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April 1, 2024

Geotechnical Report

Intrinsic Development

Brian Maenner
3622 Endeavor Ave. Ste. 101
Columbia, MO

The Village at Discovery Park Lot 13

At the intersection of NE Douglas & NW Colbern Rd
Lee's Summit, MO

OWN Proposal SP31-24-018
OWN Project 24SP30033

Report Prepared By:

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3622 Endeavor Ave. Ste. 101
Columbia, MO

Re: Geotechnical Report
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Lee's Summit, MO

OWN Proposal: SP31-24-018 / Project: 24SP30033

Dear Brian,

We appreciate the opportunity to provide this Geotechnical Report for the above referenced project. We have recently changed our name from Anderson Engineering, Inc. to OWN, Inc. to better match our people! We are still the same exact team of dedicated employee owners, now just with a better name that celebrates who we are. We look forward to working on this project with you.

Please contact Cody White, or myself with any questions. Thank you for the opportunity to be of service.

Sincerely,

OWN, Inc.

04/01/2024

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INTRODUCTION

This is the report on the results of a geotechnical investigation for the proposed project:

New multi-level buildings with parking and paving in Lot 13 of The Village at Discovery Park (The Village), Lee's Summit, Missouri

The purpose of this investigation was to perform an exploration of the subsurface soil conditions on the site and compile a report giving the findings of the exploration, logs of the borings, recommendations for the project above, and foundation design.

This investigation was performed for our client. The scope of our geotechnical investigation was detailed in our proposal and was to include drilling and sampling:

- The project proposal for the soils exploration includes 2 borings to 20 feet or auger refusal.
- An engineering report will be issued with the findings of the exploration and recommendations for site development, foundation design, and pavement design;
- An electronic copy of the report will be issued;

To accomplish the intended purpose of the geotechnical investigation, a study was conducted which consisted of (1) on-site borings to describe the subsurface conditions encountered in the borings with sampling of in-place soils; (2) laboratory analysis of the soil and rock samples obtained; and (3) an engineering analysis of the field drilling and laboratory data with an engineering report.

PROPOSED CONSTRUCTION

We understand the project will be located: see the attached sketch, and as described above. We understand or assume greater details about the development include:

- Buildings: Building 13 is planned to be a two story, athletic club with associated parking. The planned structure will have a footprint of approximately 20,000 square feet.
- Structure: Building 13, is assumed to be steel framed supported on shallow spread foundations and concrete slab on grade. Maximum column load is assumed to be 175 kips.
- Cut and fill: Ranging from 8-0 feet of fill.

The analysis and recommendations contained in this report are based upon the above-mentioned information regarding the proposed structures. If these assumptions are not correct, OWN, Inc. should be contacted to review the recommendations in light of the correct structural information.

WORK PERFORMED

ON-SITE BORINGS: The borings were generally drilled per our proposal referenced above. The borings were laid out in the field by our personnel based on the preliminary site plan and boring locations as provided by you. A sketch showing the general locations of the borings was prepared from this information and is included in the attachments as a boring location sketch.

If elevations are shown on the boring logs they are approximate elevations only taken from the topographic survey for the site and rounded to the nearest 0.5 to 1 foot based on field observations. Boring locations should be verified prior to the beginning of construction.

Representative soil and rock samples were taken of the different soil and rock encountered in the borings. These soil and rock samples were tested for moisture content, Atterberg Limits, penetrometer strength readings, and/or unconfined compressive strength readings.

The logs of borings drilled in this exploration program show descriptions of soil and rock units encountered, as well as results of field and laboratory tests presented in the attachments.

Soil samples obtained during drilling activities were taken using the split spoon sampler. This sampler is used while performing the standard penetration test. This test, described in ASTM D1586, consists of driving a two-inch diameter split spoon sampler using a weight of 140 pounds with a free fall of 30 inches. The number of blows to drive the sampler each of three successive 6-inch increments of depth in advance of drilling was recorded and is presented on the boring logs. The sum of the last two blow counts is normally taken as the penetration value expressed in blows per foot. The soil sample obtained from the sampler is considered disturbed, however, it is useful for strata identification, natural moisture content, Atterberg Limits, penetrometer strength values, and/or occasional unconfined compressive strength values.

For this project we used: CME-550X, with an automatic hammer - for purposes of our assessment of penetration resistance, we used approximately 80% efficiency, if required, in transferring energy for hammer blows per foot. This would allow us to compare to industry standard correlations developed for hammer blow resistance if required.

LABORATORY TESTING

All samples were transported to OWN's materials laboratory for further evaluation and testing. Laboratory soil testing included the determination of natural soil moisture content, Atterberg limit values, penetrometer strength readings, and permeability. Laboratory test results on soil samples recovered from the borings are recorded on the Boring Log contained in the attachments.

GEOLOGY OF THE SITE

A review of geologic maps of the area reveal the site is underlain by the Kansas City Group. Late Pennsylvanian - Missourian Series - This geologic formation consists primarily of shale and limestone with minor constituents of coal and sandstone.

SOIL MAPS

The County Soil Resource Survey (from our OWN online GIS) and the USDA Web Soil Survey were researched for the project and the soils onsite generally agree with the natural soils found during the investigation. See the attachments for soil information found.

SOIL
County Soil Resource Survey for the site is primarily mapped as:
Greeton silty clay loam, 5 to 9 percent slopes: 30080
Sampsel silty clay loam 5 to 9 percent slopes: 10117
Sharpsburg silt loam 2 to5 percent slopes: 10120

Parent Material, developed from:
Greeton: loess over residuum weathered from limestone and shale
Sampsel: residuum weathered from shale
Sharpsburg: loess

Restrictive features, bedrock:
Greeton: more than 80 inches
Sampse: more than 80 inches
Sharpsburg: more than 80 inches

Depth to water table:
Greeton: 12 to 30 inches
Sampse: 0 to 18 inches
Sharpsburg: 45 to 50 inches

Engineering properties for natural soils:
Greeton;
0 to 12 inches: silty clay loam
12 to 28 inches: silty clay loam, silty clay
28 to 30 inches: silty clay, silty clay loam
30 to 79 inches: clay, gravelly silty clay, silty clay

Sampse;
0 to 13 inches: silty clay loam
13 to 80 inches: silty clay loam, silty clay, clay

Sharpsburg;
0 to 6 inches: silt loam

6 to 16 inches: silty clay loam
16 to 46 inches: silty clay loam, silty clay
46 to 58 inches: silty clay loam, silty loam
58 to 79 inches: silt loam, silty clay loam

We drilled a nearby geotechnical project:
Project# 20KC10057: Highland Meadows, dated December, 2020.

In general we found:
Building Development Areas:

- Topsoil: dark brown topsoil damp to moist, medium firm to stiff, from 0 to 1 feet.
- Fill material: yellowish brown, lean to fat clay, CL-CH, with gray mottling damp to moist, stiff to very stiff, from 1 to 9.75-17 feet, Atterberg limits test showed LL= 45-61% with PI= 28-40%.
- 2nd deeper soil: yellowish brown shale, this was encountered in a weathered state, dense to very dense when fresh, from 5-15 feet to boring termination.
- 3rd deeper material: gray limestone fresh moderately strong moderately hard to hard, from 9.75-18.5 feet to boring termination.
- Groundwater was not encountered during drilling.

This past OWN project is generally similar to what the county soil survey reports.

VISUAL/ MAP AERIAL

The surface of the planned project area is generally:

- The site for The Village is approximately 40 acres, but is part of a much larger development. Building 13 is only one of the planned 14 structures to be built as part of The Village.
- At the time of drilling, fill placement was actively being completed in various locations of The Village. The pad site appeared to have been filled approximately 0 to 4 feet for building 13 prior to our arrival. Extensive grading activities were taking place during drilling operations. Large amounts of fill were being placed in multiple areas across the site.
- Multiple types of fill were being installed during drilling activities. Most of the fill appeared to be clays and some crushed limestone varying in size was also being placed in other areas of the project. No rock fill was observed being placed in the area of Lot 13.
- Some of the rock fill being placed in other areas was 2 to 3 feet in diameter. The contractor stated that the material still needed to be crushed or broken to a smaller size and then mixed with fines before final placement.
- Drainage from the footprint of Building 13 was to the west to where a natural swale was located. It was noted that fill material was being placed in a way that prevented water from ponding and pooling in other building footprints.

QUAD MAP; AERIALS PHOTOS, GOOGLE STREET VIEW

A review of the Quadrangle Map and past aerial photos shows the site:

- Quadrangle maps show drainage to the southwest in the area of Building 13. There is also a swale mapped to the west of Building 13.
- Past aerials show the site to have been a mixture of pasture and wooded areas. No past structures on the site were apparent.
- It appears that hay was cut in several areas of the site in the past. Crops may have also been grown on site. Discing fields can increase the depth of softer soils.
- Significant changes in elevation were shown on topographic maps prior to the start of construction on the site.

GENERAL SUBSURFACE CONDITIONS

The subsurface conditions encountered at the boring locations are shown on the boring logs. The stratification lines shown on the boring log represent the approximate boundary lines between the soil layers; in-situ, the transition may be gradual. Characterizations of the soil layers on the boring log were made from observations of the auger cuttings and split spoon samples.Below is a **generalized** description of the conditions encountered in the borings. The reader must refer to the boring logs and other attachments included with this report; there is more specific information in the logs and those documents. This information has been **simplified** to make it easier for the reader to grasp similarities in the borings; it should not be construed that this represents conditions throughout the site as soil conditions were only observed at the locations sampled and the soil conditions will vary from below, not only laterally but vertically from what is below and in the boring logs:

In general, we found: (see logs for details)

Building Development Areas:

- Fill: Gray shaley fat clay FILL, damp, very stiff, from 0 to 1 foot.
- 1st material encountered: Yellowish brown to brown shaley fat clay, CH, damp to moist, stiff to hard with interbedded limestone in the upper portion of Boring B-38-13, from 0 to 8.5-18.5 feet. Atterberg limits test showed LL= 57% with PI= 31%.
- 2nd deeper material: Gray shale, extremely to moderately weathered, extremely weak to weak rock, friable to low hardness, from 8-18.5 to 8.5-10 feet.
- 3rd deeper material: Limestone bedrock, fresh, moderately strong, moderately hard, from 10 to 11 feet or bottom of borehole in Boring B-37-13.
- Groundwater was not encountered during drilling.

Unified soil class was visually inspected during drilling activities and determined considering the Atterberg Limits and estimates of percent granular material present.

GROUNDWATER CONDITIONS

Groundwater was not encountered during drilling and should be planned for, especially in any deeper excavations, and in or near any drainage swales or near top of bedrock. It must be emphasized that the presence of perched groundwater in these soils can be encountered at any time and depth especially in fill soils, at the soil/rock interface, and near drainage swales. Rainfall and regional runoff will affect the groundwater conditions and the depths at which groundwater can be encountered will vary seasonally. As a result, the groundwater conditions encountered during construction may vary from those observed during this investigation.

