APPENDIX "A"

INFORMATION AVAILABLE TO BIDDERS

1. The following items are included herein for Bidder information.
   a. Geotechnical Investigation Report (Dated November 13, 2020), Project #20JO10068.

END OF DOCUMENT

ANDERSON ENGINEERING
EMPLOYEE OWNED

AndersonEngineeringInc.com
3213 S. West Bypass
Springfield, MO 65807
417-866-2741

11/13/2020

Buddy Webb and Company
ATTN: Buddy Webb
3057 E. Cairo Street
Springfield, MO 65802

Re: EXP - 60 Soldier Barracks
RE: 29614 Jaguar Street
Macon, MO 63552

Anderson engineering Proposal PSG-1594, AE Project # 20JO10068

Dear Mr. Webb,

Attached is the report for the above referenced project based on research and site reconnaissance. Should you have any questions regarding the report, please give John Snider or myself a call. Thank you for the opportunity to be of service.

Sincerely,

ANDERSON ENGINEERING, INC.

STATE OF MISSOURI
JOHN TONY SNIDER
NUMBER PE-2006034993
PROFESSIONAL ENGINEER

Cody Gibson	John T. Snider, PE 11/13/2020
Project Geologist	Vice President/Principal Geotechnical Engineer

Copy

Buddy Webb, buddy@webbarch.com
Cody Gibson, cgibson@andersonengineerginc.com , 417-353-3666 cell
John Snider, jsnider@andersonengineeringinc.com, 417-540-2992 cell

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INTRODUCTION:

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

- 60-Soldier Barracks and associated pavement and parking;

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, and 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:

- 3 borings down to a depth of up to 15 or auger refusal feet within the anticipated building footprints and 1 boring within the parking lot;
- An engineering report will be issued with the findings of the exploration and recommendations for site development, and foundation 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 engineering report.

PROPOSED CONSTRUCTION:

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

- cuts and fills: 5 feet or less;
- building: 1 story 60 soldier barrack;
- structure: precast concrete storm shelter;
- footings: 6 feet wide or smaller; 4 feet or smaller for columns;
- floor: concrete slab-on-grade;
- column loads: 60 kips or less assumed;
- wall loads: to be determined;

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, Anderson Engineering, 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 layout provided by you. A sketch showing the general locations of the borings was prepared from this information and is included in Appendix I 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 soil borings in this exploration were drilled using 4 inch diameter, soild-stem, and continuous flight augers. The drill rig used for all of these borings was a 2017 CME 550X ATV-mounted drill rig and is noted on the boring logs.

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 Appendix II.

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 one of the following drill rigs with automatic hammers, for purposes of our assessment of penetration resistance:

- CME-75, we used approximately 75% to 85% efficiency;
- 1999 CME-550X, we used approximately 80% to 90% efficiency;
- 2017 CME-550X, we used approximately 85% to 95% efficiency;

In transferring energy for hammer blows per foot. This allows us to compare to industry standard correlations developed for hammer blow resistance if required.

LABORATORY TESTING:

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

GEOLOGY OF THE SITE:

A review of the geologic maps of the area reveal the site is underlain by: Middle Pennsylvanian to Middle Series Desmonian Stage aged Cherokee Group, which consists of cyclic deposits of shale, sandstone, siltstone, clay and limestone with seven significant coal beds.

Due to past geologic glacial geomorphology, the material above bedrock, generally consists of:

- glacial drift;

The County Soil Resource Survey (from our Anderson Engineering online GIS) indicated the natural soils on the site were mapped as:

NE Corner: 50011, Soil Name: Winnegan loam, 20 to 35 percent slopes. The parent material of the Winnegan is reported to consist of till. Depth to restrictive features is more than 80 inches. The reported depth to water is 24 to 42 inches.

The typical soil profile is:
A - 0 to 2 inches: loam, ML, CL, P200= 65%, LL= 38%
E - 2 to 7 inches: loam, Topsoil, CL-ML, CL, P200= 65%, LL= 27%
Bt - 7 to 37 inches: clay loam, CL, CH, P200= 75%, LL= 52%
Btk- 37 to 60 inches: clay loam, CL, P200= 70%, LL= 40%

Remaining Property: 30067, Soil Name: Gorin silt loam, 3 to 9 percent slopes eroded. The parent material of the Gorin is reported to consist of Loess over pedisediment over till. The depth to a restrictive layer is more than 80 inches. The reported depth to shallow water is 18 to 30 inches.

The typical soil profile is:

- A - 0 to 12 inches: silt loam, CL, P200= 90%, LL = 32%
- Bt1 - 12 to 27 inches: silty clay, CH, CL, GC, P200= 92%, LL = 56%
- 2Btx - 27 to 48 inches: loam, SC, P200= 70%, LL = 36%
- 3Bt2 - 48 to 80 inches: clay, CH, P200=83%, LL = 54%

Also mapped: MDNR / USGS no mapped sinkholes nearby;

VISUAL:

The surface of the planned project area is generally:

- Vacant land, short grasses with a dumpster at the NW corner of the property;
- Wooded areas to the N and S;
- Cemetery to the E;

QUAD MAP; AERIALS PHOTOS, GOOGLE STREET VIEW:

A review of the Quadrangle Map for the project area shows the site slopes generally downhill from: similar to above; Quadrangle maps show the property to be situated on the top of the ridge/hill with drainage W;

Soil and rock should be similar to other projects on slope near similar elevation; for example:

- Olsson, Inc. drilled for a New Company Headquarters and Administration Building at the Macon Training Site about .1 miles to W in the past;
- For this nearby project generally they found: The soils on the site are derived from loess (a wind-blown silt) over a pedisediment (eroded material from slopes) over glacial till. Beneath the surficial materials, the subsurface conditions encountered in the borings consisted of clay soils. The upper three feet of clay soils encountered at the borings were highly plastic and exhibited relatively high moisture contents and low unit weights. A relatively thin layer of lower plasticity (lean) clay soils were encountered beneath the upper fat clay soils. These soils transitioned into medium plasticity clay soils with sand w/increasing depth. The soils were generally stiff in consistency. Moisture content was typically 18% to 25% in range.
  Groundwater was not encountered during the drilling of this project.

Current aerial photos show:

Similar to above; grass covered vacant land with wooded areas to the north and south and a fenced area to the east;

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:

- Topsoil, about .5 feet thick, see attached boring logs;
- 1st deeper soil (Boring B-2): Yellowish brown and gray lean clay, CL, with 10-30% gravel, damp, stiff to very stiff, from .3 to approximately 4.5 feet;
- 1st deeper soil (2nd deeper soil in Boring B-2) (Borings B-1, B-3, B-4) : Yellowish brown lean to fat clay, CL-CH, with trace amounts of gravels, damp to moist to most, stiff to very stiff to boring termination;
- 2nd or 3rd deeper material; Limestone was not encountered within 15 feet;
- Groundwater was not encountered during the drilling of the onsite borings;
- Natural soils encountered on site were consistent with the US Soil Survey;

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

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. Weathering left the upper 1 to 2 feet disturbed due to freeze-thaw and or shrink-swell; this zone can often be moist to very moist and only medium firm.
2. Topsoil, organic stained: about .5 feet thick, see attached boring logs; thickness varies;
3. Lean to fat clays were found onsite and have the potential to swell significantly;

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

1. Remove topsoil; and soft/medium firm, upper lean clay, and dry silty sandy soils to prepare subgrade for LVC, Low Volume Change fill materials;
2. After fill placement, foundations may have to extend past 3 feet frost depth to get to stiff, clay soils. If the the upper, soft/medium firm, existing soils area removed then this over-excavation would not be required; Lean concrete can be used for over-excavated soils or properly compacted structural soil fill to keep reinforced concrete foundations at 3 feet frost depth;
3. Depending on the amount of cut and shallower fat clays, CH, you may need to over excavate fat clays to prevent swelling of fat clay subgrades on concrete slabs on grade. These fat clays are often dry or only damp- they will swell tremendously if not over excavated, especially from running on top of bedrock for daylighted basements and retaining walls ;
4. Plan for shallow groundwater, especially during rainfalls and or wetter seasons;

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, as below.

Also, we recommend you retain us, to help you with existing, medium firm fill soils, if needed to be removed or to ensure it is satisfactory proof rolls.

RECOMMENDATIONS

SITE DEVELOPMENT

1. All site grading and excavations should be carefully observed for any DISTURBED soils, UNDOCUMENTED 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 foundations, concrete slabs, and pavements are anticipated to bear. If encountered, these soils should be removed for a depth of 18 inches below the bottom of stone below concrete slabs on grade, 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 basestone should be installed to bring the area to proposed subgrade elevations. These materials should be submitted to Anderson Engineering 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 existiclean 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 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:

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 sub grade 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 proofrolling 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 (Anderson Engineering, Inc.), and approval, the upper 6 inches of exposed sub grade should be scarified, adjusted to 0 to +4 percent above optimum moisture and compacted to at least 96.5 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 3 feet under concrete slabs on grade, it should have 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 2 feet below 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 Anderson Engineering)

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 **96.5 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 **96.5 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 system 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 are 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 sub grade 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.

Based on the findings of this exploration, we recommend that the building foundation systems be founded on controlled, compacted Fill materials placed per the Site Development section of this report, or moist, stiff, residual clay.

1. Footings resting on controlled, properly compacted fill soil or moist, stiff, residual clay may use a maximum allowable soil bearing pressure of up to 2,000 psf assuming that the site is prepared as recommended in this report and discussed in the Summary - depth may require over-excavation if bearing on only medium firm clay soil.

