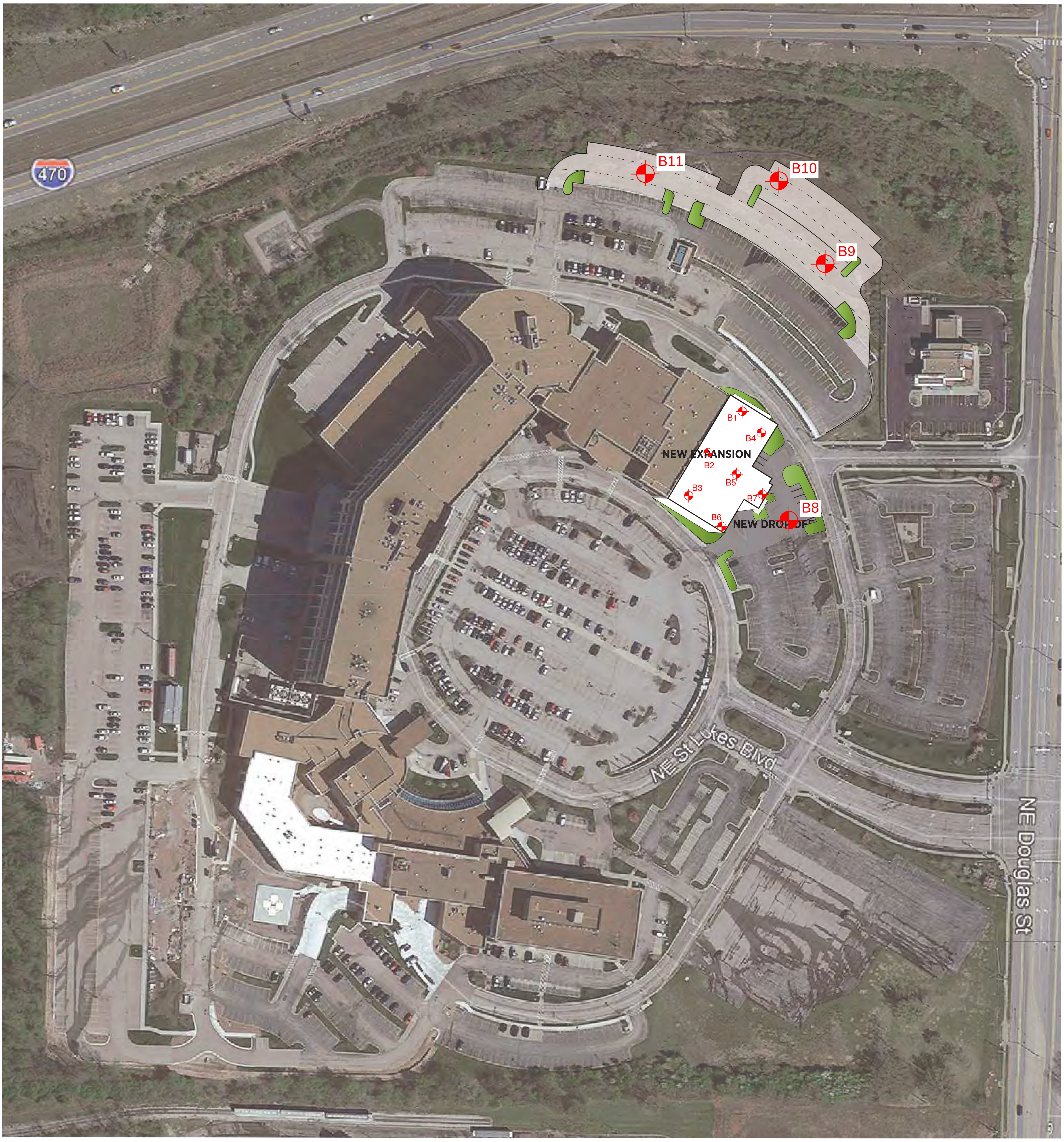
Enclosures

Appendix Section A

SITE SKETCH

Site and Boring Location Plans


St Luke's East
Lee's Summit
Legend
Boring Locations
B11
B10
B9
B1
B4
B5
B2
B6
B8
B3
B7
Summit GI
Saint Luke's Wound Care Specialists-East
scular Consultants Pc
BOK Financial
NE Douglas St
NE Douglas St
N
300 ft
Google Earth


470
B11
B10
B9
B1
B4
NEW EXPANSION
B2
B5
B3
B7
B8
B6
NEW DROP OFF
NE St Lukes Blvd
NE Douglas St

Appendix Section B

LABORATORY TEST RESULTS

Summary of Laboratory Testing

SLT 22205

Alpha-Omega Geotech, Inc.
1701 State Avenue
Kansas City, KS 66102
Office: (913) 371-0000 Fax: (913) 371-6710
Website: www.aogeotech.com

PROJECT NAME: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
PROJECT NUMBER: 22-353E
DATE: 9/28/2022

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
B1	ST-1	1.0-3.0	Brown, mottled dark brown, spotted reddish brown FAT CLAY (Possible FILL)						CH					PP=1.50
B1	ST-2	3.0-5.0	Brown, mottled reddish brown, spotted dark brown FAT CLAY (Possible FILL)	25.9	97.2	53	24	29	CH		2013	11.3		PP=0.75
B1	ST-3	5.0-7.0	Light reddish brown, mottled gray LEAN/FAT CLAY with trace of Weathered SHALE (Possible FILL)						CL-CH					PP=3.00
B1	ST-4	8.0-10.0	Brown, speckled reddish brown FAT CLAY (Possible FILL)	31.8	91.6				CH		4848	15.8		PP=1.75
B1	SS-5	13.5-15.0	Brown, mottled reddish brown and gray FAT CLAY						CH					N=8
B1	SS-6	18.5-20.0	Reddish brown, mottled light gray FAT CLAY						CH					N=7
B2	ST-1	1.0-3.0	Brown, mottled dark brown, spotted reddish brown FAT CLAY with trace of gravel (Possible FILL)						CH					PP=1.75
B2	ST-2	3.0-5.0	Brown, mottled dark brown, speckled reddish brown FAT CLAY (Weathered SHALE) (Possible FILL)	20.7	98.1				CH		2430	3.6		PP=2.00

Summary of Laboratory Testing

Alpha-Omega Geotech, Inc.
1701 State Avenue
Kansas City, KS 66102
Office: (913) 371-0000 Fax: (913) 371-6710
Website: www.aogeotech.com

PROJECT NAME: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
PROJECT NUMBER: 22-353E
DATE: 9/28/2022

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
B2	ST-3	5.0-7.0	Dark brown LEAN/FAT CLAY (Possible FILL)						CL-CH					PP=2.50
B2	ST-4	8.0-10.0	Brown, mottled light gray and reddish brown FAT CLAY (Possible FILL)	26.2	96.6	64	24	40	CH		5738	5.2		PP=2.50
B2	SS-5	13.5-15.0	Reddish brown, mottled gray FAT CLAY (Possible FILL)						CH					N=9
B2	SS-6	18.5-20.0	Light reddish brown, mottled gray FAT CLAY						CH					N=12
B2	SS-7	23.5-24.3	Dark grayish brown, spotted reddish brown FAT CLAY (Possible Weathered SHALE) (Very Hard, Very Slow Drilling)						CH					N=50/3
B3A	ST-1	1.0-3.0	Dark brown LEAN/FAT CLAY with trace of organics (finger roots) (Possible FILL)						CL-CH					PP= >4.50
B3A	ST-2	3.0-5.0	Brown, spotted olive brown and reddish brown FAT CLAY with slickend sides (Possible FILL)	21.1	104.6				CH		7889	4.4		PP=4.25
B3A	ST-3	5.0-7.0	Light brown, spotted brown FAT CLAY with trace of gravel (Possible FILL)	25.9	98.0	60	25	35	CH					PP=2.00
B3A	ST-4	8.0-10.0	Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL)						CH		2083	6.1		PP=1.00

Summary of Laboratory Testing

SLT 22205

Alpha-Omega Geotech, Inc.
1701 State Avenue
Kansas City, KS 66102
Office: (913) 371-0000 Fax: (913) 371-6710
Website: www.aogeotech.com

PROJECT NAME: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO

PROJECT NUMBER: 22-353E

DATE: 9/28/2022

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits			USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
						LL	PL	PI						
B3A	SS-5	13.5-15.0	Brown, mottled reddish brown and gray FAT CLAY (Possible FILL)						CH					N=7
B3A	SS-6	18.5-20.0	Light brown, mottled light reddish brown, spotted gray LEAN/FAT CLAY						CL-CH					N=22
B4	ST-1	1.0-3.0	Brown, mottled reddish brown, spotted gray FAT CLAY, with trace of Weathered SHALE (Possible FILL)						CH					PP= >4.50
B4	ST-2	3.0-5.0	Brown, spotted dark brown, olive brown and reddish brown FAT CLAY (Possible FILL)	23.6	96.3	56	23	33	CH		3034	2.6		PP=2.50
B4	ST-3	5.0-7.0	Light brown, spotted light reddish brown and gray FAT CLAY (Possible FILL)						CH					PP=1.00
B4	ST-4	8.0-10.0	Brown, mottled light brown, spotted dark gray FAT CLAY	24.5	97.3				CH		1668	5.3		PP=1.00
B4	SS-5	13.5-15.0	Weathered LIMESTONE (NO RECOVERY)(Very Hard, Very Slow Drilling)						LS					N=50/0
B5	ST-1	1.0-3.0	Light brown, spotted reddish brown and dark brown FAT CLAY (Possible FILL)						CH					PP=0.75

PROJECT NAME: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
PROJECT NUMBER: 22-353E
DATE: 9/28/2022

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits			USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)		% Swell	Remarks
						LL	PL	PI				%e		
B5	ST-2	3.0-5.0	Light brown, spotted reddish brown and dark brown LEAN CLAY (Weathered SHALE) (Possible FILL)	26.2	103.8	48	25	23	CL		3401	9.6		PP=2.25
B5	ST-3	5.0-7.0	Brown, spotted dark brown and gray LEAN/FAT CLAY (Possible FILL)						CL-CH					PP=1.00
B5	ST-4	8.0-10.0	Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)	26.2	97.3				CH		3826	15.7		PP=1.75
B5	SS-5	13.5-15.0	Brown, mottled reddish brown and gray FAT CLAY (Possible FILL)						CH					N=9
B5	SS-6	18.5-20.0	Light brown, mottled reddish brown and gray FAT CLAY						CH					N=17
B6	ST-1	1.0-3.0	Brown, mottled reddish brown, gray and dark brown FAT CLAY (Possible FILL)						CH					PP=1.25
B6	ST-2	3.0-5.0	Brown, mottled light gray, spotted reddish brown and dark brown FAT CLAY (Possible FILL)	23.9	102.3				CH		2538	12.2		PP=1.25
B6	SS-3	5.0-6.5	Brown, spotted reddish brown FAT CLAY (Possible FILL)						CH					N=9

PROJECT NAME: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
PROJECT NUMBER: 22-353E
DATE: 9/28/2022

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits			USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)		% Swell	Remarks
						LL	PL	PI				%e		
B6	ST-4	8.0-10.0	Brown, spotted dark brown, reddish brown and gray FAT CLAY with slickend sides	24.9	99.7	63	24	39	CH		2401	3.5		PP=2.00
B6	SS-5	13.5-15.0	Brown, mottled reddish brown and gray FAT CLAY						CH					N=12
B6	SS-6	18.5-20.0	Brown, mottled light brown, spotted gray and reddish brown FAT CLAY						CH					N=22
B7A	ST-1	1.0-3.0	Brown, spotted dark brown and gray FAT CLAY with trace of organics (Roots) (Possible FILL)						CH					PP= >4.50
B7A	ST-2	3.0-5.0	Brown, mottled reddish brown FAT CLAY (Possible FILL)	14.3	98.9	56	24	32	CH		FRACTURE			PP= >4.50
B7A	ST-3	5.0-7.0	Brown, spotted dark brown, speckled reddish brown FAT CLAY (Possible FILL)						CH					PP=2.50
B7A	ST-4	8.0-10.0	Brown, mottled reddish brown, spotted dark brown and gray FAT CLAY	24.7	100.9				CH		6096	9.6		PP=2.75
B7A	SS-5	13.5-15.0	Reddish brown, spotted gray and dark brown FAT CLAY						CH					N=11
B7A	SS-6	18.5-20.0	Light brown, mottled reddish brown FAT CLAY with trace of Weathered LIMESTONE (Very Hard, Very Slow Drilling)						CH					N=34

PROJECT NAME: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO

PROJECT NUMBER: 22-353E

DATE: 9/28/2022

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits			USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
						LL	PL	PI						
B8	ST-1	1.0-3.0	Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL)						CH					PP=2.00
B8	ST-2	3.0-5.0	Brown, mottled gray and reddish brown Weathered SHALE (Possible FILL)	21.8	106.1				SH		2105	6.1		PP=1.75
B8	SS-3	5.0-6.5	Brown, mottled light brown FAT CLAY (Possible FILL)						CH					N=11
B8	ST-4	8.0-10.0	Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)	22.5	106.0	62	24	38	CH		6505	16.8		PP=3.00
B8	SS-5	13.5-15.0	Brown, mottled reddish brown and gray FAT CLAY						CH					N=10
B9	SS-1	1.0-2.5	Brown LEAN/FAT CLAY (Possible FILL)						CL-CH					N=6
B9	SS-2	3.5-5.0	Brown LEAN/FAT CLAY (Possible FILL)						CL-CH					N=9
B9	SS-3	5.0-6.5	Brown, mottled reddish brown and gray FAT CLAY						CH					N=8
B9	SS-4	8.5-10.0	Brown, mottled reddish brown and gray FAT CLAY						CH					N=7
B10	SS-1	1.0-2.5	Brown, mottled light olive brown, spotted light gray LEAN/FAT CLAY (Possible FILL)						CL-CH					N=8