The above is a generalized description of the conditions encountered in the borings. For more specific information, the reader should refer to the boring logs included in this report.

SUMMARY OF KEY SITE CONDITIONS AND CONCLUSIONS

A summary of the site and subsurface conditions considered pertinent to the site development and foundation design for the proposed facility are as follows:

1. Prior to construction this site was generally used for farming purposes and two broad swales crossed the site. One of the broad swales is mapped immediately to the west of Building 13. Even after filling this swale, groundwater will likely still migrate through the fill soil in the area of this swale.
2. This site is planned to have significant fill depths. In some areas, the fill is planned to exceed 8 feet in depth. On the east side of the building, some areas may require no cut as that end is very close to final grade.
    a. Fill material was encountered during drilling and was actively being placed during and still after completion of drilling operations. While on site it was apparent that several different types of fill were being placed. Depth shown on the boring log may be different than what is encountered due to the ongoing placement of fill across the site.
    b. Compaction equipment was observed at the site. Density tests and field reports prepared by UES and were provided for our review. In general, compaction of recently placed fill ranged from 99.0% to 100.0% and varied from optimum at 0.0 % below and 0.9% above.
3. Consolidation testing was completed on residual and remolded samples of soil from the project site. The remolded samples were moisture conditioned and compacted to generally match the condition of the fill being placed on the site. Stress strain relationships of the residual soils were generally as expected for residual soils in the area. Strain amounts for the remolded soils were higher than we expected. This may result in higher than expected settlement amounts within the fill soils being placed by the earthwork contractor.
4. Plasticity fat clays, CH, fill soils were found onsite and have a medium to high swelling or expansive potential.
5. Buildings bearing on deep and shallow fills have an increased risk for differential settlement. This can also be said for buildings bearing on residual soils and fill soils. It

is critical that fill material be placed in accordance with the recommendations outlined in this report to help reduce settlement.

Considering the above and information we know about this site, the following conclusions are of concern to us:

1. It appeared that earthwork operations had only taken place in some areas of lot 13. As such, it is recommended that any unstable soils related to the past swales and farming operations that occurred on the site should be removed if encountered. In areas where earth work has begun, it is assumed that these soils were removed by the earthwork contractor, under the supervision of the materials testing firm, prior to placement of fill. Again, in areas that earthwork has not commenced, unstable soils should be looked for and should be removed prior to placement of structural fill.
2. Buildings bearing on deep fills and residual material have an increased risk for differential settlement. It is critical that fill placed in these areas be installed following the recommendations in this report to reduce the risk of settlement. Ground stabilization improvements are also recommended in areas where fill has been placed.
3. The contractor has been using two general soil types for fill material on the development site. The first of the two fill soils encountered was a yellowish brown with gray lean to fat, clay CL-CH. The second fill soil encountered was a reddish brown fat, clay, CH. These materials all require specific considerations during placement to minimize settlement during and after construction. Moisture content and percent compactions should be carefully monitored during construction.
4. While preliminary structural designs plan for the use of shallow spread foundations, significant total and differential settlement amounts are anticipated for Building 13. **The owner should consult with the structural engineer of record to determine if the planned structure can withstand the anticipated settlements discussed below or if other structural considerations can be implemented in the construction of the structures to handle the settlement. The owner should also be aware that these anticipated settlement amounts are based on the site conditions present during drilling. Any soil boulder fill placed after drilling that does not meet the recommendations of this report will cause settlement amounts to be more than calculated.**
    a. Settlement calculations show total settlement amounts for Building 13 to be about 1.25 to 1.75 inches to up to 8.5 inches in the areas of deepest fill. Based on consolidation testing, about one-third of the total settlement will occur during construction resulting in about 0.75 to 1.25 inches of settlement that will occur after the structures are completed. A significant amount of differential settlement is also anticipated due to the varying fill depths across these structures. It is estimated that differential settlement, after construction, could range from 1/2 to 1 inch. These settlement calculations are based on the information that the fill placement will be completed 45 to 60 days prior to construction of the structure, therefore allowing the new fill to settle prior to construction of the structure.
5. Unless the structural engineer of record can plan for the settlements described above, it is recommended that the fill and residual soils be improved with Rammed Aggregate Piers (RAP):

a. The use of a shallow foundation system bearing on compacted fill and/or native soils improved in situ by the installation of a Geopier® or stone column-like system is recommended. Proper installation of stone columns or geopiers can increase the allowable soil bearing capacity of the existing foundation soils. This increase in allowable soil bearing capacity may allow the building to be constructed with decreased settlement potential. **A ground improvement system designer should recommend the design net allowable bearing pressure as proprietary information is involved in their calculations and assessment. Contact information for Geopier contractors can be provided upon request.**
b. RAP should be placed under the building pad and building foundation area.
c. You should not drive rammed aggregate piers into areas where rock fill has been placed. An alternative should be used in areas where rock fill has been placed. Additionally, an Engineering firm specializing in the installation of rammed aggregate piers should be consulted for design. Oftentimes, RAP specialty contractors have their own design engineers.

6. Alternatively to the use of RAP for ground improvement, The residual and fill soils could be preloaded with additional soil to induce settlement prior to construction of the structures. The owner of the site should understand that preloading will require significant time and the use of settlement plates to determine when settlement has decreased to a level at which the structures can be constructed. Recommendations for pre-loading are not provided in this report, but can be provided upon request.
7. No rock coring was conducted on the subject property. We suspect the limestone encountered in the bottom of the borings is massive bedrock beneath the overburden onsite. If foundations into rock become an option you must complete rock coring to establish bearing values and help identify the presence of voids, shelfs and pinnacles in the rock foundations are to be founded in.
8. Depending on final site grades, the high plasticity fat clays may be encountered at slab, and pavement depths. This soil is medium to highly plastic and has swell potential. If just highly plastic fat clay, with little sand and gravel is encountered, it is recommended that this material be removed for 24 inches below the bottom of slabs and for a depth of 12 inches below pavement areas, if encountered. The over-excavation should extend a distance of 2 feet horizontally beyond the edge of pavements and 5 feet beyond the outer edge of footings. Also, after over-excavation, moisture conditioning of the subgrade prior to placement of structural fill will be critical. These soils should be kept moist at all times and should not be allowed to dry. Highly plastic soils that become dry are very difficult to properly return them to a moist condition.
9. After over excavation and properly compacted fill placement, foundations will have to be at about 36 inches for frost depth. Lean concrete or properly compacted fill can be used for over-excavated soils deeper than 36 inch depth to keep reinforced concrete foundations at or below 36 inch frost depth.

Based on soil sampling and laboratory testing and assuming that the site development recommendations provided below are followed, we conclude that the proposed development could be constructed on the subject property with conventional earthwork methods and use of spread foundations for buildings **if above settlement amounts are acceptable or ground stabilization improvements are completed in the area where buildings will be located.**

RECOMMENDATIONS

SITE DEVELOPMENT

1. All site grading and excavations should be carefully observed for any DISTURBED soils, UNDOCUMENTED UNSTABLE FILL material, buried structures and/or soft/medium firm, unstable soils. Unstable soils often also include moist, medium firm soils.

2. Fat clays (CH) and Lean to Fat clays (CL-CH) with a plasticity index of 30 or more may be encountered at elevations where concrete slabs and pavements are anticipated to bear. If encountered, these soils should be removed for a depth of 24 inches below basestone for concrete slabs on grade and 12 inches below basestone for concrete pavements and should be replaced per the site development recommendations of this report.

3. All pavement, topsoil/surface soil, any DISTURBED soils, any UNDOCUMENTED FILL soils, surface soil with grass and roots, any buried root balls, tree roots, buried topsoil, and loose/soft/medium firm, and/or unstable soils should be stripped and removed from the construction areas down to stiff/medium dense, undisturbed, stable soils.

4. Controlled, compacted soil structural fill or granular base stone should be installed to bring the area to the proposed subgrade elevations. These materials should be submitted to OWN for approval.

5. Provisions must be made during construction to remove any water entering the excavation.

6. The shallow clays encountered in the borings contain considerable silt content. These soils can become unstable and pump under construction loads depending on their moisture condition at the time of construction. If pumping and/or rutting occur during work on the site, activity should be halted until the affected area can be over-excavated to firm soil or stabilized. Stabilization can normally be accomplished with aeration and re-compaction, the use of ground stabilization fabric, a working mat of existing clean coarse crushed stone, or admixture incorporation. The need for these measures will depend on the location, the soil, moisture, and weather conditions at the time of earthwork and can best be evaluated at that time. Due to the variability of encountered soils and a limited number of borings performed, provisions should be made in the construction documents to provide for some over-excavation of these soils depending on the time of year that the construction is performed for site development, foundations, and pavements.

7. Site work required to obtain final subgrade elevations for the proposed development should be performed using the following criteria. This may not be completely practical due to the narrow area to work in. You should contact us if alternative recommendations are needed:

    a. After the removal of any topsoil, existing UNDOCUMENTED FILL, any debris, concrete, and any soft/medium firm and unstable soils and soils described in the Conclusions and paragraphs 1, 2, and 3 above, the subgrade should be proof rolled with a fully loaded tandem axle dump truck weighing at least 20 tons and examined by a representative of the Geotechnical Engineer prior beginning filling operation. Should soft, unstable or spongy areas be found in the subgrade at that point, they should be removed and replaced with controlled, compacted fill or shot rock.

If soft, unstable, or spongy areas are found during proof rolling the geotechnical engineer of record should be retained to provide recommendations for repair.

b. After proof rolling, and examined by a representative of the Geotechnical Engineer (OWN, Inc.), and approval, the upper 6 inches of exposed subgrade should be scarified, adjusted to -1 to +3 percent above optimum moisture, and compacted to at least 95 percent of maximum dry density as determined by Standard Proctor procedures as outlined in ASTM D698. This step is very important to minimize possible future softening and or swelling of subgrade soils.

c. Compacted fill could consist of structural soil fill, of low to moderate plasticity silty clays. The inorganic silty clay soils should have liquid limits less than 55 and a plasticity index of less than 35; except, as discussed in the Summary, for upper 24 inches below basestone for concrete slabs on grade and 12 inches below basestone for concrete pavements, it should have a liquid limit than 45 and plasticity index less than 25 - this is LVC (Low Volume Change) material. For foundations, if exposed soil cannot be maintained in a moist condition, as verified by us, before concrete placement, then the upper 18 inches below the foundation should be LVC also.

On a case by case basis, soil with up to 30% or more chert content not meeting the above plasticity requirements can be considered for use as structural fill and approval by us. (It will require gradation and Atterberg Limits testing as a minimum; swell tests may also be required plus submittal to OWN)

d. Large size rock greater than 3 inches inhibits fill compaction and should be generally excluded from structural fill.

e. Structural fill for the building pad should be placed in no greater than 8 inch loose lifts and compacted to at least 98 percent of maximum dry density as determined by Standard Proctor procedures as outlined in ASTM D698. The compacted structural fill placed for the building pad should extend a minimum of 10 ft. beyond the outside edge of the footings.

