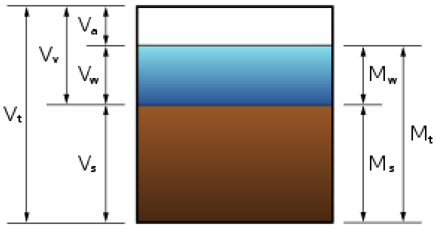
TAB 9

Tab 9 - Geotechnical Report by Lorenzen Soil Mechanics, Inc.



Lorenzen Soil Mechanics, Inc.

Clearview Subdivision

Missoula, Montana

Geotechnical Engineering Report

Prepared for:
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February 19, 2023

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1 INTRODUCTION

Professional Consultants, Inc. (PCI) requested Lorenzen Soil Mechanics, Inc. (LSM) to complete a general geotechnical/materials investigation for a subdivision within the southern portion of Missoula, Montana. The purpose of the subsurface investigation was to evaluate the subgrade materials and provide general recommendations for street typical sections, underground utilities, building foundations, slabs-on-grade, retaining walls, water infiltration, and slope stability for approximately 31.5 acres.

2 SITE EVALUATION

The site has primarily been a single-family residence with horse pastures and barns. The terrain is sloped and grades downward from the southeast to the northwest. The elevation difference is roughly 200 feet across 1,500 lineal feet or 7.5 Horizontal to 1 Vertical (7.5H:1V). The residential site with its horse barn and sheds is somewhat flatter. A few scattered coniferous trees are on the upper slope at the northeastern portion of the site. Lichen-covered surficial boulders exist within the western portion of the site and there are a few stockpiles of boulders and cobbles.

An open grassed area is to the north of the site and Hillview Way passes above the site to the east. A residential neighborhood exists to the south and west. Moose Can Gulley is a drainage feature that passes nearby to the southwest. Accesses to the proposed site will be off Elk Hills Court and Clearview Way.

Geologically, this area is mapped on the Missoula West 30’ x 60’ Quadrangle Geologic Map (MBMG Open File Report 373). The geologic map depicts the site primarily as Eocene through Miocene epochs Gravel and Clay Deposits (Tgc). Upslope to the east, the mapping describes Miocene through Pliocene epochs Alluvial Fan Deposits (Taf). The Tgc materials are characterized in the Open File Report as channel and flood plain deposits of the ancestral Clark Fork River. They include well-sorted (poorly graded) and well-rounded cobbles, gravel, sand, silt, clay, and volcanic ash deposits. The clasts are not locally derived. Its coarser material intervals are permeable, but the clay-rich zones are not. The Tgc materials are likely equivalent to the Renova Formation of southwest Montana. The Taf materials are characterized in the Open File Report as locally derived, poorly to moderately sorted conglomerate[1.] containing locally derived poorly sorted (well-graded), angular to rounded boulders, cobbles, gravel, sand, and silt. It is likely equivalent to the Sixmile Formation of southwest Montana. A portion of the geologic map is included as Figure 1.

[1.] LSM believes the term ‘conglomerate’ in the Open File Report refers to the compacted collection of particles and likely does not refer to cemented sedimentary rock. LSM uses the conglomerate term in this report to describe tightly compacted gravel and silt within a clay matrix.

Two relatively nearby water well logs data-based at the Montana Bureau of Mines and Geology were reviewed. The logs indicate depths to the groundwater table ranged from 60 to 140 feet. Such differences in groundwater table elevations are to be expected in sloping terrain. The water well drilling depths extended from 140 to 400. Bedrock was logged as shale in the shallower of the two water wells but was sandwiched between layers of water-bearing sand and gravel, indicating the shale may have been more a compact clay. The 400-foot deep water well was logged as 140 feet of clay, silt, and gravel overlying gravel, cobbles, and clay layers to the bottom of the well.

LSM conducted its subsurface investigation on August 19, 2022. A Caterpillar 308CR mini-excavator, owned and operated by Grant Creek Excavating, was used to dig a total of ten test pits (TP). Figure 2 depicts the test pit locations. Horizontal coordinates were obtained using a Garmin eTrex® 10 GPS unit. The elevations were estimated from Google Earth.

The materials encountered tended to agree with the MBMG Open File Report for the Tgc and the Taf materials in that there were gravel and sand with varying amounts of clayey fines and frequent to occasional cobble-sized particles. Test pits along the eastern portion of the site (TP-05, TP-07, TP-10) included tightly compacted gravel in a clay matrix (conglomerate). Based on the water well logs and the materials encountered during LSM's investigation, the seismic site class is recommended as 'C – Very Dense Soils and Soft Rock'.

The groundwater table was encountered in TP-06 at the time of excavation. At a later date, groundwater was encountered at the bottom of the TP-05 piezometer, but TP-06 was recorded as being dry. The moisture conditions of the subgrade materials were generally regarded as being 'dry', 'damp', or 'moist'. Logs of the test pits and the testing results are provided in Appendix A. The two MBMG water well logs and the seismic spectral acceleration design values are included in Appendix A. Photographs of the test pitting operations and soil samples are included in Appendix B.

3 RECOMMENDATIONS

In general, LSM believes the granular soils encountered across the western portion of the site are considered excellent for street and building construction. The clay layers encountered at the subgrade elevations will require some stabilization such as the use of geosynthetics and the inclusion of a subbase course within the street typical section. The recommendations that follow are generic to the test pit investigations completed thus far. LSM recommends including a more in-depth geotechnical for individual structures, or at the very least, a geotechnical review during the residential foundation excavations to verify the soils are consistent with what is provided in this general report. Some locations can expect to encounter perched groundwater zones that may develop into springs upon excavation. French drains and sumps may be necessary in some locations.

3.1 Mass Grading

The materials and topography encountered across the site are such that there will likely be some significant cuts and fill. At this time, LSM recommends limiting the cut slopes to no steeper than a 2.5H:1V. All cut slopes will need to be vegetated with grasses, shrubs, and trees. Fill slope geometries should be no steeper than a 3H:1V.

LSM is available to address steeper cut slopes and retaining wall design recommendations.

3.2 Street Typical Sections

LSM has evaluated two typical sections for standard duty street traffic for this site using the Montana Department of Transportation (MDT) and American Association of State Highway and Transportation Officials (AASHTO) methods.

The AASHTO A-1 and A-2 granular soils are considered acceptable as street subgrade soils. The A-1 soils in particular are considered excellent subgrade soils. Missoula County ranks A-1 soils as ‘good’ and A-2 soils as ‘average’. These subgrade soils were encountered primarily within the western one-half (TP-01, -02, -03, -04, and -08) of the project site. The A-4 and A-6 subgrade soils are ranked by Missoula County as being ‘poor’. These soils were encountered in the subgrade soils within the eastern one-half (TP-05, -06, -07, and -09) of the project site. TP-10 is the anomaly, located in the southeastern portion of the project and having the A-1 and A-2 granular soils.

Using Table 14.2-A in the MDT Geotechnical Manual, the ASSHTO soil classifications correlate to a Resistance value (R-value) ranging from 41 to greater than 70. LSM has conservatively based the typical section design on an R-value of 50, which correlates to a Resilient Modulus (M_R) of 20,000 psi. A California Bearing Ratio (CBR) range of 20 to 80 can be expected for the A-1 and A-2 soils. A CBR range of 3 to 25 can be expected for the A-4 soils. LSM will recommend an 18-inch thick subbase over a woven geotextile when the subgrade classifies as an A-4 or A-6 soil.

3.2.1 Typical Section for A-1 and A-2 Subgrades

The Resilient Modulus was used to calculate the design structural number for a flexible pavement. The Resistance value was correlated to a table provided in MDT’s Geotechnical Manual. Other variables include the 18-kip equivalent single axle loadings (ESALs), initial serviceability, terminal serviceability, design serviceability loss, reliability level, and the overall standard deviation. Their values and description are provided below.

- Resistance Value, R-value = 50 - a material property used by MDT to characterize the support characteristics of the roadbed soil in flexible pavement design. It measures the response of a compacted sample of soil or aggregate to a vertically applied pressure.

- Roadbed Soil Resilient Modulus, M_R = 20,000 psi - a material property used by AASHTO to characterize the support characteristics of the roadbed soil in flexible pavement design. In general terms, it is a measure of the soil’s deformation in response to repeated applications of load much smaller than a failure load.

- Equivalent Single Axle Loadings, ESALs = 1,000,000. This is an assumed value and is intended to take into account residential structure construction.

- Initial Serviceability, $p_o = 4.2$ - a measure of the pavement's smoothness or rideability immediately after construction. Serviceability is rated on a scale of 0 to 5, with 5 being a perfectly smooth pavement and 0 being a very rough or impassable pavement.

- Terminal Serviceability, $p_t = 2.2$ - the minimum tolerable serviceability of a pavement, on the same 0 to 5 scale as described in Initial Serviceability.

- Design Serviceability Loss, ΔPSI, = 2.0 – the difference between p_o and p_t.

- Reliability Level, R = 90 percent - the probability that a pavement structure will survive the design period traffic. Generally, as traffic volumes become larger, the consequences of premature pavement failure increases dramatically; therefore, high-volume roadways must be constructed with a much higher level of reliability than low-volume roadways.

- Overall Standard Deviation, $S_o = 0.49$ - accounts for all variability associated with design and construction inputs, including variability in material properties, roadbed soil properties, traffic estimates, climatic conditions, and quality of construction.

Based on the above criteria, a required Structural Number (SN) of 2.50 was calculated using a nomograph developed by AASHTO. The nomograph is included in Appendix A.

The SN represents the ability of a flexible pavement to withstand structural loadings. Using the required SN, the thicknesses of the different material layers within the typical section can be determined as:

$$SN = a_1D_1m_1 + a_2D_2m_2 + a_nD_nm_n$$

The 'a' values represent structural coefficients, the 'D' values represent the layer thicknesses, and the 'm' values represent the drainage coefficients. A value of 0.41 was used for the asphalt cement structural coefficient, $a_{1.}$ A value of 0.14 for virgin crushed base course was used for its structural coefficient, a_2. The structural coefficients are recommended values from a May 11, 2006 MDT memorandum for 'Revised Surfacing Structural Coefficients and Layer Thicknesses'. The drainage coefficient, m, is a function of the time required for the pavement to drain and the amount of time during the year that the pavement structure is exposed to moisture levels approaching saturation. MDT recommends a conservative drainage coefficient value of 1.0 for the plant mix surfacing and for the base course.

To match or exceed the required SN of 2.50, LSM proposes a typical section of:

Asphalt Plant Mix	4 inches – in two 2-inch thick lifts
3/4-inch Crushed Base	8 inches
Scarified and Wetted Subgrade	6 inches

This typical section produces a design SN of 2.76. LSM believes this to be an appropriate value, given the actual ESAL loadings are unknown at this time but may likely be less than the assumed value of 1,000,000 over a 20-year period in a residential neighborhood.

The gradation for the 3/4-inch crushed base course is provided in Table 1. Recycled concrete can be blended with the base course, provided the end result meets the gradation recommendation.