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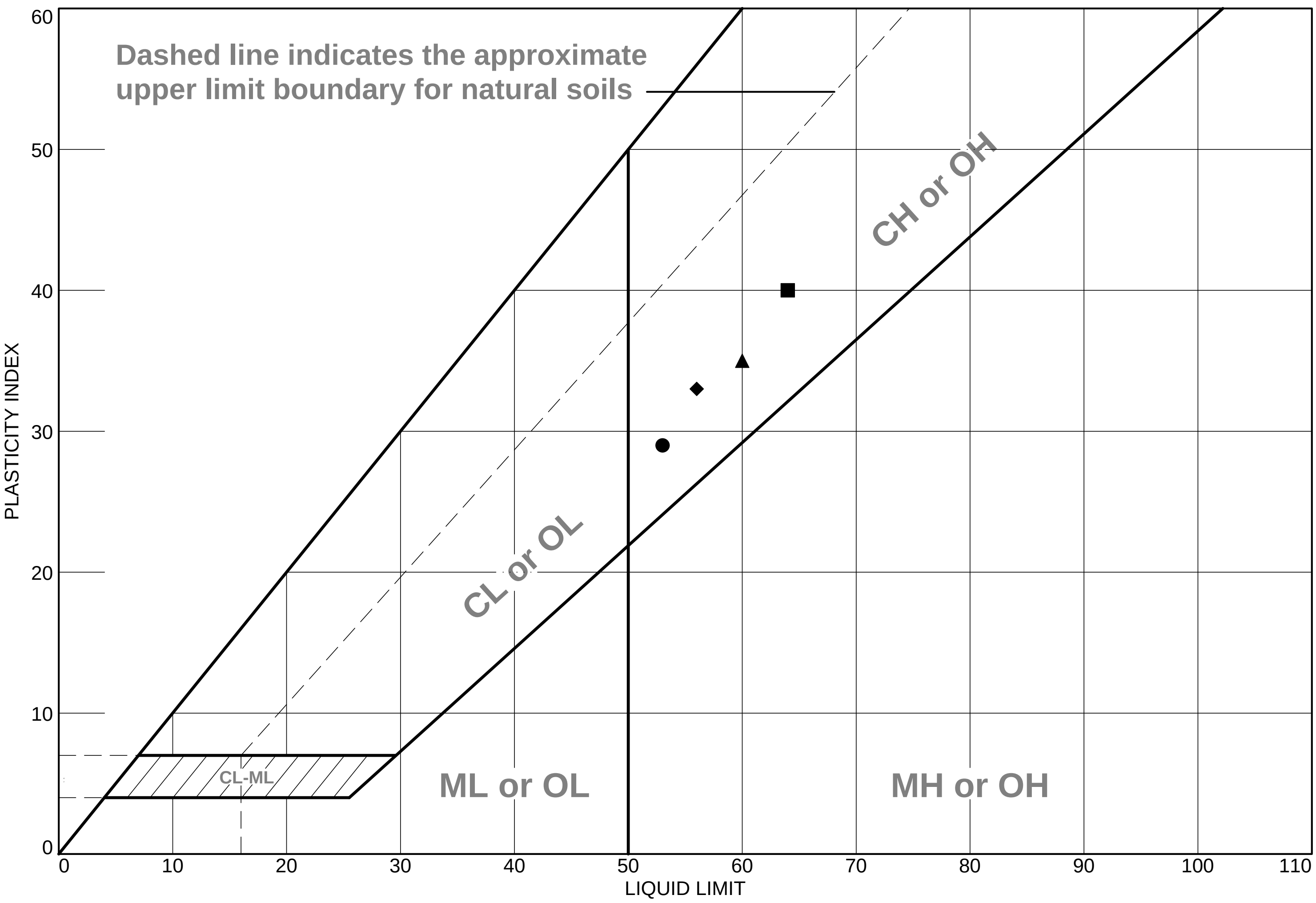
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
PROJECT NUMBER: 22-353E
DATE: 9/28/2022

Boring Number	Sample Number	Depth or Elevation	Description	Natural Moisture (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	USCS/ Visual Class.	% Passing No. 200	Unconfined Compression (psf)	%e	% Swell	Remarks
B10	SS-2	3.5-5.0	Brown LEAN/FAT CLAY (Possible FILL)						CL-CH					N=9
B10	SS-3	5.0-6.5	Brown LEAN/FAT CLAY (Possible FILL)						CL-CH					N=10
B10	SS-4	8.5-10.0	Brown, mottled dark brown LEAN/FAT CLAY (Possible FILL)						CL-CH					N=34
B10	SS-5	13.5-13.6	Weathered LIMESTONE (NO RECOVERY) (Very Hard, Very Slow Drilling)						LS					N=50/1
B11	SS-1	1.0-2.5	Brown LEAN/FAT CLAY with trace of organics (Finger Roots) (Possible FILL)						CL-CH					N=6
B11	SS-2	3.5-5.0	Dark brown FAT CLAY with trace of organics (Finger Roots) (Possible FILL)						CH					N=5
B11	SS-3	5.0-6.5	Brown, mottled gray, spotted reddish brown FAT CLAY with trace of organics (Finger Roots) (Possible FILL)						CH					N=5
B11	SS-4	8.5-9.7	Brown, mottled dark brown, spotted reddish brown FAT CLAY with trace of gravel and sand (Possible FILL) (Very Hard, Very Slow Drilling)						CH					N=50/3

LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown, mottled reddish brown, spotted dark brown FAT CLAY (Possible FILL)	53	24	29			CH
■	Brown, mottled light gray and reddish brown FAT CLAY (Possible FILL)	64	24	40			CH
▲	Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL)	60	25	35			CH
◆	Brown, spotted dark brown, olive brown and reddish brown FAT CLAY (Possible FILL)	56	23	33			CH

Project No. 22-353E **Client:** ACI BOLAND ARCHITECTS

Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

● **Source of Sample:** B1 **Depth:** 3.0 **Sample Number:** ST-2
■ **Source of Sample:** B2 **Depth:** 8.0 **Sample Number:** ST-4
▲ **Source of Sample:** B3A **Depth:** 8.0 **Sample Number:** ST-4
◆ **Source of Sample:** B4 **Depth:** 3.0 **Sample Number:** ST-2

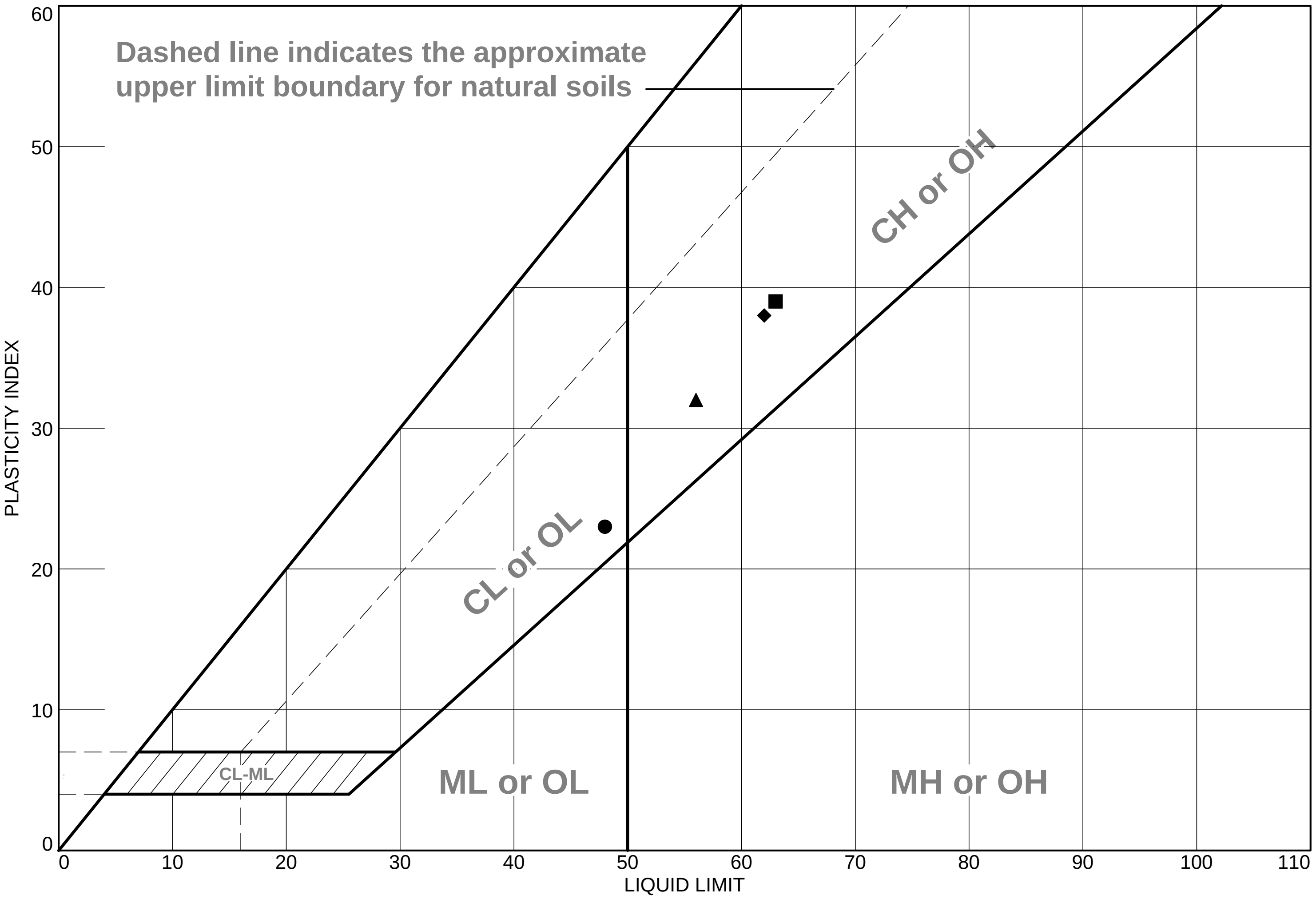
Remarks:

ALPHA-OMEGA GEOTECH

Figure

Tested By: D.B. **Checked By:** T.B.

LIQUID AND PLASTIC LIMITS TEST REPORT (ASTM D4318)



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light brown, spotted reddish brown and dark brown LEAN CLAY (Weathered SHALE), (Possible FILL)	48	25	23			CL
■	Brown, spotted dark brown, reddish brown and gray FAT CLAY with slickend sides	63	24	39			CH
▲	Brown, mottled reddish brown FAT CLAY (Possible FILL)	56	24	32			CH
◆	Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)	62	24	38			CH

Project No. 22-353E **Client:** ACI BOLAND ARCHITECTS

Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

● **Source of Sample:** B5 **Depth:** 3.0 **Sample Number:** ST-2
■ **Source of Sample:** B6 **Depth:** 8.0 **Sample Number:** ST-4
▲ **Source of Sample:** B7A **Depth:** 3.0 **Sample Number:** ST-2
◆ **Source of Sample:** B8 **Depth:** 8.0 **Sample Number:** ST-4

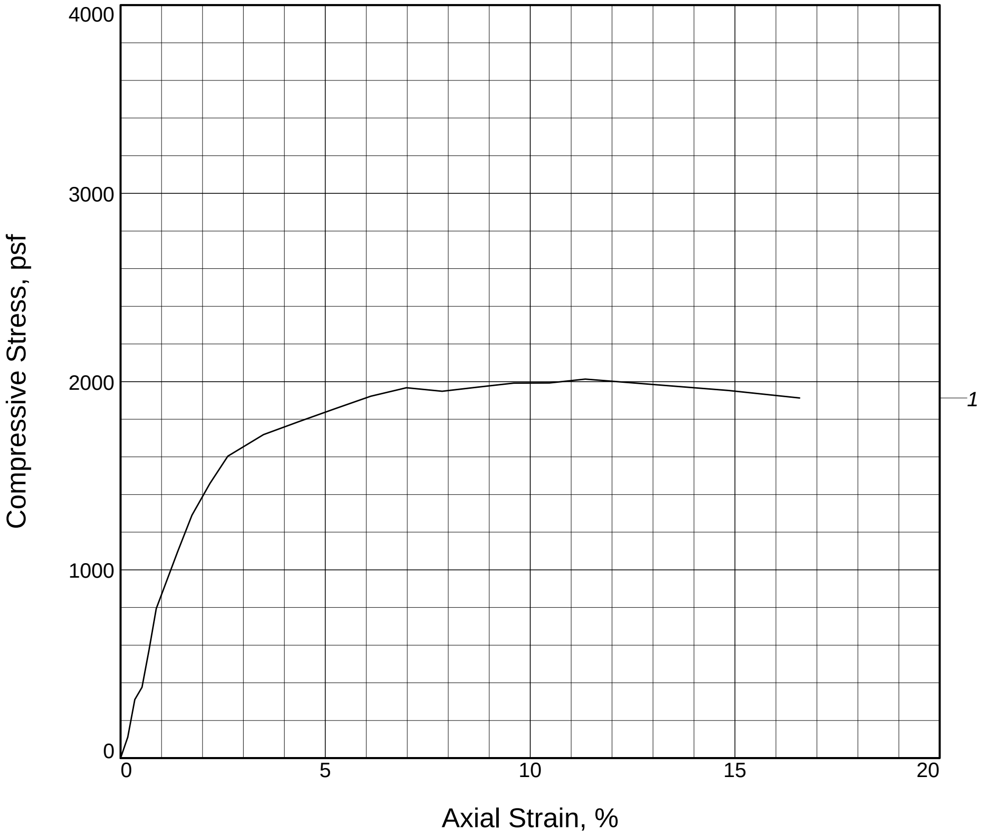
ALPHA-OMEGA GEOTECH

Remarks:

Figure

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2013			
Undrained shear strength, psf	1006			
Failure strain, %	11.3			
Strain rate, in./min.	0.080			
Water content, %	25.9			
Wet density, pcf	122.3			
Dry density, pcf	97.2			
Saturation, %	95.1			
Void ratio	0.7339			
Specimen diameter, in.	2.870			
Specimen height, in.	5.730			
Height/diameter ratio	2.00			

Description: Brown, mottled reddish brown, spotted dark brown FAT CLAY (Possible FILL)

LL = 53	**PL =** 24	**PI =** 29	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

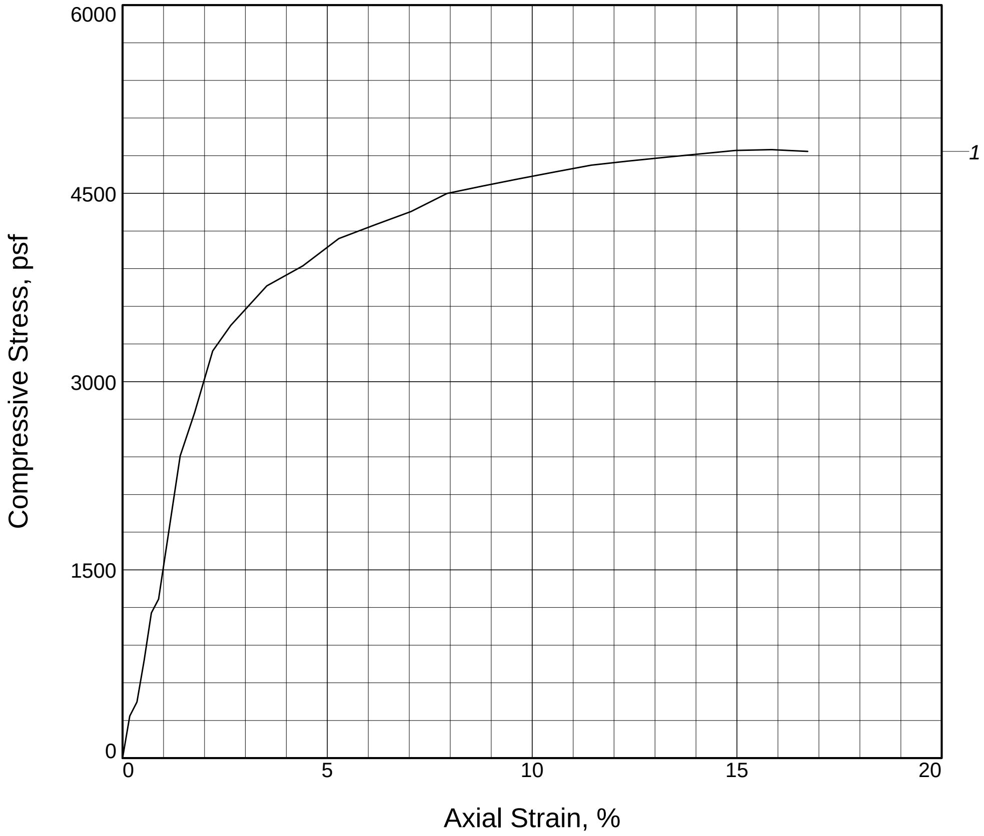
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B1 **Depth:** 3.0
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	4848			
Undrained shear strength, psf	2424			
Failure strain, %	15.8			
Strain rate, in./min.	0.080			
Water content, %	31.8			
Wet density, pcf	120.7			
Dry density, pcf	91.6			
Saturation, %	102.1			
Void ratio	0.8399			
Specimen diameter, in.	2.860			
Specimen height, in.	5.680			
Height/diameter ratio	1.99			

Description: Brown, speckled reddish brown FAT CLAY (Possible FILL)

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

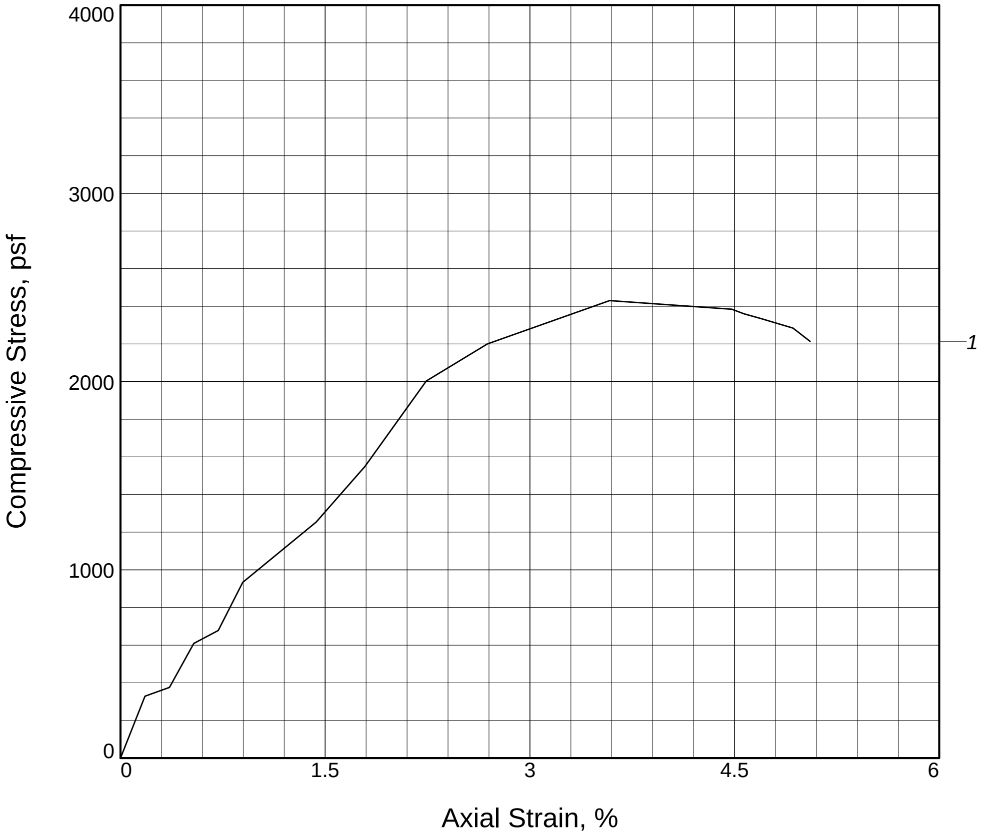
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B1 **Depth:** 8.0
Sample Number: ST-4

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2430			
Undrained shear strength, psf	1215			
Failure strain, %	3.6			
Strain rate, in./min.	0.080			
Water content, %	20.7			
Wet density, pcf	118.5			
Dry density, pcf	98.1			
Saturation, %	78.0			
Void ratio	0.7177			
Specimen diameter, in.	2.790			
Specimen height, in.	5.580			
Height/diameter ratio	2.00			

Description: Brown, mottled dark brown, speckled reddish brown FAT CLAY (Weathered SHALE) (Possible FILL)

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

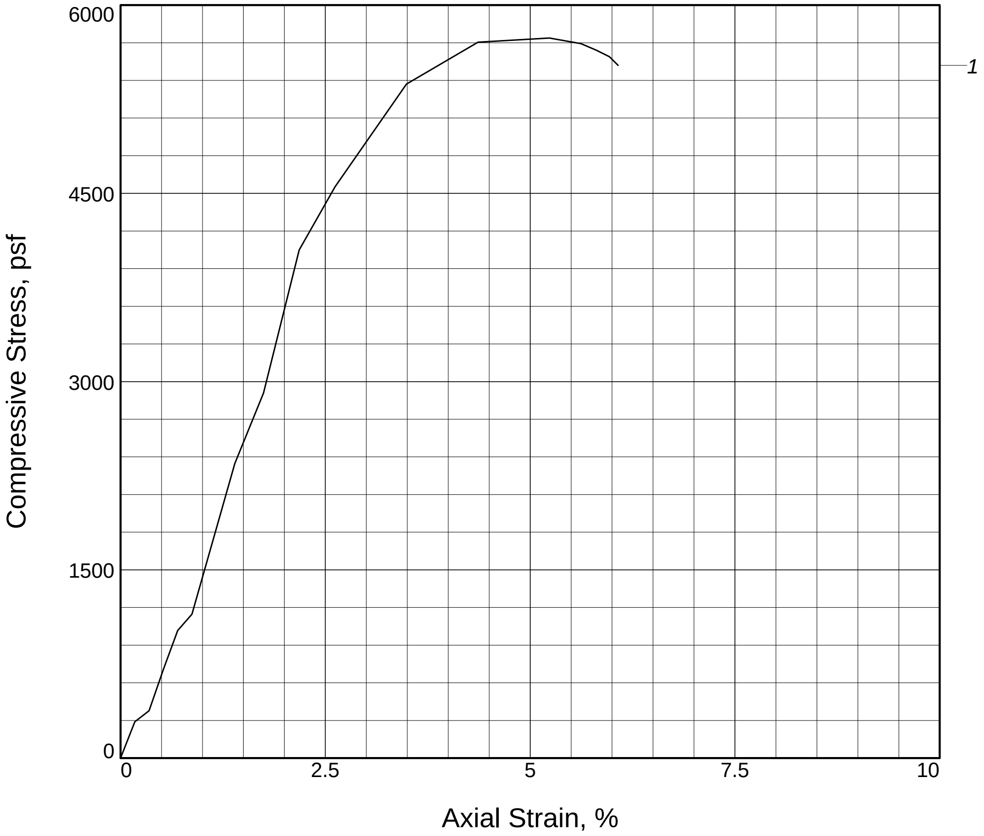
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B2 **Depth:** 3.0
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	5738			
Undrained shear strength, psf	2869			
Failure strain, %	5.2			
Strain rate, in./min.	0.080			
Water content, %	26.2			
Wet density, pcf	121.9			
Dry density, pcf	96.6			
Saturation, %	94.9			
Void ratio	0.7450			
Specimen diameter, in.	2.870			
Specimen height, in.	5.730			
Height/diameter ratio	2.00			

Description: Brown, mottled light gray and reddish brown FAT CLAY (Possible FILL)

LL = 64	**PL =** 24	**PI =** 40	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E

Date Sampled: 9/26/2022

Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

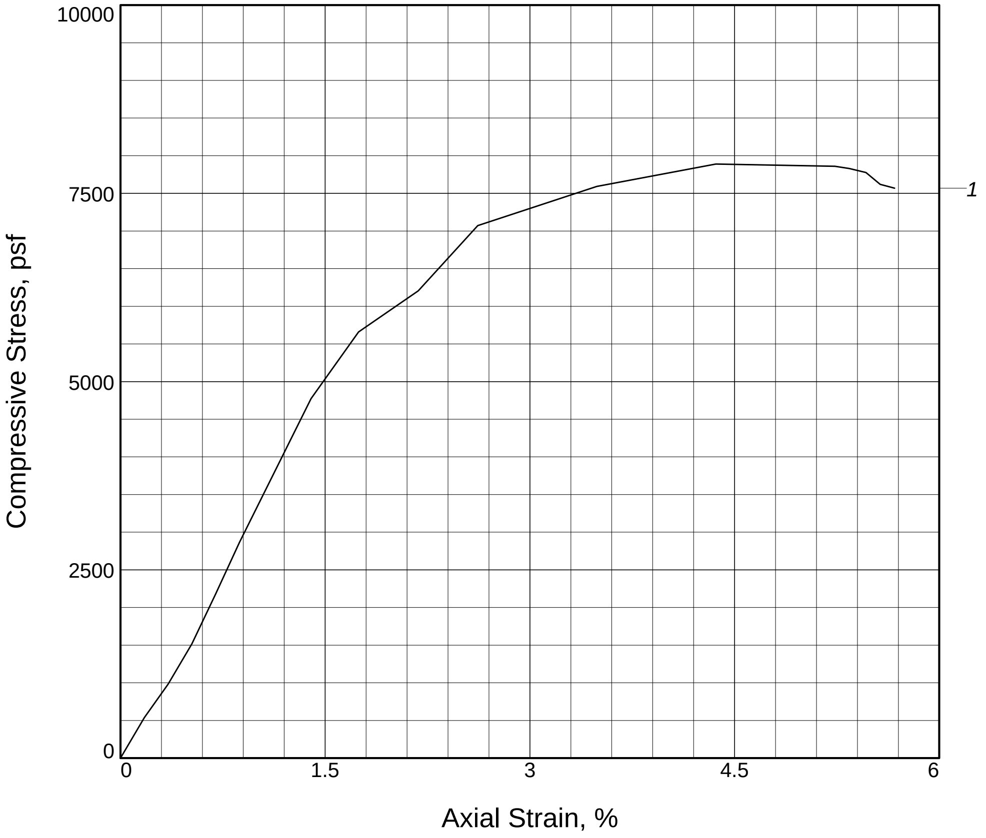
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B2 **Depth:** 8.0
Sample Number: ST-4