Structural fill for the parking and drive areas should be placed in no greater than 8 inch loose lifts and compacted to at least 98 percent of maximum dry density as determined by Standard Proctor procedures as outlined in ASTM D698.

A testing frequency of at least one field density for each 2500 square feet of fill lift, but no less than 3 tests per lift is recommended within building areas. In pavement areas, the testing frequency may be one field density for each 5000 square feet of fill lift, but no less than 3 tests per lift.

f. Moisture content of fill material should generally be controlled between 1% below and 3% above optimum as determined by ASTM D698.

g. Continuous field inspection and field density and moisture content tests should be performed on each lift of the fill to help ensure compliance with project specifications.

8. Because the surficial soils, without chert rock, on the site will become “spongy" under construction loads, they should be protected from either inundation or drying out. The entire area should be graded to provide adequate slopes and drainage systems to ensure movement of water around the site and away from the building and parking areas.

9. The soils at the site are silty in nature and susceptible to erosion. Appropriate erosion control measures, such as site contouring during grading operations and siltation fences, should be used to keep eroded material on the site.

10. All discharge from the guttering system of the proposed building and any off site discharges should not be allowed to soak into grassy areas by the building but should be carried away from the building areas. We recommend 5% slopes away from the building for the first 10 feet of grassed or landscaped areas.

11. Grading, ditches, and drains must be designed into the site plan to move surface water rapidly around and away from the building area.

12. Fall and spring seasons in this area normally receive considerable rainfall and can present difficult drying conditions when periods of rainy, overcast weather persist. The workability of the silty clay soils found on the site that is suitable for use in fill construction is greatly affected by their moisture content. Every effort should be made to seal fill areas and grade them to drain before rainfall occurs. Areas that become wet will require effort and time to disc and aerate the soils to get them back to a workable condition. Depending on the weather conditions, it may be necessary for these areas to be cut out and replaced with suitable soils or soil and shot-rock combinations.

13. Construction performed during summer months which is typically drier weather would reduce subgrade preparation difficulties and associated costs.

FOUNDATION DESIGN

Foundation design for the proposed structures must consider two factors. Foundations should be designed so that maximum possible stresses transmitted to foundation soils and rock will not exceed allowable bearing pressures as computed from reliable shear strength data on the soil and/or rock.

In addition, foundations should be sized and founded to limit the maximum anticipated total or differential movements to magnitudes which can be tolerated by the planned structural system. Construction factors such as the installation of foundation units, excavation and fill placement difficulties and surface and groundwater conditions must also be considered.

1. For buildings where footings are bearing entirely on 10 feet or less of properly compacted fill and or on moist, stiff residual clay, may use a maximum allowable soil bearing pressure of up to 2,500 psf assuming that the site is prepared as recommended in this report and, as discussed in the Summary and Conclusions above, **the structural engineer of record MUST be consulted regarding acceptable settlement for the proposed structures. If settlement from unimproved ground is not acceptable to the structural engineer of record, the soils must be improved with RAP, at which point, the RAP contractor will provide the allowable bearing capacity of the improved soils.**

2. Footing excavations should be examined to verify bearing capacity before the soil is compacted and reinforcing steel is placed.

3. After the footing excavations are completed and inspected by a representative of the Geotechnical Engineer, the bottom of the footing excavation should be cleaned of all loose soil. After inspection and cleaning, the bottom of the footing excavation should be thoroughly compacted with a mechanical tamper prior to installing reinforcing steel.

4. The recommended bearing pressure listed above, based on following the recommendations made in this report, should provide a minimum factor of safety of approximately 3 against bearing capacity failure.

5. Minimum footing dimensions of 30 inches for spread footings and 18 inches for continuous footings should be used.

6. Exterior footings should be found a minimum of 36 inches or 3 feet below finished exterior grade to help ensure being below frost penetration.

7. All footing excavations should be flat or level and well cleaned of all loose, wet soil or rock prior to concreting.

8. We recommend the ultimate coefficient of sliding friction between concrete foundations and natural, stiff clay soils or properly compacted clay soils is 0.35. The ultimate passive pressure for depths lower than 3 feet is 250 pcf, equivalent fluid pressure. We recommend you neglect the passive pressure from shallower depths due to environmental effects.

9. Removal of groundwater accumulated in excavations should be required prior to placement of concrete.

10. Careful inspection of excavations should be performed during construction to detect any unanticipated conditions such as voids, soft zones of soil, debris, filled mine prospect hole excavations, structures or other conditions that could affect the

performance of the proposed structure foundation system. If such conditions are found, the project engineer should be notified before proceeding.

11. The strength and shrink-swell properties of the soil in the footing excavations will change if exposed to weather extremes. Every effort should be made to place concrete the same day as footing excavations. If protective measures are not taken on exposed footing excavations, additional excavation of disturbed soil may be required. Highly plastic, expansive clay that is allowed to dry, will often become stronger at that time, but the potential for excessive swell becomes more likely after the footing is placed.

FOUNDATION SOIL GROUND IMPROVEMENT

Should the above recommendations be prohibitive due to cost or available means and methods, the use of a shallow foundation system bearing on compacted fill and/or native soils improved in situ by the installation of a Geopier® or stone column-like system could be used.

1. All fill should be placed up to foundation subgrade level if the site is not already at that elevation prior to installing any ground improvement elements or foundations.

2. A ground improvement system designer should recommend the design net allowable bearing pressure as proprietary information is involved in their calculations and assessment.

3. Expected settlement should be provided by the ground improvement system designer; however, we would recommend a value of 1 inch or less be considered in the design by the RAP designer. The owner and/or structural engineer should verify expected settlements do not exceed design tolerances of the structure.

4. Settlements will depend upon the variability within the structural fill and native clay subsurface profile, structural loading conditions, ground improvement design, embedment of footings, and the quality of earthwork and foundation construction. The ground improvement system designer should verify the design meets the performance criteria provided by the manufacturer.

5. The ground improvement procedures anticipated for this project generally involve installing columns of compacted crushed stone into the uncontrolled fill and native clay soils, with various methods of installation. Considering the generally cohesive nature of the encountered soils, we anticipate a replacement method (e.g., vibro-replacement stone columns, Geopiers®) will be more appropriate than a displacement method. Ground improvement procedures are usually proprietary, with design and installation performed by a specialty contractor. Due to the specialty of the ground improvement procedures, we recommend that a performance specification be used for ground improvement systems. Depending on the gravel-like content of some of the subsurface soils, it may be necessary to use temporary casing when installing the ground improvement elements. If the owner or contractor is interested in utilizing a ground improvement system for this project, we recommend

that additional discussions occur, and that these discussions involve the structural engineer, the owner, and OWN, Inc. We also recommend that a pre-construction meeting occur involving these companies and the chosen ground improvement designer and installer to open the lines of communication and discuss the stages of construction and element testing and protection.

6. The ground improvement system normally includes a specialized method of placing and compacting granular fill. As such, we recommend that general considerations applicable to placing compacted fill also be implemented when installing ground improvement system elements per the manufacturer's standard design and installation requirements. For example, the granular fill used to form the element should not include frozen material. We recommend that no permanent portion of an element be installed in frozen soil (some elements are over-built during installation, and then excavated later during foundation construction), and that any portion of an element that is allowed to freeze after construction be removed and replaced. The granular fill used to form the element should be capped with compacted cohesive soil to prevent surface water from entering the element. Surface grading should promote runoff of surface water away from the construction area. Tests are usually performed on elements when they are installed (e.g., DCP tests on Geopier® elements). We recommend the tops of the elements be compacted from the surface with hand operated compaction equipment when exposed in foundation excavations. We also recommend additional tests be performed on the elements during construction, particularly if an extended period of time elapses between element installation and foundation installation. For example, for Geopier® elements, we recommend that records be kept of which elements have the DCP tests performed during initial installation, and that DCP tests be performed on these same elements during foundation construction.

EARTHWORK DURING INCLEMENT WEATHER

1. If wet conditions are encountered during the construction period, in addition to disking and aerating soils, or shot rock, chemical stabilization consisting of fly ash or a lime kiln dust such as Calciment could be used to stabilize the soil subgrade beneath the building pad and the parking areas.

2. Chemical stabilization should not take place if the ambient temperature is less than 45 degrees Fahrenheit.

EXCAVATIONS

1. Excavations into the soil overburden at the site should be able to be performed by conventional excavation techniques and heavy equipment available in this area although considerable effort and possible drilling and breaking may be required in hard or very dense layers of soil.

2. All excavation work should be carefully observed for soft, unstable soils and/or debris especially in any deep cut areas.

3. The contractor shall be responsible for designing the excavation slopes and/or temporary shoring and bracing. All trench excavations should meet the requirements specified in federal, state, and/or local safety regulations (e.g. the latest version of OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926). The effects of surcharge loads should also be considered in the design.

4. Soil types A, B, and C, as classified by OSHA Standards, are present at the project site.

5. The contractor should perform periodic inspections of all excavations to check for stability. Tension cracking, sloughing of the soils, unusually soft soil zones, or the bulging of soil at the toe of the slope indicate stability problems that should be investigated and corrected immediately. The contractor shall be responsible for the training and safety of all individuals entering trenches and working by excavated slopes.

6. Groundwater was not encountered during drilling and/or at the completion of drilling. NRCS reports shallow water, which may be perched. Groundwater can be encountered at any time and depth especially in these soils. As a result, the groundwater conditions encountered during construction may vary from those observed during this investigation.

7. Deeper cuts may require excavated slopes to be benched. The maximum height of the cut at the up-slope ridge of the bench is 4 feet. The overall slope should still comply with OSHA requirements.

8. Any highly plastic, CH subgrades, if encountered, should be excavated and covered the same day and not be allowed to dry out. Highly plastic soils that are allowed to dry out will shrink and swell considerably. This will affect and may damage overlying structures built over it. In our experience in this area, the depth of foundations at frost depth levels are generally deep enough to keep moisture levels relatively uniform from environmental changes. However, there is risk with putting slabs and other structures over highly plastic, CH soils (discussed earlier and below).

PAVEMENT DESIGN

1. Parking lots should be designed per the requirements of Lee's Summit *Unified Development Ordinance (UCO), Section 8.620. - Parking Lot Design.* Minimum pavement sections for Parking Lot Paving are provided in this section. For asphalt pavement, minimum pavement sections also include a stabilized subgrade consisting of six inches of granular base over geogrid OR six inches of granular base over six inches of chemically stabilized soil.
2. If chemical stabilization is chosen, pavement subgrades should generally be prepared as outlined in the City of Lee's Summit Design and Construction Manual *Section 2200 - APPENDIX for CHEMICAL STABILIZATION OF SOIL using CEMENT or LIME KILN DUST* and the SITE DEVELOPMENT section of this report.
    a. For planning purposes, it is recommended that cement or lime kiln dust be applied at a rate of 10 percent by dry weight.

b. A chemical stabilization design could be conducted to determine the minimum amount of chemical product needed to meet a specified strength requirement. This would require a sample of the desired chemical additive be provided for laboratory testing.