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 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.

10. 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.

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 which 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).

SEISMIC CONDITIONS:

1. For IBC 2015 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 at least 95% of maximum dry density and within 2% of optimum moisture content, 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 18 inches of the bottom of the floor slab of the proposed structure. 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.

PAVEMENT DESIGN:

1. Pavement subgrades should generally be prepared as outlined in the SITE DEVELOPMENT section of this report. A CBR value of 3.0 was used in the design of the pavement section. Only medium firm or just stiff soil will not meet the minimum CBR requirement; soils that pass proof rolls should meet this CBR.

2. Just prior to paving, the pavement areas should be rough graded and then proof rolled with a fully loaded tandem axle dump truck. Areas where unstable or unsuitable conditions are found should be cut out and replaced with controlled, compacted fill and re-proof rolled. We assume that you will maintain construction control over the project so that our recommendations are followed, especially for proof rolling, rutting, etc.

<u>Heavy Pavements, if subgrade passes proof roll:</u>

Asphaltic Concrete:	2.5 Inches of Plant Mix Bituminous Pavement
	4.0 Inches of Plant Mix Bituminous Base
	8.0 Inches of Crushed Limestone Base Rock
	Subgrade prepared per site development section

Concrete: 6.0 Inches of Portland Cement Concrete

Concrete strength at 28 days should be a minimum of 4,000 psi.

4.0 Inches of Crushed Limestone Base Rock

Subgrade prepared per site development section

Heavy Duty Dumpster Pad / Entrances Pavement, if subgrade passes proof roll:

Concrete: 7.0 Inches of Portland Cement Concrete

Concrete strength at 28 days should be a minimum of 4,000 psi.

6.0 Inches of Crushed Limestone Base Rock

Subgrade prepared per site development section

The compaction mentioned in the above in the Site Development section should have ppq testing done. A ppq of 2.0 tsf for asphalt and 2.5 tsf for concrete should be achieved before limestone base is placed.

It should be noted that the entire thickness of baserock in the sections above must be compacted to minimum requirements. This may require a working platform be prepared prior to placement of geogrid or base rock. This could consist of scarification and re-compaction of subgrade soils or incorporation of shot rock. Again, it is recommended that a test strip be conducted to check suitability of the recommendations prior to constructing the roadway.

4. 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.

5. Concrete pavements should meet the requirements of Section 502 of the MODOT standard specifications for Portland Cement concrete pavements.

6. 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 6 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.

7. 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.

8. 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.

9. In addition to the recommendations of this report, construction of any pavement area that is or will become publicly owned and maintained should be completed in accordance with the standard specifications adopted by the public entity.

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 practice 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 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.

It is advised that Anderson Engineering 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. It is advised that Anderson Engineering, 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. Anderson Engineering, 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 Anderson Engineering, Inc. Anderson Engineering, Inc., is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of Anderson Engineering, 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.

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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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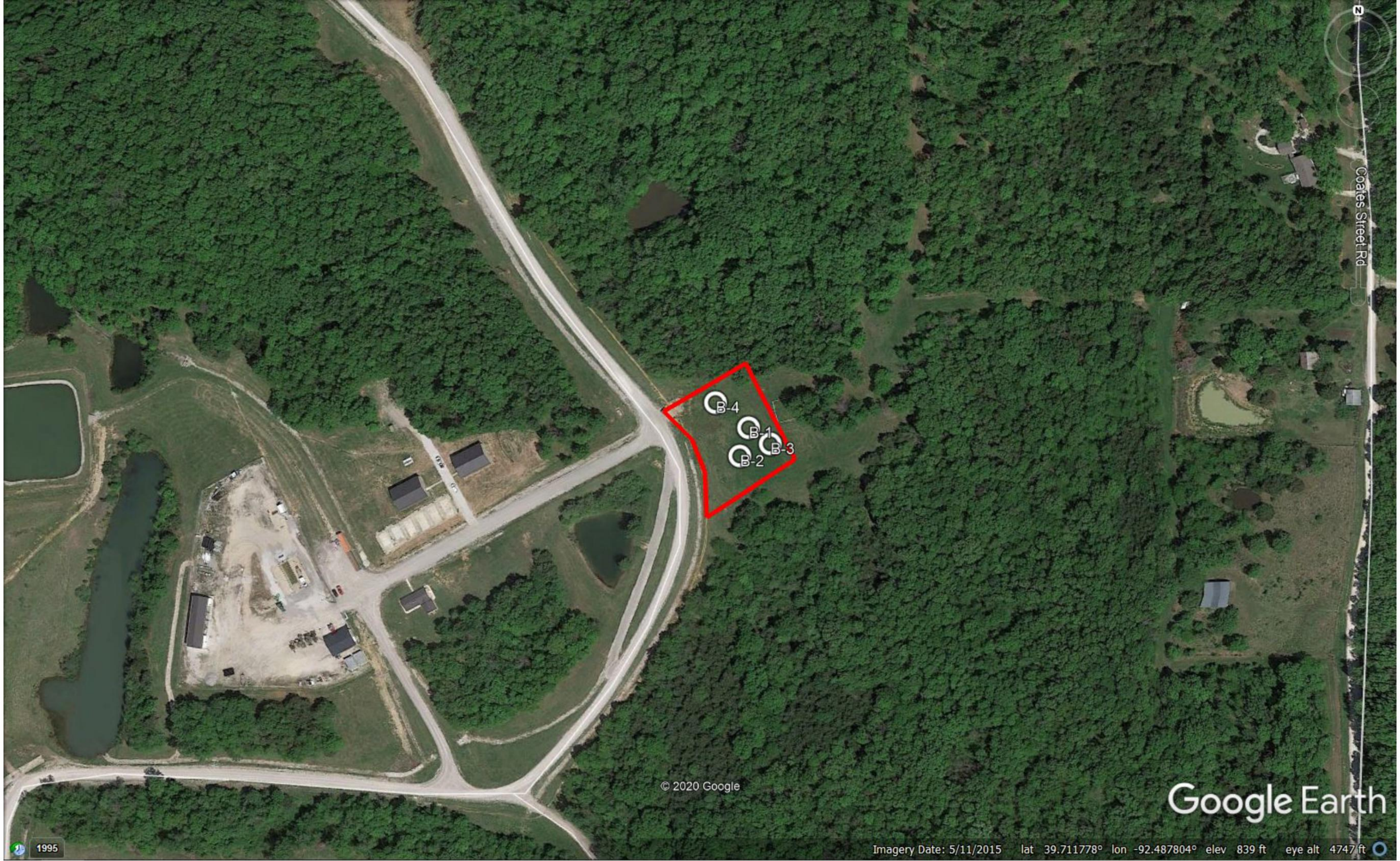
Appendix I
Figures

SITE LOCATION SKETCH
SOIL BORING LOCATION


N
B-4
B-1
B-3
B-2
© 2020 Google
Google Earth
1995
Imagery Date: 5/11/2015 lat 39.711783° lon -92.487445° elev 840 ft eye alt 3329 ft


N
Coates Street Rd
B-4
B-1
B-3
B-2
© 2020 Google
Google Earth
1995
Imagery Date: 5/11/2015 lat 39.711778° lon -92.487804° elev 839 ft eye alt 4747 ft


N
Coates Street Rd
B-4
B-1
B-3
B-2
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1995
Imagery Date: 5/11/2015 lat 39.711778° lon -92.487804° elev 839 ft eye alt 4747 ft

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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

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LITHOLOGIC SYMBOLS (Unified Soil Classification System)

	FILL
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
LS	LIMESTONE
SH	SHALE
SS	SANDSTONE

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 15 %
With	15 to 30%
Clayey, Sandy	> 30%

Silts and Clays

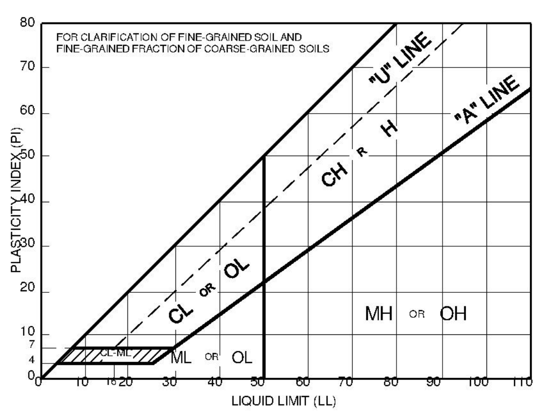
Descriptive Terms	% Coarse by Dry Weight
Trace	0 to 15 %
With	15 to 30%
Sandy, Gravelly	> 30%

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	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 case4s requiring dual symbols**	$C_U = \frac{D_{60}}{D_{10}}$ 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			



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 -	Cam 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-1

CLIENT BUDDY WEBB
PROJECT NAME T2102-0160 SOLDIER BARRACKS
PROJECT NUMBER 20JO10068
PROJECT LOCATION MACON, MO
DATE STARTED 11/3/20 **COMPLETED** 11/3/20
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AE CME 550X
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger 4"
AT TIME OF DRILLING ---
LOGGED BY CH **CHECKED BY** CW
AT END OF DRILLING ---
NOTES
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	6 INCHES TOPSOIL, DAMP TO MOIST, MEDIUM TO STFF									
0.5	YELLOW BROWN LEAN TO FAT CLAY, MOIST, STIFF TO VERY STIFF	SS		3-5-6 (11)	3.5 4.5		26.9			
1.5	YELLOW BROWN LEAN TO FAT CLAY WITH GRAY MOTTLES AND WEATHERED CHERT, MOIST, STIFF TO VERY STIFF	SS		4-6-7 (13)	4	4.97	24.6	43	15	28 0.34
3.5		SS		4-5-8 (13)	2.5	5.12	18.3	41	17	24 0.06
5	DAMP, VERY STIFF	SS		8-10-14 (24)	3.5		16.8			
8.5	DAMP, VERY STIFF	SS		4-5-7 (12)	2.75		17.3			
13.5	DAMP, VERY STIFF	SS		4-5-8 (13)	3.5		18.0			

Drilling method: auger, 0 to 15 ft.