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	7889			
Undrained shear strength, psf	3944			
Failure strain, %	4.4			
Strain rate, in./min.	0.080			
Water content, %	21.1			
Wet density, pcf	126.6			
Dry density, pcf	104.6			
Saturation, %	93.1			
Void ratio	0.6117			
Specimen diameter, in.	2.860			
Specimen height, in.	5.730			
Height/diameter ratio	2.00			

Description: Brown, spotted olive brown and reddish brown FAT CLAY with slickend sides (Possible FILL)

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Client: ACI BOLAND ARCHITECTS

Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

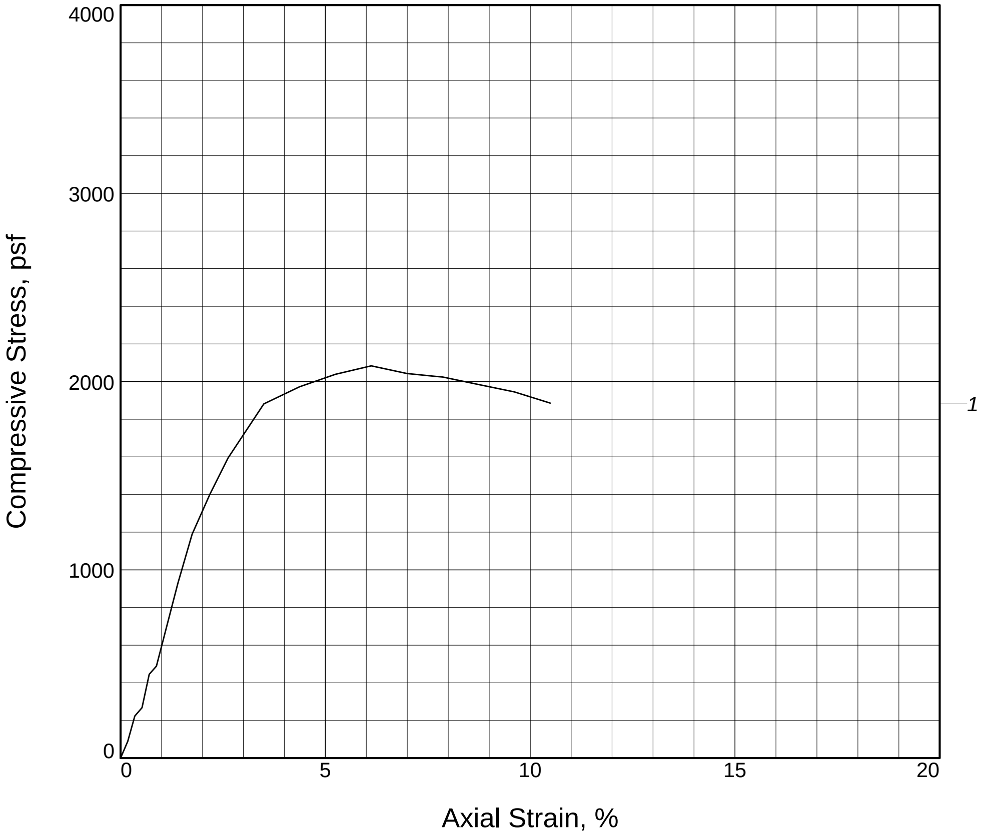
Source of Sample: B3A **Depth:** 3.0
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Figure 1 of 1

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2083			
Undrained shear strength, psf	1042			
Failure strain, %	6.1			
Strain rate, in./min.	0.080			
Water content, %	25.9			
Wet density, pcf	123.4			
Dry density, pcf	98.0			
Saturation, %	97.0			
Void ratio	0.7200			
Specimen diameter, in.	2.860			
Specimen height, in.	5.720			
Height/diameter ratio	2.00			

Description: Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL)

LL = 60 | **PL =** 25 | **PI =** 35 | **Assumed GS=** 2.70 | **Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/22/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

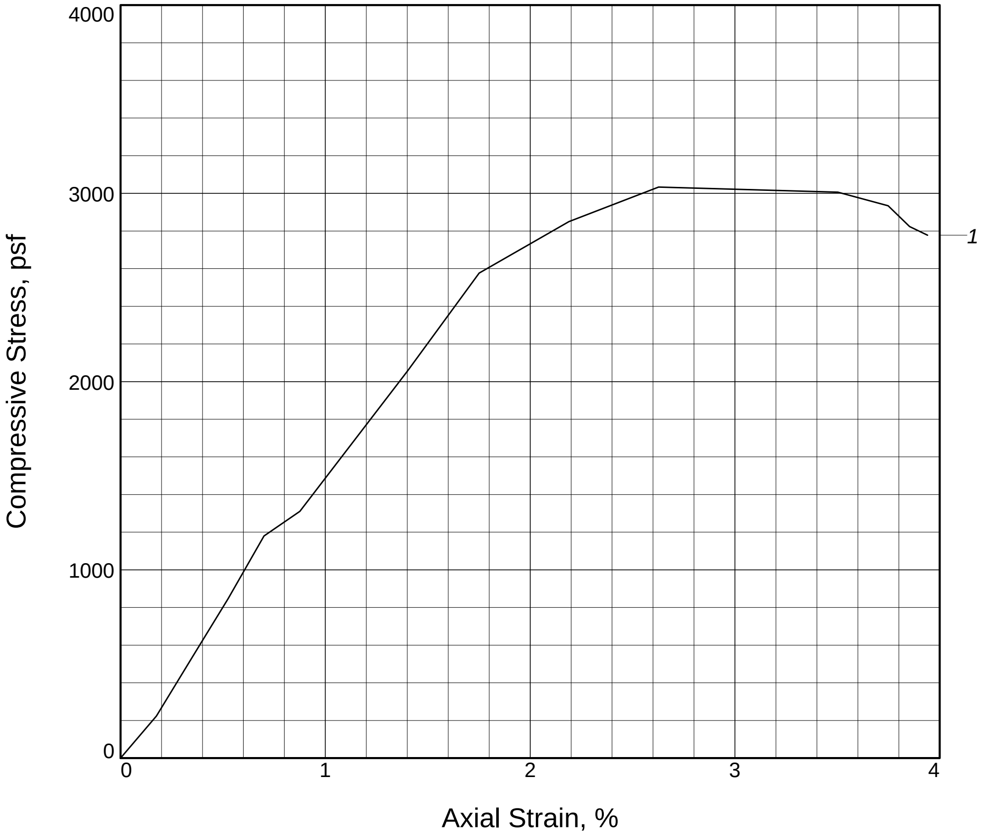
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B3A **Depth:** 8.0
Sample Number: ST-4

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3034			
Undrained shear strength, psf	1517			
Failure strain, %	2.6			
Strain rate, in./min.	0.080			
Water content, %	23.6			
Wet density, pcf	119.0			
Dry density, pcf	96.3			
Saturation, %	84.8			
Void ratio	0.7497			
Specimen diameter, in.	2.860			
Specimen height, in.	5.710			
Height/diameter ratio	2.00			

Description: Brown, spotted dark brown, olive brown and reddish brown FAT CLAY (Possible FILL)

LL = 56	**PL =** 23	**PI =** 33	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

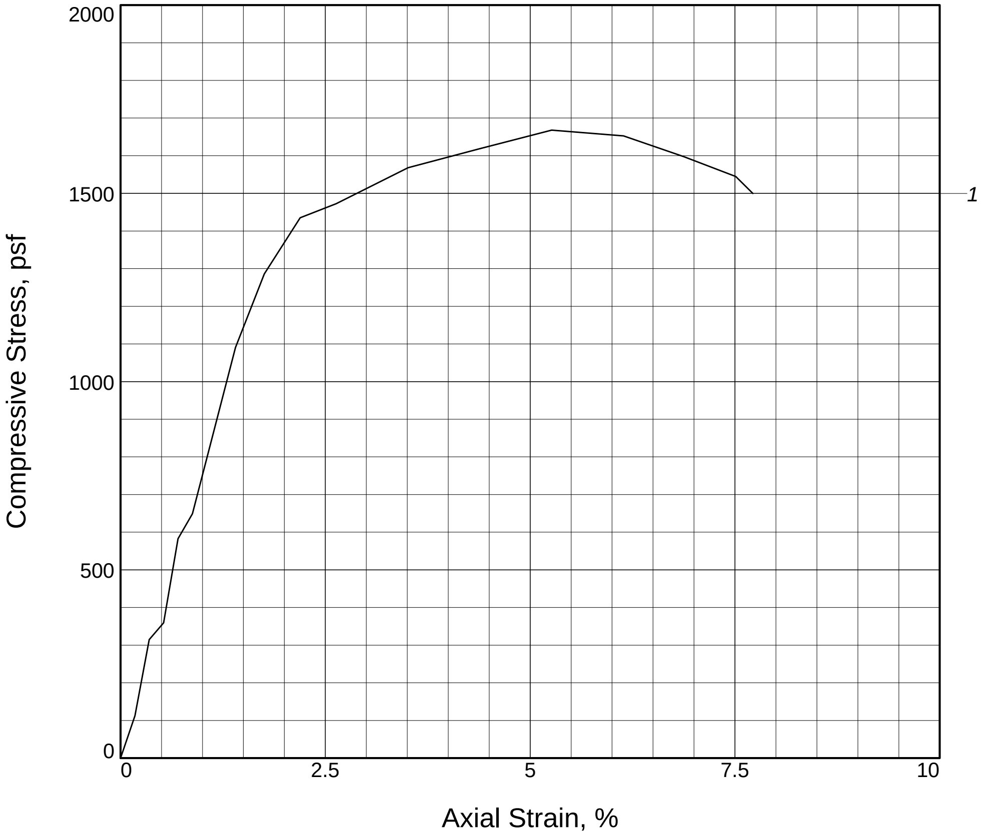
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B4 **Depth:** 3.0
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	1668			
Undrained shear strength, psf	834			
Failure strain, %	5.3			
Strain rate, in./min.	0.080			
Water content, %	24.5			
Wet density, pcf	121.1			
Dry density, pcf	97.3			
Saturation, %	90.4			
Void ratio	0.7329			
Specimen diameter, in.	2.850			
Specimen height, in.	5.700			
Height/diameter ratio	2.00			

Description: Brown, mottled light brown, spotted dark gray FAT CLAY

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:**

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

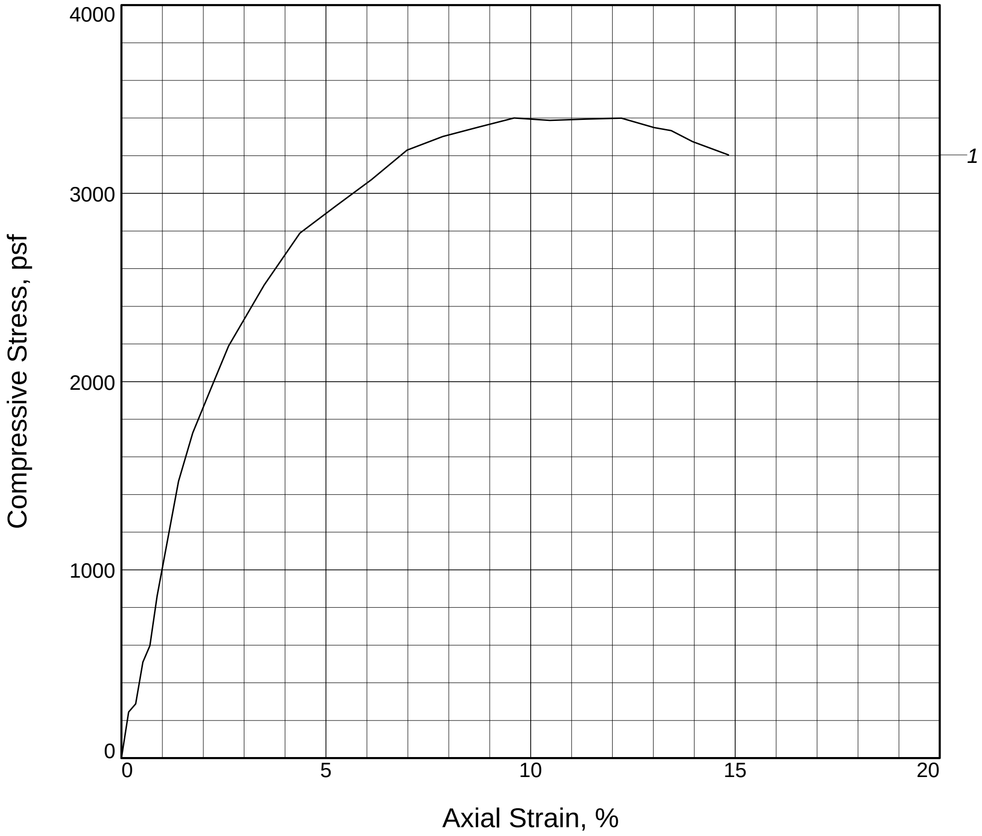
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B4 **Depth:** 8.0
Sample Number: ST-4

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3401			
Undrained shear strength, psf	1700			
Failure strain, %	9.6			
Strain rate, in./min.	0.080			
Water content, %	23.2			
Wet density, pcf	127.9			
Dry density, pcf	103.8			
Saturation, %	100.4			
Void ratio	0.6231			
Specimen diameter, in.	2.870			
Specimen height, in.	5.730			
Height/diameter ratio	2.00			

Description: Light brown, spotted reddish brown and dark brown LEAN CLAY (Weathered SHALE), (Possible FILL)

LL = 48	**PL =** 25	**PI =** 23	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