3. Just prior to paving, the pavement areas should be rough graded and then proof rolled with a loaded tandem axle dump truck. Subgrade areas that are disturbed and/or rutted during construction and backfilled trenches should be carefully observed during the proof rolling operations. Areas, where unstable or unsuitable conditions are found, should be cut out and replaced with controlled, compacted fill and re-proof rolled.
4. Minimum recommended pavement thicknesses per Section 8.620 are as follows:

Standard Duty Pavement:

Asphaltic Concrete:	1.5 Inches of Plant Mix Bituminous Surface Pavement
	4.0 Inches of Plant Mix Bituminous Base Pavement
	6.0 Inches of Crushed Limestone Base Rock
	Geogrid or 6.0 inches of stabilized subgrade
Concrete:	6.0 inches of Concrete
	4.0 inches of Crushed Limestone Base Rock

Heavy Duty Pavement:

Asphaltic Concrete:	1.5 Inches of Plant Mix Bituminous Surface Pavement
	5.0 Inches of Plant Mix Bituminous Base Pavement
	6.0 Inches of Crushed Limestone Base Rock
	Geogrid or 6.0 inches of stabilized subgrade
Concrete:	6.0 inches of Concrete
	4.0 inches of Crushed Limestone Base Rock

Heavy Duty Dumpster Pad Pavement:

Concrete:	7.0 Inches of Concrete
	Concrete strength at 28 days should be a minimum of 4,000 psi.
	7.0 Inches of Crushed Limestone Base Rock

The base rock sections above are based on the required Structural Number for the planned development traffic; they do not take into account the need for additional base rock thickness to facilitate construction. Additional base rock, especially for concrete sections, may need to be thicker to be able to support construction traffic prior to paving. Also, if specific traffic is known, these pavement sections should be checked. The minimums may need to be increased.

5. The Plant Mix Bituminous Pavement should meet the requirements of the Missouri Department of Transportation (MoDOT), Standard Specifications for Plant Mix Bituminous Pavement surface course (structural number coefficient = 0.42) as described in Section 401-Type BP-2. The Plant Mix Bituminous Base mix should

meet the requirements of Section 401 Plant Mix Bituminous Base (structural number coefficient = 0.34). The base rock (structural number coefficient = 0.14) can be constructed of compacted crushed limestone meeting the requirements of Section 304 for Aggregate Base Course. The maximum compacted thickness of any one layer of base rock material shall not exceed 6 inches with each lift compacted to 100% of maximum dry density as determined by ASTM D698 (Standard Proctor). The compacted thickness of a single layer of Plant Mix Bituminous Base Course shall be between 3 and 4 1/4 inches (except when a thinner layer thickness is specified) with each layer compacted to 95% of 50 blow Marshall Density (ASTM D1559). The compacted thickness of a single layer of Plant Mix Bituminous Pavement shall not exceed 2 inches for the surface course with each layer compacted to 98% of a laboratory specimen made in the proportions of the job-mix formula in accordance with AASHTO T167 or 96% of a laboratory specimen made in proportions of the job-mix formula in accordance with AASHTO T245.

6. Concrete pavements should meet the requirements of Section 502 of the MODOT standard specifications for Portland Cement concrete pavements. Concrete strength at 28 days should be a minimum of 4,000 psi.

7. Truck pad areas, where heavy trucks travel and park such as loading dock areas and areas in front of trash dumpsters should be constructed of 7 inches of concrete over 7 inches of base rock. For trash dumpsters, the concrete pad should be extended far enough to include the front and rear axles when lifting trash dumpsters.

8. Care must be taken to develop positive drainage across and from around the pavement edges. Water allowed to pond on or adjacent to pavements would increase the potential for moisture intrusion into the subgrade soils and could result in premature pavement failure.

9. The pavement sections given above are minimums for the design criteria. Periodic maintenance of the pavement is anticipated in the designs. A maintenance program that includes surface sealing, joint cleaning and sealing, and timely repair of cracks and deteriorated areas will increase the pavement's life.

SEISMIC CONDITIONS

1. For IBC 2018 purposes, this site should be considered a Site Class “D”.

CONCRETE FLOOR SLAB SUBGRADE PREPARATION

1. The concrete floor slab and other concrete slabs should be underlain by a minimum of 6 inches of compacted granular base course material having a maximum aggregate size of 1 ½ inches and no more than 10% passing the #200 sieve. This granular layer should be compacted to <u>at least 98% of maximum dry density and within 2% of optimum moisture content,</u> as determined by a Standard Proctor test, ASTM D 698.

The concrete slab stone subgrade should be smooth and free from irregularities in surface elevations, such as tire rutting, differences in surface elevations from passes of compaction equipment, and or use of open-graded stone without sand infilling or "choking" layer, etc. These surface elevation variations will provide areas for passive resistance to develop in the concrete during curing and restrained shrinkage cracks may occur.

2. Even after preparing the subgrade as detailed in the Site Development section of this report, it has been our experience that the concrete slab subgrades are often disturbed between completion of grading and slab construction due to weather, footing, and utility line installation, and other construction activities. For this reason, the subgrade should be evaluated by a geotechnical engineer just prior to installing the reinforcing for the slab. Areas judged by the geotechnical engineer to be unacceptable should be undercut and replaced with compacted crushed stone.

3. Highly plastic soils, if encountered, should not be within 24 inches below basestone for concrete slabs on grade and 12 inches below basestone for concrete pavements. Depending on final floor elevations, this may require over-excavation of highly plastic clays. Soils used to bring the area to subgrade should meet the criteria of the Site Development section.

4. Backfill against stem walls inside buildings should be made with a crushed limestone conforming to ASTM C33, Size 57, or equal, to minimize settlement potential. The stone should be wetted and compacted until no further consolidation is observed.

5. A vapor barrier consisting of a minimum of 6 mil polyethylene on the 6 inches of crushed base rock should be used immediately below the concrete floor slab.

6. The modulus of subgrade reaction for controlled, compacted fill of these silty clay soils with the above recommended granular base, and site development performed as recommended in this report would be 150 psi/in.

LIMITATIONS

This report has been prepared for the exclusive use of our client for specific application to the project discussed in accordance with generally accepted soils engineering practices common to the local area. This report must be read in its entirety. No other warranty, express or implied, is made. Issues beneath the ground are a significant source of issues in construction projects where risk cannot always be removed, though it can be handled. This geotechnical investigation is provided to aid in handling these risks.

Geotechnical investigation reports are unique to the specific project for which they are written. Factors considered in the preparation of this geotechnical investigation report include, but are not limited to, specific project information, specific site information, the soils encountered in the borings, and the client's risk level. This report is specifically prepared for this project and any change in project or site information should be brought to our attention so that adjustments to recommendations can be made, if necessary. Also, this report should not be relied upon by anyone other than the client for which it is written without our prior approval.

The analyses and recommendations contained in this report are preliminary and are based on the data obtained from the referenced subsurface explorations. The borings indicate subsurface conditions only at the specific locations and time, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between such locations. Inferences are made between the conditions encountered in the borings and the validity of the recommendations is based in part on assumptions about the stratigraphy made by the geotechnical engineer. Such assumptions may be confirmed only during earthwork and foundation construction. If subsurface conditions different from those described are noted during construction, recommendations in this report must be re-evaluated.

<u>It is advised that OWN be retained to consult with design team members and to review portions of drawings that are applicable to this geotechnical investigation report to limit the possibility of recommendations in this report being misunderstood by other members of the design team.</u> It is advised that OWN, Inc., be retained to observe foundation installation and earthwork construction in order to help confirm that our assumptions and preliminary recommendations are valid or to modify them accordingly. OWN, Inc., cannot assume responsibility or liability for the adequacy of recommendations if it does not observe construction.

The scope of this evaluation was limited to an evaluation of the load carrying capacity and stability of the subsoils. Oil, hazardous waste, radioactivity, irritants, pollutants, molds, or other dangerous substances and conditions in the soil, groundwater or surface water within or beyond the site studied were not the subject of this report. Their presence and/or absence are not implied or suggested by this report, and should not be inferred. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by OWN, Inc. OWN, Inc., is not responsible for any claims, damages, or liability associated with the interpretation of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of OWN, Inc. An especially potent method for handling risks related to underground concerns, especially those that stem from unforeseen factors, is to retain the engineer who authored the report for inspections, observations, and or additional investigations. Before a client seeks to use a geotechnical report, they should always ask the geotechnical engineer to determine if the geotechnical report is still reliable in light of present site conditions.

Appendix I

Site Location Sketch
Soil Boring Location
Current Aerial Photograph

Appendix II

Log Legend
Unified Soil Classification System
Boring Logs

Appendix IIA

Research
Photos, etc. (if available)
Site Checklist (if included)
Additional Information (if available)