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-2

CLIENT BUDDY WEBB

PROJECT NAME T2102-0160 SOLDIER BARRACKS

PROJECT NUMBER 20JO10068

PROJECT LOCATION MACON, MO

DATE STARTED 11/3/20 **COMPLETED** 11/3/20

GROUND ELEVATION **HOLE SIZE** 4 inches

DRILLING CONTRACTOR AE CME 550X

GROUND WATER LEVELS:

DRILLING METHOD Solid Stem Auger 4"

AT TIME OF DRILLING ---

LOGGED BY CH **CHECKED BY** CW

AT END OF DRILLING ---

NOTES

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	ATTERBERG LIMITS PLASTIC LIMIT	ATTERBERG LIMITS PI / LI
0		6 INCHES TOPSOIL, LEAN CLAY, DRY TO DAMP TO MOIST, MEDIUM FIRM TO STIFF										
1		YELLOW BROWN LEAN CLAY, DRY TO DAMP, STIFF		SS		3-6-14 (20)	3.75		5.8			
2		YELLOW BROWN LEAN CLAY WITH 0-10% CHERT, DAMP, STIFF TO VERY STIFF		SS		6-6-7 (13)	> 4.5	10.97	18.6	38	14	24 0.19
4				SS		6-9-11 (20)	4.25		18.3	25	15	10 0.33
5		YELLOW BROWN SANDY LEAN TO FAT CLAY WITH 0-15% CHERT, DAMP, STIFF		SS		8-10-14 (24)	4.5		9.5			
9		YELLOW BROWN SANDY LEAN TO FAT CLAY, DAMP, STIFF		SS		5-5-7 (12)	2		8.3			
14		DAMP, STIFF TO VERY STIFF		SS		6-8-8 (16)	3.5		17.8			
15		Bottom of borehole at 15.0 feet.										

BORING NUMBER B-3

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CLIENT BUDDY WEBB
PROJECT NAME T2102-0160 SOLDIER BARRACKS
PROJECT NUMBER 20JO10068
PROJECT LOCATION MACON, MO
DATE STARTED 11/3/20 **COMPLETED** 11/3/20
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AE CME 550X
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger 4"
AT TIME OF DRILLING ---
LOGGED BY CH **CHECKED BY** CW
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	Unconfined Qu, (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PI / LI
0.0–0.5	6 INCHES TOPSOIL, DAMP TO MOIST, MEDIUM FIRM TO STIFF	SS		2-3-5 (8)	2 / 4 / 4.5		23.1			
0.5–1.0	GRAY BROWN LEAN CLAY, DAMP TO MOIST, STIFF									
1.0–	YELLOW BROWN AND GRAY LEAN TO FAT CLAY, DAMP, STIFF	SS		3-4-6 (10)	4.5		21.6			
	YELLOW BROWN LEAN TO FAT CLAY WITH 0-15% CHERT, DAMP, STIFF	SS		4-8-11 (19)	3		18.6			
		SS		6-8-13 (21)	4.5		14.9			
	WITH SANDY SEAMS, DAMP, STIFF TO VERY STIFF	SS		5-9-12 (21)	4.5		15.4			
–15.0		SS		7-10-14 (24)	4.5		15.5			

Bottom of borehole at 15.0 feet.

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BORING NUMBER B-4

CLIENT BUDDY WEBB
PROJECT NAME T2102-0160 SOLDIER BARRACKS
PROJECT NUMBER 20JO10068
PROJECT LOCATION MACON, MO
DATE STARTED 11/3/20 **COMPLETED** 11/3/20
GROUND ELEVATION **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AE CME 550X
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger 4"
AT TIME OF DRILLING ---
LOGGED BY CH **CHECKED BY** CW
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth	DRILLING METHOD	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	Unconfined Qu, (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PI / LI
0		6 INCHES TOPSOIL, DAMP TO MOIST, MEDIUM FIRM TO STIFF	0										
1		YELLOW BROWN LEAN TO FAT CLAY WITH 0-10% CHERT, DAMP TO MOIST, VERY STIFF	1		SS		3-4-5 (9)	3.5 / 4.5		13.3			
2			2		SS		5-7-9 (16)	4.5		16.0			
3			3										
4		YELLOW BROWN LEAN TO FAT CLAY WITH 10-20% CHERT, DAMP, STIFF TO VERY STIFF	4		SS		6-8-12 (20)	4.5		14.8			
5			5										
6			6		SS		9-16-20 (36)	4.5		9.0			

Bottom of borehole at 6.5 feet.

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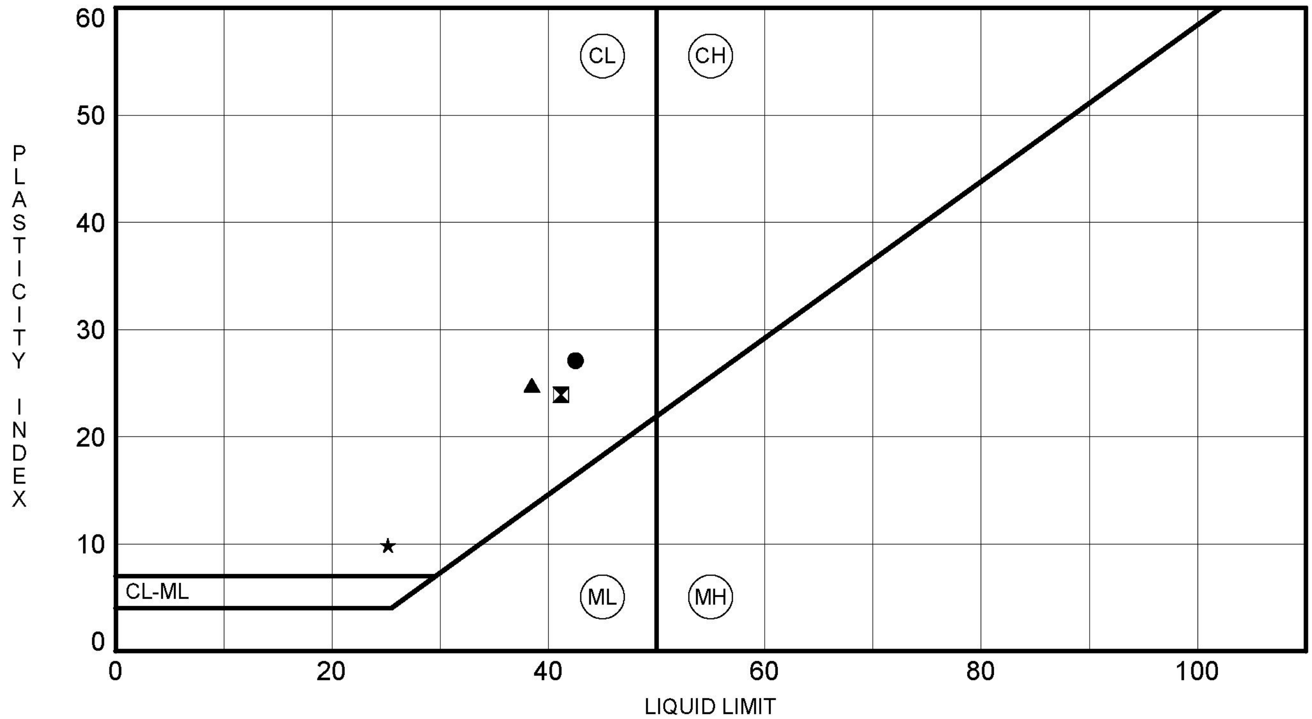
ATTERBERG LIMITS' RESULTS

CLIENT BUDDY WEBB
PROJECT NAME T2102-0160 SOLDIER BARRACKS
PROJECT NUMBER 20JO10068
PROJECT LOCATION MACON, MO



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-1**	**1.5**	**43**	**15**	**28**		
⧗	**B-1**	**3.5**	**41**	**17**	**24**		
▲	**B-2**	**1.5**	**38**	**14**	**24**		
★	**B-2**	**3.5**	**25**	**15**	**10**		

