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SUBSURFACE EXPLORATION
AND
GEOTECHNICAL ENGINEERING REPORT

NEWBERRY LANDING
LEE'S SUMMIT, MO

PREPARED FOR

Mr. Chad Anderson
MAR Building Solutions
1305 SW Jefferson Street
Lee's Summit, MO 64081

KCTE Project No. G20-18-080

April 23, 2018

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING REPORT

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Submitted to:

Mr. Chad Anderson
MAR Building Solutions
1305 SW Jefferson St
Lee's Summit, MO 64081

Submitted by:

Kansas City Testing & Engineering LLC
1308 Adams Street
Kansas City, Kansas 66103

Prepared by:

STATE OF MISSOURI
ADAM M.
McEACHRON
4/24/18
NUMBER
PE-2010005591
PROFESSIONAL ENGINEER

Adam McEachron, P.E.
Geotechnical Engineer
Construction Services Manager

Reviewed by:

Jim Byrnes, R.G.
Senior Geologist

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APPENDIXES

1.0 INTRODUCTION

Kansas City Testing & Engineering, LLC (KCTE) has completed the geotechnical engineering evaluation for the seven new single story buildings planned near the intersection of SE Broadway Drive and SE Kingsport Drive in Lee's Summit, MO. Mr. Chad Anderson with MAR Building Solutions authorized this exploration by signing KCTE's proposal number GP20-18-056.

The purpose of this geotechnical engineering exploration was to evaluate the subsurface conditions and physical properties of the soils and any bedrock encountered during the exploration, and based on that information provide geotechnical-related recommendations for design and construction of the proposed development.

1.1 Site Description

The project site is a relatively flat grass covered field. It appears that a pond and creek was once located near the area of the cul-de-sac. The site location is shown in the attached *Appendix A – Site Location Plan*.

1.2 Project Description

KCTE understands that 7 new single-story buildings are planned for the site. Structural loading for the buildings was not available at the time of this exploration. However, based on our experience with similar structures, KCTE anticipates the structure to be lightly loaded.

2.0 SUBSURFACE EXPLORTION

The site subsurface conditions were explored with fourteen (14) borings drilled at the approximate locations shown in Appendix B. The borings were drilled on April 11, 2018 and April 13, 2018 using a CME 55 truck-mounted drill rig, equipped with 4-inch-diameter, continuous flight augers. Soil samples were obtained from the borings during drilling using standard penetration, split-barrel sampling techniques (ASTM D 1586). Four (4) samples were generally obtained in the upper 10 feet of each boring and then at 5-foot intervals thereafter to the bottom of the boring.

A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as an interpolation of the subsurface conditions between samples. Final boring logs included in Appendix B represent our interpretation of the field logs and may include modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their approximate thickness, and the depths at which the samples were obtained. This information includes soil descriptions, stratifications, penetration resistances, locations of the samples, and laboratory test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual.

Field samples obtained from the borings were returned to our laboratory where they were visually classified and logged. The field exploration and laboratory test results were utilized in the development of the geotechnical recommendations.

The boring locations were established in the field by a representative of KCTE using existing site features for reference. The locations and surface elevations of the borings were not measured. If more precise boring locations and elevations are desired, KCTE recommends that a professional surveyor determine the locations and elevations of the as-drilled locations of the borings.

3.0 LABORATORY TESTING PROGRAM

Laboratory testing was performed on the soil samples to estimate pertinent engineering and index properties of the materials. Results of the laboratory tests are presented on the boring logs in Appendix B and in Appendix C. The laboratory testing program consisted of the following:

- Visual classification (ASTM Designation D 2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*)
- Moisture content tests (ASTM Designation D 2216, *Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*)
- Atterberg limits tests (ASTM Designation D 4318, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*)

4.0 SUBSURFACE CONDITIONS

This section presents a general summary of the materials encountered in the borings. Specific subsurface conditions encountered at the boring locations are presented on the respective boring logs in Appendix B. The stratification lines shown on the logs represent the approximate boundaries between material types; the transitions may vary or be gradual.

4.1 Site Stratigraphy

In general, approximately 12 inches of topsoil was encountered on the site. The topsoil was underlain by undocumented fill ranging in depth from 2.5 to 4.5 feet below existing grade. The undocumented fill material was comprised of dark brown silty clay. The undocumented fil was underlain by stiff to very stiff, high plasticity clay. The clay was underlain by shale and limestone bedrock.

4.2 Groundwater Observations

Groundwater was observed in the borings ranging from 4 to 10 feet below existing grade. Groundwater levels may not have stabilized prior to backfilling the borings. Consequently, the indicated groundwater levels, or lack thereof, may not represent present or future levels. Groundwater levels generally vary significantly over time due to seasonal variation in precipitation, recharge or other factors not evident at the time of exploration.

5.0 RECOMMENDATIONS

The following geotechnical recommendations have been developed on the basis of the subsurface conditions encountered and our understanding of the proposed construction. Should changes in the project criteria occur, a review must be made by KCTE to evaluate if modifications to our recommendations will be required.

Our recommendations are provided on the basis that our understanding of the scope of the project, as previously described, does not change and that no significant variations in the subsurface conditions occur from those reported in the final boring logs. The boring logs depict subsurface conditions only at the specified locations on the site.

5.1 Site Preparation

Initial site preparation should consist of removal of any topsoil, and any trees and root systems in the proposed construction areas. After excavating to the proposed subgrade level or proposed start of fill level, soft zones and existing undocumented fill should be undercut and replaced with engineered fill.

Subgrade preparation for fill areas should include scarifying the top 6 inches of the surface to provide better bonding. The subgrade should be dried or moisture conditioned as necessary and compacted to at least 95% of the material's maximum dry density in accordance with ASTM D698. After subgrade preparation and observations have been completed, fill placement may begin to establish construction grade.

The upper fine-grained soils encountered at this site are expected to be sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

All slopes steeper than 5 horizontal to 1 vertical (5H:1V) in fill areas should be benched prior to placement of fill. The benching of slopes allows interlocking of the fill and the natural soils, and provides a platform for compaction of the fill. Benches should be cut as the fill progresses, and bench heights should be a maximum of 3 feet. Special consideration should be given to areas where bedrock is exposed in the bench cuts. Drainage measures may be required to collect and divert groundwater from the exposed bedrock prior to placing the new fill.

