

### GEOTECHNICAL EXPLORATION REPORT Proposed Pergola Park 4<sup>th</sup>-6<sup>th</sup> Plats New Longview Lee's Summit, Missouri

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# Important Information about This Geotechnical-Engineering Report

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

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

# Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one* — *not even you* — should apply this report for any purpose or project except the one originally contemplated.

#### **Read the Full Report**

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

### Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot* accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

#### Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

# Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

#### A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmationdependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.* 

# A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

#### Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.* 

## Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, but preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/ or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

#### **Read Responsibility Provisions Closely**

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

#### **Environmental Concerns Are Not Covered**

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnicalengineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.* 

### Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.

### Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.



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Appendix B -	Boring Logs Key to Symbols Legend & Nomenclature Unified Soil Classification System (USCS) Rock Descriptors
Appendix C -	Field & Laboratory Test Results



#### **1. INTRODUCTION**

#### 1.1 General

This report summarizes the findings of our geotechnical exploration for the proposed Pergola Park 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> plats located at the New Longview subdivision in Lee's Summit, Missouri. The scope of work was outlined in our proposal dated March 8, 2019. Mr. Russell Pearson of NLV Pergola Park, LLC authorized this exploration on March 14, 2019.

The purpose of this geotechnical study is to explore the subsurface conditions at the proposed site with exploratory borings, evaluate the engineering properties of the subsurface materials with appropriate field and laboratory tests, and perform engineering analyses for developing design and construction recommendations for the proposed project.

#### **1.2 Project Description**

The proposed project will be located at the New Longview residential development in Lee's Summit, Missouri. We understand that the project will consist of the development of the residential areas and associated drives and alleyways within the proposed 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> plats of the existing subdivision. We understand that the main focus of this exploration is to evaluate the subsurface conditions at the site for mass site grading purposes, as well as to complete a pavement design section for both the drives and alleyways that transverse throughout the proposed plats.

We anticipate that the pavements will support predominately light passenger cars with less frequent panel delivery vans, passenger vans, and trash trucks.

We understand that approximately 5 to 8 feet of fill has been placed in certain portions of the site. A site grading plan was unavailable at the time of this report, but we understand that large cuts may be required in order to achieve the desired elevations of the development.

A site plan is included in Appendix A for reference.



#### 2. FIELD EXPLORATION

We drilled 15 borings for this geotechnical exploration on April 4<sup>th</sup> and 5<sup>th</sup>, 2019 with a CME 55 trackmounted drilling rig using 3.25-inch inside diameter hollow stem augers. We drilled 15 borings at various locations within the pavement footprints to depths between approximately 9.5 and 20 feet below the site grade at the time of our exploration. The boring schedule was to drill 11 borings to depths of 10 feet in areas with less existing fill, and drill 4 borings to depth of 20 feet in areas with greater fill near the edge of the lake. Some of the borings were extended to a depth of 11.5 feet to tag the native shale bedrock, while some borings were terminated prior to their scheduled depths upon encountering sampler penetration refusal on the native limestone bedrock.

We selected boring locations based on a preliminary site plan provided to us by Ms. Allsion Sperber of Sperber Contracting on March 5, 2019. GSI personnel established field locations by using a handheld GPS unit. Locations of the borings in relation to existing and proposed features are indicated on the Boring Location Plan included in Appendix A. The locations of the borings should be considered accurate only to the degree implied by the methods used in their determination.

Our drill crew obtained soil samples at the intervals shown on the boring logs in Appendix B. Recovered samples were sealed in plastic containers, labeled, and protected for transportation to the laboratory for further examination, testing, and classification.

We obtained split-barrel samples (designated "Split Spoon" or "S" samples) while performing Standard Penetration Tests (SPT) with a 1-3/8 inch I.D. thick-walled sampler, driven using an automatic hammer in general accordance with ASTM D1586, "*Penetration Test and Split-Barrel Sampling of Soils*." The "N" value, reported in blows per foot (bpf), equals the number of blows required to drive the sampler through the last 12 inches of the 18-inch sample interval using a 140-pound hammer falling 30 inches.

We obtained undisturbed samples (designated "Shelby Tube" or "U" samples) with 3-inch O.D. thinwalled tube samplers, hydraulically pushed in general accordance with ASTM D1587, "*Thin-Walled Tube Sampling of Soils for Geotechnical Purposes*."



We obtained disturbed bulk samples from auger cuttings at the borings and depth intervals as indicated in Table 2.1 below.

Boring Number	Sample Depth Interval (ft.)
B-1	1.0-5.0
B-3	0.0-5.0
B-5	0.0-5.0
B-7	2.0-5.0
B-10	1.0-5.0
B-13	3.0-7.0

#### Table 2.1 Disturbed Bulk Sample Locations

Our drilling personnel prepared field boring logs during drilling operations. These field logs report drilling and sampling methods, sampling intervals, groundwater measurements and the subsurface conditions we encountered. At the conclusion of drilling, our drill crew made groundwater measurements and backfilled the borings in accordance with Missouri state regulations.



#### **3. SITE CONDITIONS**

#### 3.1 Regional Geology

Soils in the greater Kansas City area are generally residual soils, alluvial deposits, or till. Residual soils formed as a result of weathering of bedrock, or by weathering of sediments that were transported by water, ice, wind or a combination of these. Regional soils derived from shale, limestone, and loess have high shrink-swell potentials. Major alluvial deposits occur along the Missouri and Kansas rivers and their tributaries. These consist of clay, sand and gravel sized sediments. Northern parts of the city were glaciated during the early Pleistocene time resulting in till deposits. Surface bedrock in northeastern Kansas and northwestern Missouri generally consist of limestone and shale (with sandstone found in prehistoric channels) arranged in nearly horizontal beds or layers that can be followed continuously over long distances. These bedrocks are part of the Pennsylvanian bedrock system.

#### 3.2 Surface Conditions

The project site comprises a grass and tree covered field that slopes downgradient towards the lake on all sides for a maximum elevation change of approximately 10 feet. A pergola resides near the center of the site, near the edge of the lake. This site is bound by Old Longview Lake to the south, the Longview Mansion and associated parking lot to the west, and by various access roads associated with the development of the existing plats of the subdivision.

#### 3.3 Subsurface Conditions

Although we observed some variability, the subsurface materials we encountered within the depths of exploration generally comprised 6 inches of topsoil or 6 inches of gravel pavement overlying lean to fat clay fill materials overlying native lean to fat clay, which in turn is underlain by shale and limestone bedrock. General descriptions of the strata we encountered are presented below, while more detailed subsurface information is presented on the boring logs located in Appendix B. Please note that the indicated depths are relative to the site grade at the time of our exploration.

#### Stratum 1

We encountered lean to fat clay fill materials in borings B-8 thru B-15, underlying the topsoil and gravel pavement at the surface, and extending to depths between 2.5 and 13.5 feet below the current site grade. This material was generally described as dark yellowish brown, light olive brown to dark olive brown, pale olive to olive and olive yellow, greenish gray to bluish gray, strong brown to dark



reddish brown, reddish yellow, or dark gray to gray, and moist to very moist. We measured Standard Penetration Test (SPT) N-values between 5 and 20 blows per foot (bpf), indicating that the cohesive fill materials are in a medium stiff to very stiff condition.

#### Stratum 2

We encountered native lean to fat clay in each of our borings, underlying the topsoil at the surface in borings B-1 thru B-7, and extending to depths between 5 feet and the termination depth of the borings at 11.5 feet, and underlying the fill materials in borings B-8 thru B-15, and extending to depths between 5 feet and the termination depth of the borings at 10 and 20 feet below the current site grade. This material was generally described as black to very dark brown, dark grayish brown to grayish brown, gray to dark gray, dark yellowish brown to light yellowish brown, olive brown, bluish gray, or reddish brown to strong brown, and moist to wet. We measured SPT N-values between 4 and 52 bpf and unconfined compressive strengths between 2.28 and 5.63 kips per square foot (ksf), indicating that the native lean to fat clay is in a soft to hard condition.

#### Stratum 3

We encountered shale bedrock in borings B-1, B-2, B-4, B-5, B-7 thru B-10, and B-14, underlying the native fat clay, and extending to depths between 7 feet and the boring termination depths at 9.5,10, 11.5, and 20 feet below the current site grade. This material was generally described as yellowish brown to olive gray, light olive brown to olive brown, pale olive to greenish gray, or bluish gray to very dark gray, very soft to soft rock, in a decomposed to slightly weathered condition. We measured SPT N-values between 12 bpf and 50 blows for 5.5 inches of sampler penetration.

We encountered limestone in borings B-7, B-13, and B-15, underlying the native fat clay or shale, and extending to the boring termination depths of the respective borings at 8.1, 17.13, and 13.04 feet below the current site grade. This material was generally described as gray, very soft to moderately hard rock, in a moderately weathered condition. We measured SPT N-values between 50 blows for 1.5 inches and 50 blows for one inch of sampler penetration.

#### 3.4 Groundwater Conditions

Our drill crew made water level observations during drilling and after completion of the borings to evaluate groundwater conditions. We noted groundwater in the borings and at the depths indicated in the following table.





Boring Number	Depth Below Grade During Drilling (ft.)	Depth Below Grade After Drilling (ft.)		
B-1	N.E.	N.E.		
B-2	N.E.	N.E.		
B-3	N.E.	N.E.		
B-4	N.E.	N.E.		
B-5	10.0	9.5		
B-6	10.0	9.5		
B-7	N.E.	N.E.		
B-8	N.E.	N.E.		
B-9	N.E.	N.E.		
B-10	N.E.	N.E.		
B-11	N.E.	N.E.		
B-12	N.E.	N.E.		
B-13	N.E.	N.E.		
B-14	15.5	18.5		
B-15	13.0	13.0		

#### Table 3.4-1: Groundwater Levels

\*N.E.—None Encountered

The groundwater conditions we observed during our exploration program should not be construed to represent an absolute or permanent condition. Uncertainty is involved with short-term water level observations in boreholes. The slow percolation rate of the on-site fat clay and shale and nearly impermeable limestone surface, can cause water to pond or become perched for extended time periods.

The free groundwater surface or groundwater table within unconfined aquifers is generally a subdued reflection of surface topography. Water generally flows downward from upland positions (recharge zones) to low lying areas or surface water bodies (discharge zones). As such, the groundwater level and the amount and level of any perched water on the site may be expected to fluctuate with variations in precipitation, site grading, drainage and adjacent land use. Long-term monitoring utilizing piezometers or observation wells is required to evaluate the potential range of groundwater conditions.



#### 4. LABORATORY TESTING

Our engineering staff reviewed the field boring logs to outline the depth, thickness and extent of the soil strata. The samples taken from the borings were examined in our laboratory and visually classified in general accordance with ASTM D2488, "*Description and Identification of Soils (Visual-Manual Procedure)*." We established a testing program to evaluate the engineering properties of the recovered samples. A GSI technician performed laboratory testing in general accordance with the following current ASTM test methods:

- Moisture Content (ASTM D2216, "Laboratory Determination of Water (Moisture) Content of Soil and Rock")
- Unit Weight (ASTM D7263, "Laboratory Determination of Density (Unit Weight) of Soil Specimens")
- Atterberg Limits (ASTM D4318, "Liquid Limit, Plastic Limit, and Plasticity Index of Soils")
- Minus No. 200 Sieve Wash (ASTM D1140, "Amount of Material in Soils Finer Than the No. 200 (75-μm) Sieve")
- Unconfined Compressive Strength (ASTM D2166, "Unconfined Compressive Strength of Cohesive Soil")
- Standard Proctor (ASTM D698, "Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))")
- California Bearing Ratio (ASTM D1883, "CBR (California Bearing Ratio of Laboratory-Compacted Soils")

Laboratory test results are presented on the boring logs in Appendix B and tabulated in Appendix C.

Moisture content and unit weight tests were used to evaluate the existing moisture-density condition of the soils. The Atterberg limits and Minus No. 200 sieve tests were used to help classify the soils under the Unified Soils Classification System. The Atterberg limits were also used to evaluate the plasticity characteristics of the soils. Unconfined compression tests were used to define the stressstrain characteristics and related shear strength of the soils. The standard proctor test was used to determine the moisture-density relationship of the soils. The California Bearing Ratio test evaluated the support characteristics of the proposed pavement subgrade soils.



The following data summarize our laboratory test results. We used these data to develop the allowable bearing values, anticipated settlements, and other geotechnical design criteria for the project.

Natural Moisture Content	11.8 to 29.7%
Wet Density	124.6 to 141.5 lb/ft <sup>3</sup>
Dry Density	100.0 to 117.3 lb/ft <sup>3</sup>
Unconfined Compressive Strength	2.28 to 5.63 kips/ft <sup>2</sup>
Liquid Limit	
Plastic Limit	
Plasticity Index	
Percent Passing the No. 200 Sieve	95.5 to 96.1%
• Standard Penetration Test (SPT 'N' blows per foot)	4 to 50/0.5"
Maximum Dry Density	. 100.7 to 106.8 lb/ft <sup>3</sup>
Optimum Moisture Content	18.0 to 21.1%
• CBR	

Based on the results of this testing program, we reviewed and supplemented the field logs to arrive at the final logs as presented in Appendix B. The final logs represent our interpretation of the field logs and reflect the additional information obtained from the laboratory testing. Stratification boundaries indicated on the boring logs were based on observations made during drilling, an extrapolation of information obtained by evaluating samples from the borings, and comparisons of similar engineering characteristics. Locations of these boundaries are approximate and the transitions between soil types may be gradual rather than clearly defined.



#### 5. CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 General Geotechnical Considerations

We understand that approximately 5 to 8 feet of fill has been placed in certain portions of the site. A site grading plan was unavailable at the time of this report, but we understand that large cuts may be required in order to achieve the desired elevations of the development.