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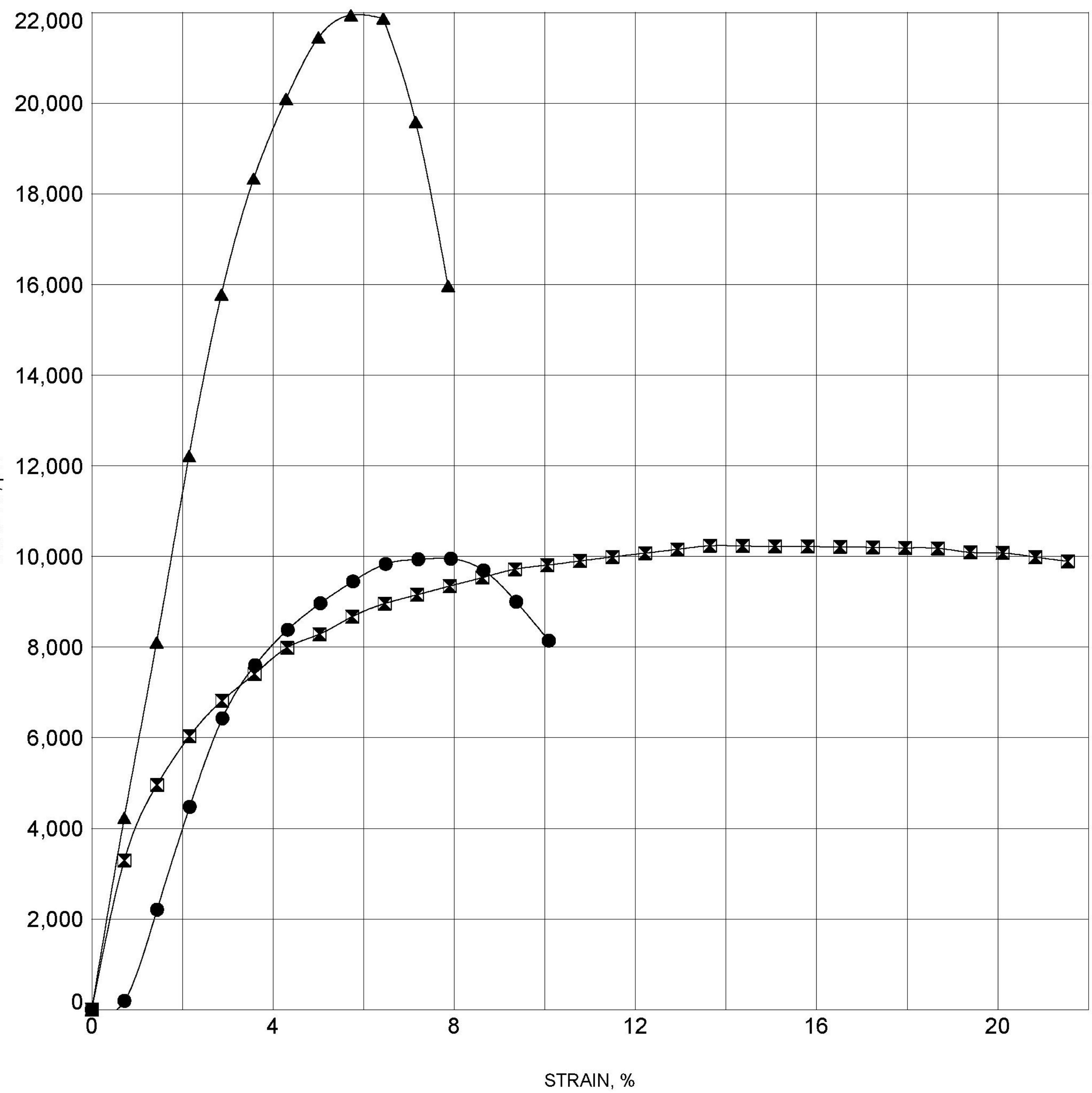
UNCONFINED COMPRESSION TEST

CLIENT BUDDY WEBB **PROJECT NAME** T2102-0160 SOLDIER BARRACKS

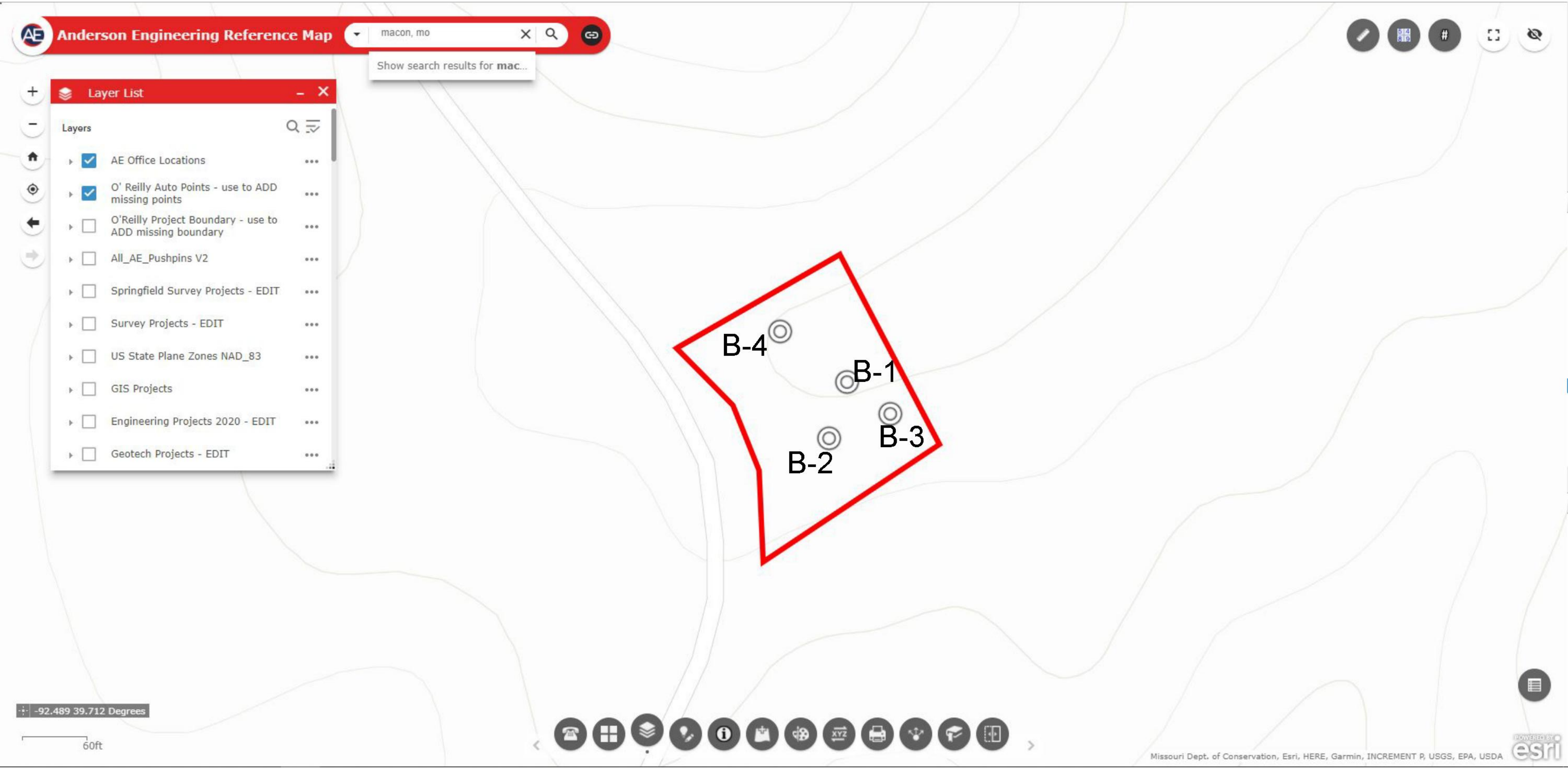
PROJECT NUMBER 20JO10068 **PROJECT LOCATION** MACON, MO



	BOREHOLE	DEPTH	Classification	γ_d	MC%	γ_w	Qu (tsf)	% Strain
●	B-1	1.5		105.4	24.6	131.3	4.97	7.93
⧗	B-1	3.5		112.6	18.3	133.3	5.12	13.65
▲	B-2	1.5		106.3	18.6	126.1	10.97	5.72

AndersonEngineeringInc.com
3213 S. West Bypass
Springfield, MO 65807
417-866-2741

Appendix IIa
Research


Anderson Engineering Reference Map
macon, mo
Show search results for mac...
Layer List
Layers
AE Office Locations
O' Reilly Auto Points - use to ADD missing points
O'Reilly Project Boundary - use to ADD missing boundary
All_AE_Pushpins V2
Springfield Survey Projects - EDIT
Survey Projects - EDIT
US State Plane Zones NAD_83
GIS Projects
Engineering Projects 2020 - EDIT
Geotech Projects - EDIT
B-4
B-1
B-3
B-2
-92.489 39.712 Degrees
60ft
Missouri Dept. of Conservation, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA


Anderson Engineering Reference Map
macon, mo
Show search results for mac...
Layer List
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
MO Overburden Depth
Name
Pc: CHEROKEE GROUP-Cabaniss Subgroup, Krebs Subgroup (Phanerozoic | Paleozoic | Carboniferous Pennsylvanian-Middle [Middle Desmonian])
Detailed Description
More info
expression
Zoom to
-92.486 39.712 Degrees
60ft
Missouri Dept. of Conservation, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA
POWERED BY esri

Cherokee Group - Cabaniss Subgroup, Krebs Subgroup

Cabaniss Subgroup - cyclic deposits, shale, sandstone, clay and several workable coal beds. Krebs Subgroup - cyclic deposits, sandstone, siltstone, shale, clay and some workable coal beds.