5.2 Existing Undocumented Fill

At the time of this exploration, and in the specific locations where drilling was conducted, undocumented fill was encountered in the borings. Undocumented fill is defined as man placed fill for which there are no records provided by a registered engineer that the fill was placed as engineered fill.

Undocumented fill encountered during development, should be removed in accordance with this report. In areas planned for structures, undocumented fill should be completely removed and replaced with engineered fill. In pavement areas, undocumented fill should be removed to a minimum depth of 1 foot below the pavement subgrade elevation. Any undocumented fill remaining below pavement areas should be thoroughly evaluated by proofrolling and excavation of test pits. Excavation of test pits into undocumented fill is recommended to further evaluate the composition and consistency of the material. If soft or unsuitable material is encountered during excavation of the test pits, it may be necessary that the undocumented fill be undercut to suitable material. If practical, the grade exposed in the undercut area should then be proofrolled to assess its stability. Soft or unstable areas should be undercut and replaced with engineered fill. If required, the exposed grade should be moisture conditioned prior to placement of engineered fill.

If undocumented fill is not removed and replaced with engineered fill, there is a significant risk that unsuitable materials may not be discovered during construction and may remain buried within the existing fill below the buildings, which could result in greater than anticipated differential settlement of the buildings. This risk cannot be eliminated without completely removing the fill.

If structures are planned for areas where there are significant depths of undocumented fill, as an alternative to removal and replacement of the undocumented fill, a deep foundation system can be recommended.

5.3 Engineered Fill

After subgrade preparation has been completed, fill placement may begin to establish construction grade. The first layer of fill material should be placed in a relatively uniform horizontal lift and be adequately keyed into the stripped and scarified subgrade soils. Fill materials should be free of organic or other deleterious material, and have a maximum particle size less than 3 inches in any direction. Some of the on-site soils may be suitable for reuse as engineered fill provided deleterious materials are removed prior to its use as engineered fill. A densely graded, crushed stone, equivalent to KDOT AB-3 aggregate or MoDOT Type 5 aggregate, is acceptable as engineered fill material. All fill material should be unfrozen and be approved by the geotechnical engineer. The geotechnical engineer should be notified at least 72 hours before fill is imported to the site, to sample and test the material. No imported material should be delivered to the site without proper sampling and testing. Fill material should meet low plasticity requirements if used under slabs.

Fill material should be placed in loose lifts having a maximum thickness of 8 inches and compacted to 95% of the maximum dry density in accordance with standard Proctor (ASTM D 698) at moisture contents between -2% and +3% of the optimum moisture content.

Backfill material over unsuitable soils (i.e., soft, wet, frozen, thawing, or spongy surface) or during unfavorable weather conditions should be prohibited. Where soil has been loosened or eroded by flooding or placement during rain, the damaged area should be removed and recompacted to the required density.

Placement of clay soils may be difficult during wet weather conditions. If the in-situ soils and imported clay soils are too wet and cannot be dried to near-optimum moisture within the construction schedule, they can be stabilized with the addition of lime or fly ash to provide a stable subgrade material. As an alternate to stabilized subgrade, granular material may be placed at the site surface to provide a working platform.

Backfilling of curbs, slab-on-grade, and other structures whose bearing surface is unprotected from water should be accomplished as soon as forms are removed to eliminate possibility of a loose subbase below the structure. Permanent slopes steeper than 3 horizontal to 1 vertical are not recommended.

5.4 Excavations and Trenches

All temporary slopes and excavations should conform to Occupational Safety and Health Administration (OSHA) Standards for the Construction Industry (29 CFR Part 1026, Subpart P). Excavations in the undocumented fill, native soils and engineered fill should be possible with conventional excavation equipment. The contractor should review the boring logs to determine the appropriate method(s) for excavation at this site.

All excavations should be kept dry during subgrade preparation. Storm water runoff should be controlled and removed to prevent severe erosion of the subgrade and eliminate free standing water. Subgrade that has been rendered unsuitable from erosion or excessive wetting should be removed and replaced with engineered fill.

Trenches should be excavated so that pipes and culverts can be laid straight at uniform grade between the terminal elevations. Trench width should provide adequate working space and sidewall clearances. Trench subgrade should be removed and replaced with engineered fill if found to be wet, soft, loose, or frozen. Trench subgrade should be compacted to a minimum of 95% of the maximum dry density in accordance with ASTM D 698 at moisture contents between -2% to +3% of the optimum moisture content.

Granular bedding materials for pipes, such as well-graded sand or gravel, may be used provided that the bottom of the trench is graded so that water flows away from structure. Open-graded granular bedding may be used provided that a separation geotextile is used at the subgrade interface. Bedding material should be graded to provide a continuous support beneath all points of the pipe and joints. Embedment material should be deposited and compacted uniformly and simultaneous on each side of the pipe to prevent lateral displacement. Compacted control fill material will be required for the full depth of the trench above the embedment material. No backfill should be deposited or compacted in standing water.

Precautions should be taken by the contractor to avoid undermining the newly constructed foundations or any existing building foundations. If needed, shoring and excavations supports should be designed to account for the existing structure loads.

5.5 Foundation Recommendations

Based on the subsurface conditions encountered, and following the recommended site preparation procedures outlined in the previous sections, the proposed structures may be supported on a shallow spread footing foundation system bearing entirely in engineered fill and/or native soil. Shallow groundwater elevations were noted in several borings, this may become an issue during foundation excavation.

5.5.1 Spread Footing Allowable Bearing Pressures

Footings founded entirely in engineered fill and/or native soils may be proportioned for a maximum allowable bearing pressure of 2,000 pounds per square foot (psf). The allowable bearing pressure is based on a factor of safety of approximately three (3) with respect to shear failure of the foundation bearing materials.

Continuous wall footings should have a minimum width of 16 inches, and isolated spread footings should have a minimum width of 30 inches. Trench footings should have a minimum width of 12 inches to facilitate cleaning and evaluation of the bearing surface. All exterior footings and footings founded in unheated portions of the structures should be supported a minimum of 36 inches below final exterior grade to provide protection against frost penetration. All footings should be earth-formed, poured in neat excavations.

5.5.2 Spread Footing Estimated Settlements

Long-term structural settlement for spread footings designed and constructed as outlined in this report should be 1-inch or less. Differential settlements should occur gradually across the proposed structure and be on the order of 3/4-inch or less in 50 feet.