We understand that the City of Lee's Summit has recently changed their standard street cross section, which would be required for the asphalt access drives throughout the subdivision. We understand that the client would prefer to reuse the pavement thicknesses as used in the Pergola Park 3<sup>rd</sup> Plat in 2006, rather than the 2018 City of Lee's Summit standard section, and may be approved with the recommendations provided within this report.

The near-surface clay soils we encountered at the site are classified as moderately to highly plastic and may be susceptible to changes in strength and volume (shrink/swell) with changes in moisture content. These soils are not recommended for direct support of pavements, unless chemically stabilized as outlined later in this report.

We did not encounter groundwater within the anticipated depth of excavations for large cuts associated with mass site grading operations.

#### 5.2 Earthwork

#### 5.2.1 Site Preparation

Trees within the areas to be prepared for development must be removed. The root-balls and surrounding soils containing observable organic material must also be removed. We expect the root-balls will extend to substantially greater depths than the topsoil stripping depth. The root-ball excavations must be filled with an engineered structural fill that is placed, moisture conditioned and compacted in accordance with Section 5.2.4.

In preparing the site for construction, existing gravel pavements, surface vegetation and topsoil containing a significant percentage of organic matter should be removed from the areas beneath structures and any other areas that are to be paved, cut or receive fill. The removal depth for this site is expected to be approximately 6 inches. However, the removal depth should be monitored during stripping and adjusted as required. This material should either be removed from the site or stockpiled for later use in landscaping of unpaved or non-structural areas.



Prior to fill placement, the top 8 inches of the ground surface in fill areas should be scarified, moisture conditioned and recompacted in accordance with Section 5.2.4 to eliminate a plane of weakness along the contact surface.

The subgrade should be proof rolled with a loaded tandem axle dump truck or equivalent (loaded water truck, loaded concrete mixer or motor grader with a minimum weight of 20 tons). A proof-roll is considered acceptable if no ruts greater than one inch deep appear behind the loaded vehicle, and no pumping or weaving is observed as the wheels pass over the area. Any soft or unsuitable areas should be compacted or removed and replaced with stable fill material similar in composition to the surrounding soils. If necessary, clean materials such as crushed concrete or crushed stone may be used to stabilize areas where wet soil or water is present. Geogrid or structural geotextile may be used in conjunction with crushed concrete or stone to provide additional stabilization.

Whether in cut or fill, the final subgrade surface must be maintained in a stable condition at the moisture content and level of compaction identified in Section 5.2.4. Verification and maintenance of the completed subgrade may require scarification, moisture conditioning, recompaction, and proof rolling.

#### 5.2.2 General Structural Fill

General structural fill should be used for mass site grading, landscaping applications or as utility trench backfill outside of building areas. General structural fill may also be used to within 8 inches of the base of any vehicular pavements. In the former applications, low volume change materials are required immediately below the pavements (low volume change material is discussed in the following section).

General structural fill may comprise cohesive or granular material but should be free from organic matter or debris. Granular materials used as general structural fill should be well graded, have a maximum particle size of 1.5 inches, and meet MoDOT freeze/thaw durability and sulfate soundness requirements.

If free of organic matter or debris, the on-site soils may be reused as general structural fill within the areas outlined above.



#### 5.2.3 Chemical Stabilization of Soil

The moderately to highly plastic clay soils we encountered in this exploration are considered moisture sensitive and may lose strength and undergo volume changes with fluctuations in moisture content. Chemical stabilization may be achieved by amending the soil with 14 to 16 percent class "C" fly ash, 6 to 8 percent cement kiln dust (CKD), or 3 to 5 percent Portland cement.

We recommend a laboratory standard Proctor Moisture-Density Relationship (ASTM D698, *"Laboratory Compaction Characteristics of Soil Using Standard Effort"*) be performed prior to field mixing using a sample of the soil to be stabilized and the proposed amendment (fly ash, CKD or Portland cement). The sample should be prepared in advance to match the intended field mix proportions, using the same amendment source as will be utilized in the field.

#### Fly Ash Stabilization

Prior to the introduction of fly ash, the soil material should be thoroughly pulverized to reduce clods to 1/2 inch or less. During the pulverization process, we recommend that water be added to reach a moisture content at or above the optimum moisture content as determined by ASTM D698 for the proposed fly ash-soil mixture. The fly ash should remain dry and be protected from external sources of moisture during transportation and storage. Fly ash material that is introduced to moisture prior to incorporation with the soil must be discarded.

The fly ash and soil should be thoroughly mixed within ½ hour after introduction. The moisture content should be field tested immediately following mixing and adjusted as needed to maintain a range between optimum and 4 percent above optimum. The fly ash-soil mixture should not be allowed to air dry. If the moisture content is determined to be in excess of 4 percent of optimum, additional fly ash should be applied to achieve the specified moisture content. Compaction of the fly ash supplemented soil should be completed within 2 hours after incorporation. Additional compaction after 2 hours may cause degradation of the soil strength. The fly ash-soil mixture should be compacted as noted in Section 5.2.4.

Fly ash mixing should not be performed at ambient air temperatures below 50 degrees Fahrenheit.



#### **Cement Kiln Dust**

Cement kiln dust can also be used as a soil stabilization agent and should be incorporated into the soils using the procedures outlined for fly ash stabilization. Cement kiln dust may be used at temperatures below 50 degrees Fahrenheit, provided the soil to be amended is frost-free.

#### Portland Cement

Type I/II Portland cement can be used as a soil stabilization agent using dry application methods as outlined above, or by injection of a liquefied cementitious mixture into the soil to be treated. Cement treatment and mixing can be performed at temperatures below 50 degrees Fahrenheit, provided the soil to be amended is frost-free.

#### Stabilized Subgrade Maintenance

Stabilized soil that will be utilized as pavement subgrade should be covered with a minimum of 3.5 inches of asphalt or the full Portland cement concrete pavement section prior to being subjected to freezing conditions. If paving does not immediately follow soil stabilization, the supplemented soil should be protected from extreme weather, kept moist, and minimally trafficked until slab placement occurs. In areas that are to be paved, an asphalt prime coat could be applied over the stabilized material surface as an alternative to periodic moisture additions to maintain acceptable moisture throughout curing.

If the stabilized subgrade deteriorates prior to paving or slab placement, we recommend any unstable areas be scarified and recompacted. We recommend an additional 3 percent class "C" fly ash be incorporated in areas that are to be scarified and recompacted. Expansive soils stabilized with cement kiln dust or Portland cement may be reworked without additional amendment. Other soil types may require the incorporation of additional cement kiln dust or Portland cement to restore the desired strength characteristics.

#### 5.2.4 Compaction of Engineered Structural Fills

Unless otherwise noted, fill materials should be placed in loose lifts not to exceed 9 inches and be compacted to a minimum of 95 percent of the maximum dry unit weight obtained from ASTM D698 (Standard Proctor). Moisture content at the time of compaction should be controlled to between optimum and 4 percent above optimum moisture content.



Granular fill materials which produce a definable moisture-density curve when tested according to ASTM D698 should be compacted to a minimum of 95 percent of the maximum dry unit weight obtained from ASTM D698. Granular fill materials which do not produce a definable moisture-density curve should be compacted to a minimum of 75 percent relative density (ASTM D4253, *"Maximum Index Density and Unit Weight of Soils Using a Vibratory Table"* and ASTM D4254, *"Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density"*). Granular materials should be placed at a moisture content that will achieve the desired densities. Please note that relative density and standard Proctor tests measure different parameters and are not interchangeable.

In general, proper compaction of cohesive soils can be achieved with sheepsfoot or pneumatic-type compactors, while compaction of granular soils can be achieved with smooth-drum or smooth-plate vibratory compactors. Water flooding is not an acceptable compaction method for any soil type.

#### 5.2.5 Excavation Slopes

Vertical cuts and excavations may stand for short periods of time, but should not be considered stable in any case. All excavations should be sloped back, shored, or shielded for the protection of workers. As a minimum, trenching and excavation activities should conform to federal and local regulations.

The lean to fat clay fill materials and native soils and shale we encountered in the test borings generally classify as a type "B" soil according to OSHA's Construction Standards for Excavations. In general, the maximum allowable slope for shallow excavations of less than 20 feet in a type "B" soil is 1.0H:1.0V, although other provisions and restrictions may apply. If different soil types are encountered, the maximum allowable slope may be different.

The Contractor is responsible for designing any excavation slopes or temporary shoring. The Contractor must also be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in federal, state, or local safety regulations, such as OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations.

The information presented in this section is solely for our client's reference. **GSI assumes no** responsibility for site safety or the implementation of proper excavation techniques.



#### 5.2.6 Rock Excavation

We anticipate the shale bedrock in mass site grading areas can be excavated with standard excavation equipment. However, lenses of harder shale or limestone may be present, requiring the use of rock excavation equipment such as rock rippers or hydraulic breakers.

#### 5.3 Pavement Recommendations

The asphalt and Portland cement concrete pavement recommendations provided below are separated into The City of Lee's Summit standard pavement section and an alternative we have provided to both the city's standard section and the pavement design used in the development of the Pergola Park 3<sup>rd</sup> Plat. The pavement sections as presented in Section 5.3.2 are structurally equivalent to one another, but may differ in initial construction cost and future potential pavement maintenance costs. To perform properly, the pavement sections require that the subgrade be prepared in accordance with the recommendations in Section 5.3.1.

#### 5.3.1 Pavement Subgrade Preparation

Pavement performance is directly affected by the degree of compaction, uniformity, and stability of the subgrade. The stability and quality of the pavement subgrade is particularly important where high traffic volume and heavy axle loads are anticipated. Based on the two design options, the pavement subgrade may comprise a combination of aggregate and chemically stabilized on-site soils. Chemical stabilization of on-site soils should be performed in accordance with Section 5.2.3.

The top 8 inches of pavement subgrade should be compacted to a minimum of 95 percent of the maximum dry unit weight determined by ASTM D698. The moisture content should also be controlled to between optimum and 4 percent above the optimum moisture content.

To detect any localized areas of instability, the final subgrade should be proof rolled with a loaded tandem axle dump truck or equivalent (loaded water truck, loaded concrete mixer or motor grader with a minimum weight of 20 tons) immediately prior to placement of the concrete or asphalt. Unstable areas should be removed and replaced or reworked to provide a more uniform subgrade. If necessary, clean materials such as crushed concrete or crushed stone may be used to stabilize areas where wet soil or water is present.



We also recommend the moisture content of the subgrade be checked prior to paving. If the moisture content is below optimum, we recommend the subgrade be scarified, moisture conditioned and recompacted according to Section 5.2.4.

#### 5.3.2 Recommended Design Sections

The pavement sections for this project are based on our experience with similar pavements and a design life of 15 to 20 years. The pavement sections recommended below are intended for passenger car and light truck traffic and parking areas. Portland cement concrete pavements are recommended for areas with frequent start-stop or turning traffic such as entrance and exit aprons, as well as areas that support stationary loads such as dumpsters. Our recommendations for asphalt and Portland cement concrete pavement sections are presented in the following tables.

	Thickness (Inches)						
	City of Lee's Summit Standard Section	GSI Alternative Pergola Park Section					
Asphalt Surface Course	2.0	2.0					
Asphalt Base Course	4.0	5.0					
Aggregate Base	6.0						
Chemically Stabilized Subgrade	6.0	8.0					

Table 5.3.2-1: Full-Depth ACC Pavement Design Recommendations for Access Drives

\*Chemically stabilized subgrade placed and compacted in accordance with Section 5.3.1.



	Thickness (Inches)					
	City of Lee's Summit Standard Section	GSI Alternative Pergola Park Sectio				
4,000 psi Air Entrained Portland Cement Concrete	6.0	6.0				
Aggregate Base	4.0					
Chemically Stabilized Subgrade	6.0	8.0				

#### Table 5.3.2-2: PCC Pavement Design Recommendations for Alleys

\*Chemically stabilized subgrade placed and compacted in accordance with Section 5.3.1.

#### 5.3.3 Asphaltic Cement Concrete Pavement Construction

Asphalt should be placed at an ambient temperature above 40 degrees Fahrenheit. Asphalt temperature at the time of compaction should be between 265 and 330 degrees Fahrenheit. We recommend the initial asphalt lift placed directly on the subgrade should be compacted to a minimum of 94 percent of the Marshall density with subsequent asphalt lifts compacted to a minimum of 96 percent of the Marshall density. Please note that recommendations regarding compaction temperature and percentage for a specific pavement design should supersede these recommendations.

All asphaltic concrete mix designs should be submitted to GSI and reviewed to determine if the designs are consistent with the recommendations given in this report. We also recommend a GSI representative be present during paving operations to help ensure adherence to project pavement specifications.

#### 5.3.4 General Pavement Considerations

Pavement service life can be significantly reduced if the pavement is constructed on a poor subgrade, if poor surface or subsurface drainage is present, or if the pavement is not maintained properly. We emphasize the importance of preparing the pavement subgrade in accordance with the procedures listed in the previous sections of this report.



Drainage of surface and subsurface water is also a critical component of pavement performance. Wetting of the subgrade soils or base course will cause loss of support strength resulting in premature pavement distress. Surface drainage should be designed to remove all water from paved areas. All curbs, including those surrounding pavement islands, should be backfilled as soon as possible after construction of the pavement. Backfill should be compacted and sloped to prevent water from ponding and infiltrating under the pavement. Regular active maintenance of pavements, which includes filling of cracks and joints, is required to minimize water infiltration and lengthen pavement life.

#### 5.4 Construction Considerations

If construction of the project is to be performed during periods of freezing temperatures, steps should be taken to prevent the soils under pavements from freezing. In no case should the fill materials, pavements, or other exterior flat work be placed on frozen or partially frozen materials. Frozen materials should be removed and replaced with a suitable material as described in earlier sections of this report.