State	Missouri
Name	Cherokee Group - Cabaniss Subgroup, Krebs Subgroup
Geologic age	Middle Pennsylvanian-Middle Series-Desmonian Stage
Lithologic constituents	Major Sedimentary > Clastic > Sandstone *(Bed)* Sedimentary > Clastic > Mudstone > Shale *(Bed)* Sedimentary > Clastic > Siltstone *(Bed)* Minor Sedimentary > Clastic > Mudstone *(Bed)* Sedimentary > Carbonate > Limestone *(Bed)* Incidental Sedimentary > Coal *(Bed)*
Comments	Cherokee Group- Cabaniss Subgroup- (200 ft. max) cyclic deposits of shale, sandstone, siltstone, clay and limestone with seven significant coal beds. Cherokee Group- Krebs Subgroup-(110 ft. max) cyclic deposits of predominantly shale and sandstone with limestone, siltstone and two significant coal beds.
Stratigraphic units	Cherokee Group- Cabaniss Subgroup (200 ft. max) includes Weir FM, Tebo FM, Scammon FM, Mineral FM, Robinson Branch FM, Fleming FM, Croweburg FM, Verdigris FM, Bevier FM, Lagonda FM, Mulky FM, Excello FM. Krebs Subgroup, includes Hathshorne FM, Warner FM, Rowe FM, Drywood FM, Bluejacket FM, Seville 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	Adair - Audrain - Barton - Bates - Benton - Boone - Callaway - Carroll - Cass - Cedar - Chariton - Cooper - Daviess - Franklin - Grundy - Harrison - Henry - Howard - Howell - Johnson - Knox - Lafayette - Lincoln - Linn - Livingston - Macon - Marion - Mercer - Monroe - Montgomery - Pettis - Pike - Putnam - Ralls - Randolph - Saint Charles - Saint Clair - Saint Louis - Saline - Schuyler - Scotland - Shelby - Sullivan - Texas - Vernon - Warren - Webster - Wright - Saint Louis

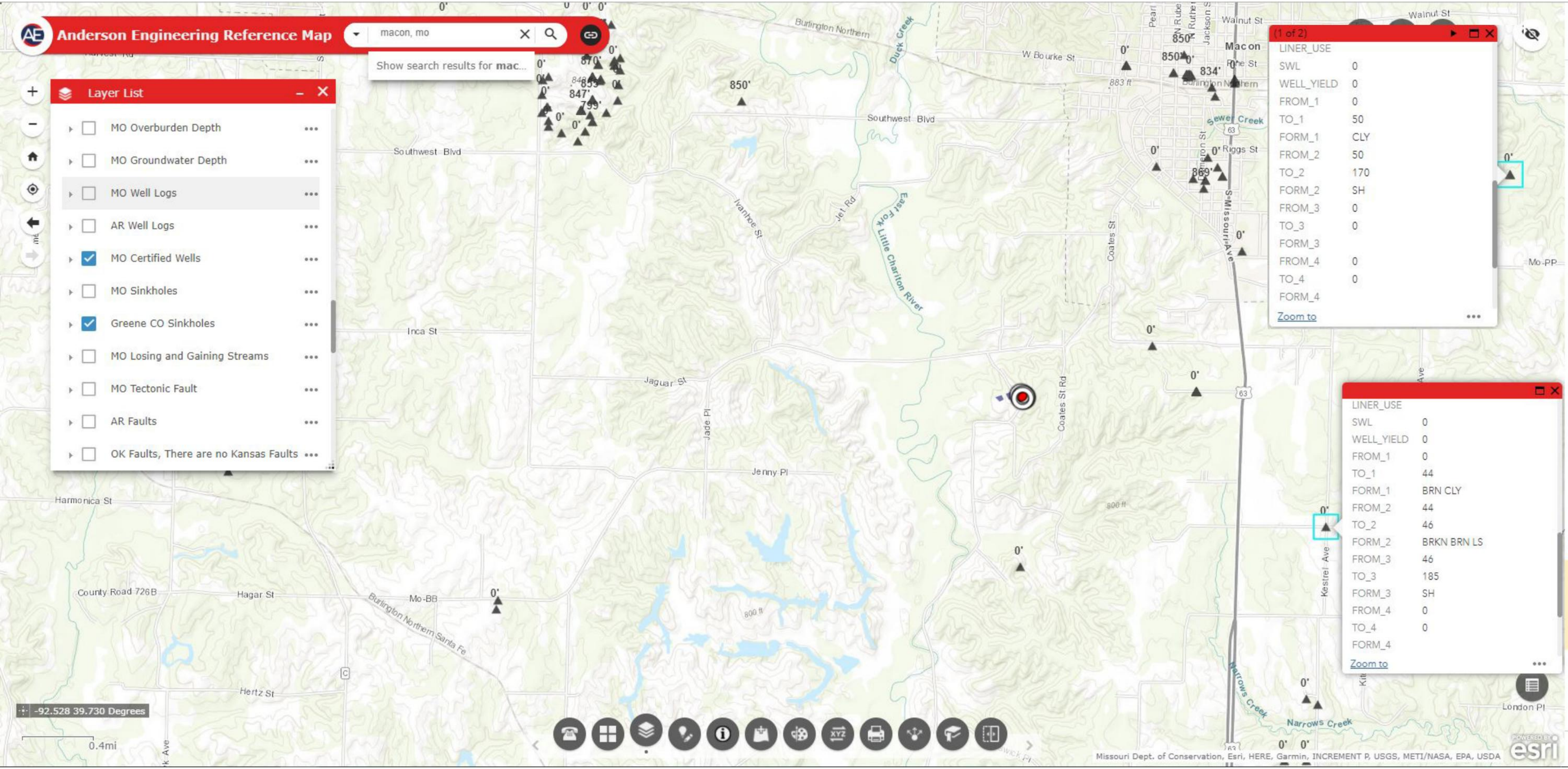

Anderson Engineering Reference Map
macon, mo
Show search results for mac...
Layer List
Joplin Sewer Mains
Joplin Storm Culverts
Joplin Storm Inlets
MO Office Soils
AR Office Soils
USA Counties for Soil Reports
MO Geologic Units
AR Geologic Units
KS Geologic Units
OK Geologic Units
MO Overburden Depth
Name
Pm: MARMATON GROUP (Phanerozoic | Paleozoic | Carboniferous Pennsylvanian-Middle [Middle Desmonian])
Detailed Description
More info
expression
Zoom to
852 ft
854 ft
COATES ST
-92.488 39.713 Degrees
200ft
Missouri Dept. of Conservation, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA
POWERED BY esri

XML | JSON

Marmaton Group

Cyclic deposits, shale and limestone with sandstone, clay and several coal beds, some workable.

State	Missouri
Name	Marmaton Group
Geologic age	Middle Pennsylvanian-Middle Series-Desmonian Stage
Lithologic constituents	Major Sedimentary > Clastic > Mudstone > Shale *(Bed)* Sedimentary > Carbonate > Limestone *(Bed)* Minor Sedimentary > Coal *(Bed)* Sedimentary > Clastic > Mudstone > Claystone *(Bed)* Sedimentary > Clastic > Mudstone *(Bed)* Sedimentary > Clastic > Sandstone *(Bed)*
Stratigraphic units	Marmaton Group- (130 ft. max) includes Fort Scott Subgroup-(30 ft. max) Blackjack Creek FM, Little Osage FM, Higginville FM. Appanoose Subgroup-(100 ft. max) Labette FM, Pawnee FM, Bandera FM, Altamont FM, Nowata FM, Lenapah FM, Holdenville 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	Adair - Audrain - Barton - Bates - Benton - Boone - Callaway - Carroll - Cass - Chariton - Daviess - Gasconade - Grundy - Harrison - Henry - Howard - Jackson - Johnson - Lafayette - Lincoln - Linn - Livingston - Macon - Maries - Mercer - Monroe - Montgomery - Osage - Pettis - Pike - Putnam - Ralls - Randolph - Ray - Saint Louis - Saline - Schuyler - Shelby - Sullivan - Vernon - Warren - Saint Louis