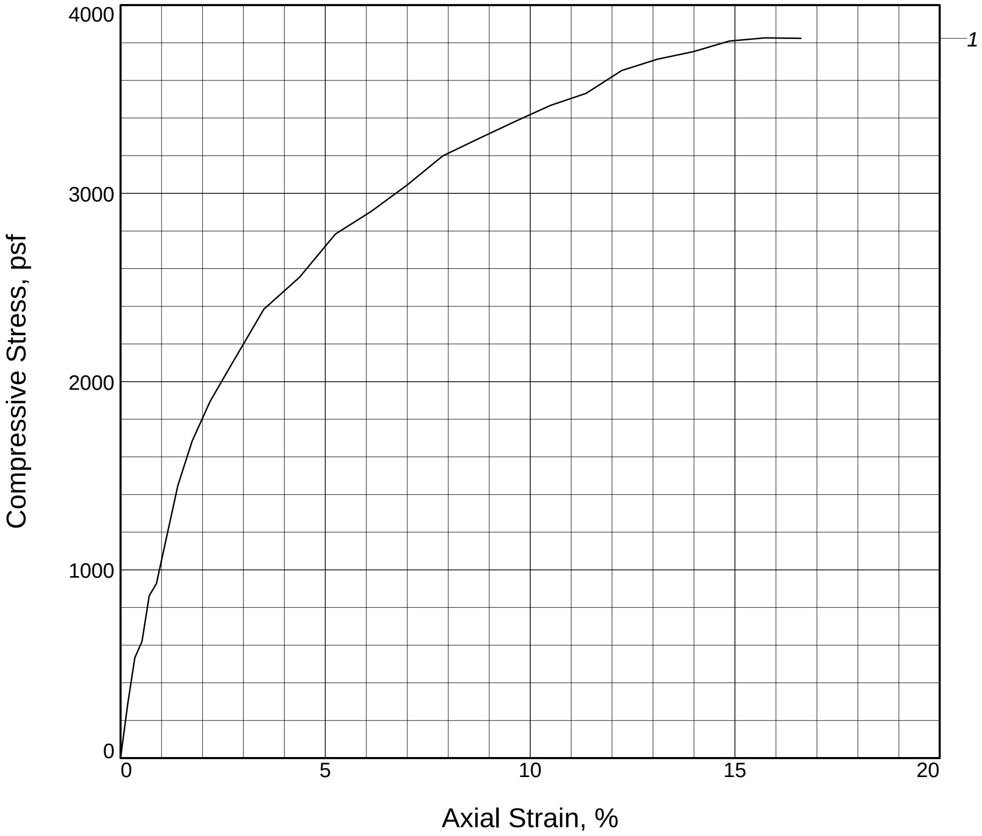
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B5 **Depth:** 3.0
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3826			
Undrained shear strength, psf	1913			
Failure strain, %	15.7			
Strain rate, in./min.	0.080			
Water content, %	26.2			
Wet density, pcf	122.8			
Dry density, pcf	97.3			
Saturation, %	96.6			
Void ratio	0.7316			
Specimen diameter, in.	2.870			
Specimen height, in.	5.720			
Height/diameter ratio	1.99			

Description: Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

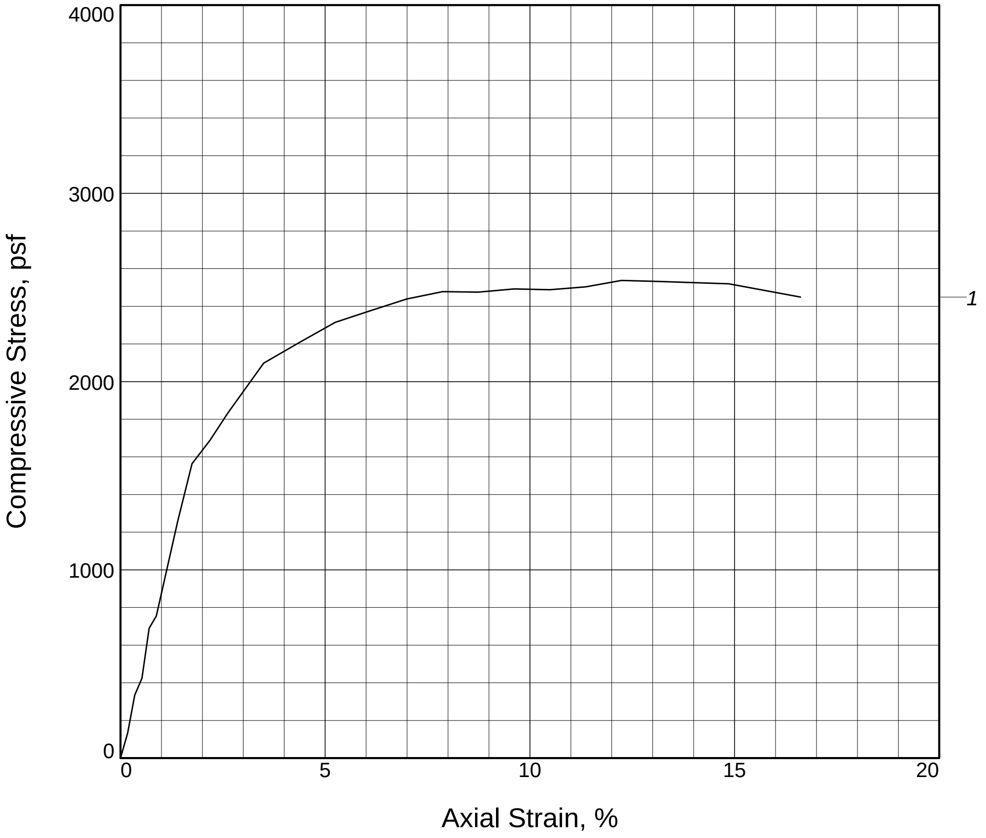
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B5 **Depth:** 8.0
Sample Number: ST-4

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2538			
Undrained shear strength, psf	1269			
Failure strain, %	12.2			
Strain rate, in./min.	0.080			
Water content, %	23.9			
Wet density, pcf	126.9			
Dry density, pcf	102.3			
Saturation, %	99.9			
Void ratio	0.6470			
Specimen diameter, in.	2.860			
Specimen height, in.	5.720			
Height/diameter ratio	2.00			

Description: Brown, mottled light gray, spotted reddish brown and dark brown FAT CLAY (Possible FILL)

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E

Date Sampled: 9/26/2022

Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

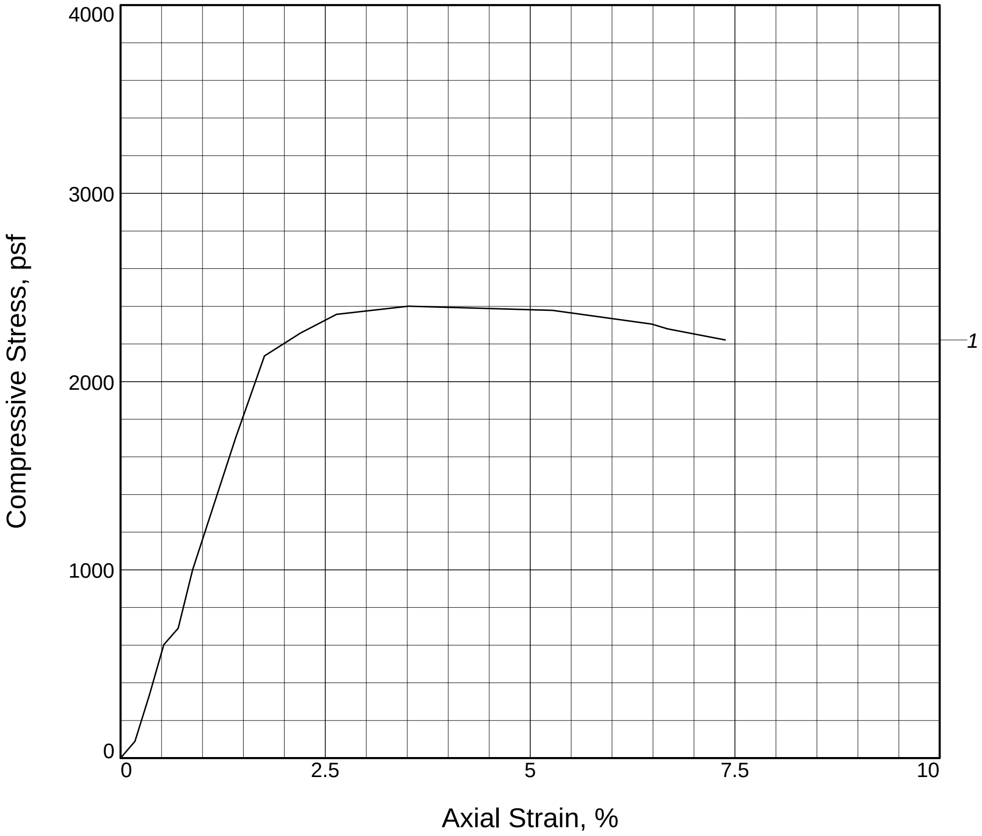
Source of Sample: B6 **Depth:** 3.0

Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2401			
Undrained shear strength, psf	1200			
Failure strain, %	3.5			
Strain rate, in./min.	0.080			
Water content, %	24.9			
Wet density, pcf	124.5			
Dry density, pcf	99.7			
Saturation, %	97.2			
Void ratio	0.6909			
Specimen diameter, in.	2.860			
Specimen height, in.	5.690			
Height/diameter ratio	1.99			

Description: Brown, spotted dark brown, reddish brown and gray FAT CLAY with slickend sides

LL = 63	**PL =** 24	**PI =** 39	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

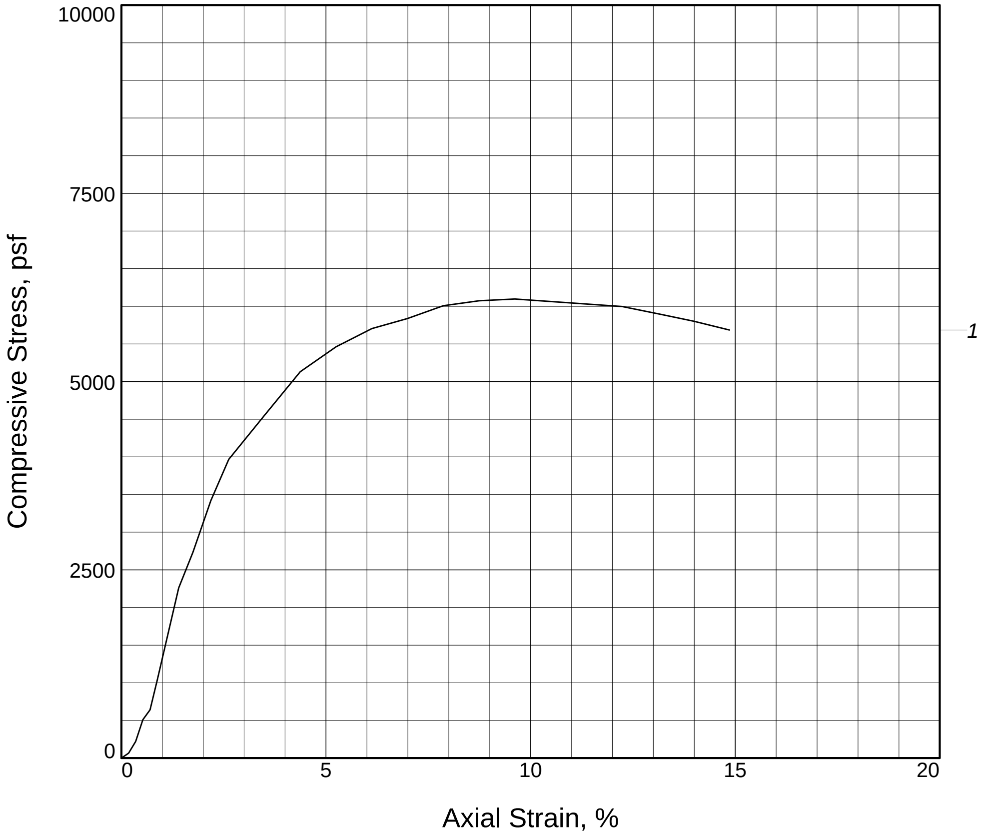
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B6 **Depth:** 8.0
Sample Number: ST-4

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	6096			
Undrained shear strength, psf	3048			
Failure strain, %	9.6			
Strain rate, in./min.	0.080			
Water content, %	24.7			
Wet density, pcf	125.8			
Dry density, pcf	100.9			
Saturation, %	99.3			
Void ratio	0.6702			
Specimen diameter, in.	2.870			
Specimen height, in.	5.720			
Height/diameter ratio	1.99			