5.5.3 Spread Footing Construction Considerations

The base of all footing excavations should be free of all water and loose material prior to placing concrete. Concrete should be placed as soon as possible after excavating so that excessive drying or disturbance of bearing materials does not occur. Should the materials at bearing level become excessively dry or saturated, we recommend that the affected material be removed prior to placing concrete.

It is recommended that all footing excavations be evaluated and tested by a geotechnical engineer immediately prior to placement of foundation concrete. Unsuitable areas identified at this time should be corrected. Corrective procedures would be dependent upon conditions encountered and may include deepening of foundation elements, or undercutting of unsuitable materials and replacement with engineered fill.

5.6 Lateral Earth Pressures

The lateral earth pressures, expressed as an equivalent fluid pressure, imposed by these materials for both above and below the groundwater table are presented in the table below. The lateral earth pressures provided do not include a surcharge load or a factor of safety.

TABLE 2 - EQUIVALENT FLUID PRESSURES FOR BELOW GRADE WALLS

Material	Condition	Drained, psf/ft	Undrained, psf/ft
Soil	At Rest (Ko)	60	90
	Active (Ka)	45	85
	Passive (Kp)	260	NA
Crushed Limestone	At Rest (Ko)	55	*
	Active (Ka)	35	*
	Passive (Kp)	330	*

* Granular backfill should be permanently drained

5.7 Slabs-On-Grade

Observation and/or testing should be performed to identify existing fill and soft or unstable soils that should be removed and replaced with engineered fill. The soils at this site are expansive, and therefore, the upper 24 inches of the subgrade below slabs-on-grade should consist of low volume change (LVC) soils with a liquid limit less than 45 and a plasticity index below 23**.** The 6-inch-thick drainage aggregate below the slab may be considered in the 24 inches of LVC below the slabs. The on-site soils at the locations sampled during this exploration generally do not meet these requirements. Imported soils or crushed stone used for the LVC layer in building pads should be tested prior to placement of the drainage layer. Compaction of low swell potential soil or crushed stone under the slab should be to a minimum of 95 percent of the material's maximum dry density as determined by ASTM D 698 at a moisture content between 0 and +4 percent of the optimum. It is very important that the subgrade soils be maintained at or above standard Proctor optimum moisture content until concrete is placed. Any rutted subgrade should be repaired prior to placement of drainage rock to avoid a potential water trap and subsequent sub grade movement.

KCTE recommends that a minimum 6-inch-thick mat of open-graded (clean) stone, with maximum particle size of ¾-inch and less than 5 percent passing the No. 4 sieve (ASTM D448, No. 467, No. 57, No. 67, or similar material) be placed beneath the floor slab to enhance drainage. The granular layer will ease construction, provide a capillary break, and aid in drainage. To remove any potential water collected under the slab, KCTE recommends a permanent dewatering system (i.e., sump pump) be installed during the installation of the crushed stone base course.

To reduce the effects of differential movement, slabs-on-grade should not be rigidly connected to columns, walls, or foundations unless it is designed to withstand the additional resultant forces. Floor slabs should not extend beneath exterior doors or over foundation grade beams, unless saw cut at the beam after construction. Expansion joints may be used to allow unrestrained vertical movement of the slabs. The floor slabs should be designed to have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage. We suggest joints be provided on a minimum spacing of 15 feet on center.

5.8 Seismic Design Considerations

The 2012 International Building Code requires a site class for the calculation of earthquake design forces. This class is a function of soil type (i.e., depth of soil and strata types). Based on the subsurface conditions of the site and the estimated shear strength properties of the materials in the upper 100 feet, Site Class “C” (i.e., very dense soil and soft rock profile) is recommended for this project.

5.9 Pavement Recommendations

Specific information on the type and volume of traffic was unavailable at the time of our subsurface exploration. We have assumed that traffic across the majority of the proposed parking areas will consist primarily of automobile and light truck traffic. Typical pavement sections for this type of traffic and facility are provided herein. A more thorough analysis of the pavement thickness design can be performed if data relating to volume and type of traffic are made available. Based on previous experience with the soil types encountered in the proposed parking lot, a CBR value of 3 was estimated for design of parking and drive pavement sections. The recommended pavement sections do not consider traffic loads from construction equipment.

5.9.1 Pavement Subgrade Preparation

Pavement subgrades should be prepared in accordance with the recommendations presented in the *Site Preparation* and *Engineered Fill* sections. Construction scheduling, involving paving and grading by separate contractors, typically results in a time lapse between the end of grading operations and the commencement of paving. Disturbance, desiccation, and/or wetting of the subgrade between grading and paving can result in deterioration of the previously completed subgrade. A non-uniform subgrade can result in poor pavement performance and local failures relatively soon after pavements are constructed.

We recommend that the pavement subgrades be proofrolled and the moisture content and density of the top 12 inches of subgrade be checked within two days prior to commencement of actual paving operations. If any significant event, such as precipitation, occurs after proofrolling, the subgrade should be reviewed by qualified personnel immediately prior to placing the pavement. The subgrade should be in its finished form at the time of the final review.

5.9.2 Typical Sections – Asphaltic Cement Concrete (ACC)

Full-depth asphaltic concrete pavements for parking areas utilized primarily by automobile traffic typically have a minimum thickness of 5.0 inches and drive lanes typically have a minimum thickness of 7.0 inches. Drive areas subject to heavy trucks, such as the area surrounding the dock, should have a minimum thickness of 9 inches. Asphalt pavement should be supported by 4-inches of compacted crushed stone (KDOT AB-3 or similar).

As an alternative to using an aggregate base, consideration could be given to stabilizing the subgrade with type "C" fly ash to a depth of 9 inches, incorporated at a rate of 15% by dry unit weight. All asphaltic concrete pavements should be constructed with a minimum surface course thickness of 2 inches. The above sections represent minimum design thicknesses and, as such, periodic maintenance should be anticipated.

5.9.3 Typical Sections – Portland Cement Concrete (PCC)

Portland cement concrete (PCC) pavements are recommended for all loading dock areas, trash receptacle pads, drive approaches, and other areas where heavy wheel loads will be concentrated. We recommend that the concrete pavements in these areas have a minimum thickness of 8.0 inches. We also recommend that a 4-inch-leveling and drainage course of clean, crushed rock be placed below all concrete pavements. The pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub drainage or connection to a suitable gravity outfall should be provided to remove water from the granular base.