Anderson Engineering Reference Map
macon, mo
Show search results for mac...
Layer List
MO Overburden Depth
MO Groundwater Depth
MO Well Logs
AR Well Logs
MO Certified Wells
MO Sinkholes
Greene CO Sinkholes
MO Losing and Gaining Streams
MO Tectonic Fault
AR Faults
OK Faults, There are no Kansas Faults
(1 of 2)
LINER_USE
SWL 0
WELL_YIELD 0
FROM_1 0
TO_1 50
FORM_1 CLY
FROM_2 50
TO_2 170
FORM_2 SH
FROM_3 0
TO_3 0
FORM_3
FROM_4 0
TO_4 0
FORM_4
Zoom to
LINER_USE
SWL 0
WELL_YIELD 0
FROM_1 0
TO_1 44
FORM_1 BRN CLY
FROM_2 44
TO_2 46
FORM_2 BRKN BRN LS
FROM_3 46
TO_3 185
FORM_3 SH
FROM_4 0
TO_4 0
FORM_4
Zoom to
Macon
Southwest Blvd
East Fork Little Chariton River
Coates St Rd
Jenny Pl
Jaguar St
Jade Pl
Ivanhoe St
Jet Rd
Inca St
Harmonica St
County Road 726B
Hagar St
Hertz St
Mo-BB
Burlington Northern Santa Fe
Kestrel Ave
Narrows Creek
London Pl
S Missouri Ave
Duck Creek
Sewer Creek
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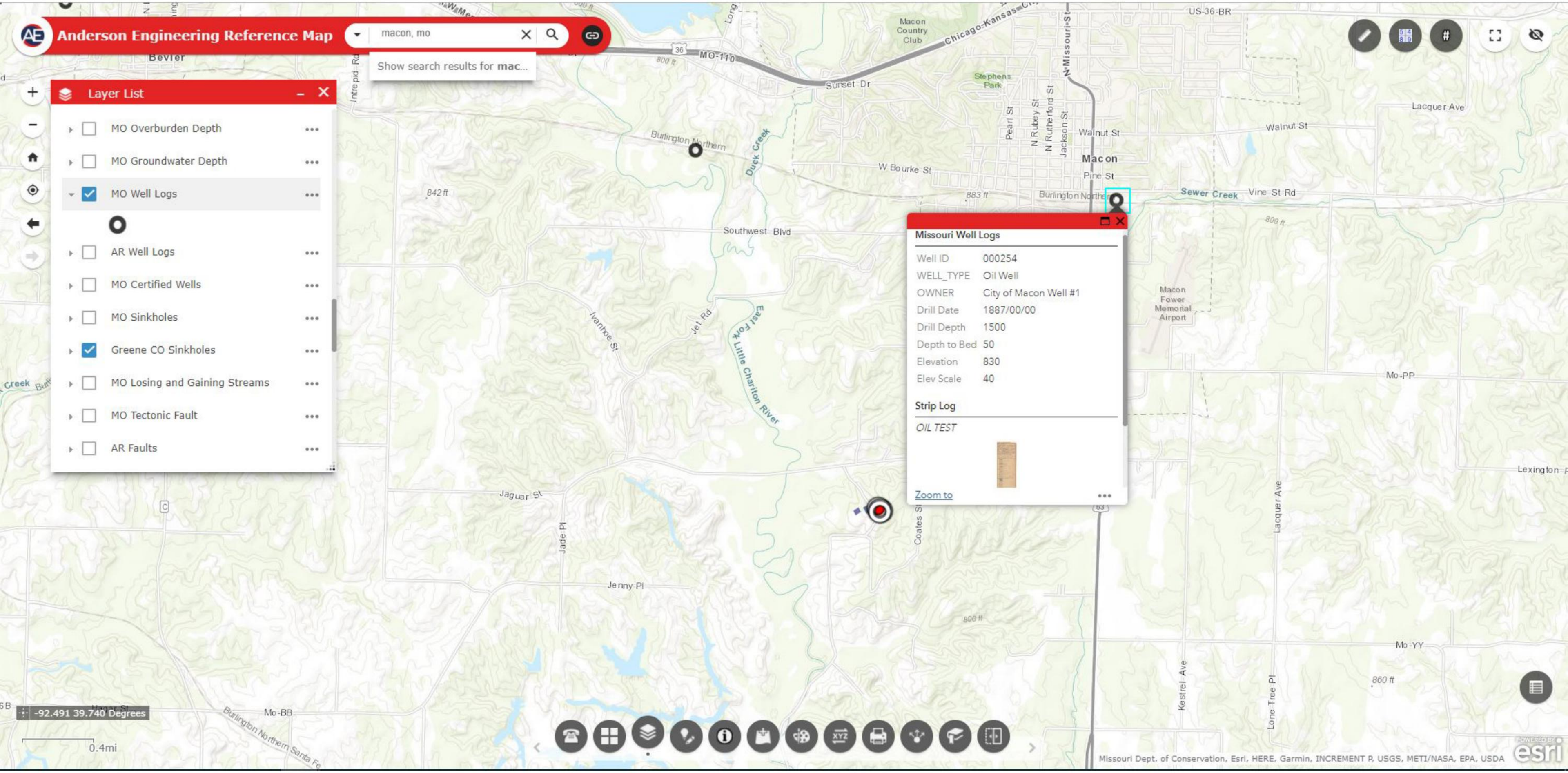
Missouri Dept. of Conservation, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA


Anderson Engineering Reference Map
macon, mo
Show search results for mac...
Layer List
MO Overburden Depth
MO Groundwater Depth
MO Well Logs
AR Well Logs
MO Certified Wells
MO Sinkholes
Greene CO Sinkholes
MO Losing and Gaining Streams
MO Tectonic Fault
AR Faults
Missouri Well Logs
Well ID 000254
WELL_TYPE Oil Well
OWNER City of Macon Well #1
Drill Date 1887/00/00
Drill Depth 1500
Depth to Bed 50
Elevation 830
Elev Scale 40
Strip Log
OIL TEST
Zoom to
Macon
Macon Country Club
Stephens Park
Macon Fower Memorial Airport
Sewer Creek
Vine St Rd
Walnut St
Pine St
W Bourke St
Southwest Blvd
Duck Creek
East Fork Little Chariton River
Ivanhoe St
Jet Rd
Jaguar St
Jade Pl
Jenny Pl
Coates St
Lacquer Ave
Kestrel Ave
Lone Tree Pl
Mo-PP
Mo-YY
Mo-BB
MO-110
US-36-BR
Sunset Dr
Burlington Northern
Lexington
-92.491 39.740 Degrees
0.4mi
Missouri Dept. of Conservation, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA

MISSOURI BUREAU OF GEOLOGY & MINES, ROLLA, MO.

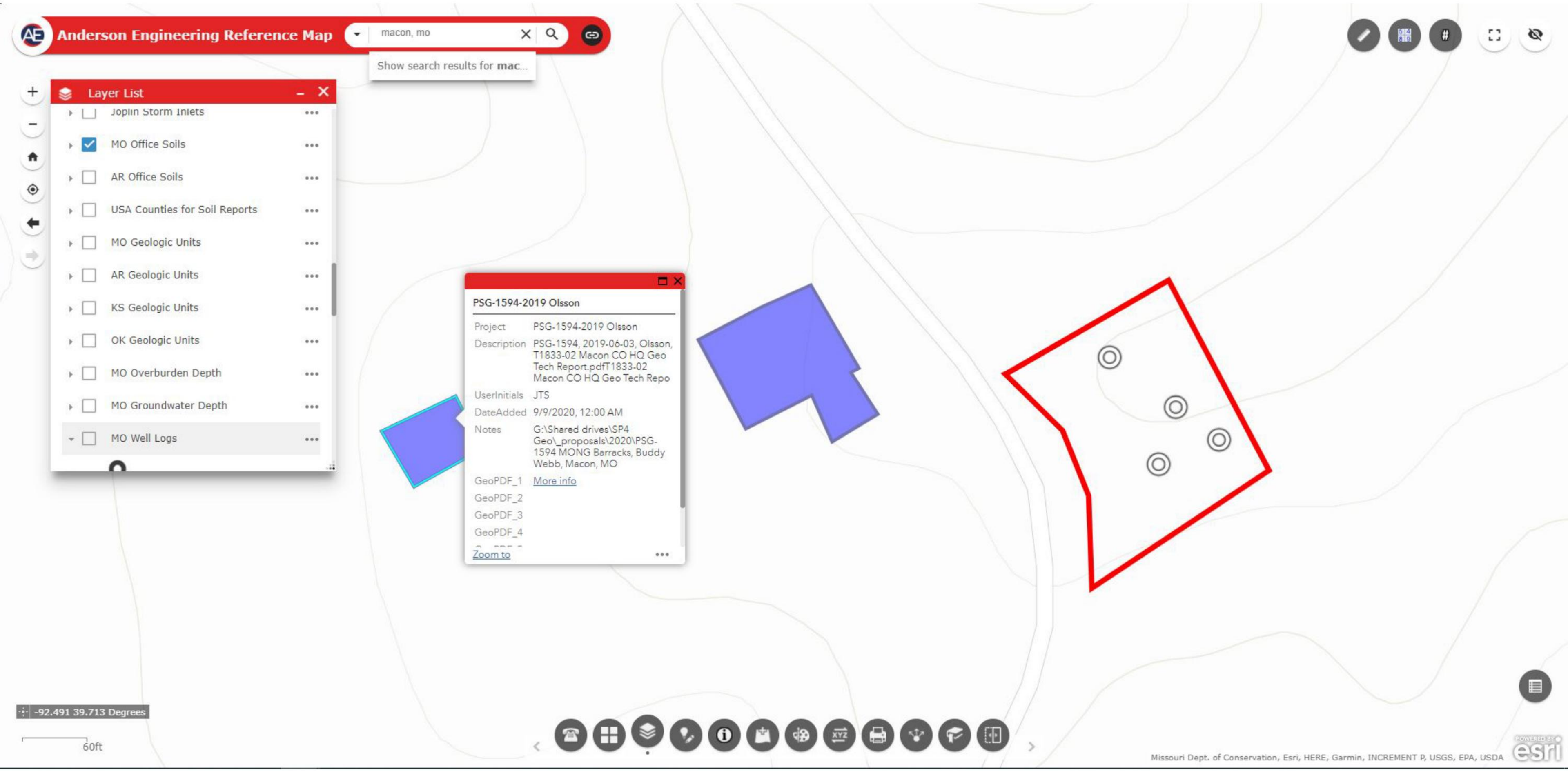
MO SURVEY Nº	OWNER	
254	City of Macon	
COUNTY	FARM in city of Macon	WELL Nº
Macon	Oil test	1
T 57 R 14	DRILLER	
	DATE 1887	0000 1
22	ELEVATION 830' (approx) (pid. 1939)	PRODUCTION
	SAMPLES STUDIED by W. V. McGee St. L. Acad. Sci - Vol. 5, 1888 pp 326-333	

REMARKS Log copied as Noted.
approx 528' W and 528' S of N.E. Cor. Sec. 21. Hole is 13" diameter To 36' - 8" To 320 5" to bottom.