Construction performed during periods of high precipitation may result in saturated unstable soils, and caving or sloughing of excavations. Control of soil moisture will be necessary for successful soil compaction, and to maintain soil bearing capacity.

#### 5.5 Construction Observation and Quality Assurance

We recommend that GSI review those portions of the plans and specifications that pertain to foundations and earthwork to evaluate consistency with our findings and recommendations. GSI will provide up to 2 hours of engineering support services at no charge to review project documents for adherence to our recommendations.

Site grading, including proof-rolling, replacement or recompaction of material, and placement of fill and backfill, should be observed by a quality assurance technician from GSI under the direction of a registered professional engineer. The technician should perform density tests and make any other observations necessary to assure that the requirements of the specifications are being achieved.

It is the opinion of GSI that construction observation by the geotechnical engineer of record or his designated representative is necessary to complete the design process. Field observation services



are viewed as essential and a continuation of the design process. Unless these services are provided by GSI, the geotechnical engineer will not be responsible for improper use of our recommendations or failure by others to recognize conditions which may be detrimental to the successful completion of the project.

GSI will be available to make field observations and provide consultation services as may be necessary. A written proposal outlining the cost of construction testing services such as soil, concrete, steel and pavement quality assurance can be provided upon request.



#### 6. CLOSING REMARKS AND LIMITATIONS

This report is presented in broad terms to provide an assessment of the subsurface conditions and their potential effect on the adequate design and economical construction of the proposed pavement sections. The analyses, conclusions, and recommendations contained in this report are based on the site conditions existing at the time of the exploration, the project layout described herein, and the assumption that the information obtained from our 15 borings is representative of subsurface conditions throughout the site.

Any changes in the design or location of the proposed structure should be assumed to invalidate the conclusions and recommendations given in this report until we have had the opportunity to review the changes and, if necessary, modify our conclusions and recommendations accordingly. If subsurface conditions different from those encountered in the explorations are observed during construction or appear to be present beneath excavations, GSI should be advised at once so that the conditions can be reviewed and recommendations reconsidered where necessary.

If there is a substantial lapse in time between the submission of this report and the start of construction, or if site conditions or the project layout have significantly changed (due to further development of grading plans, natural causes, or construction operations at or adjacent to the site), we recommend that this report be reviewed to determine the applicability of our previous conclusions and recommendations.

Our geotechnical exploration and subsequent recommendations address only the design and construction considerations contained in this report. We make no warranty for the contents of this report, neither expressed nor implied, except that our professional services were performed in accordance with engineering principles and practices generally accepted at this time and location.

The scope of services for this exploration did not include a wetlands evaluation, an environmental assessment, or an investigation for the presence of hazardous or toxic materials in the soil, surface water, groundwater, or air within or adjacent to this site. If contamination is suspected or is a concern, we recommend the scope of this study be expanded to include an environmental assessment.

This report was prepared by the firm of GSI Engineering, LLC (GSI) under the supervision of a professional engineer registered in the State of Missouri. Report preparation was in accordance with



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generally accepted geotechnical engineering practices for the exclusive use of our client for evaluating the design of the project as it relates to the geotechnical aspects discussed herein. Recommendations are based on the applicable standards of the profession at the time of this report within this geographic area. GSI Engineering, LLC will not be responsible for misrepresentation of this report resulting from partial reproduction or paraphrasing of its contents.

We appreciate the opportunity to be of service on this project. Please contact us if we can provide further information regarding the contents of this report or the scope and cost of additional services.

Respectfully submitted, GSI Engineering, LLC

Colin D. Parker, I.E. Staff Geotechnical Engineer

Jacob P. Engler, P.E. Senior Geotechnical Engin

#### CDP/JPE

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### APPENDIX A

General Vicinity Map Boring Location Plan



FIG. #:	PROJ. #:
1	1973059
date:	SCALE:
4/15/2019	NTS
DRAWN BY:	PROJECT MANAGER:
CDP	MNT



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GENERAL VICINITY MAP PERGOLA PARK 4TH-6TH PLATS LEE'S SUMMIT, MISSOURI



FIG. #:	2	PROJ. #: 1973059
DATE:	4/15/2019	SCALE: NTS
DRAWN	BY:	PROJECT MANAGER:
	CDP	MNT



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BORING LOCATION PLAN PERGOLA PARK 4TH-6TH PLATS LEE'S SUMMIT, MISSOURI

### APPENDIX B

Boring Logs Key to Symbols Legend & Nomenclature Unified Soil Classification System (USCS) Rock Descriptors

Bit Note         Used from ( = South P = Sou	BORING LOG No. B-1													
PC         WILLE GEORGEOR         Contraction         Contraction         Contraction           UBLLING         DELLING         AFTER DBLLING         AFTER DBLLING         CME to A         CME to A           N.C.         N.C.         N.C.         Direl approximation         CME to A         Status Levin	E	BORING NO. LOCATION OF BORING				ELEVATION	C	DATUM	D	RILLER		LOGGER		
WHERE         END OF         WOLDS         A FOURS         A FTEE DELLING         Oreas Fuel         O <tho< <="" td=""><td> </td><td>B-1</td><td>WATER</td><td>See Borii R LEVFI</td><td>OBSERVATIONS</td><td>I</td><td></td><td>TYPE OF SI</td><td>URFACE</td><td>J. Lear</td><td></td><td colspan="3">K. Hudson DRILL RIG</td></tho<>		B-1	WATER	See Borii R LEVFI	OBSERVATIONS	I		TYPE OF SI	URFACE	J. Lear		K. Hudson DRILL RIG		
Dist         Dist <thdis< th=""> <thdist< th="">         Dist         Di</thdist<></thdis<>	WHI	LE EN	ID OF		24 HOURS			Grass F	Field			(	CME 55	
N.E.         Being Plage Afer Unity         3.25-tot Inde Dander Hold Stan Ages         0.5           DEP         Standard Plant         LAGO ATTORY TANK         LAGO ATTORY TANK         LAGO ATTORY TANK           DEP         Standard Plant         Tot Plant         COLO. SOL BESCHPTION         LAGO ATTORY TANK         LAGO ATTORY TANK           DEP         Standard Plant         Tot Plant         Color. Color. Bool Beschption on the Refunction of the Color. Table Tank         LAGO ATTORY TANK         LAGO ATTORY TANK           Standard Plant         1         Tot Plant	DRILL	ING DRI	LLING	AFT	ER DRILLING	AFTER DRILLING			VETHOD			тот	AL DEPT	4
PEPL         Description         Descrinter         Description         D	N.E			Boring Pl	ugged After Drilling		3.25-ii	nch Inside Diamete	r Hollow	Stem Auger	rs LADO	PATORY	9.5	
FT.         No.5         BLOWS         PEC         CONCOUND CONCENTION CONTRACTING CONTRACTING         USBS WE         PEC         PE	DEP.	SAMPLE		<b>`</b>		COLOR, CONSISTE	NCY. MOIS				LABC	Drv	DATA	ELEV.
If the line         If the line <thif line<="" th="" the=""> <thif line<="" th="" the=""></thif></thif>	FT.	NO. &	BLOWS	REC.						USCS CLASS.	MC %	Dens.	q <sub>u</sub> ksf	FT.
8-1       0       0       10		TYPE	(F1)				N& UTHER	REMARKS	-0.5'			рст		
10         1         Initial status         0         0         0         0         20         17.3         5.63           5         1		S-1	9		FAT CLA	Y - very dark brown, ve	ery moist, st	iff, trace roots, trac	e 0.5		25.1			
52       12       - grayish brown, else as above       CH       22.8					rust stains	s LL=56; PL=	=25; PI=31							
30         12         as above         208         117.3         6.63           9.4         90.6.7         as above         11.8         11.8           10		6.2	12		- grayish l	prown, else as above					22.0			
s		5-2	12							СН	22.0			
U3       NA       Image: Control of Borng @ 3.6'       20.6       117.3       5.63         54       50.5.5'       Image: Control of Borng @ 3.6'       11.8       Image: Control of Borng @ 3.6'         10       Image: Control of Borng @ 3.6'         10       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'         10       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'         11       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'         11       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'         11       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'         12       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'         13       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'         20       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'       Image: Control of Borng @ 3.6'         30       Image: Control of Borng @ 3.6'	5													
33         NN         SHALE: edive gray, decomposed, very soft took, trace rust         0.5         10.5		11.2	N/A		- as above	9					20.6	117.2	5.62	
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9.4       505.5*       0.55*       0.5       0.5       11.8       1         10       1 <td></td> <td></td> <td></td> <td></td> <td>- as abov</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>					- as abov	2								
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BORING LOG No. B-2													
BORING NO. LOCATION OF BORING				ELEVATION		DATUM	D	RILLER		LOGGER			
	B-2	See Borir	OBSERVATIONS	1		TYPE OF S	SURFACE	J. Lear		DRILL RIG			
WHI	LE EN	ID OF	2	4 HOURS			Grass Field				CME 55		
DRILL	ING DRI		AFT		AFTER DRILLING	0.05	DRILLING	METHOD	Oto A		тот		H
IN.E	SAI			ugged After Drilling	SOIL [	3.25	Inch Inside Diamet	er Hollow :	Stem Augel	LABC	RATORY	11.5 π. <b>DATA</b>	
DEP.	SAMPLE	"N"	%		COLOR, CONSISTER	NCY, MOIS	STURE		USCS	мс	Dry	a	ELEV.
F1.	NO. & TYPE	BLOWS (FT)	REC.	GEOL	OGIC DESCRIPTION	I & OTHE	R REMARKS		CLASS.	%	Dens. pcf	ksf	F1.
	S-1	4		6" TOPSC LEAN CL	DIL AY - black, very moist,	medium s	stiff, trace roots	0.5'-	CL	28.4			
	U-2	N/A		FAT CLA' trace iron	Y - grayish brown, very nodules	/ moist, sti	ff, trace rust stains,	2.5'-		24.8	100.0	4.42	
5	S-3	16		- stiff to ve	ery stiff, else as above				СН	21.1			
				- vellowist	n brown, very stiff, else	e as above	3		GIT				
10	S-4	18		SHALE - 1	vellowish brown to oliv	e gray, de	composed, very so	10.0'-		19.9			
	5-5	20		rock, trace	e rust stains, trace iror	nodules	<i>c</i> '						
					Bottom of Bo	ring @ 11	.5'						
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40						FOT	Devela D	مار <u>الله</u>					
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BORING LOG No. B-3													
BORING NO. LOCATION OF BORING				ELEVATION		DATUM	C	RILLER		LOGGER			
	B-3	WATE	See Borir	ng Location Plan			TYPE OF 9		J. Lear		K. Hudson		
WHI	LE EN	ID OF	2	4 HOURS			Grass	Field			CME 55		
DRILL	ING DRI		AFT		AFTER DRILLING		DRILLING	METHOD			тот	AL DEPT	н
N.E	:. P SAI		Boring PI	ugged After Drilling	SOIL [	3.25-	Inch Inside Diamet	er Hollow	Stem Auge		RATORY	11.5 ft.	
DEP.	SAMPLE	"N"	0/.		COLOR, CONSISTER	NCY, MOIS	STURE		11808	MC	Dry	a.	ELEV.
FT.	NO. & TYPE	BLOWS (FT)	REC.	GEOL	OGIC DESCRIPTION	I & OTHE	R REMARKS		CLASS.	%	Dens. pcf	4u ksf	FT.
				6" TOPSO		P		0.5'-					
	S-1	7		LEAN CL	AY - black, very moist,	meaium s	stiff, trace roots		CL	29.7			
					/		<i>tt</i> +	2.5'-					
	S-2	10		trace iron	r - grayish brown, very seams	/ moist, sti	IT, trace rust stains,			21.8			
5				- grayish t	prown with gray mottle	s, else as	above						
	U-3	N/A								23.5	100.9	3.04	
									СН				
	S-4	12		- as above	9					21.4			
10				- grayish t	prown, else as above								
	S-5	16						11 5					
					Bottom of Bo	ring @ 11	.5'						
15													
20													
25													
30													
35													
40													
40			1	ļ	PRO	ECT	Peroola Pa	rk 4th-i	6th Plat	s.	1		
		'CT	4503 Ea	st 47 <sup>th</sup> Street South			Lee's Sum	nit Mis	souri	-			
	=0	N.	Wichita,	KS 67210		NO ·	1973050	,					
	Engine	eering	310-334	-0723			Anril 4 201	q					
							7 yrii <del>4</del> , 201	5					

					<b>BORING L</b>	_OG No	). B-4						
E	BORING NO.		LOCATIO	ON OF BORING	ELEVATION	DAT	UM	Ľ	RILLER		L	OGGER	
	В-4	WATE	See Borir	IG LOCATION Plan	I		TYPE OF S		J. Lear		K. זים		
WHI	LE EN	ID OF	2	4 HOURS			Grass	Field			(	CME 55	
DRILL	ING DR	LLING	AFT	ER DRILLING	AFTER DRILLING		DRILLING	METHOD	)		тот	AL DEPT	н
N.E	:. SA		Boring PI	ugged After Drilling	SOIL	3.25-inch	Inside Diamete	er Hollow	Stem Auge		RATORY	11.5 ft.	
DEP.	SAMPLE	"N"	0/.		COLOR, CONSISTER	NCY, MOISTUR	RE		11808	MC	Dry		ELEV.
FT.	NO. & TYPE	BLOWS (FT)	REC.	GEOL	OGIC DESCRIPTION	& OTHER RE	MARKS		CLASS.	%	Dens. pcf	ksf	FT.
				✓ ✓ ✓ ✓ ✓ _ 6" TOPSO				0.5'-					
	S-1	8		FAT CLA trace roots	r - dark grayish brown s, trace iron seams, tra	, very moist, ma ace rust stains	edium stiff to s	tiff,		25.4			
		-											
	S-2	14		above	brown, stiff, trace from	nodules, trace	root noies, eise	e as		23.5			
5				- no roots	, else as above				СН				
	S-3	12								23.5			
	S-4	15		- light yell	owish brown, else as a	above				24.5			
10	0 +	10								24.0			
	S-5	26		SHALE - g	ce iron nodules	oosed, very som	t rock, trace ru	st					
					Bottom of Bo	ring @ 11.5'							
15													
20													
25													
30													
35													
40		I		I			raola Dar	·k /+h	6th Diat	۱ ۲			
		TD	4503 Fa	st 47 <sup>th</sup> Street South			a'a Suma			.5			
	-0	<b>N</b>	Wichita,	KS 67210		NON: Le	es Sumn	III, IVIIS	souri				
	Engin	eering	316-554	-0725	JOB	NO.: 19	/3059	-					
	6,653	2013 15			D	AIE: Ap	oril 4, 2019	y					