5.9.4 Construction Considerations

Construction traffic on the pavements has not been considered in the above noted typical sections. If construction scheduling dictates the pavements will be subject to traffic by construction equipment/vehicles, the pavement thickness should be reconsidered to include the effects of the additional traffic loading. Construction traffic should not be allowed on partially completed pavements as the pavements will not have adequate structural capacity and could be damaged.

Periodic maintenance of all of the pavements should be anticipated. This should include sealing of cracks and joints and by maintaining proper surface drainage to avoid ponding of water on or near the pavement areas.

5.9.5 Drainage Considerations

If the asphaltic concrete sections are to include a granular base, the granular thickness should be uniform and the pavement subgrade should be graded to provide positive drainage of the granular base section. The granular section should be graded to adjacent storm sewer inlets or drainage ditches and provisions should be made to provide drainage from the granular section into the storm sewer. Drainage of the granular base is particularly important where two different sections of pavements (such as full-depth asphaltic concrete and Portland cement concrete with aggregate base) abut, so that water does not pond beneath the pavements and saturate the subgrade soils.

The performance of pavements will be dependent upon a number of factors, including subgrade conditions at the time of paving, rainwater runoff, and traffic. Rainwater runoff should not be allowed to seep below pavements from adjacent areas. All pavements should be sloped approximately 1/4 inch per foot to provide rapid surface drainage. Proper drainage below the pavement section helps prevent softening of the subgrade and has a significant impact on pavement performance and pavement life. Therefore, we recommend that a granular blanket drain be constructed at all storm sewer inlets within the pavement areas. The blanket drain should consist of clean, crushed stone aggregate extending a minimum of 6 inches below pavement subgrade level. The blanket drains should extend radially a minimum of 8 feet from each of the storm sewer inlets. The grade within the blanket drain should be sloped toward the storm sewer inlet, and weep holes should be drilled through the inlet to provide drainage of the granular section into the inlet. Placement of geotextile filter fabric across the weep holes could be considered to prevent loss of aggregate through the weep holes. These recommendations are very important for long-term performance of the pavements. Because pavements typically have relatively low factors of safety, it will be very important that the specifications are followed closely during pavement construction.

Based on our experience with similar projects, irrigation systems are commonly installed in the landscaped areas adjacent to portions of the pavement areas. If such an irrigation system is to be installed, we recommend that consideration be given to installing subsurface drainage lines between irrigated areas and the planned pavements. It has been our experience that the quantity of subsurface seepage originating from irrigated areas can be substantial and can adversely affect the performance of the pavement subgrade. Therefore, consideration should be given to constructing edge drain lines along the pavements located adjacent to irrigated areas, to intercept and remove subsurface water flowing from beneath the pavements. These lines should be constructed behind the curblines, on the upgradient side of the pavements, and should be sloped to provide positive gravity flow to a suitable outfall.

5.10 Moisture Protection

Foundation and concrete slab performance is influenced by how well runoff waters drain from the site. This drainage should be maintained both during construction and over the entire life of the project. The ground surface around the structures should be graded so that water flows rapidly away from the structure without ponding. The surface gradient needed to do this depends on the type of landscaping. In general, lawns within 5 feet of buildings or other structures should slope away at gradients of at least 2 percent. Densely vegetated areas should have a minimum gradient of 5 percent away from structures in the first 5 feet if it is practical to do so.

In general, the elevation of exterior grades should not be higher than the elevation of the subgrade beneath the slab to help prevent water intrusion beneath slabs. In any event, maintenance personnel should be instructed to limit irrigation to the minimum actually necessary to properly sustain landscaping plants. Should excessive irrigation, waterline breaks or unusually high rainfall occur, saturated zones and “perched” groundwater may develop. Consequently, the site should be graded so that water drains away readily without saturating the foundation or landscape areas. Potential sources of water (water pipes, drains, garden ponds, etc.) should be frequently examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired. Special care should be taken during installation of sub-floor water and sewer lines to reduce the possibility of leaks.

6.0 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 structure. 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. It is recommended that the geotechnical engineer be afforded the opportunity of a general review of the final design plans and specifications prior to construction in order to determine if they are consistent with the conclusions and recommendations given in this report. For this project, these geotechnical document review services will be provided as part of the geotechnical report cost.

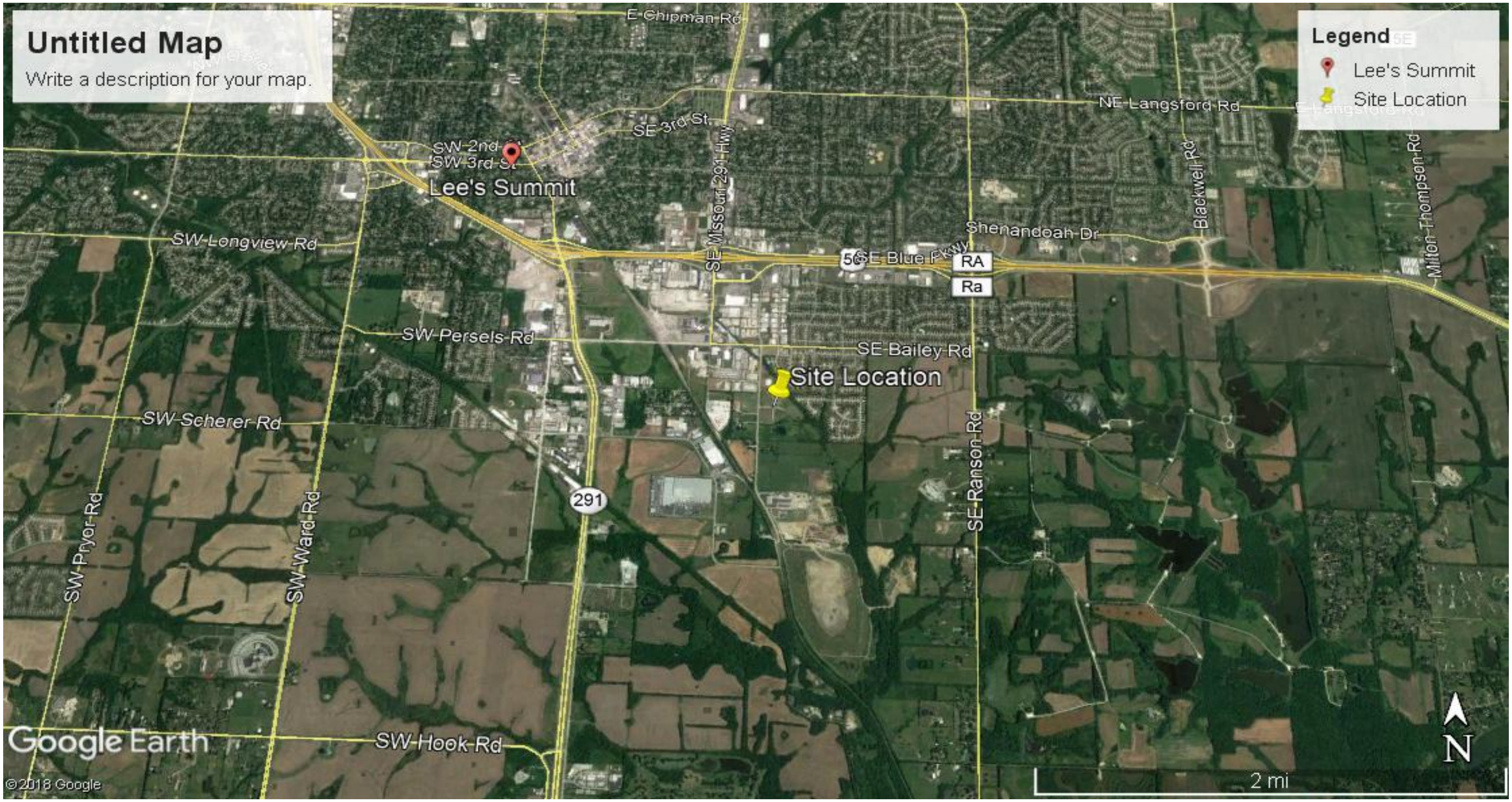
Particular details of foundation design, construction specifications or quality control may develop, and we would be pleased to respond to any questions that you may have regarding these details.