0
glacial drift
36 blue
50 Coal Bcv?
blue shale
blue clay
gray limey sh
coal.
830
185
+645
100 blue clay
108 black clay
136 gray Cal. clay
150 gr. clay, Cal
830
396
434
slightly Cal. dk. gr. sh
185 Elev. Top Miss LS = 880 / 185 / +645
200 light gray LS. with conchoidal fracture.
213 light gr sub-xline with gr. sh
light gray slightly
Calcareous sh and clay

250 Calcareous sh and clay
273 dk gr. slightly Cal. sh.
Cal. gr. sh. - 281'6"
LS - sh - ch
300
8" C. 320' Strong flow of Water.
bl. gr. Cal. sh
350 light gray - dk gray
Nodular Cal. sh.
gr. siliceous LS and chert
400 396 light buff pure Ls + calcite + siderite - conc. 123.
dk. gray arenaceous
sh. Lite gr. Cal. sh. and
450 crystals of Calcite
482 light gray aren + Cal. sh. with light buff LS as in 396-410.
500 509 blue sparry LS. with fossil Markings
532 Shaly blue Limestone
550
575
light gray and
600 dark blue Shaly LS
685 — Base blue Limestone (Cooper?)
650

650 blue Limestone (Cooper?)
652 light blue sparry
700 limestone
750 DEVONIAN
764 light blue cherty
and arenaceous LS
Middle Kimmswick
800
gray sparry LS
and fine fissile
850 blue shale
Middle and Lower Kimmswick
895
900 massive blue shale or
indurated clay
950
1500
830
-670
Glenwood - Decorah, and possible Kimmswick
Top St PETER
1000 fine Calcareous Sand



Anderson Engineering Reference Map
macon, mo
Show search results for mac...
Layer List
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
MO Overburden Depth
MO Groundwater Depth
MO Well Logs
PSG-1594-2019 Olsson
Project PSG-1594-2019 Olsson
Description PSG-1594, 2019-06-03, Olsson, T1833-02 Macon CO HQ Geo Tech Report.pdfT1833-02 Macon CO HQ Geo Tech Repo
UserInitials JTS
DateAdded 9/9/2020, 12:00 AM
Notes G:\Shared drives\SP4 Geo_proposals\2020\PSG-1594 MONG Barracks, Buddy Webb, Macon, MO
GeoPDF_1 More info
GeoPDF_2
GeoPDF_3
GeoPDF_4
Zoom to
-92.491 39.713 Degrees
60ft
Missouri Dept. of Conservation, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA
esri

BOREHOLE REPORT NO. B-1

Sheet 1 of 1

PROJECT NAME: Macon Training Site Company HQ Bldg
CLIENT: GLMV Architecture Inc
PROJECT NUMBER: E18-3101
LOCATION: Macon, Missouri

Shelby Tube

APPROX. SURFACE ELEV. (ft): 811.6

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE	0.3'								
810	FAT CLAY Grayish brown, with red, trace silt	3.0'	U 1				37.8	83.4		P. P. = 1.5
	LEAN CLAY Stiff, brown, with gray, with sand and silt	5.0'	U 2	CL		1.2	25.6	101.4	38/24	
805	FAT CLAY Stiff, gray to dark gray brown, with reddish brown, with sand									
		10	U 3			1.7	25.1	101.0		
800		13.0'								
	Light reddish brown to light gray brown, trace silt and sand	15.0'	U 4				18.8	110.4		

BASE OF BORING AT 15.0 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	5/16/19	FINISHED:	5/16/19
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	P. OWEN
METHOD: CONTINUOUS FLIGHT AUGER			

BOREHOLE REPORT NO. B-2

Sheet 1 of 1

PROJECT NAME: Macon Training Site Company HQ Bldg
CLIENT: GLMV Architecture Inc
PROJECT NUMBER: E18-3101
LOCATION: Macon, Missouri

Shelby Tube

APPROX. SURFACE ELEV. (ft): 813.2

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE	0.3'								
	FAT CLAY Brown to reddish brown, with dark gray brown	3.0'	U 1				34.9	83.9		P. P. = 1.5
810	LEAN CLAY Stiff, brown gray to dark gray, with reddish brown, with sand and silt	5	U 2			1.9	19.3	110.0		
		8.0'								
805	FAT CLAY Yellowish brown, with gray, with silt, trace sand	10	U 3			1.9	22.0	103.4		
800		13.0'								
	Yellowish brown to reddish brown, with gray, with sand	15.0'	U 4				19.6	108.2		P. P. = 4.0

BASE OF BORING AT 15.0 FEET

WATER LEVEL OBSERVATIONS	
WD	▽ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	5/16/19	FINISHED:	5/16/19
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	P. OWEN
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-3

PROJECT NAME: Macon Training Site Company HQ Bldg
CLIENT: GLMV Architecture Inc
PROJECT NUMBER: E18-3101
LOCATION: Macon, Missouri

■ Shelby Tube

APPROX. SURFACE ELEV. (ft): 812.8

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
	ROOT ZONE (0.3')	0								
810	FAT CLAY: Dark brown, with gray and red, trace gravel, organics, and silt (3.0')		U 1				31.4	87.9		P. P. = 1.0
	LEAN CLAY: Stiff, brown to reddish brown, with gray, silty, sandy (5.0')	5	U 2			1.7	18.5	112.8		
805	FAT CLAY: Stiff, yellowish brown, with gray, sandy, silty									
		10	U 3			1.5	19.3	108.7		
800	(13.0')									
	SILTY CLAY: Brown, trace gray (15.0')	15	U 4				18.1	104.7		P. P. = 1.5

BASE OF BORING AT 15.0 FEET

WATER LEVEL OBSERVATIONS	
WD	∇ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	5/16/19	FINISHED:	5/16/19
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	P. OWEN
METHOD: CONTINUOUS FLIGHT AUGER			

olsson

BOREHOLE REPORT NO. B-4

PROJECT NAME: Macon Training Site Company HQ Bldg
CLIENT: GLMV Architecture Inc
PROJECT NUMBER: E18-3101
LOCATION: Macon, Missouri

■ Shelby Tube

APPROX. SURFACE ELEV. (ft): 815.0

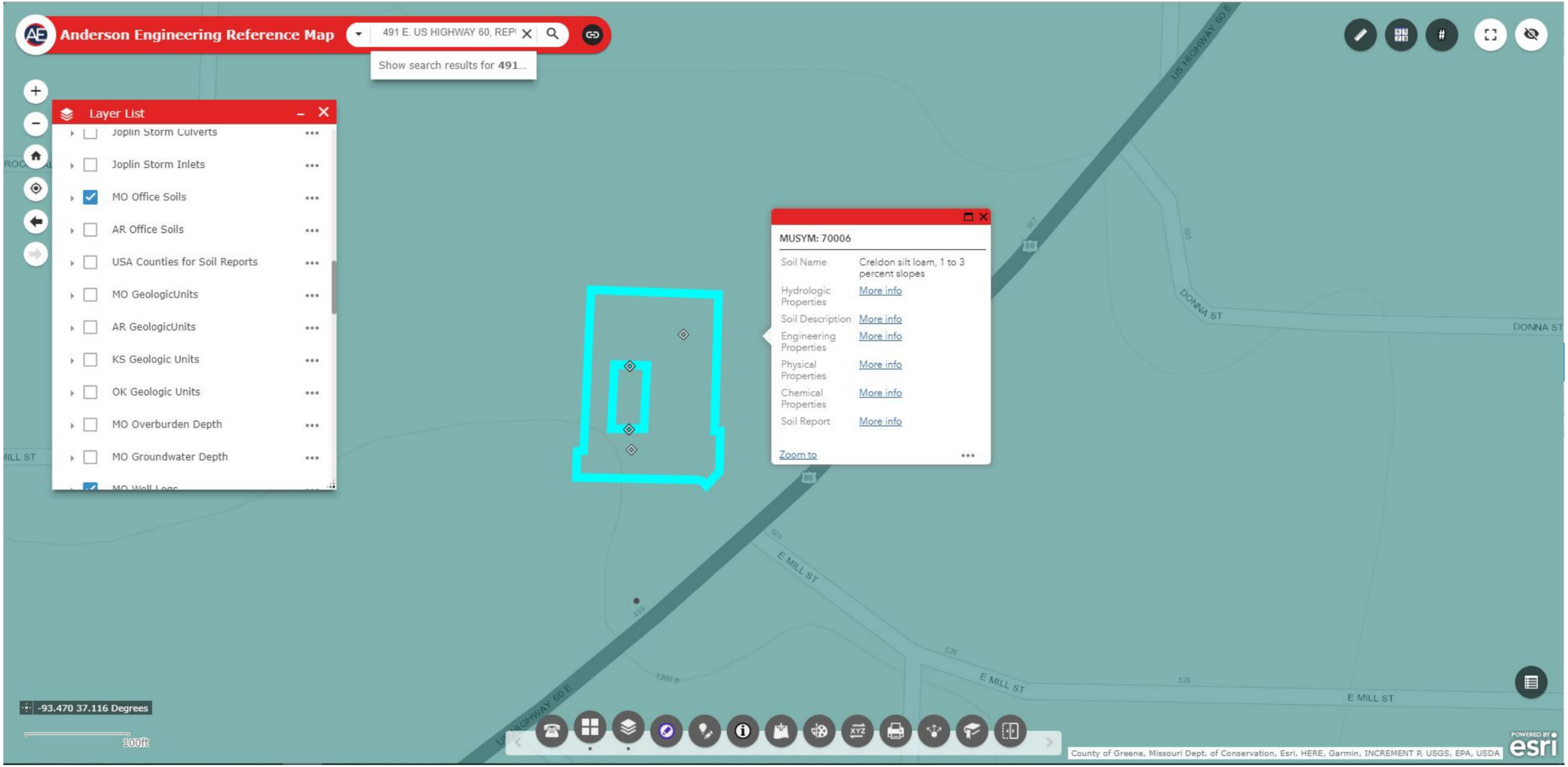
ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	CLASSIFICATION (USCS)	BLOWS/6" N-VALUE	UNC. STR. (tsf)	MOISTURE (%)	DRY DENSITY (pcf)	LL/PI (%)	ADDITIONAL DATA/ REMARKS
815	ROOT ZONE (0.3')	0								
	FAT CLAY: Dark gray brown, with red (3.0')		U 1	CH			29.8	91.7	66/45	P. P. = 1.25
810	Very stiff, reddish brown, trace gray, with sand, trace silt (8.0')	5	U 2			2.5	20.2	108.3		
805	Stiff, brown, with reddish brown and gray, trace silt and sand (13.0')	10	U 3			1.1	22.6	104.3		
800	Brown, trace gray, sandy, trace gravel (15.0')	15	U 4				19.5	106.4		P. P. = 4.0