TABLE 1: 3/4" Crushed Base Course

Sieve Size	Percent Passing
3/4"	90 - 100
3/8"	70 - 90
No. 4	40 - 70
No. 10	25 - 55
No. 200	2 - 8

LSM recommends preparing the new street typical sections by:

1. Grading to the subgrade depth, extending the typical section to at least 1 horizontal foot beyond any curb and gutter section.
2. Scarifying to a depth of at least 6 inches and wetting the scarified surface.
3. Compacting the wetted, scarified surface to a standard relative compaction of at least 95 percent and at a moisture content within 2 percent of its optimum moisture content. The subgrade may be too coarse to have a relevant Proctor moisture density curve and, similar to the perimeter footing and slab-on-graded subgrades, the maximum dry density may need to be established in the field. LSM recommends using a roller compactor having an operating weight of at least 25,000 pounds and a centrifugal force of at least 50,000 pounds.
4. Providing an 8-inch compacted thickness of 3/4-inch crushed aggregate base course meeting the gradation in Table 1. Recycled concrete can be blended with the base course, provided the end result meets the gradation recommendation.
5. Compacting the base course to a **modified relative compaction (ASTM D1557)** of at least 95 percent and to a moisture content within 2 percent of its optimum moisture content.
6. Grading the final surface to drain stormwater to dry well sumps or other City-approved stormwater detention area.

LSM recommends a performance graded PG 58-28 binder for the asphalt concrete and the plant mix surfacing aggregate meeting the Montana Public Work's gradation presented in Table 2. The gradation bands in Table 2 represent the job mix target limits, which determine the suitability of aggregate. Provide the final job mix target gradation within the specified bands and uniformly graded from coarse to fine, not to vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice-versa. For example, using the 3/8" and No. 4 sieves, a gradation of 73 percent and 48 percent passing their respective sieves is acceptable, 73 percent and 62 percent passing their respective sieves is not.

TABLE 2: Plant Mix Surfacing Gradation

Sieve Size	% Passing Job Mix Target Bands	Job Mix Tolerances
3/4"	100	---
1/2"	83 - 93	+/- 7

3/8”	73 - 87	+/- 7
No. 4	47 - 63	+/- 6
No. 10	32 - 43	+/- 6
No. 40	15 - 25	+/- 5
No. 200	5 - 7	+/- 2

The job mix formula establishes target values. During mix production, the gradations are to fall within the job mix limits presented in Table 2, i.e. if a QA job mix target of 6 has been selected for the No. 200 sieve and since the tolerance is +/-2, the job mix gradation for production would be 4 - 8.

Place the asphalt concrete plant mix surfacing in a two 2-inch thick lifts and compacting each lift to an average relative compaction (ASTM D2041) of at least 93 percent, and no individual sample being less than 92 percent.

3.2.2 Typical Section for A-4 and A-6 Subgrades

Fine-grained subgrades that include A-4 and A-6 soils will require an 18-inch thick subbase and a woven geotextile. The subbase is needed to counteract against frost heave potential inherent with silty soils. The woven geotextile acts as a separation/stabilization layer that keeps the fine-grained soils from migrating up into the subbase and provides some stabilization for when the fine-grained soils become saturated.

LSM proposes a typical section over the fine-grained subgrades of:

Asphalt Plant Mix	4 inches – in two 2-inch thick lifts
3/4-inch Crushed Base	8 inches
3-inch Crushed Subbase	18 inches
Woven Geotextile	Propex 200ST, Contech C200
Scarified and Wetted Subgrade	6 inches

Appling a value of 0.12 to represent the subbase’s structural coefficient, a_3, this typical section provides an SN of at least 4.92. The 4.92 SN does not credit the presence of woven geotextile. On previous projects, LSM has given credit for up to 3 inches of base course with the placement of a stabilization geotextile. Due to the expected variability in the subgrades with the mass grading for this project, LSM has conservatively not given structural credit for the geotextile.

LSM recommends constructing the typical section over the fine-grained soils in a manner similar to that of the A-1 and A-2 soils. The subbase and the woven geotextile placements need to be included as:

1. Over-excavating below the base course depth of 18 inches, extending the typical section to at least 1 horizontal foot beyond any curb and gutter section.
2. Scarifying to a depth of at least 6 inches and wetting the scarified surface.
3. Compacting the wetted, scarified surface to a standard relative compaction of at least 95 percent and at a moisture content within 2 percent of its optimum moisture content.

4. Providing a separation/stabilization woven geotextile meeting the engineering characteristics of Propex 200ST or Contech C200.
5. Placing the woven geotextile over the scarified, wetted, and compacted subgrade, overlapping the joints by at least 1 foot.
6. Providing a subbase meeting the gradation provided in Table 3. Recycled concrete can be blended with the base course, provided the end result meets the gradation recommendation.

TABLE 3: Subbase/Structural Backfill

Sieve Size	Percent Passing
3”	100
1”	80 - 100
1/2”	60 - 75
No. 4	35 - 55
No. 40	5 - 30
No. 200	0 - 8

7. Placing the subbase in 8-inch (maximum) thick, loose lifts and compacting each lift to a **modified relative compaction (ASTM D1557)** of at least 95 percent.
8. Providing an 8-inch compacted thickness of 3/4-inch crushed aggregate base course meeting the gradation in Table 1. Recycled concrete can be blended with the base course, provided the end result meets the gradation recommendation.
9. Compacting the base course to a **modified relative compaction (ASTM D1557)** of at least 95 percent and to a moisture content within 2 percent of its optimum moisture content.
10. Grading the final surface to drain stormwater to dry well sumps or other City-approved stormwater detention area.

3.3 Residential Foundations

The recommendations that follow are very general and are meant to provide preliminary information regarding the construction of home foundations, stem and basement walls, and slabs-on-grade. A total of only ten test pits were excavated over the 31.5-acre site. Other than installing piezometers within each of the test pits, ab extended groundwater study was not included as part of this project. Perched groundwater zones are known to exist in the general area around the periphery of this development. Moisture conditions during the subsurface investigation indicate water is moving across the site. The clay layers likely act as an aquitard that may cause the groundwater to build up in localized area. LSM recommends that during residential construction, a site investigation be completed that includes the installation of 1-inch diameter piezometers that can be periodically read to determine if groundwater is rising closer to the surface and if it could affect the foundation excavations and lower levels of home sites.

3.3.1 Residential Building Foundations on Granular Soils

Continuous and isolated spread footings can be used to support normal building loads. LSM recommends setting the foundation footing elevations at least 3 feet below the final grading.

LSM recommends preparing the continuous foundation on granular subgrades by:

1. Excavating to the subgrade elevation.
2. Scarifying to a depth of at least 6 inches. The scarifying can be completed with the excavator bucket. Remove cobble-sized particles larger than 3 inches that are brought to the subgrade surface and replace with stockpiled smaller granular spoils or imported structural backfill meeting the gradation in Table 3.

3. Wetting the scarified surface to a moisture content within 2 percent of its optimum moisture content.
4. Compacting the wetted surface to a standard relative compaction (ASTM D698) of at least 98 percent. LSM recommends using a trench roller having an operating weight of at least 3,000 pounds and a centrifugal force of at least 15,000 pounds. The subgrade soils may be too coarse to receive a relevant Proctor moisture/density relationship curve. If so, the maximum dry density for the relative compaction can be established by making repeated passes with the trench roller and checking the dry density values with a nuclear densometer until they no longer increase. That value would then be used as the maximum dry density.
5. Setting the concrete formwork and tying the reinforcement steel.
6. Providing adequate dobies and chairs to support the reinforcement steel to keep it from settling toward the bottom of the footing.

Interior isolated footings can be set directly below the slab-on-grade elevations. They are to receive a subgrade preparation treatment similar to the continuous footings. LSM recommends preparing the isolated footing subgrades by:

1. Excavating to the subgrade elevation and scarifying to a depth of at least 9 inches.
2. Removing cobbles at the subgrade surface larger than 3 inches.
3. Wetting the scarified surface to a moisture content within 2 percent of its optimum moisture content.
4. Compacting the wetted surface to a standard relative compaction (ASTM D698) of at least 98 percent. If the excavated space does not allow room for the trench roller used for the continuous footings, LSM recommends using a plate compactor having an impact force of at least 3,800 pounds.
5. Setting the concrete formwork and tying the reinforcement steel.
6. Providing adequate dobies and chairs to support the reinforcement steel to keep it from settling toward the bottom of the footing.

The scarified and compacted gravels are considered an excellent bearing surface and will offer an allowable soil bearing capacity of 4,000 pounds per square foot (psf). A coefficient of friction, μ, of 0.45 can be used for either the continuous footing or the isolated footing sliding resistance designs.

LSM believes a perimeter drain tile system is prudent for these sites, particularly if the foundations are on fine-grained subgrades. LSM recommends that after stripping the foundation forms,

1. Excavating a separate, narrow (~12 inches wide) trench that is graded to drain to daylight on a slope of at least 0.5 percent along the outer edge of the foundation trench.
2. Providing a 4-inch diameter slotted PVC drain tile, geotextile filter sock meeting the engineering characteristics of Geotex® 111F, a 6-inch cover of 3/4-inch drain rock, and a non-woven geotextile meeting the engineering characteristics of Geotex 401 to burrito-wrap the drain tile and drain rock.
3. Installing the perimeter drain tile system along the outer perimeter of the drainage trench.
4. Providing a rodent guard at the drain's outlet and riprap rock to act as a landmark and to control possible erosion.

LSM recommends good building practices by including either wide eaves or rain gutters with downspouts that carry roof runoff water at least 7 horizontal feet away from the buildings and to provide positive drainage on at least a 2 percent slope extending at least 10 feet around the entire perimeter of each of the buildings.

3.3.2 Residential Building Foundations on Fine-Grained Soils

At this time, LSM will make itself available to address fine-grained foundation subgrades as they appear on a case-by-case basis.

3.4 Foundation Stem Walls/Retaining Walls

The stockpiled native soils can be re-used as backfill against the walls, provided all the 3-inch plus sized particles are removed. Prepare the foundation walls for backfilling by:

1. Ensuring there is a water stop at the wall and footing interface.
2. Providing damp proofing or water proofing as per the Architect or Structural Engineer's recommendations. Water proofing is required for living quarters that are below the ground surface.
3. Providing rigid expanded polystyrene (EPS) insulation along the exterior perimeter of the building foundation walls. In addition to insulation, the EPS insulation will provide a cushion to help protect the damp proofing or water proofing on the foundation walls during the backfilling operations.
4. Placing each of the backfill lifts in 8-inch (maximum) thick, loose lifts and compacting each lift to a standard relative compaction of at least 95 percent and at a moisture content within 2 percent of its optimum moisture content.