This report has been prepared with generally accepted geotechnical engineering practices used in this area at the time the report was prepared. No other warranty, expressed or implied, is made. The conclusions and recommendations are based upon the data obtained from the borings drilled at the approximate locations shown in *Appendix B*. The nature and extent of the subsurface variations between borings may not become evident until excavation is performed. If during construction, soil, bedrock, fill, or groundwater conditions appear to be different than described in this report, we should be notified immediately so that re-evaluation of our recommendations may be made. On-site observation of foundation construction and sub-grade preparation by KCTE is recommended.

The scope of our services did not include any environmental assessment or investigation for the presence of hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site.

APPENDIX A

PROJECT LOCATION PLAN



Scale: Not to Scale

North

Figure 1
Site Location Plan
Newberry Landing
Lee's Summit, MO

KANSAS CITY
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Note: Figure adapted from a Google earth® image.

APPENDIX B

BORING LOCATION DRAWING
BORING LOGS


594.41'
S2° 22' 25"W
X-W/M
SS
B-1
B-2
Building #293
8,800 sf
Lot Area 0.79 Ac
B-3
B-4
Building #294-B
8,800 sf
Lot Area 0.86 Ac
B-5
B-6
Building #294-A
13,000 sf
Lot Area 0.94 Ac
B-7
B-8
B-9
B-10
Building #296
8,800 sf
Lot Area 1.10 Ac
B-11
B-12
Building #297-B
13,000 sf
Lot Area 1.10 Ac
B-13
B-14

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BORING NUMBER B-01

CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/11/18 **COMPLETED** 4/11/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING 7.75 ft
NOTES
24hrs AFTER DRILLING 6.00 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - Fat clay, dark brown, stiff, moist										
			SS 1	67	3-4-6 (10)			25.5				
			SS 2	100	3-5-5 (10)			31.9				
5		FAT CLAY, brown, stiff, moist										
			SS 3	100	2-4-4 (8)			29.8				
			SS 4	100	2-4-5 (9)			27.6				
10												
		-with silt and sandstone at 13.5 feet	SS 5	160	50/5"			24.2				
15												

Bottom of borehole at 15.0 feet.

BORING NUMBER B-02

Kansas City Testing and Engineering, LLC
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CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/11/18 **COMPLETED** 4/11/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING 10.00 ft
NOTES
24hrs AFTER DRILLING 8.75 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - Fat clay, dark brown, stiff, moist										
			SS 1	83	3-5-7 (12)			26.0				
			SS 2	100	3-4-6 (10)			26.1				
5		FAT CLAY, brown, stiff, moist										
			SS 3	100	4-6-7 (13)			25.0				
			SS 4	100	2-4-6 (10)			25.7				
10												
		LIMESTONE	SS 5	100	50/1"			20.5				

Refusal at 13.5 feet.
Bottom of borehole at 13.0 feet.

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BORING NUMBER B-03

CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/11/18 **COMPLETED** 4/11/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING 12.50 ft
NOTES
24hrs AFTER DRILLING 4.00 ft

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	Pocket Pen. (tsf)
0	FILL - Fat clay, dark brown, stiff, moist										
		SS 1	67	4-6-7 (13)			22.6				
		SS 2	89	4-6-6 (12)			25.0				
5	FAT CLAY, tan, shaley texture, very stiff, moist										
		SS 3	100	2-7-17 (24)			16.8				
		SS 4	188	26-50/2"			17.9				
10											
	-highly weathered shaley texture at 13.5 feet	SS 5	214	35-50/1"			14.8				
15											

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-04

CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/11/18 **COMPLETED** 4/11/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING ---
NOTES
24hrs AFTER DRILLING 3.50 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - Fat clay, dark brown, stiff, moist	SS 1	72	3-6-6 (12)			20.1				
		FAT CLAY, gray and brown, stiff, moist	SS 2	89	3-5-5 (10)			28.4				
5			SS 3	133	13-50			24.9				
		HIGHLY WEATHERED SHALE	SS 4	130	20-50/4"			15.5				
10		LIMESTONE										

Refusal at 11.5 feet.
Bottom of borehole at 11.5 feet.