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Appendix I

Figures

- **Site Location Sketch**
- **Soil Boring Location**

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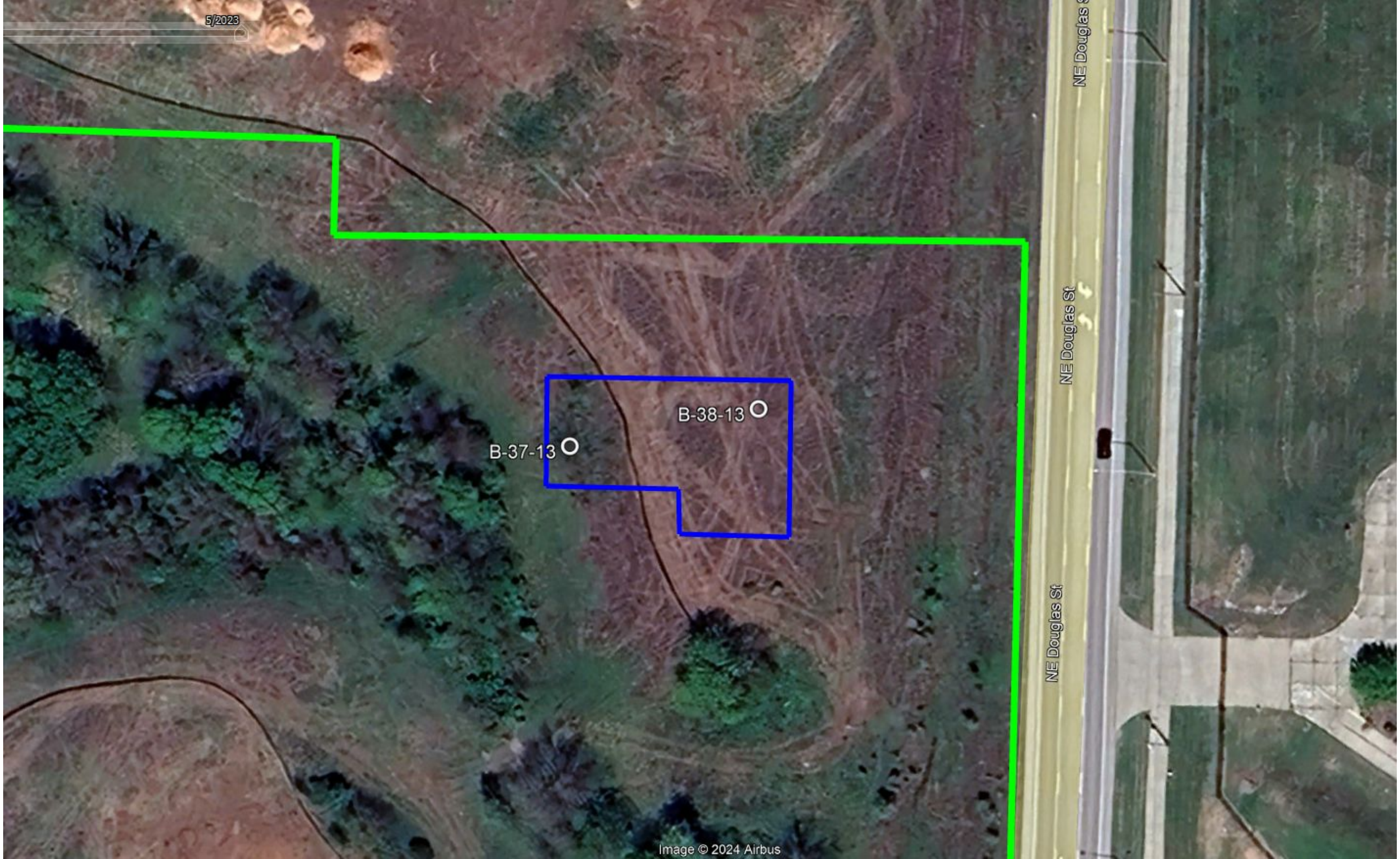

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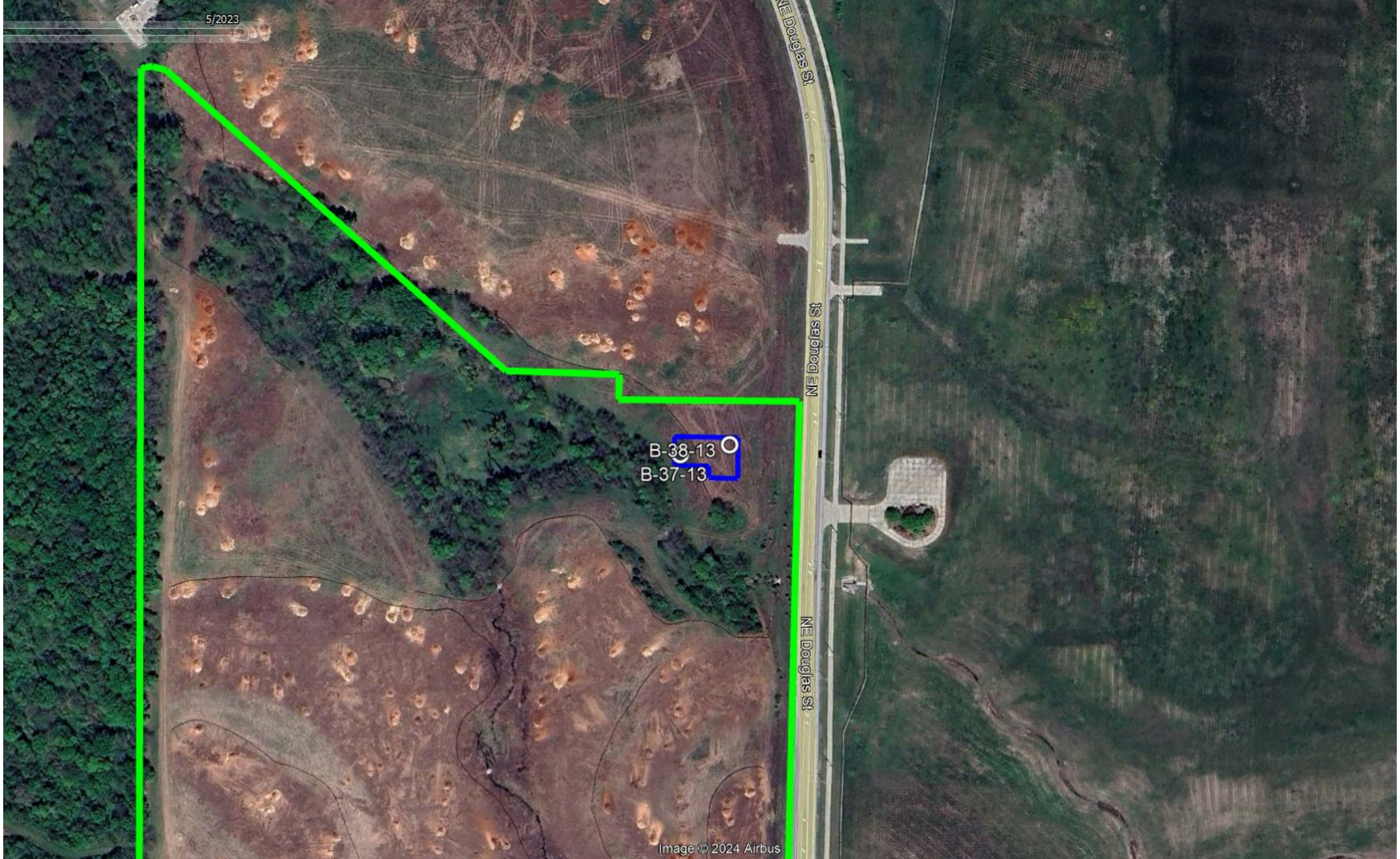
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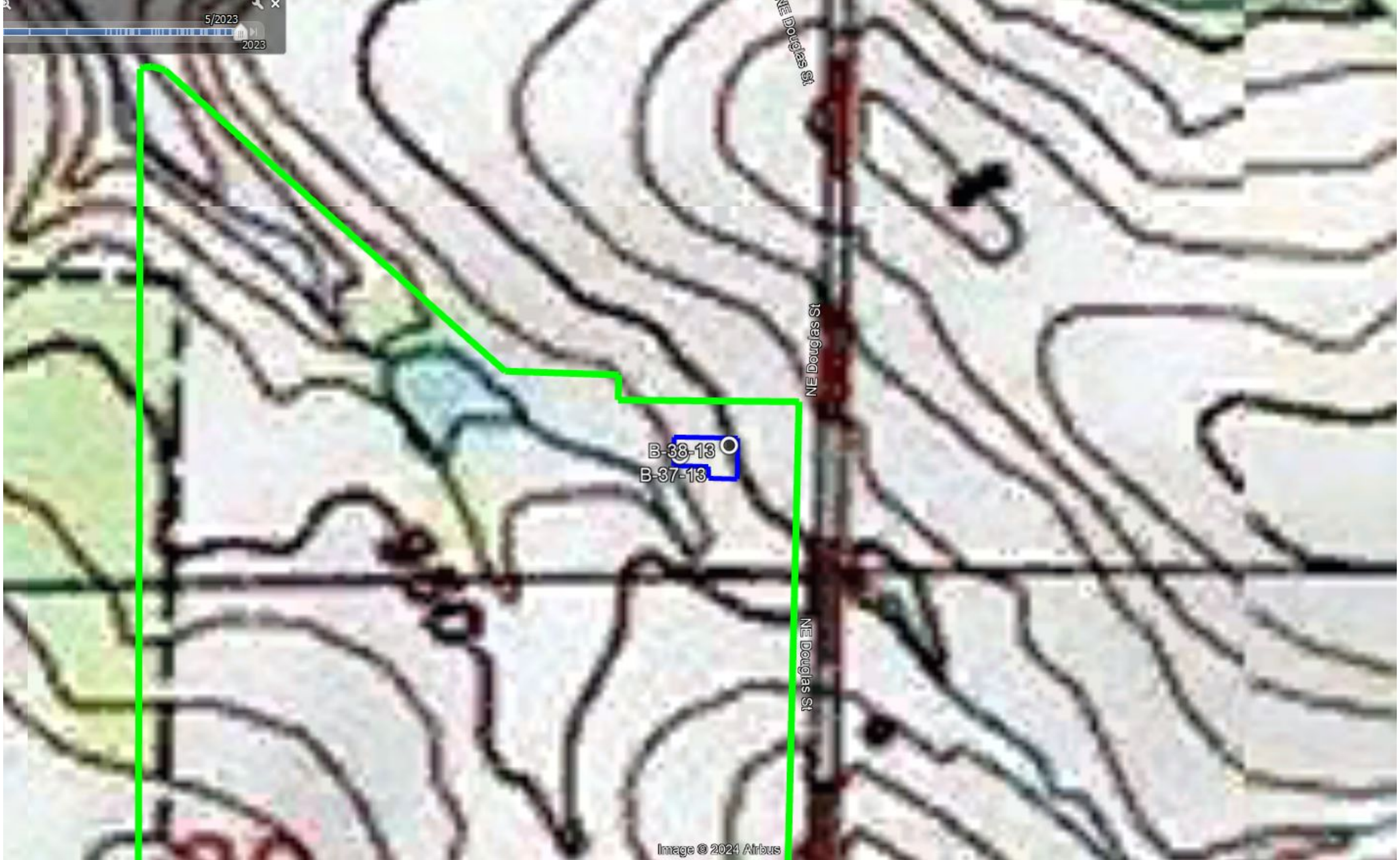
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Appendix II

Borings

- **Log Legend**
- **Unified Soil Classification System**
- **Boring Logs**

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BORING LOG LEGEND

DRILLING & SAMPLING SYMBOLS

LITHOLOGIC SYMBOLS (Unified Soil Classification System)

	FILL
	UNSTABLE SOIL
CL	LOW PLASTICITY CLAY
CH	HIGH PLASTICITY CLAY
ML	LOW PLASTICITY SILT
MH	HIGH PLASTICITY SILT
SW	WELL GRADED SAND
SP	POORLY GRADED SAND
SM	SILTY SAND
SC	CLAYEY SAND
GW	WELL GRADED GRAVEL
GP	POORLY GRADED GRAVEL
GM	SILTY GRAVEL
GC	CLAYEY GRAVEL

DRILLING	SAMPLING	WELLS
HOLLOW STEM AUGER (HSA)	SPLIT SPOON (SS)	SAND PACK
SOLID STEM / POWER AUGER (SA / PA)	SHELBY TUBE (ST)	W/SLOTTED CASING
ROCK BIT (RB)	AUGER	CONC-GROUT/FILL
ROCK CORE (RC)	GRAB/BULK (GS/BS)	BENT-GROUT/SEAL
	ROCK CORE (RC)	CEMENT/BENT GROUT

AUGERS: Hollow Stem (HSA), Solid Stem (SSA), ROCK BIT: RB, HAND AUGER: HA
ROCK CORE: with Diamond Bit (DB),
SPLIT SPOON: 2" O.D., SHELBY TUBE: 3" O.D.