Compacting these materials as backfill will offer an internal angle of friction (ϕ) of 35°, and a moist unit weight (γ_m) of at least 130 pcf. For the on-site soils being used as backfill, LSM recommends using an active equivalent fluid unit weight (γ_{fa}) of 35.2 pounds per cubic foot (pcf) for wall design where the tops of the walls are allowed to rotate, such as for retaining walls. Where the walls are rigid, such as for foundation walls, LSM recommends an at-rest equivalent fluid unit weight (γ_{f0}) of 55.4 pcf. With a level backfill, the following equations can be used to obtain a resultant lateral force (pounds per lineal foot) acting at the lower one-third of the wall heights (H in feet):

Active Pressure, P_a: 17.6 x H^2
Passive Pressure, P_p: 239.9 x H^2
At-rest Pressure, P_0: 27.7 x H^2
Seismic Pressure, P_E: 8.8 x H^2
Seismic Active Pressure, $P_{(E+a)}$: 26.4 x H^2

Retaining walls can be designed using the lateral earth pressures provided in this section. The allowable soil bearing capacity for the retaining walls is recommended to be 2,000 psf. The lower value is due to the likelihood the retaining wall base will be buried only 1 foot below the final grade. A 4-inch diameter slotted drain system is recommend directly behind the retaining walls. The drain system includes a PVC drain tile graded to drain to daylight and a 1-foot wide layer of 3/4-inch drain rock that extends from the base of the wall to its full height. The drain rock and drain tile are to be burrito-wrapped in a filter fabric meeting the engineering characteristics of Geotex 111F.

3.5 Slabs-on Grade

It is LSM's belief and opinion that the most important preparations for a slab-on-grade's subgrade include the surfaces being properly compacted and being level. LSM recommends the interior slab-on-grade subgrades be prepared by:

1. Excavating to the subgrade depth + 3 inches and scarifying the excavated surface by at least 6 inches. This can be accomplished with the excavator bucket's teeth or a disc.
2. Removing all cobble-sized particles in excess of 3 inches.
3. Moisture conditioning the scarified surface by wetting the subgrade to within 2 percent of its optimum moisture content.
4. Compacting the moisture conditioned subgrade to a standard relative compaction of at least 98 percent. Similar to the continuous and isolated footing subgrades, the slab subgrade may be too coarse to have a relevant Proctor moisture/density curve and will need to have its maximum dry density established in the field. LSM recommends using a roller compactor having an operating weight of at least 20,000 pounds and a centrifugal force of at least 40,000 pounds.
5. Removing the Plumber's and Electrician's conduit trench spoils from beneath the slab-on-grade and replacing with 3/8-inch washed rock in 12-inch thick lifts, tamping each lift to a firm surface. A low mound (~1.5 inches) of the 3/8-inch washed rock over the last lift is recommended. This is to provide material if there is some subsidence in the utility trenches prior to forming and pouring the slab concrete.
6. Providing a 3-inch thick leveling course of 3/4-inch minus cushion material meeting the gradation in Table 4. Alternatively, 3/4-inch drain rock can be used as the leveling course. A compacted, level surface prior to placing fresh concrete will help minimize concrete cracking.

TABLE 4: Leveling Course/Base Course

Sieve Size	Percent Passing

3/4”	100
3/8”	70 - 90
No. 4	40 - 70
No. 10	25 - 55
No. 200	0 - 8

7. Ensuring there are no visible rises or depressions across the compacted surface. Grade and compact the surface if it is uneven to make it level prior to placing fresh concrete.
8. Including temperature steel within the slab-on-grade at, or just above, it’s mid-depth.
9. Including sufficient dobies and chairs to provide support for the temperature steel, thereby preventing the steel from moving toward the bottom portion of the slab. LSM suggests a grid of 18-inch to 24-inch centers using No. 5 rebar or greater to provide room for the concrete flatworkers to step over the rebar during placement and finishing.

For slabs placed on the properly compacted and prepared subgrades as described, a modulus of subgrade reaction, k, of 300 pounds per square inch per inch of deflection (pci) can be used for the slab thickness design. Use a coefficient of friction, μ, of 0.45 for sliding resistance design.

Varying amounts of curling within the slabs are likely to occur due to differences in the moisture content or to temperatures variations between the top and the bottom of the slab. To help mitigate potential slab curling, LSM recommends the following options:

1. Putting a chloride-free retardant additive into the fresh concrete mix;
2. Maintaining a minimum of 1.5 inches clearance on all rebar; and,
3. Placing a 15-mil thick polyolefin vapor barrier across the prepared subgrade surface prior to placing the fresh concrete. If the roof system and walls are in place prior to the slab pour, place the vapor barrier below the leveling course to mitigate edge curling. In addition to being a vapor barrier, the Stego® vapor barrier has a radon diffusion coefficient of 8.8 x 10^{-12} square meters per second.

The purpose of the retardant in the first option is to slow the set at the surface of the slab. No chlorides are allowed in any of the admixtures for the slabs-on-grade. The concrete at the slab surface will generally harden quicker than the concrete at the bottom of the slab. This is particularly true of concrete placed during hot weather conditions. The use of a retardant can also reduce cold joints, allow smaller crews to finish flat work, and permit later joint sawing.

For joint designs, LSM suggests:

1. Including isolation joints at all interior column locations.
2. Spacing control joints from 24 to 36 times the thickness of the slab in each direction.
3. Terminating reinforcing bars within 2 inches of both sides of control joints to limit the transfer of shrinkage and contraction restraints.
4. Cutting the joints with a conventional saw within 4 to 12 hours after the concrete is finished, or with a dry-cut early entry saw within 1 to 4 hours after the concrete is finished. Extend the saw cuts to one-quarter the thickness of the slab. If fiber reinforcing

is used, increase the saw cut to one-third the thickness of the slab. If added correctly, fiber reinforcement can limit the growth of shrinkage cracking.

LSM yields to the Structural Engineer for the joint and steel reinforcement designs.

3.6 Exterior Flatwork

Exterior flatwork slabs such as utility and trash container pads, patios, lanais, sidewalks, and driveways are not anticipated to be supporting any loads other than the traffic intended for their use. LSM recommends preparing the flatwork subgrades by:

1. Excavating to the exterior flatwork subgrade.
2. Scarifying the excavation to a depth of at least 6 inches and removing all cobble-sized particles in excess of 3 inches that come to the surface.
3. Moisture-conditioning the scarified surface by wetting the subgrade to within 2 percent of its optimum moisture content.
4. Compacting the moisture-conditioned subgrade to a standard relative compaction of at least 95 percent.
5. Providing at least 6 inches of a compacted granular base course meeting the gradation presented in Table 4.
6. Compacting the base course to a relative compaction of at least 95 percent.
7. Ensuring there are no visible rises or depressions across the compacted surface and if needed, grading and further compacting the surface to make it level prior to placing fresh concrete.
8. Forming driveway slabs to be at least 6 inches thick.
9. Forming sidewalk slabs to be at least 4 inches in thickness. Where the sidewalks cross a driveway, form the sidewalk to be at least 6 inches thick.
10. Spacing the contraction joints a maximum of 8 feet apart and providing a maximum width of 1/4-inch, cut at least one-quarter of the depth of the concrete.
11. Installing expansion joints between slabs no more than 40 feet apart and at sidewalk/doorway entry interfaces. At these locations, provide a minimum width of 3/4-inch.
12. Filling all expansion joints with a field-molded sealant to prevent the infiltration of water into the underlying soils.
13. LSM suggests including steel or synthetic fibers with any tensile reinforcement to help prevent widening or horizontal separation of concrete cracks that may form.

3.7 Fresh Concrete

LSM recommends Type I/II or Type IL cement for the footings and foundation walls. LSM suggests a concrete mix design have a 4-inch maximum slump before any water reducer (plasticizer) admixture is added or up to 8 inches after it is added. The air content range should range from 5 to 8 percent for footings, foundation walls, and exterior flatwork. The inclusion of entrained air in the footings is a safeguard against concrete being placed and exposed during cold temperatures and if the frost depth extends below the footing elevation.

For the interior slab and exterior flatwork concrete, LSM recommends Type II cement *or* including a shrinkage reducing admixture and/or a hydration control admixture to Type I/II or Type IL cement. The admixtures are to be chloride-free. LSM understands Type II cement is no longer readily available in this region. The purpose of the cement type recommendation is to limit shrinkage cracking. LSM understands Type I/II cement meets the strength requirements for Type I cement and the composition requirements for Type II cement. Type I and Type III cements usually give higher early strengths than Type II cement but all else being equal, will also have higher concrete shrinkage than Type II cement. LSM recommends the maximum aggregate size be 1 ½ inches for the slab mix designs. LSM suggests the mix design have a 3-inch maximum slump before any water reducer (plasticizer) admixture is added or up to 8 inches after it is added. If fiber reinforced concrete is used, give consideration to providing a slump value associated with the fibers. Erect windbreaks and sunshades to limit rapid surface drying. Avoid curing with water that is more than 20^{o}F cooler than the concrete. These recommendations are intended to limit the amount of shrinkage cracking in the slabs.

If the concrete will be freshly cast during cold temperatures, protect the fresh concrete from freezing. Do not cast fresh concrete on frozen ground. LSM recommends the Contractor provide an approved plan for protecting concrete being placed during cold weather.

LSM yields to the Structural Engineer in each of the concrete mix designs for footings, foundation walls, slabs-on-grade, and exterior flatwork.

3.8 Slope Stability

It does appear that the current 7.5H:1V slope geometry is stable. Road cuts may steepen the slopes up to 2.5H:1V. The slopes can be assessed for the individual lots that encroach near the toe. Following the International Residential Code (IRC) R403.1.7, footings are to be located no closer than one-third the slope height or 4- feet, whichever is less, from a descending slope. The face of the structure is to be no closer than one-half the slope height or 15 feet, whichever is less, from an ascending slope. A geotechnical review is needed to determine is the structures can be closer to the slope surface.

3.9 Groundwater Table, Surface Water, and Infiltration Rate

The groundwater table was encountered during the subsurface investigation in TP-06. At a later date, the groundwater table was noted in TP-05 while TP-06 was noted as being dry. The groundwater is considered to be perched and express itself as seeps or springs in open excavations.

LSM understands the City of Missoula is concerned with stormwater migrating down-gradient to the west, perhaps expressing itself as a spring or seep downslope. Without conducting an extensive groundwater study, LSM is limited to offer design guidelines other than to note the existing ground likely allows a moderate to rapid infiltration rate downward. Based on some of the fine-grained textural classifications the percolation rates could be estimated to range from 10 to greater than 50 minutes per inch [MT Department of Environmental Quality Circular 4, 2013].

In areas where granular soils extended to depth, it has been LSM's experience in this area that an infiltration rate of 1,860 inches per hour was measured.

With hard surfacing and rooftops, plus added irrigation water that has not yet been seen across this property, surface water will likely become localized. LSM is aware there are springs nearby, likely fed by perched groundwater. If a spring is encountered, it is to be developed and routed away from the building sites. LSM can provide recommendations for developing the springs if necessary. Regardless, the residential sites must be graded during construction to limit ponding. LSM recommends berming all open excavations to prevent surface water from entering into them.