Bit Bit Rev Location of BorRisk         ELEVATION         Data Part (EVA OF BORRisk)         ELEVATION (EVEL OF BORLISK)         Description (EVEL OF BORLISK)         Description (EVEL OF BORLISK)         COOGER         Description (EVEL OF BORLISK)         Description (EVEL OF BORLISK) <thde< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th><b>BORING</b></th><th>_OG</th><th>No. B-5</th><th></th><th></th><th></th><th></th><th></th><th></th></thde<>							<b>BORING</b>	_OG	No. B-5						
Display         Littice         K. Hutchic           VMPLE_EDENCIATION CONSTRUCT         TOTE OF DESCRIPTION         DOI: 10:0000000000000000000000000000000000	E	BORING NO.		LOCATIO		RING	ELEVATION		DATUM	[	DRILLER		L	OGGER	
WHILE         END OF         COLD 24 HOURS         Cold 24 HOURS         Cold 25           DBLLMS         DATES DOLLING         AFTER DOLLING         DBLLMS         DIAL MARK DATES         TOTAL GEPTH           100.L         8.5.1.         Dung Plaged Aller Dalling         2.3-rein have Dames Findle Senin Agens         TOTAL GEPTH           100.L         8.5.1.         Dung Plaged Aller Dalling         SQL DESCRIPTION         UACONTOV DATE           0P         SAMPLE         N°         N°         COLOR, CONSISTENT, MOISTURE         UACONTOV DATE           10         SL         COLOR, CONSISTENT, MOISTURE         UACONTOV DATE         EAR (LAV. WY of the Texan, Very mode, Very staff, frame from         0.4           10         SL         10         FAT CLAV. WY off throw, Very mode, Very staff, frame from         2.3         2.3           11         Staff         FAT CLAV. WY off throw, Very staff, frame from         2.5         0.4         2.0           12         Staff         Staff         FAT CLAV. WY off ALL data staffer frame from         2.5         0.4         7.3         2.7           13         Staff         FAT CLAV. WY off ALL data staffer frame from         Staffer frame from         1.0         1.3         1.3           14         Staffer framer frame frame		В-5	WATE	See Borin	OBSERVA	TIONS			TYPE OF 9	SURFACE	J. Lear		K ID	RILL RIG	
DRLLING         DATER DRLLING         AFTER DRLLING         Description         Description         OTAL DEFT           100.1         100.1         0.51.         Booting page 3/42 Differ         Solu Description         LOBATORY DATA           101.1         100.1         100.1         100.1         USE 300.1         USE 30	WHI	LE EN		2	24 HOURS				Grass	Field	-		(	CME 55	
100.1         2.5.1         Bong Plaged Mar Dulling         3.3.8-rol hade Demark Holes Sem Auges         11.5.1           100.0 <t< td=""><td>DRILL</td><td>ING DR</td><td>ILLING</td><td>AFT</td><td>ER DRILLI</td><td>ING</td><td>AFTER DRILLING</td><td></td><td>DRILLING</td><td>METHOD</td><td>)</td><td></td><td>тот</td><td>AL DEPT</td><td>Н</td></t<>	DRILL	ING DR	ILLING	AFT	ER DRILLI	ING	AFTER DRILLING		DRILLING	METHOD	)		тот	AL DEPT	Н
Image: Source Sector 1000         Dot of Sector 10000         Dot of Sector 1000 <th< td=""><td>10.0</td><td>ft. 9</td><td>0.5 ft.</td><td>Boring Pl</td><td>ugged Afte</td><td>er Drilling</td><td></td><td>3.25</td><td>-inch Inside Diamet</td><td>er Hollow</td><td>Stem Auge</td><td>rs LARC</td><td>DATODY</td><td>11.5 ft.</td><td></td></th<>	10.0	ft. 9	0.5 ft.	Boring Pl	ugged Afte	er Drilling		3.25	-inch Inside Diamet	er Hollow	Stem Auge	rs LARC	DATODY	11.5 ft.	
PT.         NO. 6 (P)         BLOWS PRC.         COLOCIC DESCRIPTION & OTHER REMARKS         CLASS VLASS (P)         No. (P)         Define (P)         No. (P)         No. (P)         Define (P)         No. (P)         Define (P)         No. (P)         Define (P)         No. (P)         Define (P)         No. (P)         No. (P)         Define (P)         No. (P)         Define (P)         Define         Define (P)         Define	DEP.	SAMPLE					COLOR, CONSISTE	NCY, MOI	STURE			LABC	Dry	DATA	ELEV.
10         10<	FT.	NO. &	BLOWS	REC.		CEOL					CLASS.	MC %	Dens.	q <sub>u</sub> ksf	FT.
3-1         10         ICAN CAX - very most, still, trace sion         CX         QL         28.4           5-2         17         ICAN - very most, very still, trace sion         CX         QL         28.4           5-3         11         ICAN - very most, very still, trace sion         CX         QL         28.4           10         5-3         11         ICAN - verdsdin brown, very most, very still, trace sion         CX         28.4           10         5-4         11         ICAN - verdsdin brown, very most, very still, trace sion         CX         28.4           10         5-5         23         ICAN - verdsdin brown, very most, very still, trace sion         CX         28.4           10         5-5         23         ICAN - verdsdin brown, very most, very still, trace sion         CX         29.0           10         5-5         23         ICAN - verdsdin brown, very most, very still, trace sion         CX         10.0           10         5-5         23         ICAN - verdsdin brown, very most, very still, trace sion         10.0         17.3         ICAN - verdsdin brown, very most, very still brown, very most, v		ITFE	(F1)		<u> </u>				K KEWIAKKS	0 5'-			per		
40         1000000000000000000000000000000000000		S-1	10			LEAN CL/	AY - very dark brown,	very mois	t, stiff, trace iron	0.0	CI	26.4			
8-2         17         Image: Constraint of the state o			-			1000005,1				0.51	UL				
5         5-3         11         Image: Second sec		S-2	17			FAT CLA	<ul> <li>reddish brown, ver</li> </ul>	y moist, ve	ery stiff, trace iron	2.5 -		23.7			
5       - is above       OH       23.0         10       5.4       62       FAT CLAY w/ GRAVEL - dark yellowish brown, molet, hard, fine       6.6       OH       17.3       Image: Compare of the composed way soft rock, trace rust       10.0       17.3       Image: Compare of the com						nouules									
8-3       11       Image: Solution of Boring @ 11.5"       CH       23.0         10       9-4       92       Image: Solution of Boring @ 11.5"       10.0         15       1.5       1.5       1.5       1.5         15       1.5       1.5       1.5       1.5         20       1.5       1.5       1.5       1.5         15       1.5       1.5       1.5       1.5         20       1.5       1.5       1.5       1.5         15       1.5       1.5       1.5       1.5         20       1.5       1.5       1.5       1.5         20       1.5       1.5       1.5       1.5         20       1.5       1.5       1.5       1.5         20       1.5       1.5       1.5       1.5         30       1.5       1.5       1.5       1.5         30       1.5       1.5       1.5       1.5         30       1.5       1.5       1.5       1.5         40       1.5       1.5       1.5       1.5         40       1.5       1.5       1.5       1.5         40       1.5       <	5		-			as above									
10         54         52           10         54         52           10         55         23             10         54         52             10         55         23             10         54         52             11         11.5         11.5             12         11.5         11.5             13         11.5         11.5             14         12         11.5             15         13         11.5             16         13         11.5             17         11.5         11.5             18         11.5         11.5             19         10         11.5             10         12         11.5             10         12         11.5             10         12         11.5             10         12         11.5             10         12         11.5             10         12         12             10         12         12             10         12		S-3	11			- 45 4000	2				СН	23.0			
10         S-4         52         FATCLAV W GRAVEL - dark vejlowish brown, molet, hard, fine         6.5         17.3         V           8.5         23         SHALE - olive grav, decomposed, vey soft rock, trace runt         100         17.3         V           8.5         23         SHALE - olive grav, decomposed, vey soft rock, trace runt         100         17.3         V           15         3         Sottem of Boring @ 11.5'         11.5         11.5         11.5           15         3         Sottem of Boring @ 11.5'         11.5         11.5         11.5           20         3         Sottem of Boring @ 11.5'         11.5         11.5         11.5           35         3         Sottem of Boring @ 11.5'         11.5         11.5         11.5           30			-												
10         S-4         52         For CLV wid GRAVEL - dark yellowish brown, molet, hard, fine         8-5         CH         17.3         III.3           5-5         23         III.2         IIII.2         IIII.2         III.2															
9.54         52         For coarse limeature nodules & lagaments         CH         17.3         17.3           9.55         23         SHALE - olive gray, decomposed, very soft rock, trace rust         10.0°         11.5°         11.5°           15         15         15         11.5°         11.5°         11.5°         11.5°           20         20         10         11.5°         11.5°         11.5°         11.5°           20         23         State at 7° Street South Weight, state unt with other Media         11.5°         11.5°         11.5°           30         10         10         10         10.0°         11.5°         11.5°           22         10         10         10.0°         11.5°         11.5°         11.5°           33         10         10         10.0°         11.5°         11.5°         11.5°           33         10         10         10.0°         10.0°         10.0°         10.0°           33         10         10         10.0°         10.0°         10.0°         10.0°           40         10.0°         10.0°         10.0°         10.0°         10.0°         10.0°         10.0°           33         10.0°			-			FATCLAY	/ w/ GRAVEL - dark v	ellowish h	rown moist hard f						
0       8-5       23       SHALE - olive gray, decomposed, very soft rock, trace rust       10.0 <td>10</td> <td>S-4</td> <td>52</td> <td></td> <td></td> <td>to coarse</td> <td>limestone nodules &amp; f</td> <td>ragments</td> <td></td> <td></td> <td>СН</td> <td>17.3</td> <td></td> <td></td> <td></td>	10	S-4	52			to coarse	limestone nodules & f	ragments			СН	17.3			
30       23       stame, trace iron nodules         Bottom of Boring @ 11.5'       11.5'         15       10         20       10         20       10         20       10         20       10         20       10         20       11.5'         21       11.5'         22       11.5'         23       11.5'         24       11.5'         25       11.5'         26       10         27       10         28       10         29       10         20       10         21       10         22       10         23       10         24       11.5'         25       10         26       10         27       10         28       10         29       10         20       10         20       10         20       10         20       10         20       10         20       10         20       10         20<	10	<u>е</u> Е				SHALE - o	olive gray, decompose	ed, very so	oft rock, trace rust	——10.0'-					ŧ
Bottom of Boring @ 11.5 Bottom of Boring @ 11		3-5	23			stains, tra	ce iron nodules								
15         15         20							Bottom of Bo	oring @ 11	.5'	-					
15         20         20         20         20         20         21         22         23         30         31         32         33         3402         35         36         37         38         39         39         30         30         30         30 <td></td>															
15         20															
20 20 20 20 20 25 26 30 30 30 30 40 FROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO: 1973059	15														
20           20           20           20           25           26           30           30           30           30           30           30           30           30           310           32           33           34           40           PROJECT:           Pergola Park 4th-6th Plats           LOCATION:           Lee's Summit, Missouri           JOB NO:           JOB NO:           1973059															
20 20 20 20 20 20 20 20 20 20															
20 26 26 26 26 26 26 26 26 26 26															
22 25 26 30 30 40 <b>PROJECT:</b> Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO:: 1973059															
25 26 30 30 30 40 <b>PROJECT:</b> Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO:: 1973059	20														
25 30 30 30 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059															
25 26 30 30 30 35 35 40 40 40 40 40 40 40 40 40 40															
25 30 30 30 40 40 For GSS Engineering 4503 East 47 <sup>n</sup> Street South Wichta, K5 67210 316-554-0725 Michigan K 2011 316-554-0725 Michigan K 2011 Michigan K 2011 M															
25 30 30 30 40 40 40 40 40 40 40 40 40 4															
40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059															
30 30 35 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059															
30 30 30 30 30 35 35 40 40 FOSSI ast 47" Street South Wichta, KS 67210 316-554-0725 4503 East 47" Street South Wichta, KS 67210 316-554-0725 316-554-0725 4503 East 47" Street South Wichta, KS 67210 316-554-0725 4503 East 47" Street South Wichta, KS 67210 316-316 4503 East 47" Street South Wichta, KS 67210 316-316 4503 East 47" Street South Wichta, KS 67210 316-316 4503 East 47" Street South Wichta, KS 67210 316-317 4503 East 47" Street South Wichta, KS 6703 4503 East 47" Street South Wichta, KS 6703 4503 East 47"															
30         30         30         31         35         35         35         40         PROJECT: Pergola Park 4th-6th Plats         LOCATION: Lee's Summit, Missouri         JOB NO.: 1973059															
30 30 30 30 40 40 40 40 40 40 40 40 40 4															
30 35 35 40 40 40 40 40 40 40 40 40 40															
40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059	30														
35         35         40         40         PROJECT: Pergola Park 4th-6th Plats         LOCATION: Lee's Summit, Missouri         JOB NO.: 1973059															
35 36 40 40 40 40 40 40 40 40 40 40															
35 36 37 38 39 40 40 40 40 40 40 40 40 40 40															
35 40 40 40 40 40 40 40 40 40 40	L ]														
40 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059	35														
40 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059															
40 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059															
40 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059															
40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059	$\vdash$														
40       PROJECT: Pergola Park 4th-6th Plats         LOCATION: Lee's Summit, Missouri       JOB NO.: 1973059	$\vdash$														
Image: Project:Pergola Park 4th-6th PlatsImage: Description of the project in the p	40								Devela D	الله ما					
Image: ConstructionConstructionConstructionConstructionConstructionEngineering316-554-0725316-554-0725JOB NO.: 1973059			TO	1503 5-	et 47th Ctore	+ Courth			Pergola Pal	гк 4th-	oth Plat	S			
Engineering 316-554-0725 JOB NO.: 1973059		- 6	<b>IC</b>	Wichita,	, KS 67210	a south		IION:	Lee's Sumn	nit, Mis	ssouri				
		Engin	eering	316-554	-0725		JOB	NO.:	1973059						
DATE: April 4, 2019		5	0				D	ATE:	April 4, 201	9					