___ LBS or ____ PSI next to DRILLING METHOD OR SHELBY TUBE SAMPLER is down pressure to advance or sample at depth shown.

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and ASTM D-2487 and D-2488. They include consistency, moisture, and color. field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.

Fine grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays, if they are plastic, and silts if they are slightly plastic or non-plastic. Coarse grained soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: sand, gravel, cobbles, or boulders. Other descriptions include: color, moisture, consistency for clays and silts, and relative density for granular soils. Geologic description of bedrock if encountered is also shown.

2. Surface elevations and horizontal locations, for borings, test pits, mapped data, GIS information, if provided, should be considered approximate or estimated. They are provided to illustrate the relative location of a sample location to other sample locations. Their accuracy for survey grade location should not be relied upon, unless they have been surveyed and specifically noted.

3. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not guaranteed to be representative of subsurface conditions at other locations or times. Graphic descriptions are for illustrative purposes only. Authorized users must read the boring log, legend, and report.

ABBREVIATIONS

N	- BLOWS PER FOOT
LL	- LIQUID LIMIT (%)
PL	- PLASTIC LIMIT (%)
PI	- PLASTIC INDEX (%)
LI	- LIQUIDITY INDEX (%)
W	- MOISTURE CONTENT (%)
DD/WD	- DRY/WET DENSITY (PCF)
NP	- NON PLASTIC
-200	- % PASSING # 200 SIEVE
PP	- POCKET PENETROMETER (TSF) ">" is greater than; "<" is less than
UC	- UNCONFINED COMPRESSION
PID	- PHOTOIONIZATION DETECTOR
ppm	- PARTS PER MILLION

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

Water levels indicated on the Boring Logs are the levels measured in the borings at the time indicated. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with short term observations.

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Key to Soil Symbols and Terms

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE-GRAINED SOILS: Sands and Gravels

Descriptive Terms	Relative Density	SPT Blow Count
Very loose	0 to 15 %	< 4
Loose	15 to 35 %	4 to 10
Medium dense	35 to 65 %	10 to 30
Dense	65 to 85 %	30 to 50
Very dense	85 to 100 %	> 50

FINE-GRAINED SOILS: Silts and Clays

Descriptive Terms	Unconfined Compressive Strength tsf	SPT Blow Count
Very soft	< 0.25	< 2
Soft	0.25 to 0.5	2 to 4
Medium firm	0.5 to 1.0	4 to 8
Stiff	1.0 to 2.0	8 to 15
Very stiff	2.0 to 4.0	15 to 30
Hard	> 4.0	> 30

SPT: Standard Penetration Test: Number of blows of 140 LB hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) Split-spoon sample (SS) the last 12 inches of an 18-inch drive (ASTM-1586).

COMPOSITION:

Sands and Gravels

Descriptive Terms	% FINES by Dry Weight
Trace	0 to 5 %
With	5 to 15%
Clayey, Silty	> 15%

Silts and Clays

Descriptive Terms	% COARSE by Dry Weight
Trace	0 to 15 %
With	15 to 30%
Sandy, Gravelly	> 30%

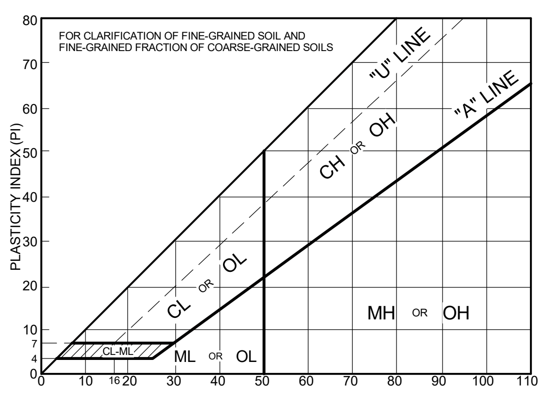
PLASTICITY

Descriptive Terms	Liquid Limit
Lean	< 50%
Fat	> 50%

Descriptive Terms	Plasticity Index
Non-plastic	0
Very Low	1 to 10%
Low	11 to 20%
Medium	21 to 30%
High	31 to 40%
Very High	> 40%

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW
		Gravel with fines (Appreciable amount of fines)	GM* d / u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4. Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-silt mixtures	Atterberg limits above "A" line or P.I. greater than 7
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP	Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM* d / u	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4. Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line or P.I. greater than 7
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and Clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or disto-maceous fine sandy or silty soils, organic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
	Highly Organic Soils		Pt	Peat and other highly organic soils	

Determine percentages of sand and gravel from grain size curve, Depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows:
Less than 5 percent....... GW, GP, SW, SP
More than 12 percent....... GM, GC, SM, SC
6 to 12 percent....... Borderline cases requiring dual symbols**



Plasticity Chart

Material		Particle Size: Sieve sizes	Particle Size: mm
Sand:	Coarse	#10 to #4	2.00 to 4.76
	Medium	#40 to #10	0.42 to 2.00
	Fine	#200 to #40	0.074 to 0.42
Silt		< # 200 (do hydrometer)	0.002 to 0.074
Clay		-	< 0.002 (< 0.005 for USDA)

Material		Particle Size: Sieve	Particle Size: mm
Gravel	Fine	#4 to 3/4 in.	4.76 to 19.1
	Coarse	3/4 in. to 3 in.	19.1 to 76.2
Cobble		3 in. to 12 in.	76.2 to 304.8
Boulders		12 in. to 36 in.	304.8 to 914.4

* Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg Limits: suffix d used when L.L. is 23 or less and the P.I. is 6 or less; the suffix is used when L.L. is greater than 26.

** Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

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Key to Rock Symbols and Terms

LIMESTONE	CHERTY LIMESTONE
DOLOMITE	OOLITIC LIMESTONE
SHALE	CHERTY DOLOMITE
SILTSTONE	SANDSTONE
BROKEN ROCK	CHERT
WEATHERED ROCK	VOID
HIGHLY WEATH. ROCK	COAL

ROCK QUALITY DESIGNATION (RQD)
Description of Rock Quality

Descriptive Terms	% RQD
Very Poor	0 to 25 %
Poor	25 to 50%
Fair	50 to 75%
Good	75 to 90%
Excellent	90 to 100%

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

TERMS DESCRIBING WEATHERING, STRENGTH, OR HARDNESS

WEATHERING:

Descriptive Terms	Recognition
Extremely Weathered -	Material can be granulated by hand.
Highly Weathered -	More than half of the rock is decomposed; rock is weakened so that a 2 inch diameter sample can be broken readily by hand across rock fabric.
Moderately Weathered -	Rock is discolored, a minimum 2 inch diameter sample cannot be broken readily by hand across rock fabric.
Slightly Weathered -	Rock is slightly discolored, but not noticeably lower in strength than fresh rock.
Fresh -	Rock shows no discoloration, loss of strength, or other affect of weathering.

STRENGTH:

	Recognition
Extremely Weak Rock -	Can be indented by thumb nail. May be broken by hand readily.
Very Weak Rock -	Can be peeled by pocket knife. Crumbles under firm blow with end of a rock hammer. May be broken by hand with difficulty.
Weak Rock -	Can be peeled by with difficulty with pocket knife.
Moderately Strong Rock -	Can be indented 5 mm (0.2 inches) with sharp end of pick.
Strong Rock -	Requires one hammer blow to fracture.
Very Strong Rock -	Requires many hammer blows to fracture.
Extremely Strong Rock -	Can only be chipped with hammer blows.

SCRATCH HARDNESS:

Descriptive Terms	Recognition
Soft -	Applicable only to plastic materials.
Friable -	Easily crumbled by hand, pulverized, or reduced to powder; to soft to be cut by pocket knife.
Low Hardness -	Can be gouged deeply or carved with a pocket knife.
Moderately Hard -	Can be readily scratched by knife blade; scratch leaves heavy trace of dust and is readily visible after powder has been blown away.
Hard -	Can be scratched with pocket knife only with difficulty; scratch produces little powder; traces of knife steel may be visible.
Very Hard -	Cannot be scratch with pocket knife; knife steel marks are left on surface.

*
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BORING NUMBER B-37-13

CLIENT INTRINSIC DEVELOPMENT
PROJECT NAME THE VILLAGE AT DISCOVERY PARK
PROJECT NUMBER 24SP30033
PROJECT LOCATION LEE'S SUMMIT, MO
DATE STARTED 3/6/24 **COMPLETED** 3/6/24
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR OWN ATV-17
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger 4"
AT TIME OF DRILLING --- NO WATER
LOGGED BY JS-CH **CHECKED BY** GW
AT END OF DRILLING --- NO WATER
NOTES LOT 13
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	Unconfined Qu, (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PI / LI
0–1	GRAY SHALEY FAT CLAY, DAMP, VERY STIFF **FILL**	SS		8-9-11 (20)			14.5			
1–2.5	LITTLE RECOVERY YELLOWISH BROWN SHALEY FAT CLAY WITH GRAY MOTTLES, DAMP, HARD	SS		7-11-13 (24)	4.5		21.3			
3.5–5	DAMP, HARD	SS		4-12-39 (51)	> 4.5		21.1			
5–6.5	DAMP, STIFF	SS		8-5-5 (10)			11.5			
8.5–10	GRAY SHALE, EXTREMELY WEATHERED, EXTREMELY WEAK ROCK, FRIABLE LITTLE RECOVERY	SS		50/1"			22.8			
10–11	LIMESTONE, FRESH, MODERATELY STRONG ROCK, MODERATELY HARD, DRILLED WITH 1000 PSI PULL DOWN PRESSURE									

Drilling method column note at 8.5 ft: 1000

Bottom of borehole at 11.0 feet.