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BORING NUMBER B-05

CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/11/18 **COMPLETED** 4/11/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING ---
NOTES
▽ **24hrs AFTER DRILLING** 6.00 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - Fat clay, dark brown, stiff, moist										
			SS 1	61	3-6-5 (11)			29.5				
		FAT CLAY, brown and gray, stiff, moist	SS 2	89	3-5-6 (11)			22.0				
5		▽										
		-with iron nodules at 7 feet	SS 3	100	5-15-20 (35)			26.5				
		VERY WEATHERED SHALE	SS 4	100	10-20-25 (45)			18.0				
10												
			SS 5	100	18-50/2"			17.5				
15												

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-06

CLIENT G20-18-080 **PROJECT NAME** Newberry

PROJECT NUMBER G20-18-080 **PROJECT LOCATION**

DATE STARTED 4/11/18 **COMPLETED** 4/11/18 **GROUND ELEVATION** **HOLE SIZE** inches

DRILLING CONTRACTOR **GROUND WATER LEVELS:**

DRILLING METHOD **AT TIME OF DRILLING** ---

LOGGED BY SC **CHECKED BY** AM **AT END OF DRILLING** 13.00 ft

NOTES **24hrs AFTER DRILLING** 6.00 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - Fat clay, dark brown, stiff, moist										
			SS 1	72	3-4-4 (8)			25.9				
		FAT CLAY, brown, stiff, moist	SS 2	89	3-4-7 (11)			23.5				
5												
		-brown and grey below 6 feet	SS 3	100	3-3-3 (6)			28.1				
			SS 4	100	2-6-20 (26)			28.6				
10												
		VERY WEATHERED SHALE	SS 5	100	50/3"			14.7				

Bottom of borehole at 13.8 feet.

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BORING NUMBER B-07

CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/13/18 **COMPLETED** 4/13/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - fat clay, dark brown, stiff, moist										
			SS 1	67	4-4-4 (8)			25.5				
		FAT CLAY, gray, stiff, moist										
			SS 2	100	3-5-7 (12)			22.9				
5												
		-firm at 7 feet	SS 3	100	2-3-3 (6)			28.1				
			SS 4	100	50			36.4				
10		LIMESTONE										

Refusal at 10.7 feet.
Bottom of borehole at 10.7 feet.

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BORING NUMBER B-08

CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/13/18 **COMPLETED** 4/13/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTIC LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	Pocket Pen. (tsf)
0		FAT CLAY, gray, stiff, moist										
			SS 1	72	3-4-5 (9)			21.1	44	19	25	
			SS 2	100	3-5-7 (12)			25.8				
5												
			SS 3	100	4-5-6 (11)			32.4				
10			SS 4	100	2-3-5 (8)			32.5				
		LIMESTONE										

Refusal at 12.3 feet.
Bottom of borehole at 12.3 feet.

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BORING NUMBER B-09

CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/13/18 **COMPLETED** 4/13/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0		FAT CLAY, brown, stiff, moist										
			SS 1	67	3-5-5 (10)			24.4	43	27	16	
			SS 2	78	3-4-6 (10)			21.9				
5												
		-with silt and sandy shale fragments at 7 feet	SS 3	89	4-4-6 (10)			31.4				
		LIMESTONE	SS 4		50/0"							

Refusal at 9.2 feet.
Bottom of borehole at 9.2 feet.

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BORING NUMBER B-10

CLIENT	G20-18-080	**PROJECT NAME**	Newberry
PROJECT NUMBER	G20-18-080	**PROJECT LOCATION**	
DATE STARTED	4/13/18 **COMPLETED** 4/13/18	**GROUND ELEVATION**	**HOLE SIZE** inches
DRILLING CONTRACTOR		**GROUND WATER LEVELS:**	
DRILLING METHOD		**AT TIME OF DRILLING**	---
LOGGED BY	SC **CHECKED BY** AM	**AT END OF DRILLING**	---
NOTES		**AFTER DRILLING**	---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0		FAT CLAY, brown, stiff, moist										
			SS 1	83	2-4-4 (8)			28.0				
			SS 2	100	3-4-6 (10)			30.1				
5												
		HIGHLY WEATHERED SHALE	SS 3	100	50/3"			12.6				
		LIMESTONE						15.2				

Refusal at 7.5 feet.
Bottom of borehole at 7.5 feet.

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BORING NUMBER B-11

CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/11/18 **COMPLETED** 4/11/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING 10.50 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTIC LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	Pocket Pen. (tsf)
0		FAT CLAY, brown, firm, moist										
			SS 1	78	3-3-3 (6)			27.5	40	25	15	
			SS 2	100	3-3-3 (6)			25.9				
5		HIGHLY WEATHERED SHALE										
			SS 3	94	12-12-12 (24)			15.5				
10			SS 4	100	13-50							
		LIMESTONE										

Refusal at 11.2 feet.
Bottom of borehole at 11.2 feet.

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BORING NUMBER B-12

CLIENT G20-18-080 **PROJECT NAME** Newberry
PROJECT NUMBER G20-18-080 **PROJECT LOCATION**
DATE STARTED 4/13/18 **COMPLETED** 4/13/18 **GROUND ELEVATION** **HOLE SIZE** inches
DRILLING CONTRACTOR **GROUND WATER LEVELS:**
DRILLING METHOD **AT TIME OF DRILLING** ---
LOGGED BY SC **CHECKED BY** AM **AT END OF DRILLING** ---
NOTES **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTIC LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - Fat clay, dark brown, stiff, moist										
			SS 1	78	2-3-5 (8)			27.2				
		FAT CLAY, brown, stiff, moist										
			SS 2	89	3-4-5 (9)			26.1				
5												
			SS 3		50/0"							
		LIMESTONE										

Refusal at 8.0 feet.
Bottom of borehole at 8.0 feet.

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BORING NUMBER B-13

CLIENT	G20-18-080	**PROJECT NAME**	Newberry
PROJECT NUMBER	G20-18-080	**PROJECT LOCATION**	
DATE STARTED	4/11/18 **COMPLETED** 4/11/18	**GROUND ELEVATION**	**HOLE SIZE** inches
DRILLING CONTRACTOR		**GROUND WATER LEVELS:**	
DRILLING METHOD		**AT TIME OF DRILLING**	---
LOGGED BY	SC **CHECKED BY** AM	**AT END OF DRILLING**	---
NOTES		**▼ 24hrs AFTER DRILLING**	8.30 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - Fat clay, dark brown, stiff, moist	SS 1	78	3-4-6 (10)			21.4	48	26	22	
		FAT CLAY, brown, stiff, moist	SS 2	89	4-6-6 (12)			24.9				
5												
	▼		SS 3	100	3-5-5 (10)			30.9				
		-gray, firm, at 8.5 feet	SS 4	100	3-3-3 (6)			44.1				
10		LIMESTONE										

Refusal at 12.0 feet.
Bottom of borehole at 12.0 feet.