					<b>BORING I</b>	_OG	No. B-6							
E	BORING NO.		LOCATIO		ELEVATION		DATUM	D	RILLER		L	OGGER		
	B-6	WATER	See Born	OBSERVATIONS			TYPE OF S	URFACE	J. Lear		K.	RILL RIG		_
WHI	LE EN	ID OF	2	24 HOURS			Grass F	Field			(	CME 55		_
DRILL			AFT		AFTER DRILLING	0.05		METHOD	01 1		тот		H	
10.0	n. 9		Boring Pi	ugged After Drilling	SOIL	3.25	inch Inside Diamete	r Hollow	Stem Auge		RATORY	11.5 ft. ΠΔΤΔ		_
DEP.	SAMPLE	"N"	%		COLOR, CONSISTE	NCY, MOI	STURE		USCS	MC	Dry	a	ELE	v.
F1.	NO. & TYPE	BLOWS (FT)	REC.	GEOI	OGIC DESCRIPTION	& OTHE	R REMARKS		CLASS.	%	Dens. pcf	ksf	F1.	
					)IL NV block moist stiff	troop root	0	0.5'-			-			
	S-1	11				liace 100	5		CL	20.1				
		-		FATCLAN	/ black to gray yory	moist stiff	traco iron podulos	2.5'-						
	S-2	12		trace rust	stains	1110151, 5111	, trace non noutres,			24.8				
5		-												
	6.2	10		- gray, ext	ensive rust staining, e	lse as abo	ove			22.7				
		10								23.7				
									СН					
		-		modium	stiff trace rust stains									
10	S-4	7		- medium		eise as ai	Jove			24.1				T
10	0.5			- grayish t	prown, wet, medium st	iff to stiff,	else as above						¥	-
	5-5	8			<b>D</b> # (D		-							
					Bottom of BC	ring @ 11	.5							
15														
15														
20														
25														
30														
35														
40														
					PROJ	ECT:	Pergola Par	k 4th-6	6th Plat	S				
	•	SI	4503 Ea	st 47 <sup>th</sup> Street South		FION:	Lee's Summ	nit, Mis	souri					
	Engin	eering	316-554	-0725	JOB	NO.:	1973059							
	8	8			D	ATE:	April 4, 2019	)						

					<b>BORING</b>	OG No. B-7						
E	BORING NO.		LOCATIO		ELEVATION	DATUM		DRILLER		L	OGGER	
	B-1	WATE	See Borin	OBSERVATIONS	I	TYPE OF	SURFACE	J. Lear		K.		
WHI	LE EN	ID OF	2	24 HOURS		Grass	s Field	-		(	CME 55	
DRILL	ING DRI	LLING	AFT	ER DRILLING	AFTER DRILLING	DRILLING	G METHOD	)		тот	AL DEPT	н
N.E	.   N		Boring Pl	ugged After Drilling	SOIL E	3.25-inch Inside Diame	eter Hollow	Stem Auge		PATORY	10.0 ft.	
DEP.	SAMPLE	"N"	0/		COLOR, CONSISTER	NCY, MOISTURE		11606	MC	Dry		ELEV.
FT.	NO. & TYPE	BLOWS (FT)	REC.	GEOI	OGIC DESCRIPTION	& OTHER REMARKS		CLASS.	%	Dens.	Чu ksf	FT.
	=	()					0.5'-			P 0.		
	S-1	10		FAT CLA trace rust	Y - gravish brown, very stains, trace roots	/ moist, stiff, trace iron nodul	les,		21.2			
	S-2	20		- grayish i else as at	prown to dark brown, n pove	noist, very stiff, no rust, no ir	ron,	СН	21.4			
5				SHALE - 0	olive gray, highly weat	hered, very soft rock						
	S-3	12				•			20.1			
					NE - gray, moderately	weathered, very soft to soft	rock 7.0'-					
	\ S-4	50/1"	/		Bottom of Br	vring @ 8.1'	8.1'-					
					Bottom of Bo	Jing @ 0.1						
10												
15												
20												
25												
30												
35												
40				1		ECT: Doraolo Do	ork Ath	6th Diat				
		T2'	4503 Fa	st 47 <sup>th</sup> Street South			ain 4111- mit 11/1-		5			
	-0	<b>N</b>	Wichita,	KS 67210			iiiit, iviis	ssouri				
	Engine	eering	316-554	-0725	JOB	NU.: 19/3059	10					
	1 <sub>1</sub> = 112	-201672			D	AIE: April 5, 201	19					

					<b>BORING L</b>	.OG No	o. B-8						
E	BORING NO.			ON OF BORING	UM	D			L	OGGER			
	D-0	WATE	R LEVEL	OBSERVATIONS			TYPE OF SU	JRFACE	J. Leai		DI	RILL RIG	
WHI		ID OF	2				Grass F	ield			) TOT	CME 55	
N.E		N.E.	Boring Pl	ugged After Drilling	AFTER DRILLING	3.25-inch	Inside Diameter	Hollow S	Stem Auger	rs	101	AL DEPTI 10.0 ft.	
	SAI	MPLE DAT	4		SOIL E	ESCRIPTION				LABC	RATORY	DATA	
FT.	SAMPLE NO. &	"N" BLOWS	% BEC		COLOR, CONSISTE	NCY, MOISTUI	RE		USCS	MC	Dry Dens.	9 <sub>U</sub>	FT.
	TYPE	(FT)	KLO.	GEOL	DIL DESCRIPTION	I & OTHER RE	MARKS	0.51	CLAGO.	70	pcf	NJI	
	S-1	13		FILL (FAT	CLAY) - dark yellowis	sh brown with o	live brown, stror	0.5'- ng	<b>E</b> II 1	22.1			
				iron nodul	es, trace decomposed	I shale			FILL				
	S-2	13		FAT CLA	Y - dark gray, moist, st	iff, trace rust st	ains, trace topso	pil 2.5		19.5			
5				- olive bro	wn with dark gray, els	e as above			СН				
	S-3	10								24.6			
					inter dina tenang milita								
10	S-4	14		SHALE - I soft rock,	trace rust stains, trace	iray, decompos iron nodules	sed, very soft to			22.4			
10					Bottom of B	oring @ 10'							
15													
20													
25													
-													
30													
35													
40													
					PROJ	ECT: Pe	ergola Park	4th-6	oth Plat	S			
	•	S	4503 Ea Wichita	st 47 <sup>th</sup> Street South KS 67210		<b>ION:</b> Le	e's Summi	it, Mis	souri				
	Engin	eering	316-554	-0725	JOB	<b>NO.:</b> 19	73059						
	3	9			D	ATE: Ap	oril 5, 2019						

					<b>BORING L</b>	.OG N	o. B-9						
E	BORING NO.		LOCATIO		ELEVATION	D	ATUM	D	RILLER		L	OGGER	
	B-9	WATE	See Borir	OBSERVATIONS			TYPE OF SI	IRFACE	J. Lear				
WHI	LE EN	ID OF	2	4 HOURS			Grass F	ield			(	CME 55	
DRILL	ING DRI	LLING	AFT	ER DRILLING	AFTER DRILLING		DRILLING N	IETHOD			тот	AL DEPT	н
N.E			Boring Pl	ugged After Drilling	5011 5	3.25-in	ch Inside Diameter	r Hollow S	Stem Auge		PATORY	10.0 ft.	
DEP.	SAMPLE	"N"	<b>1</b>		COLOR. CONSISTEN	NCY. MOIST	URE			LABO	Drv	DATA	ELEV.
FT.	NO. &	BLOWS	REC.	6501			SEMADKE		CLASS.	мс %	Dens.	q <sub>u</sub> ksf	FT.
	ITFE			GEOL			KEMARK3	0 5'-			per		
	S-1	6		FILL (LEA	N CLAY) - light olive b	prown to oliv	e with dark gray,	- 0.0					
					LL=44; PL=	=21; PI=23							
	S-2	8		- medium	stiff to stiff, trace rust	stains, trace	iron nodules, else		FILL	26.3			
	02									2010			
5													
	S-3	11		stains, tra	ce iron nodules	i, very moist,	stiff, trace rust			27.8			
									СН				
				SHALE - C	live brown with gray	decomposed	soft rock_trace						
10	S-4	13		rust stains	, trace iron nodules	accompeter	., con roon, adoo			22.9			
					Bottom of B	oring @ 10'							
15													
20													
25													
$\vdash$													
30													
$\mid \mid \mid$													
35													
40		I	1	I	DPO I	FCT· □	Pernola Darl	¢ ⊿th-4	Sth Plat	۱ <u>ــــــــــــــــــــــــــــــــــــ</u>	1		l
		'CT	4503 Ea	st 47 <sup>th</sup> Street South			on's Summ	、+u=( i+ N/i~		5			
	<b>U</b>	<b>N</b>	Wichita,	KS 67210			.55 3 3011111	it, iviis	soull				
	Engine	eering	316-554	-0725	JOB	NO.: 1	973059						
	5.49A	area.			D	AIE: /	pril 5, 2019						

					BORING L	OG No. B-10						
E	BORING NO.		LOCATIO	ON OF BORING	ELEVATION	DATUM	[	DRILLER		L	OGGER	
<u> </u>	B-10	WATE	See Borir	ng Location Plan				J. Lear		K.	Hudson	
WHI	LE EN		2	4 HOURS		Gravel R	oadway	-		(	CME 55	
DRILL	ING DR	ILLING	AFT	ER DRILLING	AFTER DRILLING	DRILLING	METHOD	)		тот	AL DEPT	Н
N.E			Boring Pl	ugged After Drilling	5011.0	3.25-inch Inside Diamet	er Hollow	Stem Auge	rs LARC	DATODY	10.0 ft.	
DEP.	SAMPLE				COLOR, CONSISTEN	NCY, MOISTURE		11000	LABC	Dry	DATA	ELEV.
FT.	NO. &	BLOWS	REC.	0501				CLASS.	MC %	Dens.	q <sub>u</sub> ksf	FT.
	TIPE	(F1)		6" GRAVE		A OTHER REWARKS	0 5'-			рсі		
	S-1	16		FILL (FAT	CLAY) - olive brown	with dark reddish brown, mois	st,	EUI	17.2			
		-		decompos	sed shale		0.51	FILL				
	S-2	10		FAT CLAY	- strong brown with g	ray, very moist, stiff, trace ru	2.5'- st		21.4			
		- 10		stains, tra	ce iron noucles			СН	2			
5		-										
	S-3	33		SHALE - p trace rust	stains, trace iron nodu	ecomposed, very soft to soft r Iles	OCK,		20.1			
		-										
		-		- pale oliv	e to olive brown with s	trong brown and gray, highly	to					
10	S-4	95/11"		moderatel	y weathered, soft rock	, friable, else as above			17.1			
					Bottom of B	oring @ 10'						
15												
20												
25												
30												
35												
40												
			1		PRO.J	ECT: Pergola Par	rk 4th-	6th Plat	S	1	L	
		LCI	4503 Ea	st 47 <sup>th</sup> Street South		ION: Lee's Sum	nit Mi	ssouri	-			
		NJ1	Wichita,	KS 67210		<b>NO ·</b> 1072050	, ייווע					
	Engin	eering	316-554	-0/25	100	ATE: April 5 004	0					
						AIE: April 5, 201	ฮ					

					BORING L	OG N	lo. B-11						
E	BORING NO.			ON OF BORING	ELEVATION		DATUM	C	RILLER		L	OGGER	
	B-11	WATE	R LEVEL	OBSERVATIONS			TYPE OF S	URFACE	J. Lear		DI	RILL RIG	
WHI	LE EN	ID OF	2	4 HOURS			Grass	Field			(	CME 55	
DRILL	ING DR		AFT		AFTER DRILLING		DRILLING	METHOD			тот	AL DEPT	H
N.E			Boring PI	ugged After Drilling	SOIL	3.25-	Inch Inside Diamete	er Hollow	Stem Auge		RATORY	10.0 ft.	
DEP.	SAMPLE	"N"	0/.		COLOR, CONSISTER	NCY, MOIS	STURE		11808	MC	Dry	a	ELEV.
FT.	NO. &	BLOWS (FT)	REC.	GEOI					CLASS.	%	Dens.	Чu ksf	FT.
		()						0.5'-			<b>P</b> 01		
	S-1	7		FILL (FAT stiff, trace	CLAY) - pale olive to decomposed shale, to	olive brow race rust st	n, very moist, medi ains, trace iron	um		26.9			
				- olive bro	race limestone fragme wn with strong brown,	ents dark gray,	and pale olive, els	e	FILL				
	S-2	7		as above	-					28.8			
5		-											
	S-3	21		FAT CLA stains, tra	Y - olive brown with grace iron nodules	ay, moist, v	very stiff, trace rust			21.4			
									СН				
	S-4	11		- gray with	n strong brown mottles	, very mois	st, stiff, else as abo	ve		27.3			
10					Bottom of B	oring @ 10	)'						
15													
20													
25													
30													
35													
40													
-+0			1	ļ	PROJ	ECT:	Pergola Par	k 4th-	6th Plat	: S	1		
		SI	4503 Ea	st 47 <sup>th</sup> Street South	LOCAT	TION:	Lee's Summ	nit, Mis	souri				
	Engin	eering	Wichita, 316-554	KS 67210 -0725	JOB	NO.:	1973059						
	Engin	cering			D	ATE:	April 5, 2019	9					
							, <b>-</b>						