OWN, Inc.
3213 S. West Bypass
Springfield, MO 65807
Telephone: 417-866-2741
Fax: 417-866-2778

BORING NUMBER B-38-13

CLIENT INTRINSIC DEVELOPMENT
PROJECT NAME THE VILLAGE AT DISCOVERY PARK
PROJECT NUMBER 24SP30033
PROJECT LOCATION LEE'S SUMMIT, MO
DATE STARTED 3/6/24 **COMPLETED** 3/6/24
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR OWN ATV-17
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger 4"
AT TIME OF DRILLING --- NO WATER
LOGGED BY JS-CH **CHECKED BY** GW
AT END OF DRILLING --- NO WATER
NOTES LOT 13
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DRILLING METHOD	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	Unconfined Qu, (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PI / LI
0		YELLOWISH BROWN SHALEY FAT CLAY, DAMP, VERY STIFF		SS		5-7-14 (21)	3	3.16	20.5	57	26	31 -0.18
2		BROKEN LIMESTONE COBBLE, DAMP, VERY DENSE		SS		14-28-34 (62)			14.4			
3		YELLOWISH BROWN AND GRAY SHALEY FAT CLAY, DAMP, STIFF		SS		5-4-5 (9)			18.4			
5		BROKEN LIMESTONE COBBLE, MEDIUM DENSE LITTLE RECOVERY		SS		5-5-5 (10)						
6		BROWN AND REDDISH BROWN FAT CLAY, MOIST, STIFF		SS		4-6-8 (14)	2.5		28.0			
13.5		REDDISH BROWN FAT CLAY WITH YELLOW MOTTLES, MOIST, STIFF		SS		3-4-5 (9)	2.5		36.2			
18.5		GRAY SHALE, MODERATELY WEATHERED, WEAK ROCK, LOW HARDNESS	1000	SS		50/1"			14.5			

Bottom of borehole at 20.0 feet.

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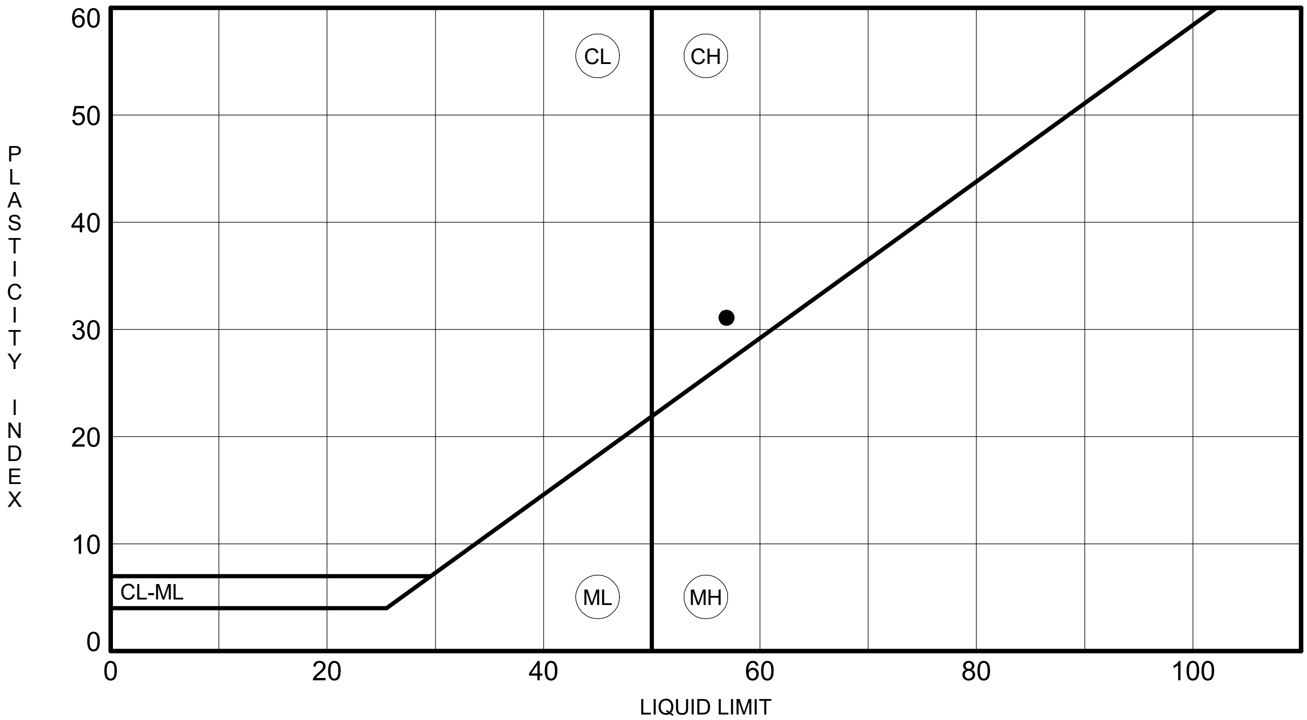
ATTERBERG LIMITS' RESULTS

CLIENT INTRINSIC DEVELOPMENT

PROJECT NAME THE VILLAGE AT DISCOVERY PARK

PROJECT NUMBER 24SP30033

PROJECT LOCATION LEE'S SUMMIT, MO



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-38-13**	**0.0**	**57**	**26**	**31**		

UNCONFINED COMPRESSION TEST

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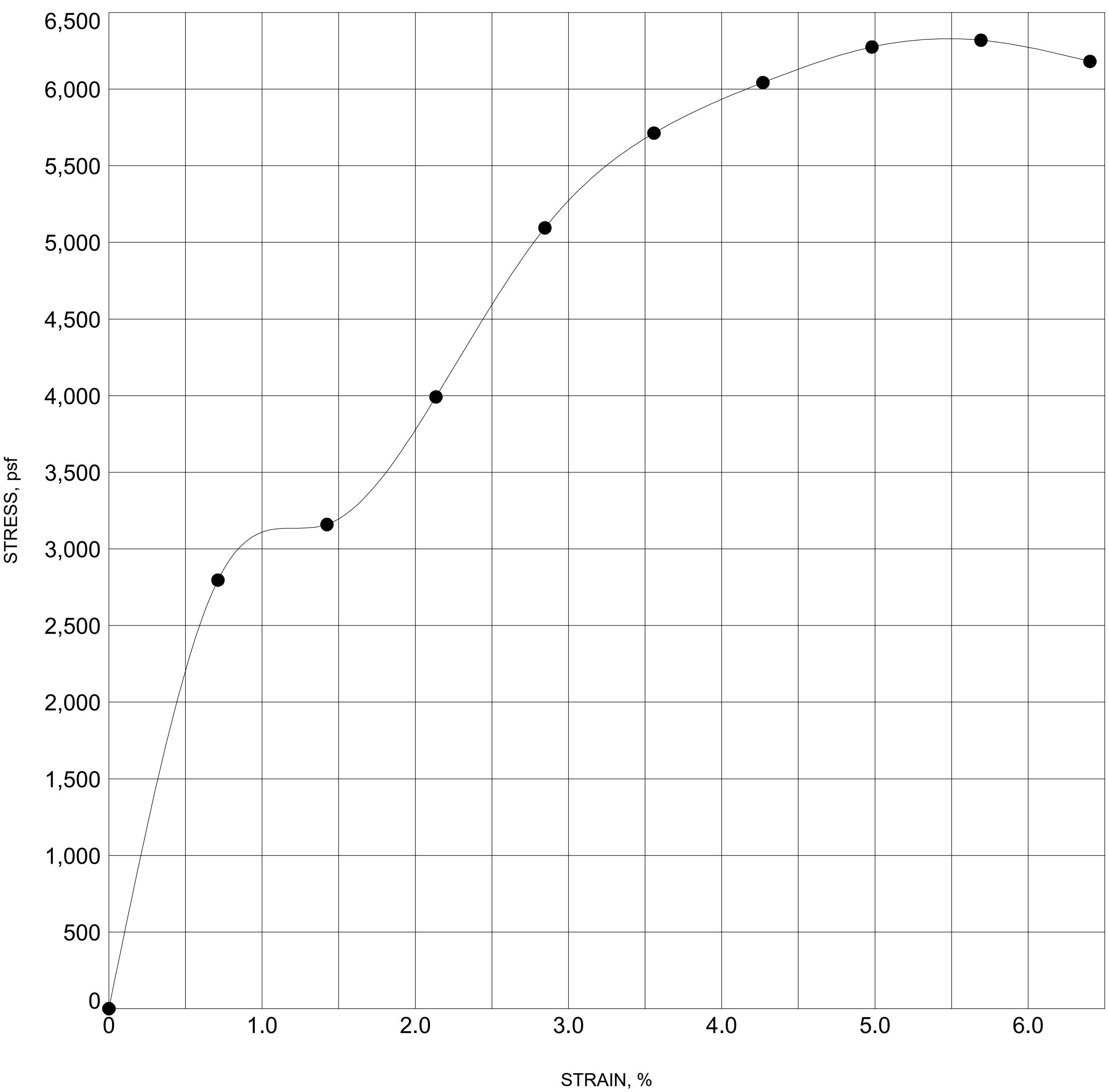
Fax: 417-866-2778

CLIENT INTRINSIC DEVELOPMENT
PROJECT NAME THE VILLAGE AT DISCOVERY PARK
PROJECT NUMBER 24SP30033
PROJECT LOCATION LEE'S SUMMIT, MO



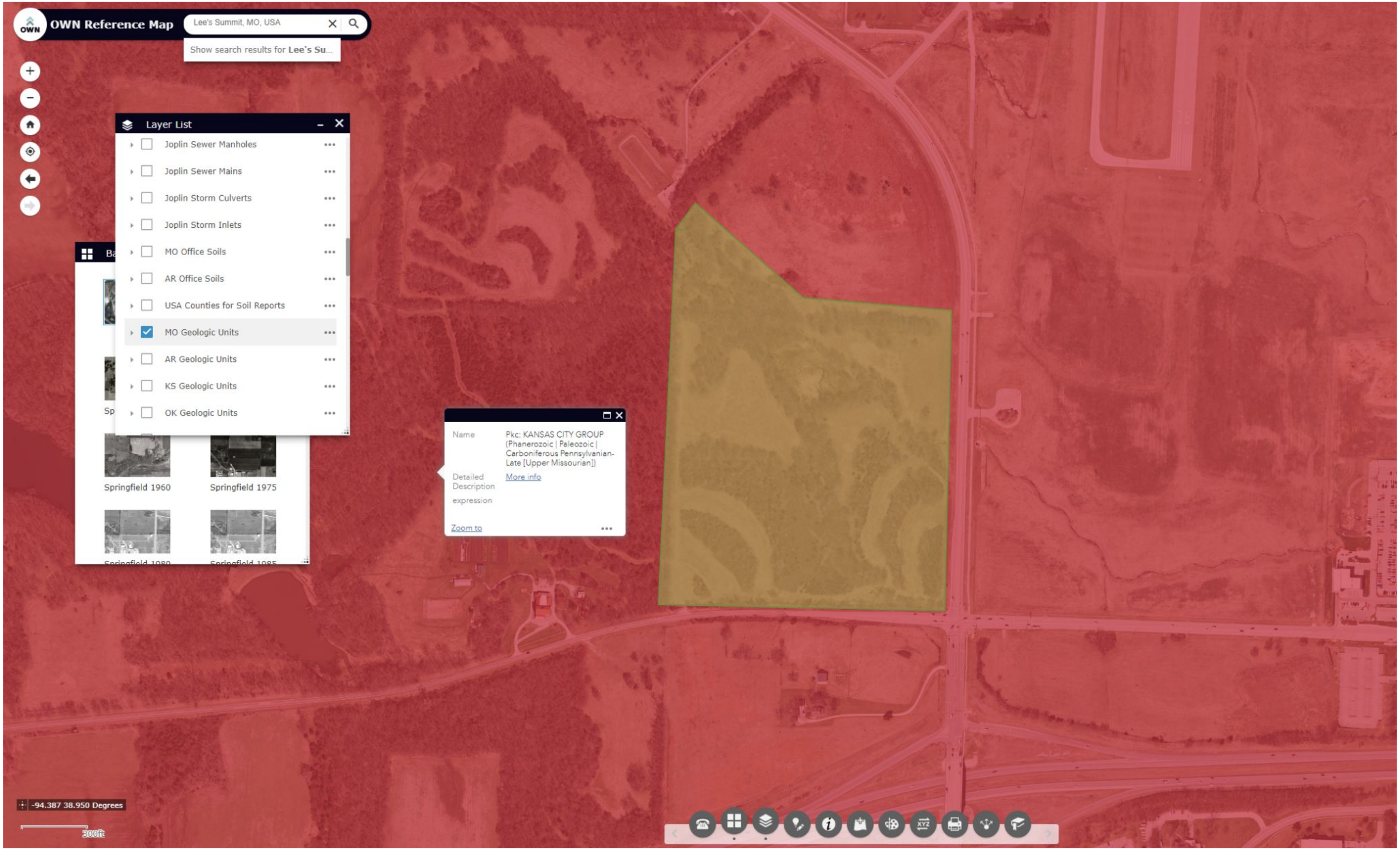
	BOREHOLE	DEPTH	Classification	γ_d	MC%	γ_w	Qu (tsf)	% Strain
●	**B-38-13**	**0.0**		**101.9**	**20.5**	**122.7**	**3.16**	**5.69**