3.10 Underground Utilities

For utility trench excavations, the trench materials are expected to meet OSHA's requirements for a Type C soil. The steepest unsupported slope within a Type C soil trench is a 1 1/2H: 1V.

Use bedding soils that are minus 3/4-inch granular materials and are non-corrosive. A non-corrosive soil has a resistivity value greater than 3,000 ohm-centimeters. LSM recommends extending the bedding soil from the bottom of the utility trench to 6 inches above the top of the utility conduits. The native materials can be re-used as trench backfill over the bedding, provided the 3-inch and greater materials are removed. If the excavated cobble-sized materials are placed back in the utility trench, there will likely be uneven settlement due to the confined space in which to get an adequately sized piece of compaction equipment on the over-sized materials.

Soil compaction in utility trenches deeper than 5 feet should be performed using a remote trench compactor and observed by an inspector. The loose lift thickness are not to exceed 8 inches. When the backfill has been brought back to within 5 feet of the surface, perform compaction testing. Compact the trench backfill soils in 8-inch (maximum) thick, loose lifts to a standard relative compaction of at least 95 percent and at a moisture content within 2 percent of its optimum moisture content.

3.11 Seismic Considerations

The Missoula area is within the Northern Intermountain Seismic Belt. The ASCE/SEI 7-22 Hazards Report was used to develop the spectral response values for a seismic site class 'C', "Very Dense Soil and Soft Rock". LSM recommends the maximum credible spectral response accelerations at short 0.2-second periods, S_{MS}, and at 1-second periods, S_{M1}, to determine the seismic design base shear. A risk category of II was used for residential housing. The spectral response acceleration parameters are presented in Table 5.

The seismic backfill pressures against the buried portion of the foundation walls can be determined by adding a seismic event component, P_E, based on Seed and Whitman (1970) to the coefficient of active pressure P_a. The P_E was calculated to be 9.5 x H^2, making the active pressure against the wall during an earthquake equal to 24.7 x H^2 and was presented in Section 3.2. A factor of safety of 1.1 can be used for earthquake design lateral earth pressures and the allowable bearing capacity can be increased by one-third for seismic design.

TABLE 5: Seismic Coefficients

ASCE/SEI 7-22, Earthquake Loads	
Site Class Definition	C
Mapped Spectral Response Acceleration Parameter, S_S for 0.2 second	0.42g
Mapped Spectral Response Acceleration Parameter, S_1 for 1.0 second	0.12g
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S_{MS}	0.46g
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S_{M1}	0.18g
Design Spectral Response Acceleration Parameter, S_{DS}	0.31g
Design Spectral Response Acceleration Parameter, S_{D1}	0.12g
Mean Peak Ground Acceleration, PGA_M	0.19g

Due to the expected groundwater depth being greater than 15 feet, liquefaction is considered to be a low concern at this site during a major earthquake.

3.12 Shrink/Swell Characteristics

The volume change potential for the coarse grained soils is considered low during seasonal moisture fluctuations for this particular site. The fine-grained soils that may be encountered within the foundation and slab-on-grade subgrades should be considered to have a medium to high volume change potential. These sites should be modified to limit their volume change potential. LSM does recommend that individual lots receive a geotechnical investigation specific to their site prior to design.

The frost heave potential is considered high if the subgrades are on fine-grained soils. Every effort must be made to direct surface water away from building foundation and flatwork subgrades. LSM recommends positive drainage away from the building's exterior perimeters be in place by providing at least 2 percent grades extending at least 10 horizontal feet away from the building's perimeters.

The collapse potential of the on-site soils is considered low due to the age of the soil profile.

3.13 Compaction and Fresh Concrete Testing Frequency

LSM recommends a compaction testing frequency presented in Table 6 for the foundation, slab-on-grade, and street subgrades, wall backfill, and utility trench backfill. LSM recommends concrete sampling and testing for fresh concrete. In addition to the compaction and fresh concrete testing, LSM recommends including applicable special inspections as per the International Building Code, Chapter 17.

TABLE 6: Testing Frequency

Compaction Testing	
Beneath Column Footings	1 Test per Footing
Beneath Wall Footings	1 Test per 75 Lineal Feet of Wall
Foundation Wall/Column Backfill	1 Test per 100 Lineal Feet of Wall per Lift
Slabs-on-Grade Subgrade	1 Test per 2,000 Square Feet

Exterior Flatwork Subgrade	1 Test per 1,000 Square Feet
Roadway & Parking Subgrade and Aggregates	1 Test per 4,000 Square Feet
Utility Trench Backfill	1 Test per 200 Lineal Feet per Lift
Concrete Testing	
Structural Concrete[1]	1 Test per 50 Cubic Yards per Day
Non-Structural Concrete	1 Test per Day

[1] Structural concrete includes all footings, foundation walls, slabs, and other load bearing elements.

4 BASIS OF RECOMMENDATIONS

The analyses and recommendations submitted in this general report are based upon the subsurface investigation that was used to provide generic instructions for the subgrade preparations. Often, variations occur within the subgrade, the nature and extent of which do not become evident until additional exploration or construction is conducted. The test pits completed thus far are widely spaced but do provide an initial understanding as to the local geology.

This report is for the exclusive use of PCI and their design team. In the absence of LSM's written approval, LSM makes no representation and assumes no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes.

Professional Certification

I hereby certify that this report was prepared by me and that I am a duly Licensed Professional Engineer under the laws of the State of Montana.

TODD A. LORENZEN
PEL-PE-LIC-10067

Todd Lorenzen

February 19, 2023

Todd Lorenzen, P.E.
Geotechnical Engineer

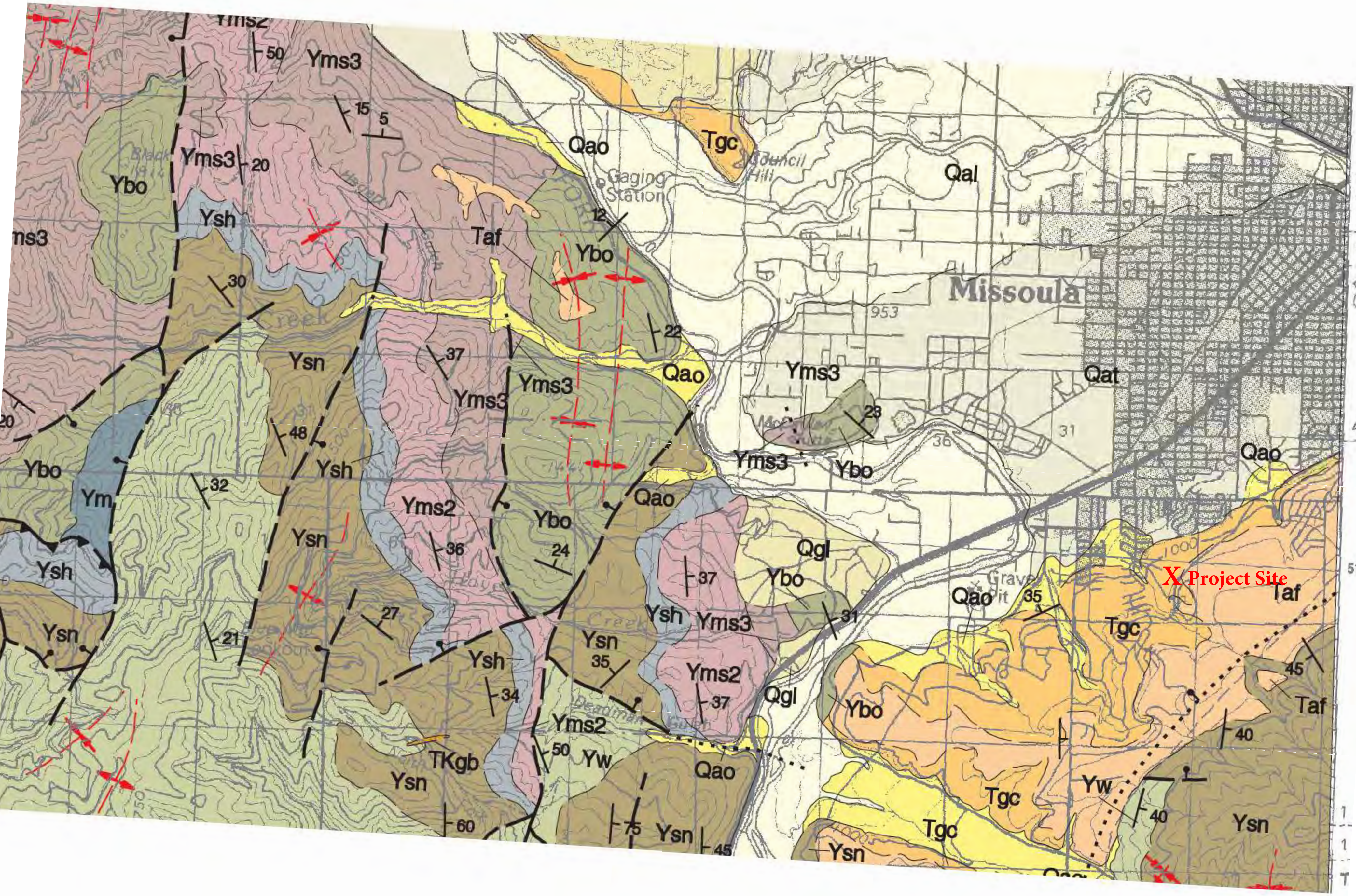


Figure 1: Portion of Montana Bureau of Mines and Geology Open File Report 373, Geologic Map of Missoula-West 30' x 60' Quadrangle; 1998 Reed S. Lewis.

Figure 2: Test Pit Locations

APPENDIX A. LOGS OF TEST PITS AND TESTING INFORMATION

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	☒	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	CA:	≋	Casing Advancer
ST:	■	Thin-Walled Tube - 2" O.D., unless otherwise noted	DA:	◨	Drill Auger
CB:	⧗	California Sampler - 2" I.D., 2.5" O.D., unless otherwise noted	HA:		Hand Auger
DB:	▯	Diamond Bit Coring - 4", NX, unless otherwise noted	RB:		Rock Bit
BS:	▨	Bulk Sample or Auger Sample	GS:	✋	Grab Sample

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". The field blow counts are reported for each 6-inch interval, or portion thereof if greater than 50 blows are required to advance the full 6-inch interval. For over-sized split spoon samplers, non-standard hammers, or non-standard drop heights, the field penetration values are reported on the bore log. The values must be corrected to obtain the N-value.