					BORING L	OG No. B-12						
B	ORING NO.				ELEVATION	DATUM	0	DRILLER		L	OGGER	
	B-12	WATE	R LEVEL	OBSERVATIONS		TYPE OF S	SURFACE	J. Lear		n Di	RILL RIG	
WHI	LE EN	ID OF	2	24 HOURS		Grass	Field			(	CME 55	
DRILL	ING DR		AFT		AFTER DRILLING	DRILLING	METHOD	)		тот		Н
N.E	SA		Boring Pi	ugged After Drilling	SOIL	3.25-Inch Inside Diamet	er Hollow	Stem Auger		RATORY	20.0 ft.	
DEP.	SAMPLE	"N"	%		COLOR, CONSISTE	NCY, MOISTURE		USCS	мс	Dry	a.,	ELEV.
F1.	NO. & TYPE	BLOWS (FT)	REC.	GEOI	OGIC DESCRIPTION	& OTHER REMARKS		CLASS.	%	Dens.	ksf	F1.
					)IL CLAX) dark alive br	own to olive with grove moint	0.5'-					
	S-1	7		medium s decompos	tiff, trace rust stains, to sed shale	race iron nodules, trace			24.4			
	S-2	15		- greenish mottles, e	LL=57; PL= gray to pale olive with lse as above	eddish yellow to strong brov reddish yellow to strong brov	wn		24.2			
5				- pale oliv	e with dark reddish bro	own trace fine gravel, else as						
	U-3	N/A		above				FUL				
		-				k		TILL				
10	S-4	20			estone fragments, els	e as above			20.5			
15	S-5	12		FAT CLA rust stains	Y - dark gray with yello	wish brown, moist, stiff, trace	13.5'-					
								СН				
	S-6	12		- gray to b else as ab	oluish gray with yellowi	sh brown, trace iron nodules,						
20					Bottom of B	oring @ 20'	20.0'-					
25												
30												
35												
40												
40			1	1	PROJ	ECT: Pergola Par	rk 4th-	6th Plat	S	1	I	
	<b>-</b> (	ST	4503 Ea	st 47 <sup>th</sup> Street South		FION: Lee's Sumn	nit, Mis	ssouri				
	Engin	eering	Wichita, 316-554	, KS 67210 I-0725	JOB	NO.: 1973059	•					
	Engin	eering	010.004			ATE: April 5 201	9					
						<b></b> , pin 0, 201	-					

					BORING L	OG No. B-13						
E	BORING NO.		LOCATIO		ELEVATION	DATUM				L	OGGER	
<u> </u>	в-13	WATE	See Borin	OBSERVATIONS	I	TYPE OF S	SURFACE	J. Lear		K DI	RILL RIG	
WHI	LE EN	ID OF	2	24 HOURS		Grass	Field			(	CME 55	
DRILL	ING DR		AFT		AFTER DRILLING	DRILLING	METHOD	Chorr A		тот	AL DEPT	Н
N.E	=.   I   SA		вогing Pl A	uggea Atter Drilling	SOIL E	3.25-inch Inside Diamet	er Hollow	Stern Auger		RATORY	DATA	
DEP.	SAMPLE	"N"	%		COLOR, CONSISTER	NCY, MOISTURE		USCS	мс	Dry	a.,	ELEV.
F1.	NO. & TYPE	BLOWS (FT)	REC.	GEOL	OGIC DESCRIPTION	& OTHER REMARKS		CLASS.	%	Dens.	ksf	F1.
		_				moist stiff trace rust stains	0.5'-					
	S-1	12		trace iron	nodules, trace decom	posed shale, trace limestone	,		20.1			
				- dark oliv	e brown with strong bi	own and pale olive, else as		FILL				
	S-2	9		above					23.5			
5												
	S-3	11		FAT CLAY	<ul> <li>dark gray with stror</li> </ul>	ng brown mottles, moist, stiff,	5.0'-		25.0			
	0-0			trace rust	stains, trace from hoot	lies			20.0			
		-		modium	stiff, also as above							
40	U-4	N/A		- medium					26.9	100.1	2.28	
10												
								СН				
	S-5	12		- dark grag as above	y, stiff, slightly blocky,	trace decomposed shale, els	e					
15		-										
	∖ S-6	50/1.5"	/	LIMESTO	NE - gray, moderately	weathered, soft to moderate						
				hard rock	Bottom of Bo	ina @ 17.13'						
20												
25												
30												
35												
40							1 44					
		TO	1502 E-	et 47th Streat Courth	PROJ	ECI: Pergola Pai	rk 4th-	oth Plat	S			
	- G	<b>D</b>	4503 Ea Wichita,	, KS 67210	LOCA	IUN: Lee's Sumn	nıt, Mis	ssouri				
	Engin	eering	316-554	-0725	JOB	NO.: 1973059						
		677D			D	ATE: April 5, 201	9					

Before         Usedem of a control of Book model         Data matrix         Description         Liser         Kindloor           WHLE         Vertex Local costeria and matrix         Costeria and matrix         Costeria and matrix         State and						BORING L	OG No.	B-14						
Print         Winter Sector assertive root is sertive root is service of the sector root is service of the service of the sector root is service of the se	E	BORING NO.				ELEVATION	DATU	M	C	RILLER		L	OGGER	
UNITALING         Dirac of the control of the con		D-14	WATE	See Born	OBSERVATIONS			TYPE OF SUF	RFACE	J. Lear		R D	RILL RIG	
DRLLING         ATTER DRLLING         ATTER DRLLING         DEFLING         DEFLING         DEFLING         DEFLING         TOTAL DEFT           10.6.8         10.6.8         Burge parage Adm Cells         3.25 wint heids burgers Adm Cells         3.26 wint heids burgers Adm Cells         3.26 wint heids burgers Adm Cells         3.26 wint heids bu	WHI	LE EN	ID OF	2	24 HOURS			Grass Fie	eld			(	CME 55	
15.5.T.         Damp Puope Aler Toring         23.5.5.01 fueld Encader Holes Sien Alegaria         20.1.           PP.         MO.A.         Toring Puope Aler Toring         COLOR. COUNSETERVIX, NOITING:         UGGS         K.         Decemporal Signal         Ter.           PP.         MO.A.         Toring Puope Aler Toring         COLOR. COUNSETERVIX, NOITING:         UGGS         K.         Decemporal Signal         Ter.           Image: Signal Puope         Toring Puope Aler Toring         Counset Toring Puope	DRILL	ING DR	LLING	AFT	ER DRILLING	AFTER DRILLING		DRILLING ME	THOD			тот	AL DEPT	H
DEP:         MARPIE IN MONSTRE         DUCAS         MC         Deprese         No.         EFY.           5         10         0 </td <td>15.5</td> <td>ft. 18</td> <td>B.5 ft.</td> <td>Boring Pl</td> <td>ugged After Drilling</td> <td>8011</td> <td>3.25-inch lr</td> <td>nside Diameter H</td> <td>Hollow</td> <td>Stem Auge</td> <td></td> <td>DATORY</td> <td>20.0 ft.</td> <td></td>	15.5	ft. 18	B.5 ft.	Boring Pl	ugged After Drilling	8011	3.25-inch lr	nside Diameter H	Hollow	Stem Auge		DATORY	20.0 ft.	
FT.         NY08         BLOWS         BACK         VALUE COLORD DESCRIPTION & OTHER REMARKS         USASS         N*         Depict         N* <td>DEP.</td> <td>SAMPLE</td> <td>NIFEE DATA</td> <td>•   0/</td> <td></td> <td>COLOR, CONSISTE</td> <td>NCY, MOISTURI</td> <td>E</td> <td></td> <td>11000</td> <td>LABC</td> <td>Dry</td> <td></td> <td>ELEV.</td>	DEP.	SAMPLE	NIFEE DATA	•   0/		COLOR, CONSISTE	NCY, MOISTURI	E		11000	LABC	Dry		ELEV.
The         IP         IP         IP         IP           8-1         6         1         1         1         1         22.7         22.7         23.6         22.7         23.6         22.7         23.6         22.7         23.6         24.7<	FT.	NO. &	BLOWS	REC.	GEOL					CLASS.	мс %	Dens.	q <sub>u</sub> ksf	FT.
8-1         6         PLL EAT CLAY - store prove, very nois, median stift, taxae         7         22.7           52         10			(F1)		GLOL			IANNO	0.5'-			pci		
Image: Second		S-1	6		FILL (FAT	CLAY) - strong brown	n, very moist, me	edium stiff, trace	0.0		22.7			
92       10       - ebe to dive brow with blaff gray and other yellow, stift, trace       FL       235         5       -			-											
indication in the latter is a second in		S-2	10		- olive to o	live brown with bluish ed shale, else as abo	gray and olive y	ellow, stiff, trace	)	FILL	23.6			
5         8.3         14         FAT CLAY - dark gray with strong brown motiles, moist, set, 5.0         21.1           0         5.4         0         - very dark gray to black, else as above         CH         28.3           15         5.5         13         SHALE - oale clove to builtin gray with yelscuich horsen motiles         CH         28.3           15         5.5         13         SHALE - oale clove to builtin gray with yelscuich horsen motiles         CH         28.3           16         5.5         13         SHALE - oale clove to builtin gray with yelscuich horsen motiles         CH         28.3           16         5.5         13         SHALE - oale clove to builtin gray with yelscuich horsen motiles         CH         28.3           16         5.5         13         SHALE - oale clove to builtin gray with yelscuich horsen motiles         CH         28.3           16         5.5         13         SHALE - oale clove to builtin gray with yelscuich horsen motiles         CH         28.3           20         5.6         13         Sectorn of Boring @ 20         20.0         CH         29.3           20         5.6         14         5.6         CH         29.3         CH         20.0           25         14         14         14			-											
9-3       14       Image: Section of Boord Boor	5		-											
10         3-4         9         -very dark gray to black, elie as above         CH         28.3         Image: CH         29.3         Im		S-3	14		trace rust	stains, trace iron nodu	lles	s, moist, stiff,			21.1			
10       84       9       • very dark gray to black, else as above       CH       28.3       Image: CH       28.3         15       8.5       13       SHALE - pale dive to blaish gray with yellowish brown motiles.       13.6       Image: CH       28.3       Image: CH       29.3       Image: CH       29.3       Image: CH       29.3       Image: CH       29.3 </td <td></td> <td></td> <td>-</td> <td></td>			-											
3-4       9														
10       5-4       9       CH       23.3       CH       23.3         15       5-5       13       SHALE - pale plive to blaich gray with yellowish brown motiles.       13.5       CH       23.3       CH       23.3         15       5-5       13       SHALE - pale plive to blaich gray with yellowish brown motiles.       13.5       CH       23.3       CH       20.3         20       5-6       55       SHALE - pale plive to blaich gray with yellowish brown motiles.       13.5       CH       20.3       CH       20.3         20       5-6       55       SHALE - pale plive to blaich gray with yellowish brown motiles.       13.5       CH       20.0       CH       20.3         20       5-6       55       SHALE - pale plive to blaich gray with yellowish brown motiles.       13.5       CH       20.0       CH       20.0         20       5-6       55       Shate gray mathemed. no rust. no iron, else as above       20.0       CH       20.0			-		- very dark	gray to black, else a	s above							
13       13       Skiller - pale olive to bluich gray with yellowish brown motiles.       1.3.5       1.3.5         15       13       14       Skiller - pale olive to bluich gray with yellowish brown motiles.       1.3.5       1.4.5         15       5.6       5.6	10	S-4	9							СН	28.3			
15       13         15       13         16       13         17       14.E <sup>2</sup> - pale dive to blaish gray with yellowish brown mottles, 13.5 <sup>4</sup> 16       14         17       14.E <sup>2</sup> - pale dive to blaish gray with yellowish brown mottles, 13.5 <sup>4</sup> 18       14.E <sup>2</sup> - pale dive to blaish gray with yellowish brown mottles, 14.E <sup>2</sup> - wery dark gray, slightly weathered, no rust, no iron, else as above         20       8-6         20       8-6         20       Bottom of Boring @ 20 <sup>2</sup> 20.0 <sup>1</sup> 14.1         21       Bottom of Boring @ 20 <sup>2</sup> 20       8-6         20       8-6         20       9-0         21       14.1         22       8-10         23       14.1         24       14.1         25       9-00 <sup>2</sup> 26       14.1         27       20.0 <sup>1</sup> 28       15.1         29       15.2         20       14.1         20       14.1         20       14.1         20       14.1         20       14.1         20       15.2														
13       SHALE - paie bliet to blieth gray with yellowith brown motiles.       13.5         15       13       SHALE - paie bliet to blieth gray with yellowith brown motiles.       13.5         16       S+5       13       SHALE - paie bliet to blieth gray with yellowith brown motiles.       13.5         20       S+6       55       -very dark gray, sightly weathered, no rust, no iron, else as above       20.0         20       S+6       55       Bottom of Boring @ 20'       20.0       20.0         20       S+6       55       Bottom of Boring @ 20'       20.0       20.0         20       S+6       S       Bottom of Boring @ 20'       20.0       20.0         20       S+6       S       Bottom of Boring @ 20'       20.0       20.0         21       S+6       S       Bottom of Boring @ 20'       20.0       20.0         25       S+7       Secondary S														
15       13       HALE-pale olive to bluish gray with yellowish brown mottles.       135         15       13       HALE-pale olive to bluish gray with yellowish brown mottles.       135         16       14       HALE-pale olive to bluish gray with yellowish brown mottles.       135         20       8-6       55       - vary dark gray, slightly weathered, no rust, no iron, else as above       200         20       8-6       55       Botom of Boring @ 20       200       200         25       0       8-0       Botom of Boring @ 20       200       0         25       0       0       0       0       0       0         30       0       0       0       0       0       0       0         30       0       0       0       0       0       0       0       0         30       0														
55       9-5       13       Image: SPACE space stars in the set of the to builting gaty with yearowan brown modules.         1       1       1       Image: SPACE space stars is the set of the to builting gaty with yearowan brown modules.         20       5-6       55       Image: SPACE space stars is the set of the to builting gaty with yearowan brown modules.         20       5-6       55       Image: SPACE space stars is the set of the to builting gaty with yearowan brown modules.         20       5-6       55       Image: SPACE space stars is the set of the to builting gaty with yearowan brown modules.         20       5-6       55       Image: SPACE space stars is the set of the to builting gaty with yearowan brown modules.         20       5-6       55       Image: SPACE space stars is the set of the top set of t			-			ala aliva ta bluiala ana		h	-13.5'-					
15       - very dark gray, slightly weathered, no rust, no iron, else as above       20       5-6       55         20       5-6       55       Bottom of Boting @ 20'       20.0       I       I         25       -       Bottom of Boting @ 20'       20.0       I       I       I         26       -       I	45	S-5	13		decompos	ed, soft rock, trace ru	iy with yellowish st stains, trace ir	on nodules						
20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-7       Bottom of Boring @ 20         20       1       1       1         20       1       1       1         21       1       1       1         25       1       1       1         26       1       1       1         27       1       1       1         28       1       1       1         30       1       1       1         30       1       1       1         30       1       1       1         30       1       1       1         30       1       1       1         30       1       1       1         30       1       1       1         30       1       1       1         30       1       1       1         30       1       1       1	15		-											$\overline{\nabla}$
20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-6       55         20       5-7       20.0         20       1       1         25       5       5         26       5       5         27       1       1         28       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1         30       1       1														-
20       3-6       55       -very dark gray, slightly weathered, no rust, no iron, else as above       20.0														
35-6       55       -very dark gray, slightly weathered, no rust, no iron, else as above       200       200         20       35-6       55       Bottom of Boring @ 20'       20.01       Image: Superstand Superstan														
20       0.0          20.0        20.0 <td< td=""><td></td><td>S-6</td><td>55</td><td></td><td>- very dark</td><td>gray, slightly weathe</td><td>red, no rust, no i</td><td>ron, else as</td><td></td><td></td><td></td><td></td><td></td><td>-</td></td<>		S-6	55		- very dark	gray, slightly weathe	red, no rust, no i	ron, else as						-
25 26 27 28 29 30 30 30 30 40 40 40 40 40 40 40 40 40 4	20					Bottom of B	oring @ 20'		-20.0'					
25 26 30 30 30 35 35 35 35 35 35 35 35 35 35						Bottom of B	oning @ 20							
25 26 26 26 26 29 30 30 30 30 30 40 40 40 40 40 40 40 40 40 4														
25 26 27 28 29 29 20 20 30 30 30 30 30 30 30 30 40 40 40 40 40 40 40 40 40 4														
25 26 27 30 30 30 30 30 30 30 30 30 30														
30         30         30         35         35         36         37         40         PROJECT: Pergola Park 4th-6th Plats         LOCATION: Lee's Summit, Missouri         JDB NO: 1973059         DATE: April 5, 2019	25													
30 30 30 30 30 30 30 30 35 35 35 40 40 40 40 40 40 40 40 40 40														
30 30 30 33 35 35 40 40 FROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO:: 1973059 DATE: April 5, 2019														
30 30 30 30 35 35 35 40 40 FreeSsing 4503 East 47" Street South Wichta, KS 67210 316-554-0725 Mark S 67210 316-554-0725 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO: 1973059 DATE: April 5, 2019														
30 30 30 30 40 40 40 40 40 40 40 40 40 4														
35         35         36         40         PROJECT: Pergola Park 4th-6th Plats         LOCATION: Lee's Summit, Missouri         JOB NO.: 1973059         DATE: April 5, 2019	30													
35         35         36         40         PROJECT: Pergola Park 4th-6th Plats         LOCATION: Lee's Summit, Missouri         JOB NO.: 1973059         DATE: April 5, 2019														
35         35         36         40         40         PROJECT: Pergola Park 4th-6th Plats         LOCATION: Lee's Summit, Missouri         JOB NO.: 1973059         DATE: April 5, 2019														
35 36 37 37 38 40 40 40 40 40 40 40 40 40 40														
35 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059 DATE: April 5, 2019														
33       33         34       35         35       36         40       40         40       PROJECT: Pergola Park 4th-6th Plats         LOCATION:       Lee's Summit, Missouri         JOB NO.:       1973059         DATE:       April 5, 2019														
40 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059 DATE: April 5, 2019	35													
40 40 FROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059 DATE: April 5, 2019														
40 40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059 DATE: April 5, 2019	$\vdash$													
40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059 DATE: April 5, 2019														
40 PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059 DATE: April 5, 2019														
Image: Project with the street South wichita, KS 67210         316-554-0725    PROJECT: Pergola Park 4th-6th Plats LOCATION: Lee's Summit, Missouri JOB NO.: 1973059 DATE: April 5, 2019	40													
4503 East 47th Street South Wichita, KS 67210 316-554-0725       LOCATION: Lee's Summit, Missouri JOB NO.: 1973059 DATE: April 5, 2019						PROJ	ECT: Per	gola Park	4th-	6th Plat	S			
Engineering         316-554-0725         JOB NO.: 1973059           DATE:         April 5, 2019		•		4503 Ea Wichita	st 47 <sup>m</sup> Street South . KS 67210		FION: Lee	e's Summit	i, Mis	ssouri				
DATE: April 5, 2019		Engin	eering	316-554	-0725	JOB	NO.: 197	3059						
		0	9			D	ATE: Apr	il <u>5, 20</u> 19						