Description: Brown, mottled reddish brown, spotted dark brown and gray FAT CLAY

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

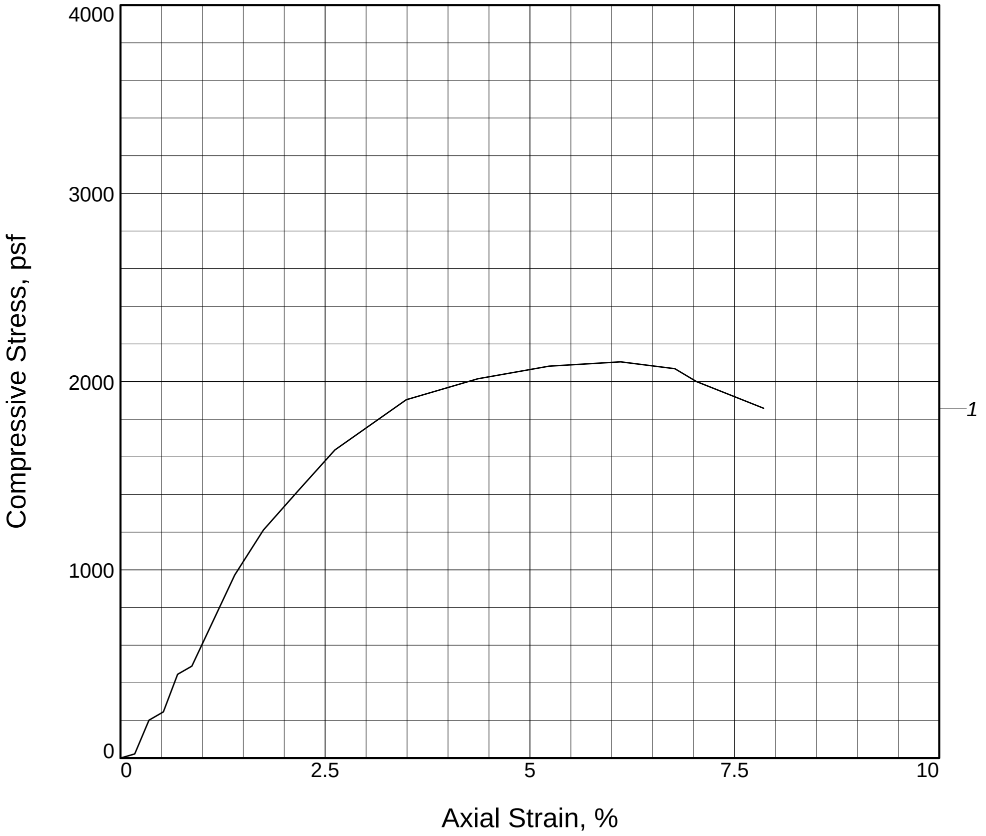
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B7A **Depth:** 8.0
Sample Number: ST-4

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2105			
Undrained shear strength, psf	1052			
Failure strain, %	6.1			
Strain rate, in./min.	0.080			
Water content, %	21.8			
Wet density, pcf	129.2			
Dry density, pcf	106.1			
Saturation, %	99.8			
Void ratio	0.5894			
Specimen diameter, in.	2.860			
Specimen height, in.	5.730			
Height/diameter ratio	2.00			

Description: Brown, mottled gray and reddish brown Weathered SHALE (Possible FILL)

LL =	**PL =**	**PI =**	**Assumed GS=** 2.70	**Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

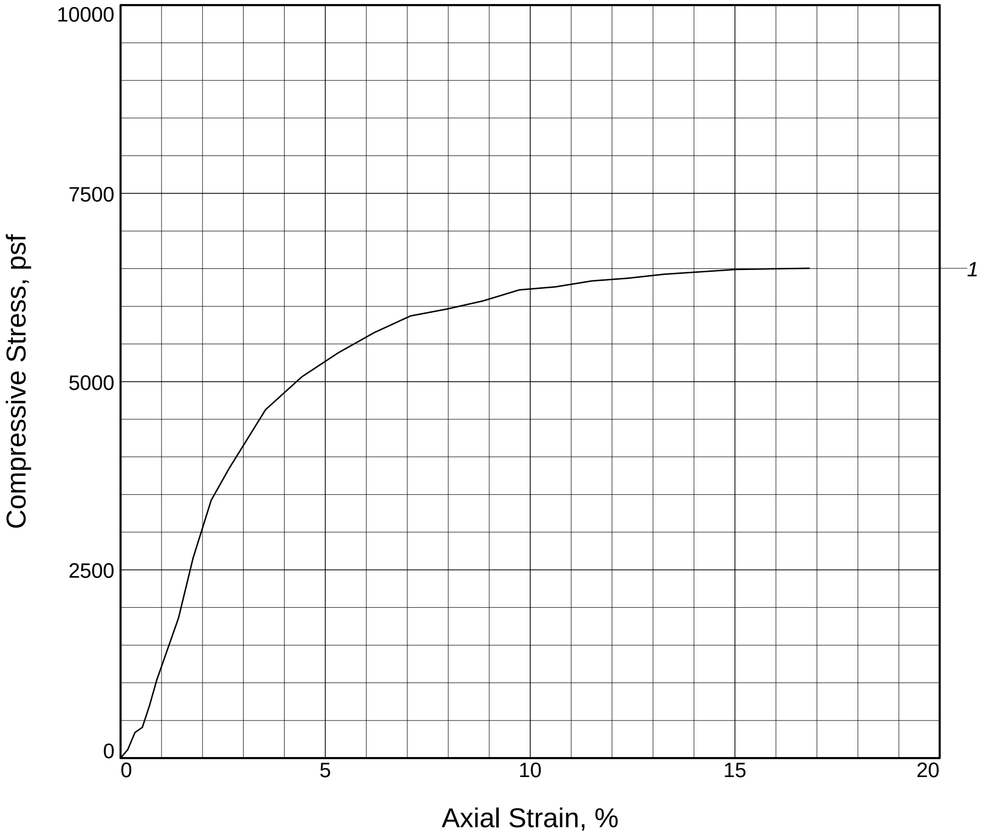
Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B8 **Depth:** 3.0
Sample Number: ST-2

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	6505			
Undrained shear strength, psf	3252			
Failure strain, %	16.8			
Strain rate, in./min.	0.080			
Water content, %	22.5			
Wet density, pcf	129.9			
Dry density, pcf	106.0			
Saturation, %	103.1			
Void ratio	0.5905			
Specimen diameter, in.	2.840			
Specimen height, in.	5.650			
Height/diameter ratio	1.99			

Description: Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)

LL = 62 | **PL =** 24 | **PI =** 38 | **Assumed GS=** 2.70 | **Type:** Undisturbed

Project No.: 22-353E
Date Sampled: 9/26/2022
Remarks:

Figure 1 of 1

Client: ACI BOLAND ARCHITECTS

Project: ST. LUKE'S EAST HOSPITAL EXPANSION & RENOVATION

Source of Sample: B8 **Depth:** 8.0
Sample Number: ST-4

ALPHA-OMEGA GEOTECH

Tested By: D.B. **Checked By:** T.B.

Appendix Section C

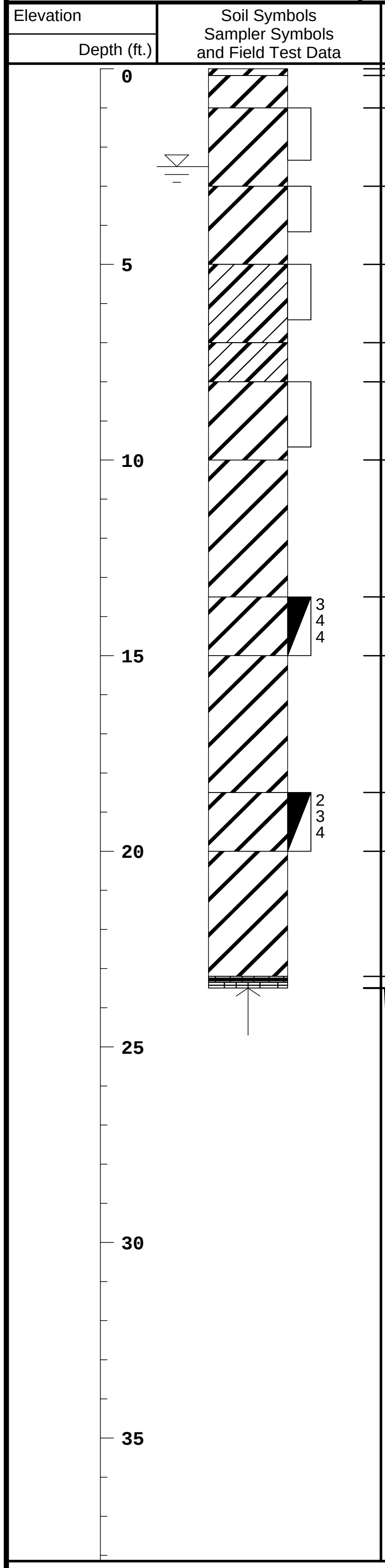
BORING LOGS

Note: The logs of subsurface conditions shown in this section apply only at the specific boring location and depths at the date indicated and might not be indicative of all subsurface conditions that may be encountered. This information is not warranted to be representative of subsurface conditions at other locations, depths and times. The passage of time or construction operations at or adjacent to this site may result in changes to the soil conditions at these boring locations and depths. As a result, the character of subsurface materials shall be each bidder's responsibility.

ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B1

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION & **PROJECT NO.:** 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: NWC **ELEVATION:** N/D
DRILLER: K.K. **LOGGED BY:** J.M.
DRILLING METHOD: POWER AUGER **DATE:** 9-17-22
DEPTH TO - WATER> INITIAL: ▽ 2.5' **AFTER 24 HOURS:** ▼ **CAVING>** NONE



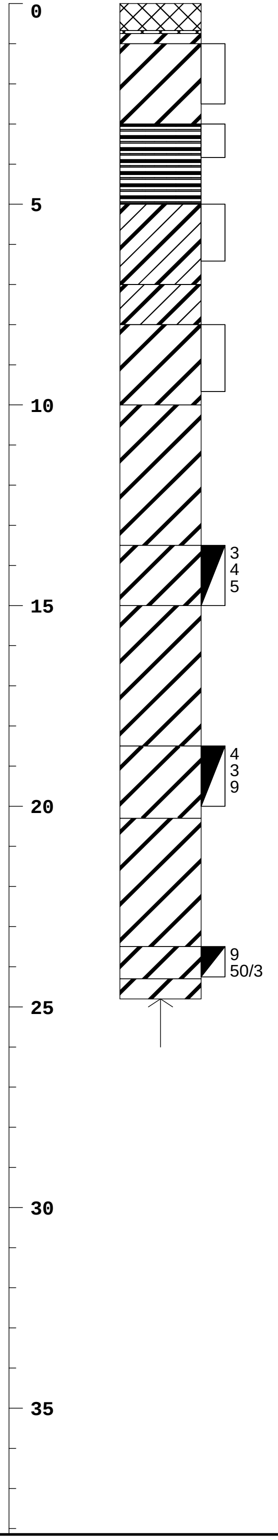
Depth (ft.)	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0.17	FAT CLAY (Root Zone) (Possible FILL)								CH
1.0	Brown, mottled dark brown, spotted reddish brown FAT CLAY (Possible FILL)								CH
3.0	Brown, mottled dark brown, spotted reddish brown FAT CLAY (Possible FILL)							1.50	CH
5.0	Brown, mottled reddish brown, spotted dark brown FAT CLAY (Possible FILL)	25.9	97.2	53	29		2013	0.75	CH
7.0	Light reddish brown, mottled gray LEAN/FAT CLAY with trace of Weathered SHALE (Possible FILL)							3.00	CL-CH
8.0	Light reddish brown, mottled gray LEAN/ FAT CLAY with trace of Weathered SHALE (Possible FILL)								CL-CH
10.0	Brown, speckled reddish brown FAT CLAY (Possible FILL)	31.8	91.6				4848	1.75	CH
13.5	Brown, speckled reddish brown FAT CLAY								CH
15.0	Brown, mottled reddish brown and gray FAT CLAY								CH
18.5	Brown, mottled reddish brown and gray FAT CLAY								CH
20.0	Reddish brown, mottled light gray FAT CLAY								CH
23.2	Reddish brown, mottled light gray FAT CLAY								CH
23.5	Weathered LIMESTONE (Very Hard, Very Slow Drilling)								LS

Auger refusal on Weathered LIMESTONE at about 23.5 feet. End of boring at about 23.5 feet.

ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B2

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION & **PROJECT NO.:** 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: WEST BLDG **ELEVATION:** N/D
DRILLER: K.K. **LOGGED BY:** J.M.
DRILLING METHOD: POWER AUGER **DATE:** 9-16-22
DEPTH TO - WATER> INITIAL: ▽ NONE **AFTER 24 HOURS:** ▼ **CAVING>** ☾ NONE

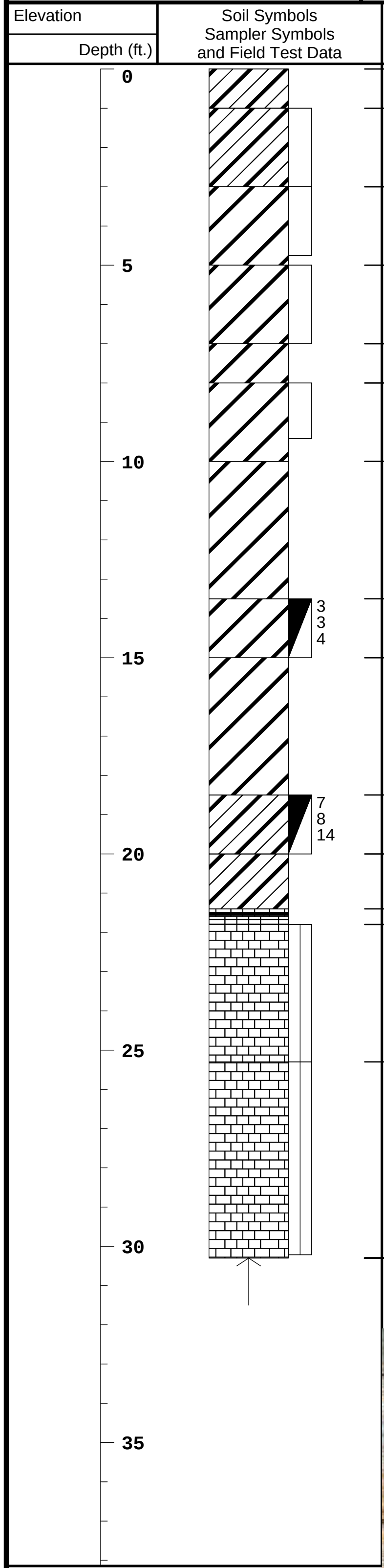


Description	Depth (ft.)	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
Asphalt (Probable FILL)	0.67								FILL
Gravel (Probable FILL)	0.75								FILL
Brown, mottled dark brown, spotted reddish brown FAT CLAY with trace of gravel (Possible FILL)	1.0								CH
Brown, mottled dark brown, spotted reddish brown FAT CLAY with trace of gravel (Possible FILL)	3.0							1.75	CH
Brown, mottled dark brown, speckled reddish brown FAT CLAY (Weathered SHALE) (Possible FILL)	5.0	20.7	98.1				2430	2.00	SH
Dark brown LEAN/FAT CLAY (Possible FILL)	7.0							2.50	CL-CH
Dark brown LEAN/FAT CLAY (Possible FILL)	8.0								CL-CH
Brown, mottled light gray and reddish brown FAT CLAY (Possible FILL)	10.0	26.2	96.6	64	40		5738	2.50	CH
Brown, mottled light gray and reddish brown FAT CLAY (Possible FILL)	13.5								CH
Reddish brown, mottled gray FAT CLAY (Possible FILL)	15.0								CH
Reddish brown, mottled gray FAT CLAY	18.5								CH
Light reddish brown, mottled gray FAT CLAY	20.3								CH
Light reddish brown, mottled gray FAT CLAY	23.5								CH
Dark grayish brown, spotted reddish brown FAT CLAY (Possible Weathered SHALE) (Very Hard, Very Slow Drilling)	24.3								CH
Dark grayish brown, spotted reddish brown FAT CLAY (Possible Weathered SHALE) (Very Hard, Very Slow Drilling)	24.8								CH
Auger refusal on Weathered LIMESTONE at about 24.8 feet. End of boring at about 24.8 feet.									