WL:	Water Level	WS:		While Sampling	NE:	Not Encountered
WCl:	Wet Cave-In	WD:	▽	While Drilling		
DCI:	Dry Cave-In	BCR:		Before Casing Removal		
AB:	After Boring	ACR:	▼	After Casing Removal		

Groundwater table levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater table levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater table levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: gravel or sand. Cobbles and boulders are not part of the USCS system but are included, when present, as percentages. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; depending on their plasticity, they are described as clay or silt. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils are defined on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 - 1,000	2 - 4	Soft
1,001 - 2,000	5 - 8	Medium Stiff
2,001 - 4,000	9 - 15	Stiff
4,001 - 8,000	16 - 30	Very Stiff
8,000 +	30 +	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	California Barrel (CB) Blows/Ft.	Relative Density
0 - 4	0 - 6	Very Loose
5 - 10	7 - 18	Loose
11 - 30	19 - 58	Medium Dense
31 - 50	59 - 98	Dense
50 +	99 +	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of Other Constituents	Percent of Dry Weight
Trace	< 15
With	15 - 30
Modifier	> 30

USCS* GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

*For AASHTO grain size the #4 sieve is replaced with the #10 sieve

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of Other Constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity_Index
Non-Plastic	0
Slightly	1 - 5
Low	6 - 10
Medium	11 - 20
Highly	21 - 40
Very Highly	> 40

GENERAL NOTES

Description of Rock Properties

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very Slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately Severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Highly	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very Highly	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete/Residual Soil	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

FIELD HARDNESS (for engineering description of rock not to be confused with Moh's scale for minerals)

Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately Hard	Can be scratched with knife or pick. Gouges or grooves to 1/4 in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very Soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding and Foliation Spacing in Rock [a]

Spacing	**Joints**	**Bedding/Foliation**
Less than 2 in.	Very Close	Very Thin
2 in. - 1 ft.	Close	Thin
1 ft. - 3 ft.	Moderately Close	Medium
3 ft.-10 ft.	Wide	Thick
More than 10 ft.	Very Wide	Very thick

Rock Quality Designation (RQD)[b]		**Joint Openness Descriptors**	
ROD, as a percentage	Diagnostic description	Openness	Descriptor
Exceeding 90	Excellent	No Visible Separation	Tight
90 - 75	Good	Less than 1/32 in.	Slightly Open
74 - 50	Fair	1/32 to 1/8 in.	Moderately Open
49 - 25	Poor	1/8 to 3/8 in.	Open
Less than 25	Very poor	1/2 in. to 1 1/4 in.	Moderately Wide
		Greater than 1 1/4 in.	Wide

a. Spacing refers to the distance normal to the planes of the described feature, which are parallel to each other or nearly so.
b. RQD (given as a percentage) = (Σ of core 4 in. and longer) / (length of run).

References: American Society of Civil Engineers Manuals and Reports on Engineering Practice - No. 56, American Society of Civil Engineers, 1976.
U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.
AASHTO M145, 2010.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	$Cu \geq 4$ and $1 \leq Cc \leq 3$	GW	Well-graded Gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$	GP	Poorly graded gravel [F]
		Gravels with Fines More than 12% fines	Fines classify as ML or MH	GM	Silty Gravel [F,G,H]
			Fines classify as CL or CH	GC	Clayey Gravel [F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	$Cu \geq 6$ and $1 \leq Cc \leq 3$	SW	Well-graded Sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$	SP	Poorly graded Sand [I]
		Sands with Fines More than 12% fines	Fines classify as ML or MH	SM	Silty Sand [G,H,I]
			Fines classify as CL or CH	SC	Clayey Sand [G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line	CL	Lean Clay [K,L,M]
			PI < 4 or plots below "A" line	ML	Silt [K,L,M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic Clay [K,L,M,N]
					Organic Silt [K,L,M,O]
	Silts and Clays Liquid Limit 50 or more	inorganic	PI plots on or above "A" Line	CH	Fat Clay [K,L,M]
			PI plots below "A" line	MH	Elastic Silt [K,L,M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic Clay [K,L,M,P]
					Organic Silt [K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contains cobbles and/or boulders, add "with cobbles or boulders, or both" as necessary to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt. GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E]
$$Cu = D_{60} / D_{10} \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.

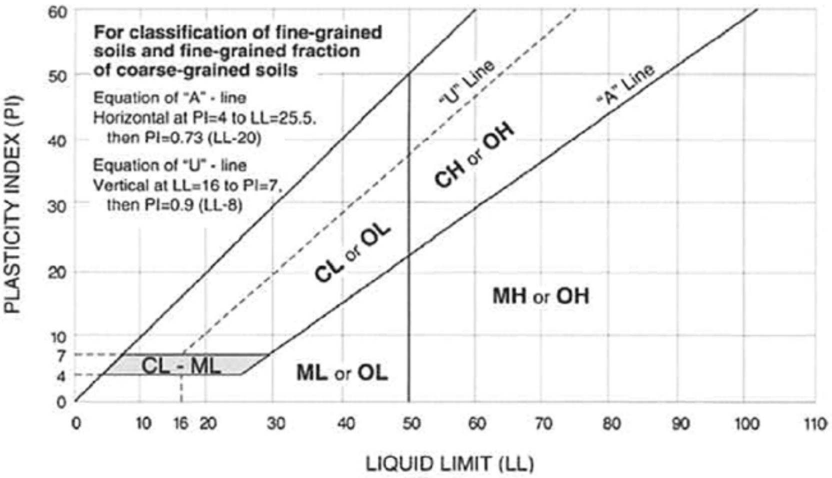
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

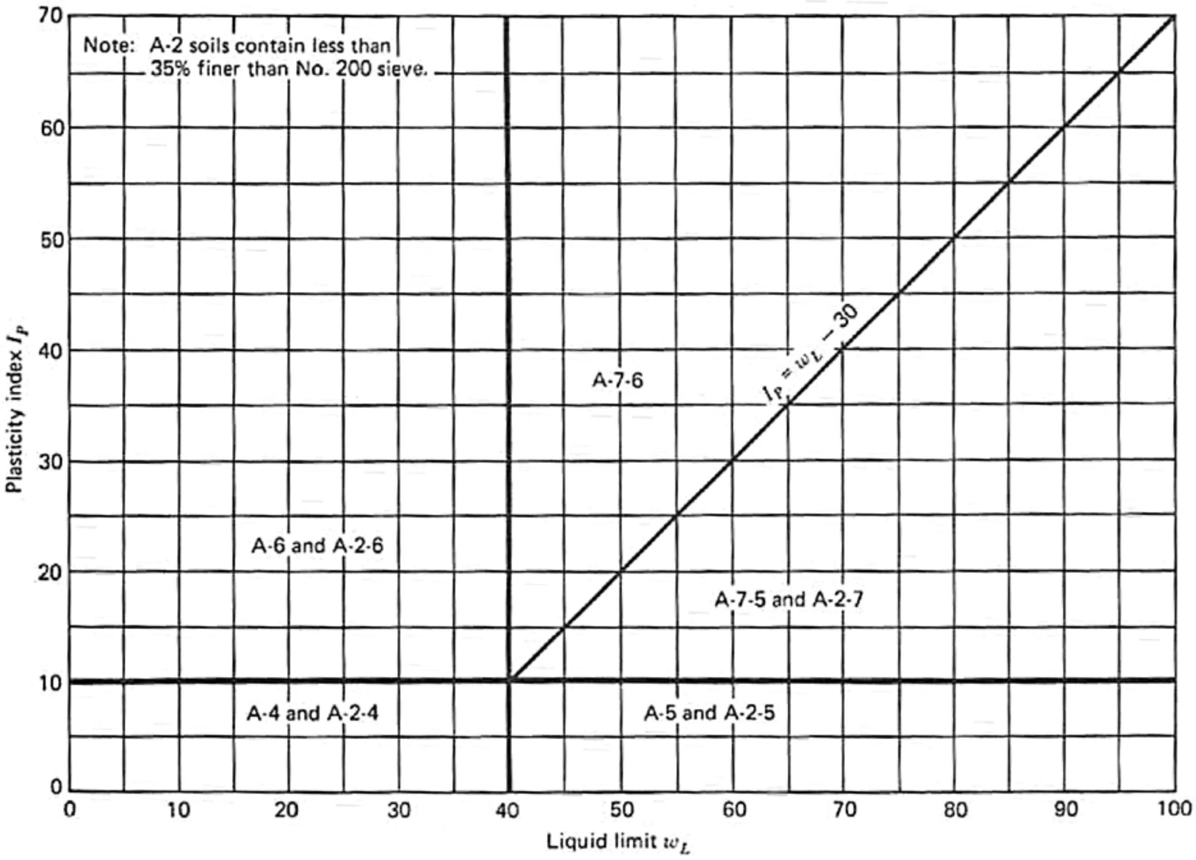
[Q] PI plots below "A" line.



AASHTO SOIL CLASSIFICATION SYSTEM

General classification	**Granular materials** (35 percent or less of total sample passing No. 200)							**Silt-clay material** (More than 35 percent of total sample passing No. 200)			
Group classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7 [1]
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve analysis percent passing											
No. 10	50 max										
No. 40	30 max	50 max	51 max								
No. 200	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40											
Liquid limit, w_L				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plastic Index, I_P	6 max		NP	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min
Significant constituent materials	gravel and sand		fine sand	silty and clayey gravel and sand				silty soils		clayey soils	

[1] Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL minus 30.



Lorenzen Soil Mechanics, Inc.
2720 Palmer Street, Unit C
Missoula, MT 59808
Telephone: 406-830-0633

TEST PIT NUMBER TP-01

CLIENT Professional Consultants Inc.

PROJECT NAME Clearview

PROJECT NUMBER BE22

PROJECT LOCATION MIssoula

DATE STARTED 8/19/22 **COMPLETED** 8/19/22

GROUND ELEVATION 3317 ft **TEST PIT SIZE** 36 inches

EXCAVATION CONTRACTOR Grant Creek Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD CAT 308CR

AT TIME OF EXCAVATION --- GW table was not encountered.

LOGGED BY Lorenzen **CHECKED BY** Lorenzen

AT END OF EXCAVATION --- GW table was not encountered.

NOTES N46° 49.628'; W114° 01.819'

82hrs AFTER EXCAVATION --- GW table was not encountered.

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0	GB	MC = 4% LL = 26 PL = 22 Fines = 59%	ML	0.8	(ML) TOPSOIL, Loam [A-4], thick Grass Vegetation; dry; grayish brown (10YR 5/2); no reaction to 10% HCl solution; slightly plastic; low dry strength, friable; low toughness. Army Corps of Engineers Cone Penetrometer was pushed 1.75 inches at the ground surface under a 320 psi loading.	3316.3
	GB	MC = 1%	GP		(GP) Poorly Graded GRAVEL with Sand, frequent Cobbles [A-1]; rounded to subrounded, flat; dry; dark grayish brown (10YR 4/4) matrix; no reaction to 10% HCl solution.	
2.5						
	GB	MC = 3%			Army Corps of Engineers Cone Penetrometer was pushed 1.75 inches at 3 feet under a 320 psi loading.	
5.0						
				6.3		3310.8
	GB	MC = 8%	GC	7.5	(GC) Clayey GRAVEL [A-2]; rounded to subrounded; moist; dark yellowish brown (10YR 4/6) matrix; no reaction to 10% HCl solution. Fines are medium plastic.	3309.5
7.5	GB	MC = 5%	GP	8.0	(GP) Poorly Graded GRAVEL with Sand, frequent Cobbles [A-1]; rounded to subrounded, flat; moist; yellowish brown (10YR 5/4) matrix; no reaction to 10% HCl solution.	3309.0

Bottom of test pit at 8.0 feet.