					<b>BORING L</b>	OG No. B-15						
E	BORING NO.				ELEVATION	DATUM	0	DRILLER		L	OGGER	
	B-15	WATE	See Born	OBSERVATIONS		TYPE OF S	SURFACE	J. Lear		к D	. Hudson	
WHI	LE EN	ND OF	2	24 HOURS		Grass	Field				CME 55	
DRILL	ING DR	ILLING	AFT	ER DRILLING	AFTER DRILLING	DRILLING	METHOD			тот	AL DEPT	H
13.0	tt. 13		Boring Pl	ugged After Drilling		3.25-inch Inside Diamet	ter Hollow	Stem Auge		PATORY	13.04 ft.	
DEP.	SAMPLE	"N"	- / 0/		COLOR, CONSISTE	NCY, MOISTURE		LISCS	MC	Dry		ELEV.
FT.	NO. &	BLOWS	REC.	GEO		& OTHER REMARKS		CLASS.	WC %	Dens.	q <sub>u</sub> ksf	FT.
		,		2			0.5'-			poi		
	S-1	5		FILL (FA	F CLAY) - dark olive br stiff_trace rust stains_t	own to olive brown, very mois race iron nodules, trace	st,		27.8			
		-		decompo	sed shale							
	S-2	8		- medium	stiff to stiff, else as ab	ove		FILL	24.5			
		-										
5		-				·····	5.0'-		-			
	S-3	9		stains, tra	ace iron nodules	e, very moist, suit, trace rust			26.8			
		-										
		_		- dark gra	y, medium stiff, trace o	decomposed shale, else as		<u></u>				
10	U-4	N/A		above				Сп	27.5	103.0	2.35	
		_										
	∖ S-5	50/1.5"	/	LIMESTO	NE - gray, moderately	weathered, moderately hard	-13.0					¥ ¥
				rock	Bottom of Bo	ring @ 13.04'						
15												
20												
25												
30												
$\mid - \mid$												
35												
40												
			1		PROJ	ECT: Percola Pa	rk 4th-	6th Plat	S		1	
		SI	4503 Ea	st 47 <sup>th</sup> Street South	LOCAT	FION: Lee's Sum	nit. Mi	ssouri				
		Ņ	Wichita,	, KS 67210		NO · 1073050	,					
	Engin	eering	310-554	-0/23		ATE: April 5 201	0					
L						ATE. April 5, 201	ฮ					

	KEY TO SYMBOLS
Symbol	Description
<u>Strata</u>	symbols
	Topsoil
	Fat Clay
	Shale
	Lean Clay
	Fat Clay with Gravel
	Limestone
	Fill - Cohesive
	Gravel
Misc. S	Symbols
	Water table during drilling
Ţ	Water table at the conclusion of drilling
Notes:	
1. The e 3.25-	exploratory borings were drilled on April 4 and 5, 2019 using inch inside diameter hollow stem augers.
2. These recon	e logs are subject to the limitations, conclusions, and mendations in this report.
3. Resulthe	ts of tests conducted on samples recovered are reported on ogs.

#### Boring Log Legend and Nomenclature

Items shown on boring logs refer to the following:

- 1. <u>Depth</u> Depth below ground surface or drilling platform
- 2. **<u>Sample</u>** -Types designated by letter:
  - *A* Disturbed sample, obtained from auger cuttings or wash water.
  - *S* Split barrel sample, obtained by driving a 2-inch split-barrel sampler unless otherwise noted.
  - C California liner sample, obtained using a thick-walled liner sampler containing 2-inch-diameter liner tubes.
  - *U* Undisturbed sample, obtained using a thin-walled tube, 3-inch-diameter, or as noted, and open sampling head.
  - *Recovery* Recovery is expressed as a percentage of the length recovered to the total length pushed, driven or cored.

Resistance - Resistance is designated as follows:

- P Sample pushed in one continuous movement by hydraulic rig action.
- 12 The Standard Penetration Resistance is the number of blows for the last 12 inches of penetration of split spoon sampler, driven by a 140-pound hammer falling 30 inches.
- 50/4" Number of blows to drive sampler distance shown.
- 3. <u>Soil Description</u> Description of material according to the Unified Soil Classification: word description giving soil constituents, consistency or density, and other appropriate classification characteristics. Geologic name or type of deposit and other pertinent information, where appropriate, is shown under Geologic Description or other Remarks. A solid line indicates the approximate location of stratigraphic change.
- 4. Lab Data Laboratory test data.

#### 5. Legend

A.D. —	After drilling	N.A. —	Not Applicable
A.T.D. —	At time of drilling	N.D. —	Not detectable due to
C.F.A. —	Continuous flight auger		drilling method
D.W.L. —	Drill water loss	N.E. —	None encountered
D.W.R. —	Drill water return	N.R. —	Not recorded
E.D. —	End of drilling	R.Q.D. —	Rock quality designation
н.в. —	Hole backfilled	R.W.B. —	Rotary wash boring

6. <u>Limitations</u> - The lines between materials shown on the boring logs represent approximate boundaries between material types and the changes may be gradual. Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water levels may occur with time. The boring logs in this report are subject to the limitations, explanations and conclusions of this report.

### UNIFIED SOIL CLASSIFICATION SYSTEM

GROUP NAME	GROUP SYMBOL	SOIL DESCRIPTION	COMMENTS			
Peat	Pt	Highly Organic Soils				
Fat Clay	СН	Clay - Liquid Limit => 50*				
Elastic Silt	MH	Silt - Liquid Limit => 50*	50% or More Is Smaller than			
Lean Clay	CL	Clay - Liquid Limit < 50*	No. 200 Sieve			
Silt	ML	Silt - Liquid Limit < 50*				
Silty Clay	CL-ML	Silty Clay*				
Clayey Sand	SC	Sands with 12 to 50%				
Silty Sand	SM	Smaller than No. 200 Sieve				
Poorly-Graded Sand with Clay	SP-SC		More then 50% to Lorger			
Poorly-Graded Sand with Silt	SP-SM	Sands with 5 to 12%	than No. 200 Siovo and			
Well-Graded Sand with Clay**	SW-SC	Smaller than No. 200 Sieve	% Sand > % Gravel			
Well-Graded Sand with Silt**	SW-SM					
Poorly-Graded Sand	SP	Sands with Less than 5%				
Well-Graded Sand**	SW	Smaller than No. 200 Sieve				
Clayey Gravel	GC	Gravels with 12 to 50%				
Silty Gravel	GM	Smaller than No. 200 Sieve				
Poorly-Graded Gravel with Clay	GP-GC		More then 50% to Lorger			
Poorly-Graded Gravel with Silt	GP-GM	Gravels with 5 to 12%	then No. 200 Siove and			
Well-Graded Gravel with Clay**	GW-GC	Smaller than No. 200 Sieve	Crowel > % Sound			
Well-Graded Gravel with Silt**	GW-GP	1	% Graver > % Sand			
Poorly-Graded Gravel	GP	Gravels with Less than 5%				
Well-Graded Gravel**	GW	Smaller than No. 200 Sieve				

\*See Plasticity Chart for definition of silts and clays. If organic, use OL or OH. \*\*See definition of well-graded



Engineering

#### LEGEND OF TERMS

MOISTURE CONDITIONS Dry, Slightly Moist, Moist, Very Moist, Wet (Saturated)