ALPHA-OMEGA GEOTECH

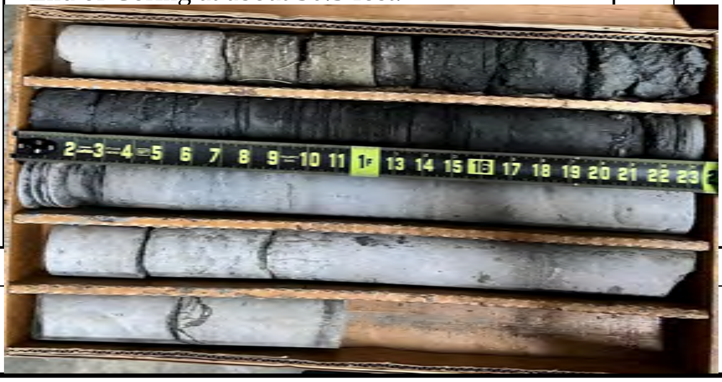
LOG OF BORING
No. B3A

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION & **PROJECT NO.:** 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: SWC **ELEVATION:** N/D
DRILLER: K.K. **LOGGED BY:** J.M.
DRILLING METHOD: POWER AUGER **DATE:** 9-17-22
DEPTH TO - WATER> INITIAL: ⊻ NONE **AFTER 24 HOURS:** ▼ **CAVING>** C NONE



Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
Dark brown LEAN/FAT CLAY with trace of organics (finger roots) (Possible FILL) 1.0								CL-CH
Dark brown LEAN/FAT CLAY with trace of organics (finger roots) (Possible FILL) 3.0							>4.50	CL-CH
Brown, spotted olive brown and reddish brown FAT CLAY with slickend sides (Possible FILL) 5.0	21.1	104.6				7889	4.25	CH
Light brown, spotted brown FAT CLAY with trace of gravel (Possible FILL) 7.0							2.00	CH
Light brown, spotted brown FAT CLAY with trace of gravel (Possible FILL) 8.0								CH
Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL) 10.0	25.9	98.0	60	35		2083	1.00	CH
Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL) 13.5								CH
Brown, mottled reddish brown and gray FAT CLAY (Possible FILL) 15.0								CH
Light brown, spotted brown FAT CLAY with trace of gravel (Possible FILL) 18.5								CH
Light brown, mottled light reddish brown, spotted gray LEAN/FAT CLAY 20.0								CL-CH
Light brown, mottled light reddish brown, spotted gray LEAN/FAT CLAY 21.4								CL-CH
Weathered LIMESTONE (Very Hard, Very Slow Drilling) 21.8								LS
LIMESTONE TURNING TO SHALE AT 22.4' [REC=99, RQD=5] 25.3								LS
LIMESTONE [REC=100,RQD= 96] 30.3								LS

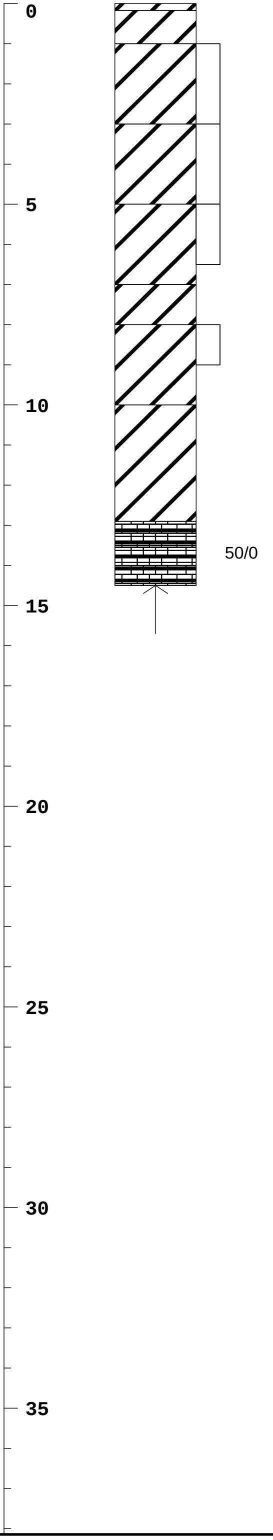
Auger refusal on LIMESTONE at about 21.8 feet.
End of Coring at about 30.3 feet.



ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B4

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION & **PROJECT NO.:** 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: NEC **ELEVATION:** N/D
DRILLER: K.K. **LOGGED BY:** J.M.
DRILLING METHOD: POWER AUGER **DATE:** 9-17-22
DEPTH TO - WATER> INITIAL: ▽ NONE **AFTER 24 HOURS:** ▼ **CAVING>** NONE



Depth (ft.)	Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0.17		FAT CLAY (Root Zone) (Possible FILL)								CH
1.0		Brown, mottled reddish brown, spotted gray FAT CLAY, with trace of Weathered SHALE (Possible FILL)								CH
3.0		Brown, mottled reddish brown, spotted gray FAT CLAY, with trace of Weathered SHALE (Possible FILL)							>4.50	CH
5.0		Brown, spotted dark brown, olive brown and reddish brown FAT CLAY (Possible FILL)	23.6	96.3	56	33		3034	2.50	CH
7.0		Light brown, spotted light reddish brown and gray FAT CLAY (Possible FILL)							1.00	CH
8.0		Light brown, spotted light reddish brown and gray FAT CLAY (Possible FILL)								CH
10.0		Brown, mottled light brown, spotted dark gray FAT CLAY	24.5	97.3				1668	1.00	CH
12.9		Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL)								CH
13.5	50/0	Weathered LIMESTONE (Very Hard, Very Slow Drilling)								LS
14.5		Weathered LIMESTONE (NO RECOVERY)(Very Hard, Very Slow Drilling)								LS

Auger refusal on Weathered LIMESTONE at about 14.5 feet. End of boring at about 14.5 feet.

ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B5

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION & **PROJECT NO.:** 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: MID BLDG **ELEVATION:** N/D
DRILLER: K.K. **LOGGED BY:** J.M.
DRILLING METHOD: POWER AUGER **DATE:** 9-16-22
DEPTH TO - WATER> INITIAL: ⊻ NONE **AFTER 24 HOURS:** ▼ **CAVING>** ☾ NONE

Soil Symbols Sampler Symbols and Field Test Data	Description	Depth	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
	Asphalt (Probable FILL)	0.75								FILL
	Gravel (Probable FILL)	0.92							0.75	FILL CH CH
	Light brown, spotted reddish brown and dark brown FAT CLAY (Possible FILL)	1.0	23.2	103.8	48	23		3401	2.25	CL
	Light brown, spotted reddish brown and dark brown FAT CLAY (Possible FILL)	3.0							1.00	CH
	Light brown, spotted reddish brown and dark brown LEAN CLAY (Weathered SHALE), (Possible FILL)	5.0	26.2	97.3				3826	1.75	CH CH
	Brown, spotted dark brown and gray LEAN/FAT CLAY (Possible FILL)	7.0								CH
	Brown, spotted dark brown and gray LEAN/FAT CLAY (Possible FILL)	8.0								
3 4 5	Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)	10.0								CH
	Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)	13.5								CH
6 7 10	Brown, mottled reddish brown and gray FAT CLAY (Possible FILL)	15.0								CH
	Brown, mottled reddish brown and gray FAT CLAY	18.5								CH
	Light brown, mottled reddish brown and gray FAT CLAY	20.0								LS SH
	Brown, mottled reddish brown and gray FAT CLAY	21.4								
	Weathered LIMESTONE (Very Hard, Very Slow drilling)	21.8								LS
	LIMESTONE [REC=100, RQD=91]	25.3								
	LIMESTONE [REC=100, RQD=100]	30.3								

Auger refusal on Weathered LIMESTONE at about 21.8 feet. End of Coring at about 30.3 feet

ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B6

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION &
PROJECT NO.: 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: MID BLDG
ELEVATION: N/D
DRILLER: K.K.
LOGGED BY: J.M.
DRILLING METHOD: POWER AUGER
DATE: 9-16-22
DEPTH TO - WATER> INITIAL: ▽ 17.9'
AFTER 24 HOURS: ▼
CAVING> NONE

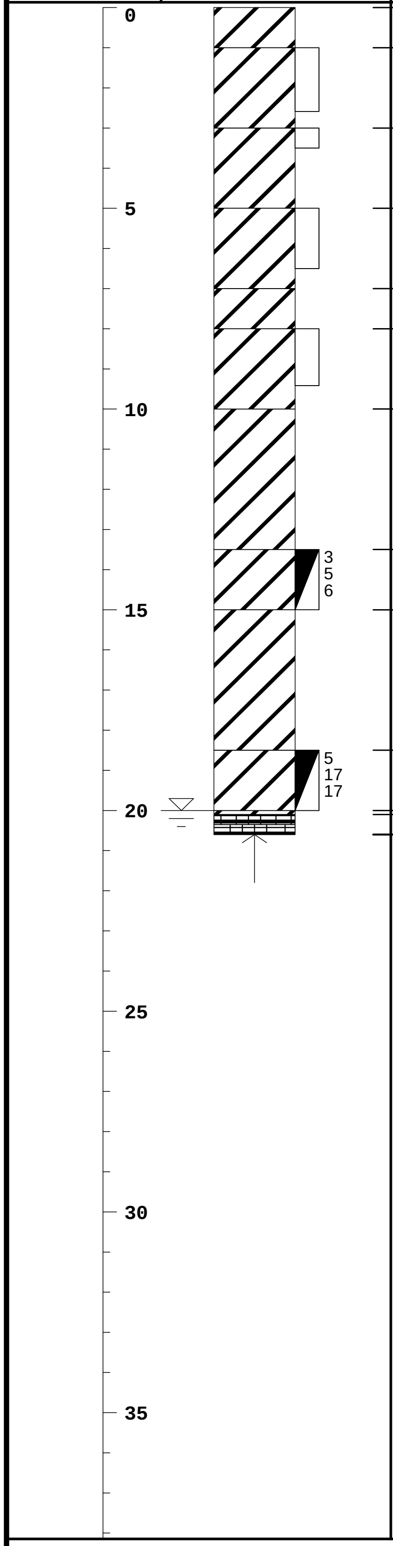
Elevation Depth (ft.)	Soil Symbols Sampler Symbols and Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0.58		Asphalt (Probable FILL)								FILL
1.0		Gravel (Probable FILL)								FILL
3.0		Brown, mottled reddish brown, gray and dark brown FAT CLAY (Possible FILL)							1.25	CH
5.0		Brown, mottled light gray, spotted reddish brown and dark brown FAT CLAY (Possible FILL)	23.9	102.3				2538	1.25	CH
6.5	3 4 5	Brown, spotted reddish brown FAT CLAY (Possible FILL)								CH
8.0		Brown, spotted reddish brown FAT CLAY								CH
10.0		Brown, spotted dark brown, reddish brown and gray FAT CLAY with slickend sides	24.9	99.7	63	39		2401	2.00	CH
13.5		Brown, spotted dark brown, reddish brown and gray FAT CLAY with slickend sides								CH
15.0	3 5 7	Brown, mottled reddish brown and gray FAT CLAY								CH
17.8		Brown, mottled reddish brown and gray FAT CLAY								CH
18.5		Weathered LIMESTONE								LS
20.0	6 9 13	Brown, mottled light brown, spotted gray and reddish brown FAT CLAY								CH
22.0		Brown, mottled light brown, spotted gray and reddish brown FAT CLAY								CH
22.4		Weathered LIMESTONE (Very Hard, Very Slow drilling)								LS
24.9		LIMESTONE W/ SHALE SEAMS [REC=89, RQD=90]								LS
29.9		LIMESTONE [REC=100, RQD=93]								LS

Auger refusal on LIMESTONE at about 22.4 feet.
End of Coring at about 29.9 feet.