Appendix IIa

Research

OWN

Engineering beyond.™


OWN Reference Map
Lee's Summit, MO, USA
Show search results for Lee's Su...
Layer List
Joplin Sewer Manholes
Joplin Sewer Mains
Joplin Storm Culverts
Joplin Storm Inlets
MO Office Soils
AR Office Soils
USA Counties for Soil Reports
MO Geologic Units
AR Geologic Units
KS Geologic Units
OK Geologic Units
Springfield 1960
Springfield 1975
Name
Pkc: KANSAS CITY GROUP (Phanerozoic | Paleozoic | Carboniferous Pennsylvanian-Late [Upper Missourian])
Detailed Description
More info
expression
Zoom to
-94.387 38.950 Degrees
300ft

Kansas City Group

Cyclic deposits, limestone and shale with minor sandstone and coal.

State	Missouri
Name	Kansas City Group
Geologic age	Late Pennsylvanian-Upper Series-Missourian Stage
Lithologic constituents	Major Sedimentary > Clastic > Mudstone > Shale *(Bed)* Sedimentary > Carbonate > Limestone *(Bed)* Minor Sedimentary > Coal *(Bed)* Sedimentary > Clastic > Sandstone *(Bed)*
Stratigraphic units	Kansas City Group- (160ft. Max) includes Bronson Subgroup- Hertha FM, Ladore FM, Swope FM, Galesburg FM, Dennis FM. Linn Subgroup- Cherryvale FM, Drum FM, Chanute FM, Iola FM.(includes Raytown Limestone Member), Zarah Subgroup- Lane FM, Wyandotte FM(includes Argentine Limestone Member), Bonner Springs FM.
References	Howe, W.B. and Koenig, 1961, The Stratigraphic Succession in Missouri: Missouri Geological Survey and Water Resources, Vol XL. 2nd Series.
NGMDB product	NGMDB product page for 81881
Counties	Andrew - Bates - Buchanan - Caldwell - Carroll - Cass - Clay - Clinton - Daviess - DeKalb - Gentry - Grundy - Harrison - Jackson - Johnson - Lafayette - Livingston - Mercer - Nodaway - Platte - Ray - Sullivan - Worth


40108
30080
30080
10117
10128
10120
Douglas
Colbern

Report — Map Unit Description

Jackson County, Missouri

30080—Greenton silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2xjd9
Elevation: 640 to 1,120 feet
Mean annual precipitation: 35 to 41 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 177 to 209 days
Farmland classification: Not prime farmland

Map Unit Composition

Greenton and similar soils: 90 percent
Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 12 inches: silty clay loam
Bt - 12 to 28 inches: silty clay
2Bt - 28 to 30 inches: silty clay
2C - 30 to 79 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: Yes

Report — Map Unit Description

Jackson County, Missouri

10117—Sampsel silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2qkzz
Elevation: 600 to 1,120 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Sampsel and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampsel

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex, concave
Parent material: Residuum weathered from shale

Typical profile

Ap - 0 to 13 inches: silty clay loam
Bt - 13 to 80 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Minor Components

Greenton

Percent of map unit: 8 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Snead

Percent of map unit: 7 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Hydric soil rating: No

Description — Map Unit Description

Report — Map Unit Description

Jackson County, Missouri

10120—Sharpsburg silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2yy7v
Elevation: 1,000 to 1,300 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sharpsburg and similar soils: 90 percent
Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sharpsburg

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silt loam
A - 6 to 16 inches: silty clay loam
Bt1 - 16 to 22 inches: silty clay loam
Bt2 - 22 to 46 inches: silty clay loam
BC - 46 to 58 inches: silty clay loam
C - 58 to 79 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 45 to 50 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sibley

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Higginsville, eroded

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Description — Map Unit Description

Report — Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Jackson County, Missouri

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H
10117—Sampsel silty clay loam, 5 to 9 percent slopes														
Sampsel	85	C/D	0-13	Silty clay loam	CL	A-6, A-7, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	90-95-100	35-43 -50	15-20-25
			13-80	Silty clay loam, silty clay, clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-99-100	95-98-100	52-64 -75	35-41-47
10120—Sharpsburg silt loam, 2 to 5 percent slopes														
Sharpsburg	90	C	0-6	Silt loam	CL, ML	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-100-100	93-97-100	41-44 -46	17-18-18
			6-16	Silty clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-100-100	93-97-100	41-45 -50	19-21-24
			16-22	Silty clay loam, silty clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-100-100	94-98-100	47-51 -56	26-28-30
			22-46	Silty clay loam, silty clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-100-100	94-98-100	47-51 -56	26-29-32
			46-58	Silty clay loam, silt loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-100-100	93-99-100	35-41 -47	17-22-26
			58-79	Silt loam, silty clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-99-100	92-97-100	35-40 -44	17-20-23
10128—Sharpsburg-Urban land complex, 2 to 5 percent slopes														
Sharpsburg	60	D	0-17	Silt loam	CL, ML	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	95-98-100	34-44 -46	11-18-18
			17-55	Silty clay loam, silty clay	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	95-98-100	39-50 -56	19-25-30
			55-60	Silt loam, silty clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	95-98-100	37-51 -52	18-28-28
30080—Greenton silty clay loam, 5 to 9 percent slopes														
Greenton	90	C/D	0-12	Silty clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	88-98-100	86-96- 98	39-53 -56	19-26-28
			12-28	Silty clay loam, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	87-98-100	85-96-100	45-57 -63	25-33-37
			28-30	Silty clay, silty clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	95-96-100	87-95-100	84-93-100	49-57 -62	28-34-37
			30-79	Clay, gravelly silty clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	77-96-100	61-91-100	54-89-100	52-87- 98	49-61 -64	29-36-38
40108—Snead-Rock outcrop complex, warm, 14 to 30 percent slopes														
Snead, warm	65	D	0-10	Silty clay loam	CH, CL	A-6, A-7-6	0- 1- 4	0- 5- 14	93-97-100	93-97-100	86-95-100	79-89- 98	38-48 -52	18-25-28
			10-20	Silty clay, channery silty clay, clay, channery clay	CH, CL	A-7-5, A-7-6	0- 1- 5	0- 5- 19	89-97-100	89-97-100	83-96-100	77-93-100	48-61 -72	31-36-41
			20-24	Channery silty clay, clay, silty clay, channery clay	CH, CL	A-7-5, A-7-6	0- 0- 0	0- 4- 16	80-95-100	80-95-100	74-94-100	69-91-100	48-62 -72	30-37-42
			24-35	Silty clay, channery clay, channery silty clay, clay	CH, CL	A-7-5, A-7-6	0- 0- 0	0- 9- 16	80-90-100	80-90-100	74-89-100	69-86-100	47-61 -71	30-36-41
			35-45	Bedrock	—	—	—	—	—	—	—	—	—	—
Rock outcrop	20		0-79	Bedrock	—	—	—	—	—	—	—	—	—	—

Report — Chemical Soil Properties

Jackson County, Missouri

Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	*meq/100g*	*meq/100g*	*pH*	*Pct*	*Pct*	*mmhos/cm*	
10117—Sampsel silty clay loam, 5 to 9 percent slopes								
Sampsel	0-13	26-36	—	5.6-7.3	0	0	0.0-2.0	0
	13-80	18-36	—	5.6-7.8	0	0	0.0-2.0	0
10120—Sharpsburg silt loam, 2 to 5 percent slopes								
Sharpsburg	0-6	21-23	—	5.6-7.3	0	0	0.0-2.0	0
	6-16	22-27	—	5.6-7.3	0	0	0.0-2.0	0
	16-22	27-32	—	5.1-6.5	0	0	0.0-2.0	0
	22-46	27-33	—	5.6-6.5	0	0	0.0-2.0	0
	46-58	19-27	—	5.6-7.3	0	0	0.0-2.0	0
	58-79	19-25	—	5.6-7.3	0	0	0.0-2.0	0
10128—Sharpsburg-Urban land complex, 2 to 5 percent slopes								
Sharpsburg	0-17	18-29	—	5.1-6.5	0	0	0.0-2.0	0
	17-55	19-32	—	4.5-6.0	0	0	0.0-2.0	0
	55-60	17-29	—	5.6-6.5	0	0	0.0-2.0	0
Urban land	—	—	—	—	—	—	—	—
30080—Greenton silty clay loam, 5 to 9 percent slopes								
Greenton	0-12	22-31	—	5.6-6.0	0	0	0.0-2.0	0
	12-28	24-37	—	6.1-6.5	0	0	0.0-2.0	0
	28-30	26-36	—	6.6-7.3	0	0	0.0-2.0	0
	30-79	26-37	—	7.9-8.4	0-10	0	0.0-2.0	0
40108—Snead-Rock outcrop complex, warm, 14 to 30 percent slopes								
Snead, warm	0-10	22-32	—	6.1-7.3	0	0	0.0-2.0	0
	10-20	30-45	—	6.6-8.4	5-10	0	0.0-2.0	0
	20-24	30-44	—	6.6-8.4	5-10	0	0.0-2.0	0
	24-35	29-44	—	6.6-8.4	5-10	0	0.0-2.0	0
	35-45	—	—	—	—	—	—	—
Rock outcrop	0-79	—	—	—	—	—	—	—