BASE OF BORING AT 15.0 FEET

WATER LEVEL OBSERVATIONS	
WD	∇ Not Encountered
IAD	▼ Not Encountered
AD	▼ Not Performed

OLSSON, INC.
1700 E. 123RD STREET
OLATHE, KANSAS 66061

STARTED:	5/16/19	FINISHED:	5/16/19
DRILL CO.:	OLSSON	DRILL RIG:	CME 45
DRILLER:	K. PATTERSON	LOGGED BY:	P. OWEN
METHOD: CONTINUOUS FLIGHT AUGER			



Anderson Engineering Reference Map
491 E. US HIGHWAY 60, REPI
Show search results for 491...
Layer List
Joplin Storm Culverts
Joplin Storm Inlets
MO Office Soils
AR Office Soils
USA Counties for Soil Reports
MO GeologicUnits
AR GeologicUnits
KS Geologic Units
OK Geologic Units
MO Overburden Depth
MO Groundwater Depth
MUSYM: 70006
Soil Name
Creldon silt loam, 1 to 3 percent slopes
Hydrologic Properties
More info
Soil Description
More info
Engineering Properties
More info
Physical Properties
More info
Chemical Properties
More info
Soil Report
More info
Zoom to
US HIGHWAY 60 E
DONNA ST
E MILL ST
-93.470 37.116 Degrees
100ft
County of Greene, Missouri Dept. of Conservation, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA

Macon County, Missouri (MO121)

Macon County, Missouri (MO121)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
30067	Gorin silt loam, 3 to 9 percent slopes, eroded	0.6	70.3%
50011	Winnegan loam, 20 to 35 percent slopes	0.3	29.7%
Totals for Area of Interest		**0.9**	**100.0%**

Report — Map Unit Description

Macon County, Missouri

30067—Gorin silt loam, 3 to 9 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2qmwx
Elevation: 500 to 1,050 feet
Mean annual precipitation: 35 to 41 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 177 to 209 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Gorin and similar soils: 95 percent

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

Description of Gorin

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loess over pedisediment over till

Typical profile

A - 0 to 12 inches: silt loam
Bt1 - 12 to 27 inches: silty clay
2Bt2 - 27 to 48 inches: loam
3Bt3 - 48 to 80 inches: clay

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Medium
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 18 to 30 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 capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F109XY003MO - Loess Upland Woodland
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Report — Map Unit Description

Macon County, Missouri

50011—Winnegan loam, 20 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2qnz1
Elevation: 700 to 900 feet
Mean annual precipitation: 37 to 41 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 189 to 212 days
Farmland classification: Not prime farmland

Map Unit Composition

Winnegan and similar soils: 90 percent

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

Description of Winnegan

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Parent material: Till

Typical profile

A - 0 to 2 inches: loam
E - 2 to 7 inches: loam
Bt - 7 to 37 inches: clay loam
Btk - 37 to 60 inches: clay loam

Properties and qualities

Slope: 20 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well 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 24 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: F109XY009MO - Till Protected Backslope Forest, F109XY022MO - Till Exposed Backslope Woodland
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Description — Corrosion of Concrete

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Tables — Corrosion of Concrete — Summary By Map Unit

Summary by Map Unit — Macon County, Missouri (MO121)

Summary by Map Unit — Macon County, Missouri (MO121)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
30067	Gorin silt loam, 3 to 9 percent slopes, eroded	High	0.6	70.3%
50011	Winnegan loam, 20 to 35 percent slopes	High	0.3	29.7%
Totals for Area of Interest			**0.9**	**100.0%**

Description — Corrosion of Steel

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Tables — Corrosion of Steel — Summary By Map Unit

Summary by Map Unit — Macon County, Missouri (MO121)

Summary by Map Unit — Macon County, Missouri (MO121)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
30067	Gorin silt loam, 3 to 9 percent slopes, eroded	High	0.6	70.3%
50011	Winnegan loam, 20 to 35 percent slopes	High	0.3	29.7%
Totals for Area of Interest			**0.9**	**100.0%**

Report — Chemical Soil Properties

Macon 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*	
30067—Gorin silt loam, 3 to 9 percent slopes, eroded								
Gorin	0-12	9.1-27	—	5.1-6.5	0	0	0.0-2.0	0
	12-27	15-22	16-33	3.5-5.5	0	0	0.0-2.0	0
	27-48	14-20	9.3-18	4.5-5.5	0	0	0.0-2.0	0
	48-80	11-27	—	4.5-6.0	0	0	0.0-2.0	0
50011—Winnegan loam, 20 to 35 percent slopes								
Winnegan	0-2	25-40	23-38	4.5-7.3	0	0	0.0-2.0	0
	2-7	10-20	8.0-15	4.5-6.5	0	0	0.0-2.0	0
	7-37	20-30	18-27	4.5-6.5	0	0	0.0-2.0	0
	37-60	12-20	10-18	7.4-8.4	1-5	0	0.0-2.0	0

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).

Macon 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*
30067—Gorin silt loam, 3 to 9 percent slopes, eroded														
Gorin	95	C	0-12	Silt loam	CL, CL-ML	A-4, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	90-95-100	75-90- 95	25-32 -43	7-10-17
			12-27	Silty clay loam, silty clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	85-92- 95	45-56 -64	25-34-40
			27-48	Loam, clay loam	CL	A-7-6, A-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-88- 95	60-70- 80	29-36 -41	12-17-21
			48-80	Clay, clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	95-98-100	95-98-100	90-95-100	70-83- 95	46-54 -65	26-32-40
50011—Winnegan loam, 20 to 35 percent slopes														
Winnegan	90	D	0-2	Loam	ML, CL	A-7-6, A-6	0- 0- 0	0- 0- 0	95-100-100	90-98-100	75-90- 95	55-65- 75	31-38 -45	11-15-18
			2-7	Loam	CL-ML, CL	A-6, A-4	0- 0- 0	0- 0- 0	95-100-100	90-98-100	75-90- 95	55-65- 75	21-27 -39	6-8 -17
			7-37	Clay loam, clay	CL, CH	A-7-6	0- 0- 0	0- 0- 0	95-100-100	90-95-100	80-95-100	65-75- 95	46-52 -59	25-27-33
			37-60	Clay loam, loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	95-100-100	90-95-100	75-90-100	55-70- 80	31-40 -46	13-21-25

Report — Chemical Soil Properties

Greene 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*	
70006—Creldon silt loam, 1 to 3 percent slopes								
Creldon	0-10	12-18	8.0-18	4.5-7.3	0	0	0.0-2.0	0
	10-16	15-24	12-24	4.5-6.5	0	0	0.0-2.0	0
	16-24	15-24	12-24	4.5-6.5	0	0	0.0-2.0	0
	24-42	9.0-15	6.0-14	4.5-5.5	0	0	0.0-2.0	0
	42-51	6.0-12	5.0-10	4.5-6.0	0	0	0.0-2.0	0
	51-79	25-40	20-40	4.5-6.5	0	0	0.0-2.0	0

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).

Greene 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*
70006—Creldon silt loam, 1 to 3 percent slopes														
Creldon	90	C	0-10	Silt loam	CL, ML	A-4, A-6	0- 0- 0	0- 0- 0	100-100-100	95-100-100	90-95-100	70-80-90	20-30-40	2-9 -15
			10-16	Silty clay loam, silty clay	CL	A-7-6, A-6	0- 0- 0	0- 0- 0	95-100-100	90-100-100	85-95-100	80-90-95	35-43-50	15-20-25
			16-24	Silty clay loam, silty clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	95-100-100	90-100-100	85-95-100	80-88-95	44-55-60	22-30-35
			24-42	Silt loam, silty clay loam, gravelly silty clay loam, gravelly silt loam	CL, GC	A-6, A-7-6	0- 0- 0	0- 0- 5	60-75-100	55-70-100	50-65-95	45-65-90	35-40-45	15-20-25
			42-51	Very gravelly silty clay loam, extremely gravelly silty clay loam, extremely cobbly silt loam	GC, CL	A-2-6, A-7-6	0- 0- 0	0-45- 50	35-50-65	30-45-60	25-40-55	20-35-50	35-40-45	15-20-25
			51-79	Very gravelly clay, gravelly clay, clay	CH, GC	A-2-7, A-7-6	0- 0- 0	5- 5- 30	40-90-95	35-85-90	30-70-75	30-65-70	55-68-80	35-48-60