BORING NUMBER B-14

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CLIENT G20-18-080
PROJECT NAME Newberry
PROJECT NUMBER G20-18-080
PROJECT LOCATION
DATE STARTED 4/11/18 **COMPLETED** 4/11/18
GROUND ELEVATION **HOLE SIZE** inches
DRILLING CONTRACTOR
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY SC **CHECKED BY** AM
AT END OF DRILLING ---
NOTES
24hrs AFTER DRILLING 7.75 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	UNCONF COMPR. (psf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Pocket Pen. (tsf)
0		FILL - Fat clay, brown, firm, moist										
			SS 1	94	2-2-3 (5)			33.2				
		FAT CLAY, brown, firm, moist										
			SS 2	89	2-3-4 (7)			33.5				
5		HIGHLY WEATHERED SHALE										
			SS 3	94	3-4-6 (10)			30.3				
			SS 4	100	50			30.4				
		LIMESTONE										

Refusal at 9.3 feet.
Bottom of borehole at 9.3 feet.

APPENDIX C

LABORATORY TEST RESULTS

Kansas City Testing and Engineering, LLC
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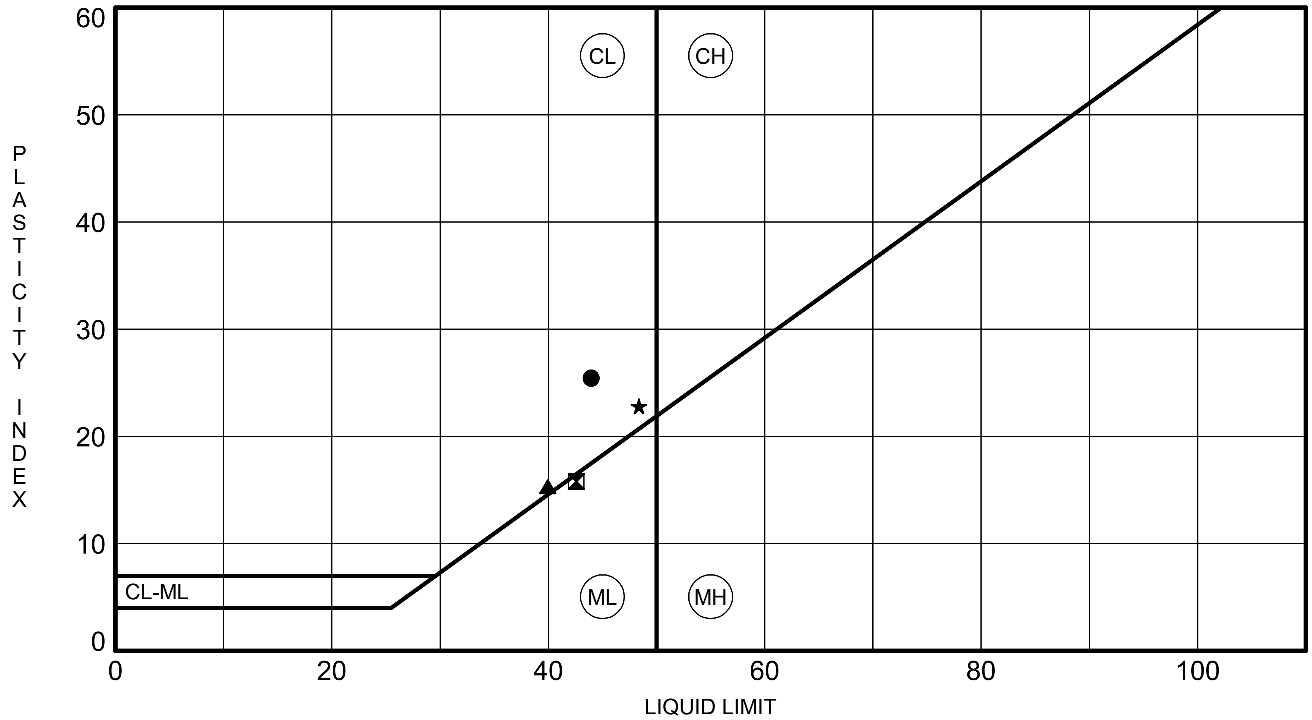
ATTERBERG LIMITS' RESULTS

CLIENT G20-18-080 **PROJECT NAME** Newberry

PROJECT NUMBER G20-18-080 **PROJECT LOCATION**



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-08**	**1.0**	**44**	**19**	**25**		
⊠	**B-09**	**1.0**	**43**	**27**	**16**		
▲	**B-11**	**1.0**	**40**	**25**	**15**		
★	**B-13**	**1.0**	**48**	**26**	**22**		

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SUMMARY OF LABORATORY RESULTS

CLIENT G20-18-080 **PROJECT NAME** Newberry

PROJECT NUMBER G20-18-080 **PROJECT LOCATION**

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-01	1.0							25.5			
B-01	3.0							31.9			
B-01	7.0							29.8			
B-01	8.5							27.6			
B-01	13.5							24.2			
B-02	1.0							26.0			
B-02	3.0							26.1			
B-02	7.0							25.0			
B-02	8.5							25.7			
B-02	13.0							20.5			
B-03	1.0							22.6			
B-03	3.0							25.0			
B-03	7.0							16.8			
B-03	8.5							17.9			
B-03	13.5							14.8			
B-04	1.0							20.1			
B-04	3.0							28.4			
B-04	7.0							24.9			
B-04	8.5							15.5			
B-05	1.0							29.5			
B-05	3.0							22.0			
B-05	7.0							26.5			
B-05	8.5							18.0			
B-05	13.5							17.5			
B-06	1.0							25.9			
B-06	3.0							23.5			
B-06	7.0							28.1			
B-06	8.5							28.6			
B-06	13.5							14.7			
B-07	1.0							25.5			
B-07	3.0							22.9			
B-07	7.0							28.1			
B-07	8.5							36.4			
B-08	1.0	44	19	25				21.1			
B-08	3.0							25.8			
B-08	7.0							32.4			
B-08	8.5							32.5			
B-09	1.0	43	27	16				24.4			
B-09	3.0							21.9			
B-09	7.0							31.4			
B-10	1.0							28.0			
B-10	3.0							30.1			
B-10	7.0							12.6			

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SUMMARY OF LABORATORY RESULTS