#### SOIL CONSISTENCY

#### Fine-Grained Soils

Description	SPT (N)	UCS (q <sub>u,</sub> tsf)
Very Soft	0-2	0-0.25
Soft	2-4	0.25-0.50
Medium Stiff	4-8	0.50-1.0
Stiff	8-16	1.0-2.0
Very Stiff	16-32	2.0-4.0
Hard	>32	>4.0

#### Coarse-Grained Soils

Description	SPT (N)
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

#### **CLASSIFICATION OF SANDS & GRAVELS**



Well-Graded Sands (SW):  $C_u \ge 6$  and  $1 \le C_c \le 3$ 

Well-Graded Gravels (GW):  $C_u \ge 4$  and  $1 \le C_c \le 3$ 



### **ROCK DESCRIPTORS**

#### **DEGREE OF WEATHERING**

Descriptor	Definition
Unweathered	No evidence of any chemical or mechanical alteration
Slightly Weathered	Slight discoloration on surface, slight alteration along discontinuities, less than 10% of the rock volume atlered
Moderately Weathered	Discoloring evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering "halos" evident, 10% to 50% of the rock altered
Highly Weathered	Entire mass discolored, alteration pervading nearly all of the rock with some pockets of slightly weathered rock noticeable, some minerals leached away
Decomposed	Rock reduced to a soil with relict rock texture, generally molded and crumbled by hand

HARDNESS								
Descriptor	Definition							
Very Soft	Can be deformed by hand							
Soft	Can be scratched with a fingernail							
Moderately Hard	Can be scratched easily with a knife							
Hard	Can be scratched with difficulty with a knife							
Very Hard	Cannot be scratched with a knife							

#### **TFXTURF\***

TEXTORE											
Texture	Grain Diameter	Particle Name	Rock Name								
*	80 mm	Cobble	Conglomerate								
*	5 - 80 mm	Gravel									
Coarse Grained	2 - 5 mm										
Medium Grained	0.4 - 2 mm	Sand	Sandstone								
Fine Grained	0.1 - 0.4 mm										
Very Fine Grained	0.1 mm	Clay, silt	Shale, Claystone, Siltstone								

#### **ROCK STRUCTURE**

Descriptor	Definition
Massive	3 feet thick or greater
Thick Bedded	Beds from 1 foot to 3 feet thick
Medium Bedded	Beds from 4 in. to 1 foot thick
Thin Bedded	4 inches thick or less

\* Sedimentary Rocks

#### DISCONTINUITIES

#### Joints

- 1.) Type: Type of joint if it can be readily determined (i.e., bedding, cleavage, foliation, schistosity, or extension.)
- 2.) Degree of joint wall weathering:
  - (i) Unweathered: No visible signs are noted of weathering; joint wall rock is fresh, crystal bright.
  - (ii) Slightly weathered joints: Discontinuities are stained or discolored and may contain a thin coating of altered material. Discoloration may extend into the rock from the discontinuity surfaces to a distance of up to 20% of the discontinuity spacing
  - (iii) Moderately weathered joints: Slight discoloration extends from discontinuity planes for greater than 20% of the discontinuity spacing. Discontinuities may contain filling of altered material. Partial opening of grain bounderies may be observed.
  - (iv) Highly weathered joints: Entire mass discolored, alteration pervading nearly all of the rock with some pockets of slightly weathered rock noticeable, some minerals leached away.
  - (v) Completely weathered joints: Rock reduced to a soil with relicit rock texture, generally molded and crumbled by hand.

### APPENDIX C

Field & Laboratory Test Results

SUMMARY OF FIELD AND L									BORA	ГО	RY	T	EST	S	
Boring No.	SAMPLE NO.	SAMPLE DEPTH	DIA.	MOISTURE	U WE WET	NIT IGHT DRY	VOID RATIO	SAT. (%)	UNCONF. COMPR. STR.	AT	TERBE LIMITS	RG	PASS NO. 200	SPT "N" (blows	USCS SOIL CLASS.
		(ft.)	(in.)	(%)	(pcf)	(pcf)	(e)		(ksf)	LL	PL	PI	(%)	/ft)	
B-1	S-1	0.5-2.0		25.1						56	25	31		9	CH
	S-2	2.5-4.0		22.8										12	CH
	U-3	5.0-7.0	2.78	20.6	141.5	117.3	0.409	100	5.63					N/A	CH - Shale
	S-4	8.5-9.5		11.8										50/5.5"	Shale
B-2	S-1	0.5-2.0		28.4										4	CL
	U-2	2.5-4.5	2.78	24.8	124.8	100.0	0.653	100	4.42					N/A	СН
	S-3	5.0-6.5		21.1										16	СН
	S-4	8.5-10.0		19.9										18	СН
	S-5	10.0-11.5												26	Shale
B-3	S-1	0.5-2.0		29.7		<u> </u>		L						7	CL
	S-2	2.5-4.0		21.8		<u> </u>		L		<b> </b>				10	СН
	U-3	5.0-7.0	2.89	23.5	124.6	100.9	0.639	97	3.04	<u> </u>	<u> </u>			N/A	СН
	S-4	8.5-10.0		21.4		<u> </u>	<u> </u>							12	СН
	S-5	10.0-11.5									<u> </u>			16	СН
	0.1	0.5.0.0		05.1		<b> </b>			ļ						011
В-4	5-1	0.5-2.0		25.4										8	CH
	S-2	2.5-4.0		23.5										14	СН
	S-3	5.0-6.5		23.5										12	CH
	S-4	8.5-10.0		24.5										15	CH
	S-5	10.0-11.5												26	Shale
5.5														4.0	
B-5	S-1	0.5-2.0		26.4										10	CL
	S-2	2.5-4.0		23.7										17	CH
	S-3	5.0-6.5		23.0										11	CH
	S-4	8.5-10.0		17.3										52	CH w/ GP
	S-5	10.0-11.5												23	Shale
	0.4	0500		00.4										4.4	
B-0	5-1	0.5-2.0		20.1										11	
	5-2	2.5-4.0		24.8										12	CH
	5-3	5.0-6.5		23.7										10	CH
	5-4	8.5-10.0		24.1										/	CH
	5-5	10.0-11.5												8	CH
D 7	C 1	0520		24.2										10	
D-1	5-1	0.5-2.0		21.2										10	
	3-2	2.5-4.0		21.4										20	
	S-3 € /	0.0-0.0		20.1										1Z	Jimostone
	5-4	0.0-0.1												50/1°	Limestone
Ро	C 1	0520		22.4										10	
D-0	0-1 0-1	0.5-2.0		22.1 10 F										13	
	3-2 6-2	2.3-4.0		19.0										10	
	<u>১-</u> ১	5.U-0.5		24.0										10	
	5-4	0.0-10.0		22.4	1		<u> </u>							14	Shale
	ļ														
			G	SI Enainee	rina L					F	ROJ	ECT		4-	
			4503	3 E. 47th S	treet S	outh	Pergola Park 4th-6th Plats								
	( 🛶			(316) 55/	3 0/210 L-0725	,	Lee's Summit. Missouri								
			W	ww.asinet	work.co	om 🛛	PROJECT NUMBER DATE								
				3				1973	059			A	oril 15	5, 2019	
							I					-		,	

SUMMARY OF FIELD A						D A	ND	ND LABORATORY TESTS							
BORING NO.	SAMPLE NO.	SAMPLE	DIA.	MOISTURE	UN WEI WET	VIT IGHT DRY	VOID	SAT. (%)	UNCONF.	AT	TERBE LIMITS	RG	PASS	SPT "N"	USCS SOIL CLASS.
HV.		(ft.)	(in.)	(%)	(pcf)	(pcf)	(e)	(70)	COMPR. STR. (ksf)		PL	PI	NO. 200 (%)	(blows /ft)	
B-9	S-1	0.5-2.0		,	(,	(F=-)	,		(itor)	44	21	23	\ <sup>/0</sup> /	6	Fill (CL)
	S-2	2.5-4.0	I	26.3		<b>├</b> ───	'	<u> </u>	<u> </u>	<u>├</u>	<u> </u>	<u> </u>	'	8	Fill (CL)
	S-3	5.0-6.5		27.8		1	1		†					11	СН
	S-4	8.5-10.0	·	22.9										13	Shale
B-10	S-1	0.5-2.0		17.2										16	Fill (CH)
	S-2	2.5-4.0		21.4										10	СН
	S-3	5.0-6.5	ا 	20.1	<b></b> '	<u> </u>	<u> </u>	$\square$	<u> </u>	<b> </b> '	$\square$	Ļ	<u> </u> '	33	Shale
	S-4	8.5-10.0		17.1	<b> </b> '		<b></b> '		ļ'	<b> </b> '	┢	<b> </b> '	<b> </b> '	95/11"	Shale
	$\vdash$				<b> </b> '		<b> </b> '	┣──	ļ'	<b> </b> '	┢	<b> </b> '	<b>↓</b> '	<u> </u>	
B-11	S-1	0.5-2.0		26.9	<b> </b> '		<b></b> '	┣──	ļ'	<b> </b> '	┣—	<b> </b> '	<b> </b> '	7	Fill (CH)
	<u>S-2</u>	2.5-4.0		28.8	<b> </b> '	───	<b> </b> '	┣───	<b></b> '	<b> </b> '	—	<b> </b> '	<b> '</b>	/	
	5-3	5.0-6.5		21.4	<b> </b> '	───	<b> </b> '	──	<b></b> '	<b> </b> '	—	┨────	<b> '</b>	21	CH
	5-4	8.5-10.0		27.3	<b> </b> '	──	<u> '</u>	┣──	<u> </u> '	──'	┣—	<b> </b> '	<b> '</b>	11	Сп
R-12	S-1	0.5-2.0	i	24.4	'	├───	'	┣──	<u> </u>	57	21	36	<b> </b> '	7	Fill (CH)
	<u>S-2</u>	25-40		24.4	'	├───		┣──	'	57	1 1	30		15	Fill (CH)
	U-3	5 0-7 0		27.2	'	├───	'	├──	'	<b> </b> '	├──	<u> </u>		N/A	Fill (CH)
	S-4	8.5-10.0	i	20.5	'	├	'	<u> </u>	<u> </u>	<b> </b> '	├──	<u> </u>	<u>├</u> /	20	Fill (CH)
	S-5	13.5-15.0	l	20.0	'	├───	'	<u> </u>		$\vdash$	├──	$\vdash$	<b>├</b> ───′	12	СН
	S-6	18.5-20.0	·	<b>├</b> ───┦		├───		<u> </u>	+	'	<u> </u>	<u> </u>		12	СН
		1.0.0 =		ł – – •	'	1									
B-13	S-1	0.5-2.0		20.1		1					1	1	<u>├</u> ───	12	Fill (CH)
	S-2	2.5-4.0		23.5										9	Fill (CH)
	S-3	5.0-6.5		25.9										14	CH
	U-4	8.5-10.5	2.79	26.9	127.0	100.1	0.652	100	2.28					N/A	СН
	S-5	13.5-15.0												12	СН
	S-6	17.0-17.13												50/1.5"	Limestone
				<u>['</u>	Ĺ'	<u> </u>	<u> </u>			<b></b> '		<u> </u>	<u> </u>	<u> </u>	
B-14	S-1	0.5-2.0	ا 	22.7	<b></b> '		ļ			<b></b> '	$\square$	ļ'	ļ	6	Fill (CH)
	S-2	2.5-4.0	ا 	23.6	<b> </b> '	└───	<u> </u>	$\vdash$	<u> </u>	<b> </b> '	$\vdash$	<u> </u>	<u> </u> '	10	Fill (CH)
	S-3	5.0-6.5		21.1	<b> </b> '		<b></b> '		'	<b> </b> '	┢	<b> </b> '	<b></b> '	14	CH
	S-4	8.5-10.0		28.3	<b> </b> '		<u> </u>	—	ļ'	<b> </b> '	┣—	<b> </b> '	<b> </b> '	9	CH
	5-5	13.5-15.0		<b>↓</b> ′	<b> </b> '	───	<b> </b> '	┣──	<b></b> '	<b> </b> '	—	<b> </b> '	<b> '</b>	13	Shale
	5-6	18.5-20.0	1	────′	<b> </b> '	───	<b> </b> '	—	<b></b> '	<b> </b> '	—	──'	<b> '</b>	55	Shale
P 15	<u><u> </u></u>	0520	i	27.9	<b> </b> '	───	<u> </u>	┣───	<b></b> '	<b> </b> '	—	<b> </b> '	┟────′		
D-10	<u> </u>	25-40	I	21.0	<b> </b> '	├───	'	┣──	<u> </u>	<b> </b> '	├──	──	<b> </b> '	2 2	
	<u>S-3</u>	50-65		24.5	'	├───	'	┣───	'	<b> </b> '	├		'	Q Q	
	11-4	8 5-10 5	2 79	20.0	131.4	103.0	0.605	100	2.35	<b> </b> '	├──	<u> </u>		N/A	СН
	S-5	13 0-13.04	2.10	21.5	101.1	100.0	0.000	100	2.00	<b> </b> '	├──	<u> </u>	<b>├</b> ────′	50/1.5"	Limestone
			I	<b>├</b> ───┦	'	├───			<sup>-</sup>	'	├──		<sup>1</sup>	00, 1.0	Lintottone
B-3	A-1	0.0-5.0		3.6 (Air Dry)		1	1		<u> </u>	53	22	31	96.1	N/A	СН
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B-1,-5,-7	A-1	Varies	·	2.3 (Air Dry)			l'			47	19	28	95.5	N/A	CL
	I		·												
B-10,-13	A-1	Varies		2.3 (Air Dry)						57	23	34	95.7	N/A	Fill (CH) - CH
										F	ROJ	ECT			
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