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Missoula, MT 59808
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TEST PIT NUMBER TP-02

PAGE 1 OF 1

CLIENT Professional Consultants Inc.
PROJECT NAME Clearview
PROJECT NUMBER BE22
PROJECT LOCATION MIssoula
DATE STARTED 8/19/22   **COMPLETED** 8/19/22
GROUND ELEVATION 3287 ft   **TEST PIT SIZE** 36 inches
EXCAVATION CONTRACTOR Grant Creek Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 308CR
AT TIME OF EXCAVATION --- GW table was not encountered.
LOGGED BY Lorenzen   **CHECKED BY** Lorenzen
AT END OF EXCAVATION --- GW table was not encountered.
NOTES N46° 49.627'; W114° 01.916'
82hrs AFTER EXCAVATION --- GW table was not encountered.

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0	GB	MC = 4%	ML	1.2	(ML) TOPSOIL, Sandy Loam with Gravel [A-4] and Lichen-covered Surficial Boulders, thick Grass Vegetation; dry; dark gray (10YR 4/1); no reaction to 10% HCl solution. Gravels and Boulders are rounded to subrounded. Army Corps of Engineers Cone Penetrometer was pushed 1.75 inches at the ground surface under a 320 psi loading.	3285.8
2.5	GB GB GB	MC = 3% MC = 3% MC = 6%	GP-GM	4.0	(GP-GM) Poorly Graded GRAVEL with Silt and Sand [A-1], traces of Mica; rounded to subrounded; dry; dark brown (10YR 3/3) matrix; no reaction to 10% HCl solution. Fines are medium plastic. Army Corps of Engineers Cone Penetrometer was pushed 4.75 inches at 3 feet under a 320 psi loading.	3283.0
	GB	MC = 26%	ML	5.0	(ML) SILT with Sand [A-4]; damp; light yellowish brown (2.5Y 6/3); no reaction to 10% HCl solution; medium plastic; low dry strength, friable.	3282.0
5.0	GB	MC = 20% LL = 42 PL = 26 Fines = 84%	ML	7.0	(ML) SILT with Sand [A-4]; damp; light olive brown (2.5Y 5/3); no reaction to 10% HCl solution; medium plastic, rapid dilatency; low toughness; low dry strength, friable.	3280.0
7.5	GB	MC = 22% LL = 41 PL = 26 Fines = 87%	ML	8.0	(ML) SILT [A-4]; damp; olive brown (2.5Y 4/3); no reaction to 10% HCl solution; medium plastic, rapid dilatency; low toughness; low dry strength, friable.	3279.0

Bottom of test pit at 8.0 feet.

Lorenzen Soil Mechanics, Inc.
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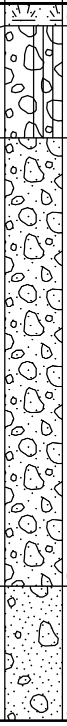
Telephone: 406-830-0633

TEST PIT NUMBER TP-03

PAGE 1 OF 1

CLIENT Professional Consultants Inc.
PROJECT NAME Clearview
PROJECT NUMBER BE22
PROJECT LOCATION MIssoula
DATE STARTED 8/19/22 **COMPLETED** 8/19/22
GROUND ELEVATION 3309 ft **TEST PIT SIZE** 36 inches
EXCAVATION CONTRACTOR Grant Creek Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 308CR
AT TIME OF EXCAVATION --- GW table was not encountered.
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
AT END OF EXCAVATION --- GW table was not encountered.
NOTES N46° 49.591'; W114° 01.917'
82hrs AFTER EXCAVATION --- GW table was not encountered.

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	MATERIAL DESCRIPTION	
0.0–0.3	GB	MC = 3%	ML	(ML) TOPSOIL, Sandy Loam [A-4] with Surficial Boulders, thick Grass Vegetation; dry; very dark grayish brown (10YR 3/2); no reaction to 10% HCl solution. Boulders are rounded to subrounded.	3308.8
0.3–1.5	GB	MC = 4%	GP-GM	(GP-GM) Poorly Graded GRAVEL with Silt and Sand, frequent Cobbles [A-1]; subrounded, flat; damp; very dark grayish brown (10YR 3/2) matrix; no reaction to 10% HCl solution. Army Corps of Engineers Cone Penetrometer was pushed 1.75 inches at the ground surface under a 320 psi loading.	3307.5
1.5–6.5	GB GB	MC = 4% MC = 5%	GP	(GP) Poorly Graded GRAVEL with Sand, frequent Cobbles [A-1], becoming more Sandy with depth; subrounded, flat; damp; dark yellowish brown (10YR 3/4, 4/4) matrix with very pale brown (10YR 8/2) coatings; no reaction to 10% HCl solution. Army Corps of Engineers Cone Penetrometer was pushed 2.75 inches at 2 feet under a 320 psi loading.	3302.5
6.5–8.0	GB	MC = 4%	SP	(SP) Poorly Graded SAND with Gravel [A-1]; damp; yellowish brown (10YR 5/4); no reaction to 10% HCl solution. Gravels are coarse, subrounded.	3301.0



Bottom of test pit at 8.0 feet.

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TEST PIT NUMBER TP-04

PAGE 1 OF 1

CLIENT Professional Consultants Inc.

PROJECT NAME Clearview

PROJECT NUMBER BE22

PROJECT LOCATION MIssoula

DATE STARTED 8/19/22 **COMPLETED** 8/19/22

GROUND ELEVATION 3347 ft **TEST PIT SIZE** 36 inches

EXCAVATION CONTRACTOR Grant Creek Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD CAT 308CR

AT TIME OF EXCAVATION --- GW table was not encountered.

LOGGED BY Lorenzen **CHECKED BY** Lorenzen

AT END OF EXCAVATION --- GW table was not encountered.

NOTES N46° 49.596'; W114° 01.736'

82hrs AFTER EXCAVATION --- GW table was not encountered.

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
0.0	GB	MC = 4%	ML		0.8	(ML) TOPSOIL, Sandy Loam [A-4], trace fine Gravel, thick Grass Vegetation; dry; very dark gray (10YR 4/1); no reaction to 10% HCl solution. Gravels are subrounded, flat. Army Corps of Engineers Cone Penetrometer was pushed 4.25 inches at the ground surface under a 320 psi loading.	3346.3
	GB	MC = 3%	GC		2.3	(GC) Clayey GRAVEL [A-2]; subrounded to subangular, flat; dry; dark yellowish brown (10YR 4/4) matrix; no reaction to 10% HCl solution. Fines are medium plastic.	3344.8
2.5 5.0	GB	MC = 9%	GC		6.0	(GC) Clayey GRAVEL [A-2] with Coatings; subrounded to subangular, flat; damp to moist; dark yellowish brown (10YR 4/6) matrix; matrix has no reaction to 10% HCl solution; coatings have a strong reaction to 10% HCl solution. Fines are medium plastic and have a low to medium dry strength, crumbly. Army Corps of Engineers Cone Penetrometer was pushed 2 inches at 3.5 feet under a 320 psi loading.	3341.0
7.5	GB	MC = 11%	CL		8.0	(CL) Lean CLAY with Gravel [A-6]; moist, dark yellowish brown (10YR 4/4); medium plastic; low dry strength, crumbly.	3339.0
10.0	GB GB	MC = 21% MC = 19% LL = 42 PL = 19	CL		10.0	(CL) Lean CLAY [A-6]; moist, dark yellowish brown (10YR 4/4); highly plastic; medium dry strength, crumbly.	3337.0

Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-05

CLIENT Professional Consultants Inc.
PROJECT NAME Clearview
PROJECT NUMBER BE22
PROJECT LOCATION MIssoula
DATE STARTED 8/19/22 **COMPLETED** 8/19/22
GROUND ELEVATION 3380 ft **TEST PIT SIZE** 36 inches
EXCAVATION CONTRACTOR Grant Creek Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 308CR
AT TIME OF EXCAVATION --- GW table was not encountered.
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
AT END OF EXCAVATION --- GW table was not encountered.
NOTES N46° 49.602'; W114° 01.611'
▽ **82hrs AFTER EXCAVATION** 9.75 ft / Elev 3370.25 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0	GB	MC = 3%	ML	0.7	(ML) TOPSOIL, Sandy Loam, with Gravel [A-4], thick Grass Vegetation; dry; very dark grayish brown (10YR 3/2); no reaction to 10% HCl solution. Gravels are subangular to angular, flat. Army Corps of Engineers Cone Penetrometer was pushed 7.25 inches at the ground surface under a 320 psi loading.	3379.3
	GB	MC = 1%	GC	1.7	(GC) Clayey GRAVEL [A-2]; subrounded to subangular; dry; dark yellowish brown (10YR 4/4); no reaction to 10% HCl solution. Fines are medium plastic.	3378.3
2.5	GB	MC = 9% LL = 33 PL = 17	CL	▨ 4.5	(CL) Lean CLAY [A-6]; damp; strong brown (7.5YR 4/6); no reaction to 10% HCl solution; medium plastic; low dry strength, crumbly. Army Corps of Engineers Cone Penetrometer was pushed 1 inch at 3 feet under a 320 psi loading. Material is very tight and difficult to excavate below 2.5 feet.	3375.5
5.0				△ △	Tightly compacted Conglomerate of GRAVEL and CLAY, likely Sixmile Creek Formation; damp; strong brown (7.5YR 4/6) and dark brown (7.5YR 3/4) matrices; medium to strong reaction to 10% HCl solution.	
	GB	MC = 4%		△ △		
7.5	GB	MC = 5%		△ △		
10.0	GB	MC = 11%		△ △ 10.0 ▽		3370.0

Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-06

PAGE 1 OF 1

CLIENT Professional Consultants Inc.

PROJECT NAME Clearview

PROJECT NUMBER BE22

PROJECT LOCATION MIssoula

DATE STARTED 8/19/22 **COMPLETED** 8/19/22

GROUND ELEVATION 3355 ft **TEST PIT SIZE** 36 inches

EXCAVATION CONTRACTOR Grant Creek Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD CAT 308CR

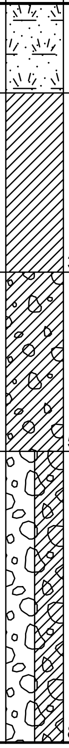
∇ **AT TIME OF EXCAVATION** 8.00 ft / Elev 3347.00 ft

LOGGED BY Lorenzen **CHECKED BY** Lorenzen

▼ **AT END OF EXCAVATION** 8.00 ft / Elev 3347.00 ft

NOTES N46° 49.560'; W114° 01.757'

82hrs AFTER EXCAVATION --- GW table was not encountered.



DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
0.0	GB	MC = 4% LL = NP PL = NP Fines = 53%	ML		1.0	(ML) TOPSOIL, Gravelly Loam [A-4], thick Grass Vegetation - still green; dry; dark grayish brown (10YR 4/2); no reaction to 10% HCl solution; non-plastic. Gravels are subrounded, flat. Army Corps of Engineers Cone Penetrometer was pushed 3.25 inches at the ground surface under a 320 psi loading.	3354.0
2.5	GB	MC = 18%	CL		3.0	(CL) Lean CLAY [A-6] with Inclusions; damp; brown (10YR 4/3) with white (10YR 8/1) inclusions; Clay has a weak reaction to 10% HCl solution, Inclusions have a strong reaction to 10% HCl solution; medium plastic; low dry strength, crumbly.	3352.0
5.0	GB	MC = 12%	CL		5.0	(CL) Lean CLAY with Gravel [A-6]; moist; dark yellowish brown (10YR 4/4); no reaction to 10% HCl solution; medium plastic; low dry strength, crumbly. Army Corps of Engineers Cone Penetrometer was pushed 2.5 inches at 3.2 feet under a 320 psi loading.	3350.0
7.5	GB GB	MC = 6% MC = 10%	GP-GC		▼ 8.3	(GP-GC) Poorly Graded GRAVEL with Clay and Sand [A-1]; rounded to subrounded; moist to wet; reddish brown (5YR 4/4, 5/4) matrix; no reaction to 10% HCl solution. Fines are medium plastic.	3346.8

Bottom of test pit at 8.3 feet.

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TEST PIT NUMBER TP-07

PAGE 1 OF 1

CLIENT Professional Consultants Inc.

PROJECT NAME Clearview

PROJECT NUMBER BE22

PROJECT LOCATION MIssoula

DATE STARTED 8/19/22 **COMPLETED** 8/19/22

GROUND ELEVATION 3400 ft **TEST PIT SIZE** 36 inches

EXCAVATION CONTRACTOR Grant Creek Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD CAT 308CR

AT TIME OF EXCAVATION --- GW table was not encountered.

LOGGED BY Lorenzen **CHECKED BY** Lorenzen

AT END OF EXCAVATION --- GW table was not encountered.

NOTES N46° 49.557'; W114° 01.660'

82hrs AFTER EXCAVATION --- GW table was not encountered.

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0	GB	MC = 3% LL = NP PL = NP Fines = 57%	ML		(ML) TOPSOIL, Gravelly Silt Loam [A-4], thick Grass Vegetation; dry; very dark grayish brown (10YR 3/2); no reaction to 10% HCl solution; non-plastic. Gravels are subangular, flat. Army Corps of Engineers Cone Penetrometer was pushed 5 inches at the ground surface under a 320 psi loading.	
1.0						3399.0
	GB	MC = 2%	GP-GM		(GP-GM) Poorly Graded GRAVEL with Silt and Sand, frequent Cobbles [A-1]; subrounded to subangular, flat; dry; brown (7.5YR 4/4) matrix; no reaction to 10% HCl solution. Fines are medium plastic.	
2.5						3397.5
	GB	MC = 14%	CL		(CL) Lean CLAY with Gravel [A-6]; damp; brown (7.5YR 4/4); no reaction to 10% HCl solution; medium plastic; low dry strength, crumbly. Gravels are subangular to angular. Army Corps of Engineers Cone Penetrometer was pushed 8.5 inches at 3.5 feet under a 320 psi loading.	
5.0						
	GB	MC = 16%				
7.5						
8.0						3392.0
					Tightly compacted Conglomerate of GRAVEL and CLAY, likely Sixmile Creek Formation; damp; brown (7.5 YR 4/4) matrix; medium to strong reaction to 10% HCl solution.	
10.0	GB	MC = 8%				3390.0

Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-08

PAGE 1 OF 1

CLIENT Professional Consultants Inc.
PROJECT NAME Clearview
PROJECT NUMBER BE22
PROJECT LOCATION MIssoula
DATE STARTED 8/19/22 **COMPLETED** 8/19/22
GROUND ELEVATION 3329 ft **TEST PIT SIZE** 36 inches
EXCAVATION CONTRACTOR Grant Creek Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 308CR
AT TIME OF EXCAVATION --- GW table was not encountered.
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
AT END OF EXCAVATION --- GW table was not encountered.
NOTES N46° 49.533'; W114° 01.886'
82hrs AFTER EXCAVATION --- GW table was not encountered.

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
0.0	GB	MC = 3%	ML		0.3	(ML) TOPSOIL, Sandy Loam, with Gravel [A-4], Grass Vegetation; dry; very dark grayish brown (10YR 3/2); no reaction to 10% HCl solution. Gravels are subangular, flat.	3328.8
			GP-GM			(GP-GM) Poorly Graded GRAVEL with Silt and Sand [A-1]; rounded to subrounded; dry; strong brown (7.5YR 4/6) to brown (7.5YR 4/4) matrix; no reaction to 10% HCl solution. Fines are medium plastic.	
	GB	MC = 2%					
2.5						Army Corps of Engineers Cone Penetrometer was pushed 1.5 inches at the ground surface under a 320 psi loading.	
	GB	MC = 3%				Army Corps of Engineers Cone Penetrometer was pushed 0.5 inches at 3 feet under a 320 psi loading.	
5.0							
	GB	MC = 3%					
7.5							
	GB	MC = 4%			8.5		3320.5

Bottom of test pit at 8.5 feet.

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TEST PIT NUMBER TP-09

PAGE 1 OF 1

CLIENT Professional Consultants Inc.

PROJECT NAME Clearview

PROJECT NUMBER BE22

PROJECT LOCATION MIssoula

DATE STARTED 8/19/22 **COMPLETED** 8/19/22

GROUND ELEVATION 3373 ft **TEST PIT SIZE** 36 inches

EXCAVATION CONTRACTOR Grant Creek Excavating

GROUND WATER LEVELS:

EXCAVATION METHOD CAT 308CR

AT TIME OF EXCAVATION --- GW table was not encountered.

LOGGED BY Lorenzen **CHECKED BY** Lorenzen

AT END OF EXCAVATION --- GW table was not encountered.

NOTES N46° 49.518'; W114° 01.768'

82hrs AFTER EXCAVATION --- GW table was not encountered.

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0	GB	MC = 5% LL = NP PL = NP Fines = 59%	ML	1.0	(ML) TOPSOIL, Loam [A-4], thick Vegetation; dry; very dark grayish brown (10YR 3/2); no reaction to 10% HCl solution; non-plastic. Army Corps of Engineers Cone Penetrometer was pushed 3.25 inches at the ground surface under a 320 psi loading.	3372.0
	GB	MC = 3%	CL	2.0	(CL) Lean CLAY with Gravel [A-6]; damp; dark yellowish brown (10YR 4/4); no reaction to 10% HCl solution; medium plastic; low dry strength, crumbly. Gravels are subrounded to angular.	3371.0
2.5	GB	MC = 14% LL = 35 PL = 22 Fines = 88%	CL	5.0	(CL) Lean CLAY [A-6]; damp; brown (7.5YR 4/4); no reaction to 10% HCl solution; medium plastic; low dry strength, crumbly. Army Corps of Engineers Cone Penetrometer was pushed 5.5 inches at 3 feet under a 320 psi loading.	3368.0
5.0	GB	MC = 11%	CL	7.5	(CL) Lean Clay with Ashy deposits [A-6]; damp; strong brown (7.5YR 4/6); strong reaction to 10% HCl solution; medium plastic; low dry strength, crumbly.	3365.5
7.5	GB	MC = 9%	GC	9.5	(GC) Clayey GRAVEL [A-2]; subrounded to subangular; moist; brown (7.5YR 4/4) matrix; no reaction to 10% HCl solution. Fines are medium plastic.	3363.5

Bottom of test pit at 9.5 feet.

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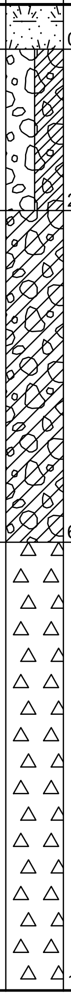
TEST PIT NUMBER TP-10

PAGE 1 OF 1

CLIENT Professional Consultants Inc.
PROJECT NAME Clearview
PROJECT NUMBER BE22
PROJECT LOCATION MIssoula
DATE STARTED 8/19/22 **COMPLETED** 8/19/22
GROUND ELEVATION 3420 ft **TEST PIT SIZE** 36 inches
EXCAVATION CONTRACTOR Grant Creek Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD CAT 308CR
AT TIME OF EXCAVATION --- GW table was not encountered.
LOGGED BY Lorenzen **CHECKED BY** Lorenzen
AT END OF EXCAVATION --- GW table was not encountered.
NOTES N46° 49.501'; W114° 01.715'
82hrs AFTER EXCAVATION --- GW table was not encountered.



DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0	GB	MC = 2% LL = NP PL = NP Fines = 40%	ML	0.5	(ML) TOPSOIL, Gravelly Sandy Loam [A-4], thick Vegetation; dry; very dark grayish brown (10YR 3/2); no reaction to 10% HCl solution; non-plastic. Gravels are subrounded to subangular, flat. Army Corps of Engineers Cone Penetrometer was pushed 0.5 inches at the ground surface under a 320 psi loading.	3419.5
	GB	MC = 4%	GP-GC	2.3	(GP-GC) Poorly Graded GRAVEL with Clay and Sand [A-1]; subangular to angular; dry; dark yellowish brown (10YR 3/6) matrix; no reaction to 10% HCl solution. Fines are medium plastic.	3417.7
2.5 5.0	GB	MC = 7%	GC	6.0	(GC) Clayey GRAVEL [A-2]; subangular to angular, flat; damp; brown (7.5YR 4/4) matrix; no reaction to 10% HCl solution. Fines are medium plastic. Army Corps of Engineers Cone Penetrometer was pushed 0.5 inches at 3.5 feet under a 320 psi loading.	3414.0
7.5 10.0	GB GB	MC = 6% MC = 12%		11.0	Tightly compacted Conglomerate of GRAVEL and CLAY, likely Sixmile Creek Formation; damp; yellowish brown (10YR 5/8) to brown (7.5 YR 4/4) matrices; no reaction to 10% HCl solution.	3409.0

Bottom of test pit at 11.0 feet.