CLIENT G20-18-080 **PROJECT NAME** Newberry

PROJECT NUMBER G20-18-080 **PROJECT LOCATION**

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-10	8.5							15.2			
B-11	1.0	40	25	15				27.5			
B-11	3.0							25.9			
B-11	7.0							15.5			
B-12	1.0							27.2			
B-12	3.0							26.1			
B-13	1.0	48	26	22				21.4			
B-13	3.0							24.9			
B-13	7.0							30.9			
B-13	8.5							44.1			
B-14	1.0							33.2			
B-14	3.0							33.5			
B-14	7.0							30.3			
B-14	8.5							30.4			

APPENDIX D

GENERAL NOTES AND SOIL CLASSIFICATIONS FOR ENGINEERING PURPOSES

General Notes

KANSAS CITY TESTING & ENGINEERING, LLC

DRILLING NOTES

DRILLING AND SAMPLING SYMBOLS

AS	Auger Sample
CS	Continuous Sampler
HA	Hand Auger
HS	Hollow Stem Auger
PA	Power Auger
CF	Continuous Flight Auger
WB	Wash Bore
RB	Rock Bit
SS*	Split Spoon
ST	Shelby Tube

* The Standard Penetration Test (SPT) is conducted in conjunction with the split-spoon sampling procedure. The "N" value corresponds to the number of blows required to drive the the last 1 foot of an 18-inch-long, 2-inch O.D. split-spoon sampler with a 140-lb hammer falling a distance of 30 inches. The Standard Penetration Test is carried out according to ASTM D 1586.

WATER LEVEL MEASUREMENTS

ATD	At Time of Drilling
EOD	End of Drilling
AD	After Drilling

SOIL PROPERTIES & DESCRIPTIONS

TEXTURE

PARTICLE	*SIZE*
Clay	<0.002 mm
Silt	<#200 Sieve
Sand	#4 to #200 Sieve
Gravel	3 inch to #4 Sieve
Cobbles	12 inch to 3 inch
Boulders	> 12 inch

COMPOSITION

SAND & GRAVEL	
trace	< 15%
with	15% - 29%
some	> 30%
FINES (clay & silt)	
trace	< 5%
with	5% - 12%
some	> 12%

Soil descriptions are based on the Unified Soil Classification System (USCS) as outlined in ASTM D 2487 and D 2488. The USCS group symbol on the boring logs corresponds to the group names listed below. The descriptions include soil constituents, consistency or relative density, color and other appropriate descriptive terms. Geologic description of bedrock, when encountered, also is shown in the description column.

COHESIVE SOILS

CONSISTENCY	*UNCONFINED COMPRESSIVE STRENGTH* (psf)	(kPa)
Very Soft	< 500	< 24
Soft	500-1000	24-48
Medium Stiff	1001-2000	49-96
Stiff	2001-4000	97-192
Very Stiff	4001-8000	193-383
Hard	> 8001	> 384

PLASTICITY	Liquid Limit, %
Lean	< 45
Lean to Fat	45 - 49
Fat	> 50

COHESIONLESS SOILS

RELATIVE DENSITY	*N VALUE*
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 49
Very Dense	> 49

BEDROCK PROPERTIES & DESCRIPTIONS

ROCK QUALITY DESIGNATION (RQD)**

QUALITY	*RQD, %*
Very Poor	0-25
Poor	25-50
Fair	50-75
Good	75-90
Excellent	90-100

**RQD is defined as the total length of sound core pieces, 4 inches (102 mm) or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.

DEGREE OF WEATHERING

Slightly Weathered	Slight decomposition of parent material.
Weathered	Well developed and decomposed.
Highly Weathered	Highly decomposed, may be extremely broken.

SOLUTION AND VOID CONDITIONS

Solid	Contains no voids.
Vuggy	Containing small cavities < 1/2 " (13mm)
Porous	Containing numerous voids, may be interconnected.
Cavernous	Containing cavities, sometime large.

When classification of bedrock materials has been estimated from disturbed samples, core samples and petrographic analysis may reveal other rock types.

HARDNESS & DEGREE OF CEMENTATION

LIMESTONE	
Hard	Difficult to scratch with knife.
Moderately Hard	Scratch with knife but not fingernail.
Soft	Can be scratched with fingernail.
SHALE	
Hard	Scratch with knife but not fingernail.
Moderately hard	Can be scratched with fingernail.
Soft	Can be molded easily with fingers.
SANDSTONE	
Well Cemented	Capable of scratching with a knife.
Cemented	Can be scratched with knife.
Poorly Cemented	Can be broken easily with fingers.

BEDDING CHARACTERISTICS

TERM	*THICKNESS, INCHES (MM)*
Very Thick Bedded	> 36 (915)
Thick Bedded	12-36 (305-915)
Medium Bedded	4-12 (102-305)
Thin Bedded	1-4 (25-102)
Very Thin Bedded	0.4-1 (10-25)
Laminated	0.1-0.4 (2.5-10)
Thinly Laminated	< 0.1 (<2.5)

Bedding Planes - Planes dividing layers, beds or strata of rocks.
Joint - Fracture in rock, usually vertical or transverse to bedding.
Seam - Applies to bedding plane with unspecified weathering.

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 – 11
(Based on Unified Soil Classification System)

MAJOR DIVISIONS				GROUP SYMBOL	GROUP NAME
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel [F]
		Gravels with Fines More than 12% fines	Fines classify as ML or MH	GM	Silty gravel [F G H]
			Fines classify as CL or CH	GC	Clayey gravel [F G H]
	Sands 50% or more of coarse faction passes No. 4 sieve	Clean Sands Less than 5% fines	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand [I]
		Sands with Fines More than 12% fines	Fines classify as ML or MH	SM	Silty Sand [G H I]
			Fines classify as CL or CH	SC	Clayey sand [G H I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line	CL	Lean clay [K L M]
			PI < 4 or plots below "A" line	ML	Silt [K L M]
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OL	Organic clay [K L M N] Organic silt [K L M O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [K L M]
			PI plots below "A" line	MH	Elastic silt [K L M]
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OH	Organic clay [K L M O] Organic silt [K L M O]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
[D] Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $Cc=(D_{30})^2 / (D_{10} \times D_{90})$
[F] If soil contains ≥15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥15% gravel, add "with gravel" to group name.
If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
[K]. If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
[L] If solid contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A: line.
[P] PI plots on or above "A: line.
[Q] PI plots below "A: line.