ALPHA-OMEGA GEOTECH

LOG OF BORING No. B7A

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION & **PROJECT NO.:** 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: SEC **ELEVATION:** N/D
DRILLER: K.K. **LOGGED BY:** J.M.
DRILLING METHOD: POWER AUGER **DATE:** 9-17-22
DEPTH TO - WATER> INITIAL: ▽ 20' **AFTER 24 HOURS:** ▼ **CAVING>** NONE



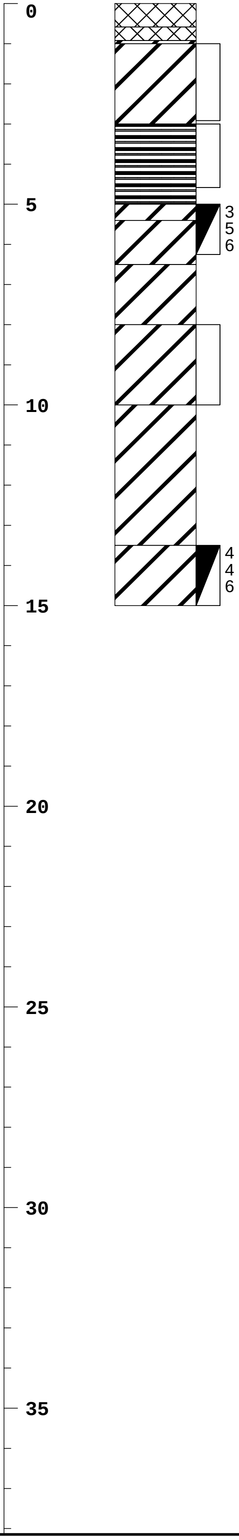
Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
Brown, spotted dark brown and gray FAT CLAY with trace of organics (Roots) (Possible FILL) 1.0								CH
Brown, spotted dark brown and gray FAT CLAY with trace of organics (Roots) (Possible FILL) 3.0							>4.5	CH
Brown, mottled reddish brown FAT CLAY (Possible FILL) 5.0	14.3	98.9	56	32		FRACT	>4.50	CH
Brown, spotted dark brown, speckled reddish brown FAT CLAY (Possible FILL) 7.0							2.50	CH
Brown, spotted dark brown, speckled reddish brown FAT CLAY (Possible FILL) 8.0								CH
Brown, mottled reddish brown, spotted dark brown and gray FAT CLAY 10.0	24.7	100.9				6096	2.75	CH
Brown, mottled reddish brown, spotted dark brown and gray FAT CLAY 13.5								CH
Reddish brown, spotted gray and dark brown FAT CLAY 15.0								CH
Reddish brown, spotted gray and dark brown FAT CLAY 18.5								CH
Light brown, mottled reddish brown FAT CLAY with trace of Weathered LIMESTONE (Very Hard, Very Slow Drilling) 20.0								CH
Light brown, mottled reddish brown FAT CLAY with trace of Weathered LIMESTONE (Very Hard, Very Slow Drilling) 20.1								CH
Weathered LIMESTONE (Very Hard, Very Slow Drilling) 20.6								LS

Auger refusal on LIMESTONE at about 20.6 feet.
End of boring at about 20.6 feet.

ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B8

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION &
PROJECT NO.: 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: EAST BLDG ENTRY
ELEVATION: N/D
DRILLER: K.K.
LOGGED BY: J.M.
DRILLING METHOD: POWER AUGER
DATE: 9-16-22
DEPTH TO - WATER> INITIAL: ▽ NONE **AFTER 24 HOURS:** ▼
CAVING> NONE



Description	Depth (ft.)	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
Asphalt (Probable FILL)	0.58								FILL
Gravel (Probable FILL)	0.92								FILL
Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL)	1.0								CH
Brown, mottled reddish brown and dark brown FAT CLAY (Possible FILL)	3.0							2.00	CH
Brown, mottled gray and reddish brown Weathered SHALE (Possible FILL)	5.0	21.8	106.1				2105	1.75	SH
Brown, mottled light brown FAT CLAY (Possible FILL)	5.4								CH
Brown, mottled light brown FAT CLAY (Possible FILL)	6.5								CH
Brown, mottled light brown FAT CLAY (Possible FILL)	8.0								CH
Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)	10.0	22.5	106.0	62	38		6505	3.00	CH
Brown, mottled reddish brown and gray, spotted dark brown FAT CLAY (Possible FILL)	13.5								CH
Brown, mottled reddish brown and gray FAT CLAY	15.0								CH

End of boring at about 15.0 feet

ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B9

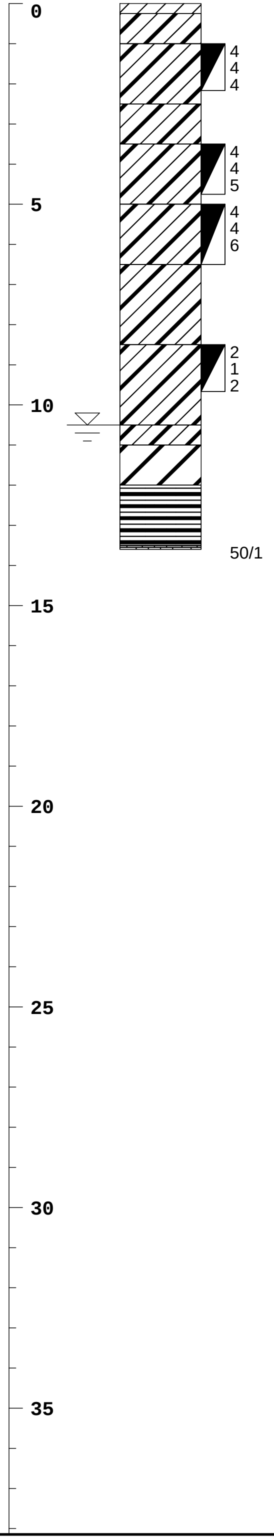
PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION &
PROJECT NO.: 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: EAST PARKING
ELEVATION: N/D
DRILLER: K.K.
LOGGED BY: J.M.
DRILLING METHOD: POWER AUGER
DATE: 9-19-22
DEPTH TO - WATER> INITIAL: ▽ NONE **AFTER 24 HOURS:** ▼
CAVING> NONE

Elevation / Depth (ft.)	Soil Symbols Sampler Symbols and Field Test Data	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0.25		LEAN CLAY (Root Zone) (Possible FILL)								CL
1.0		Brown LEAN/FAT CLAY (Possible FILL)								CL-CH
2.5	3 3 3	Brown LEAN/FAT CLAY (Possible FILL)								CL-CH
3.5		Brown LEAN/FAT CLAY (Possible FILL)								CL-CH
5.0	4 4 5	Brown LEAN/FAT CLAY (Possible FILL)								CL-CH
6.5	3 4 4	Brown, mottled reddish brown and gray FAT CLAY								CH
8.5		Brown, mottled reddish brown and gray FAT CLAY								CH
10.0	2 3 4	Brown, mottled reddish brown and gray FAT CLAY								CH
		End of boring at about 10.0 feet								

ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B10

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION & **PROJECT NO.:** 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: MID PARKING **ELEVATION:** N/D
DRILLER: K.K. **LOGGED BY:** J.M.
DRILLING METHOD: POWER AUGER **DATE:** 9-19-22
DEPTH TO - WATER> INITIAL: ▽ 10.5 **AFTER 24 HOURS:** ▼ **CAVING>** ☾ NONE



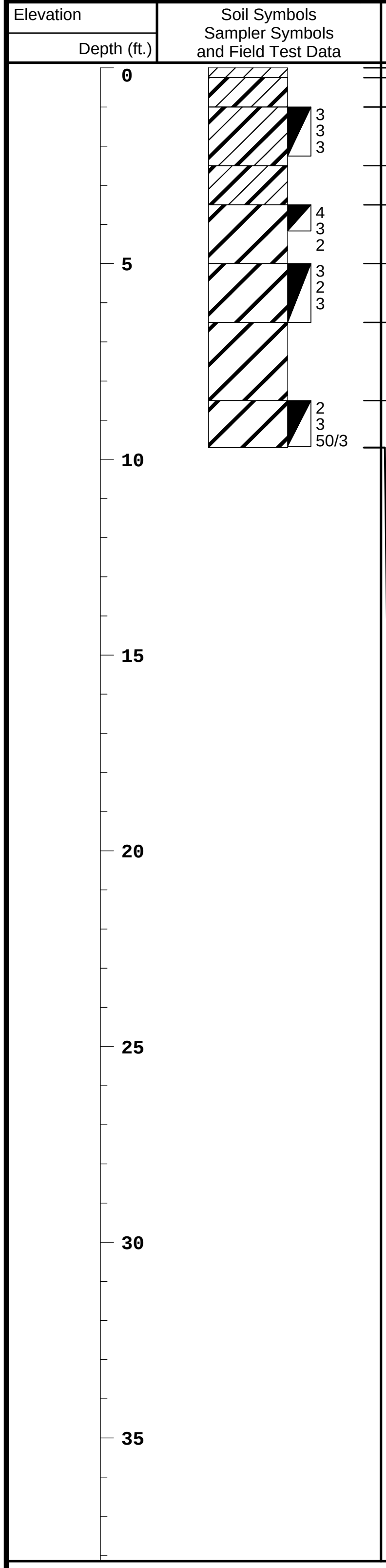
Depth (ft.)	Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
0.25	LEAN CLAY (Root Zone) (Possible FILL)								CL
1.0	Brown, mottled light olive brown, spotted light gray LEAN/FAT CLAY (Possible FILL)								CL-CH
2.5	Brown, mottled light olive brown, spotted light gray LEAN/FAT CLAY (Possible FILL)								CL-CH
3.5	Brown, mottled light olive brown, spotted light gray LEAN/FAT CLAY (Possible FILL)								CL-CH
5.0	Brown LEAN/FAT CLAY (Possible FILL)								CL-CH
6.5	Brown LEAN/FAT CLAY (Possible FILL)								CL-CH
8.5	Brown LEAN/FAT CLAY (Possible FILL)								CL-CH
10.5	Brown, mottled dark brown LEAN/FAT CLAY (Possible FILL)								CL-CH
11.0	Brown, mottled dark brown LEAN/FAT CLAY (Possible FILL)								CL-CH
12.0	FAT CLAY								CH
13.5	Weathered SHALE								SH
13.6	Weathered LIMESTONE (NO RECOVERY) (Very Hard, Very Slow Drilling)								LS

End of boring at about 13.6 feet

ALPHA-OMEGA GEOTECH

LOG OF BORING
No. B11

PROJECT: ST. LUKE'S EAST HOSPITAL EXPANSION & **PROJECT NO.:** 22-353E
CLIENT: ACI BOLAND ARCHITECTS
PROJECT LOCATION: 100 NE ST. LUKE'S BLVD., LEE'S SUMMIT, MO
LOCATION: WEST PARKING **ELEVATION:** N/D
DRILLER: K.K. **LOGGED BY:** J.M.
DRILLING METHOD: POWER AUGER **DATE:** 9-19-22
DEPTH TO - WATER> INITIAL: ⊽ NONE **AFTER 24 HOURS:** ▼ **CAVING>** ☾ NONE



Description	w%	DDen pcf	LL	PI	200 %	Uncomp. psf	PPen. tsf	USCS/ Visual Class.
LEAN CLAY (Root Zone) (Possible FILL) 0.25								CL
Brown LEAN/FAT CLAY with trace of organics (Finger Roots) (Possible FILL) 1.0								CL-CH
Brown LEAN/FAT CLAY with trace of organics (Finger Roots) (Possible FILL) 2.5								CL-CH
Brown LEAN/FAT CLAY with trace of organics (Finger Roots) (Possible FILL) 3.5								CL-CH
Dark brown FAT CLAY with trace of organics (Finger Roots) (Possible FILL) 5.0								CH
Brown, mottled gray, spotted reddish brown FAT CLAY with trace of organics (Finger Roots) (Possible FILL) 6.5								CH
Brown, mottled gray, spotted reddish brown FAT CLAY with trace of organics (Finger Roots) (Possible FILL) 8.5								CH
Brown, mottled dark brown, spotted reddish brown FAT CLAY with trace of gravel and sand (Possible FILL) (Very Hard, Very Slow Drilling) 9.7								CH

End of boring at about 9.7 feet

KEY TO SYMBOLS

Strata symbols

Symbol	Description
▨	FAT CLAY
▨	LEAN/FAT CLAY
▦	Weathered LIMESTONE
▩	Fill
▤	Weathered SHALE
▦	LIMESTONE
▤	SHALE
▨	LEAN CLAY

Misc. Symbols

Symbol	Description
▽	Water table during drilling
↑	Drill rejection

Soil Samplers

Symbol	Description
▯	Undisturbed thin wall Shelby tube
◩	Standard penetration test
◫	Rock core

Notes:

1. Borings were drilled on September 17, 2022 using solid auger, split spoon sampler and shelby tube sampler techiniques.

2. Ground water not encountered while drilling at the reported depths.

3. Borings were staked by Alpha-Omega, Inc.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. Results of tests conducted on samples recovered are reported on the logs. Abbreviations are:

DDen = natural dry density (pcf) LL = Liquid limit
w% = natural moisture content (%) PI = Plasticity index
UComp = Unconfined compression (psf) PPen = Pocket Penetrometer
-200 = percent passing #200 sieve (%) RQD = Rock Quality
DCP = Dynamic Cone Penetrometer