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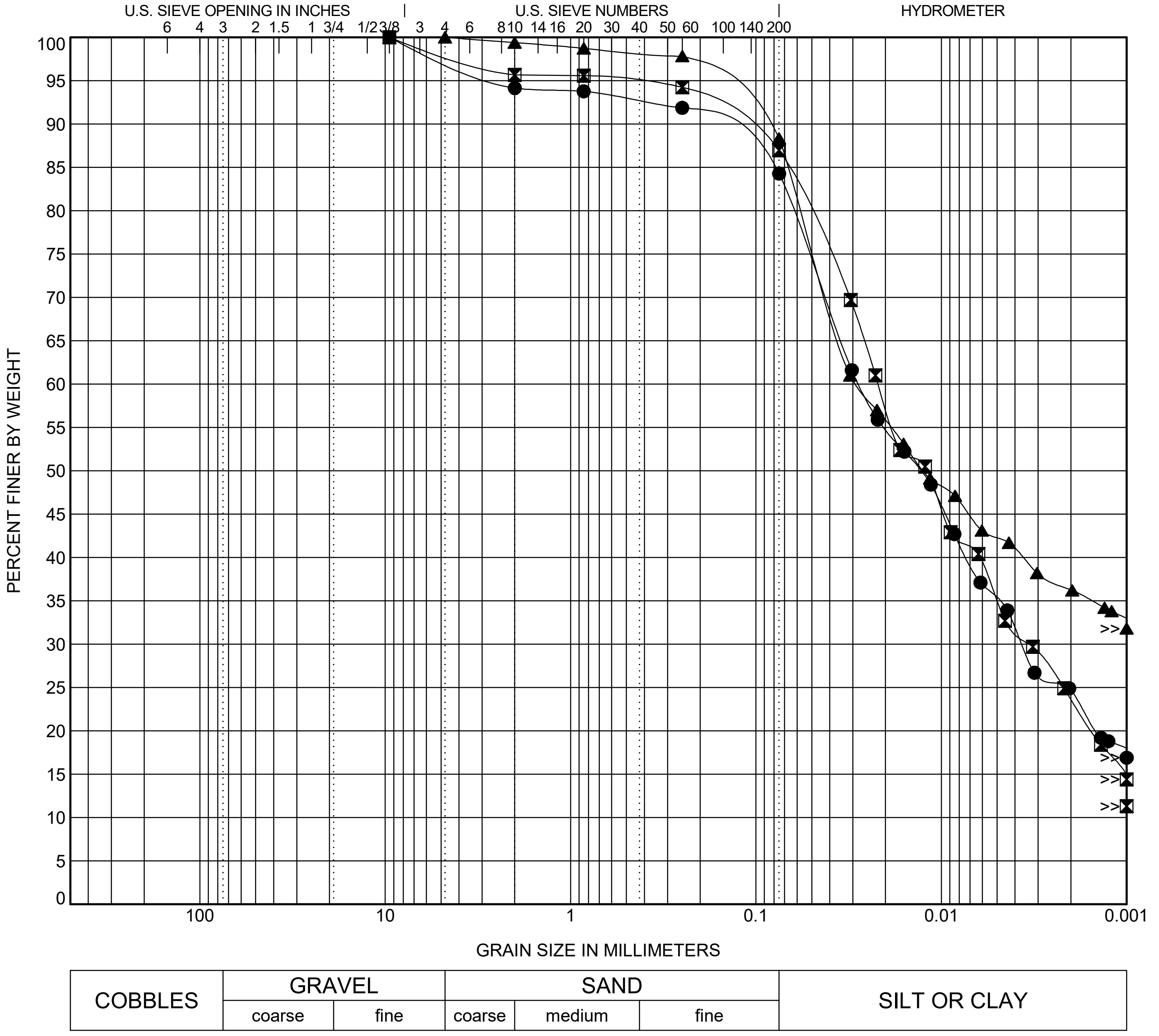
GRAIN SIZE DISTRIBUTION

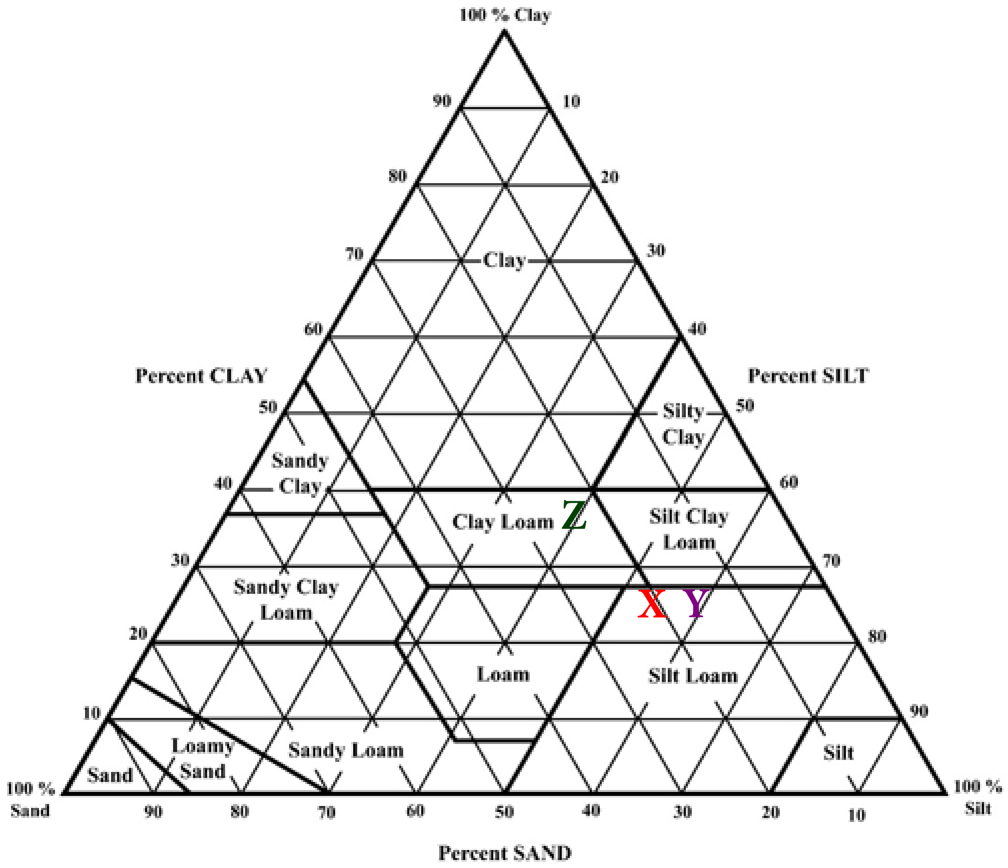
CLIENT Professional Consultants Inc.
PROJECT NAME Clearview
PROJECT NUMBER BE22
PROJECT LOCATION MIssoula



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**TP-02**	**5.8**	**SILT with SAND(ML)**	**42**	**26**	**16**		
☒	**TP-02**	**7.8**	**SILT(ML)**	**41**	**26**	**15**		
▲	**TP-09**	**3.0**	**LEAN CLAY(CL)**	**35**	**22**	**13**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-02**	**5.8**	**9.5**	**0.028**	**0.004**		**2.6**	**13.1**	**49.2**	**35.1**
☒	**TP-02**	**7.8**	**9.5**	**0.022**	**0.003**		**1.9**	**11.1**	**52.0**	**35.0**
▲	**TP-09**	**3.0**	**4.75**	**0.029**			**0.0**	**11.7**	**46.0**	**42.3**

U.S.D.A. Textural Classification



X = TP-02 @ 5.75 feet: Silt Loam

Y = TP-02 @ 7.75 feet: Silt Loam

Z = TP-09 @ 3 feet: Clay Loam

Lorenzen Soil Mechanics, Inc.

Crestview Development

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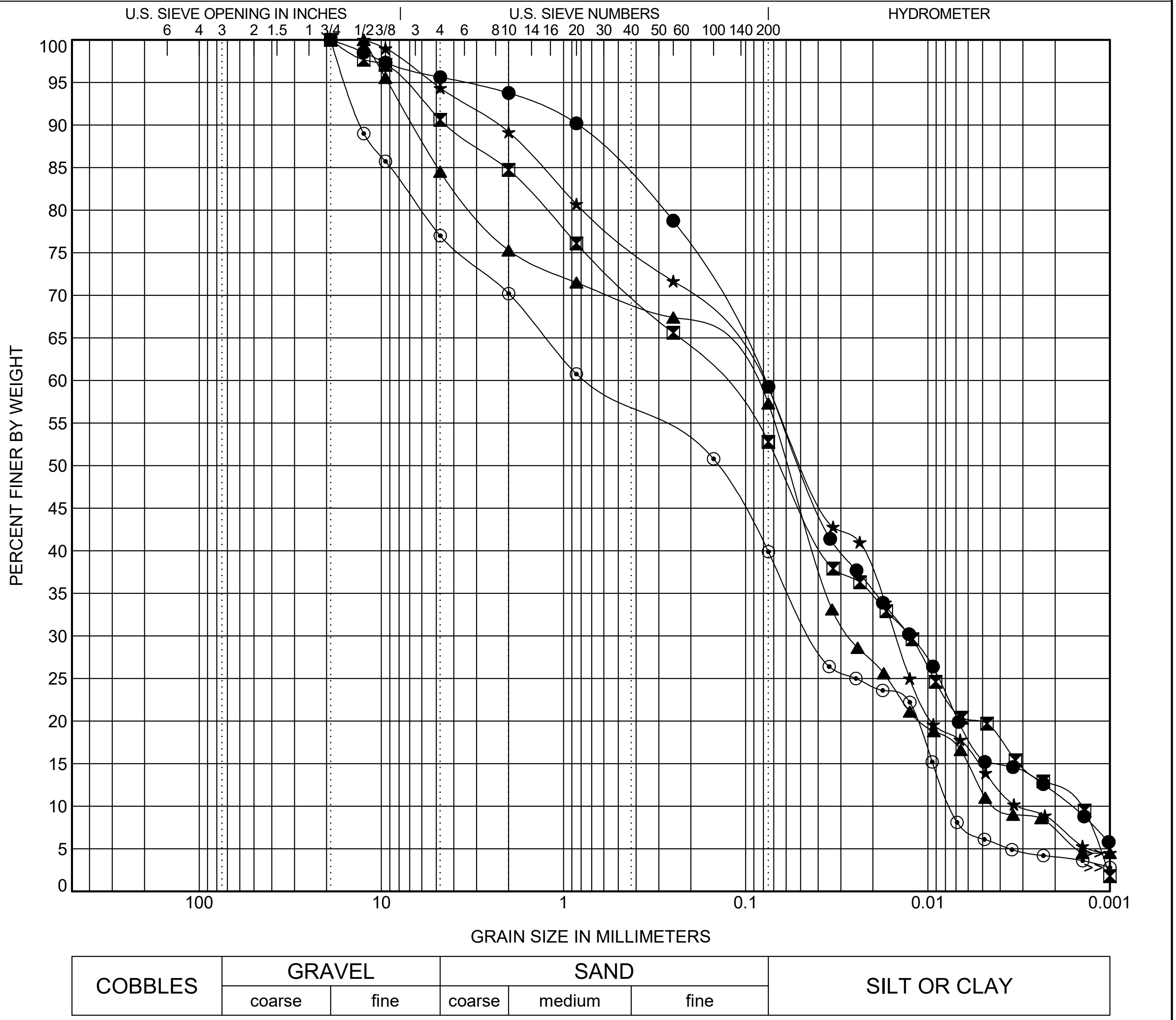
GRAIN SIZE DISTRIBUTION

CLIENT Professional Consultants Inc.

PROJECT NAME Clearview

PROJECT NUMBER BE22

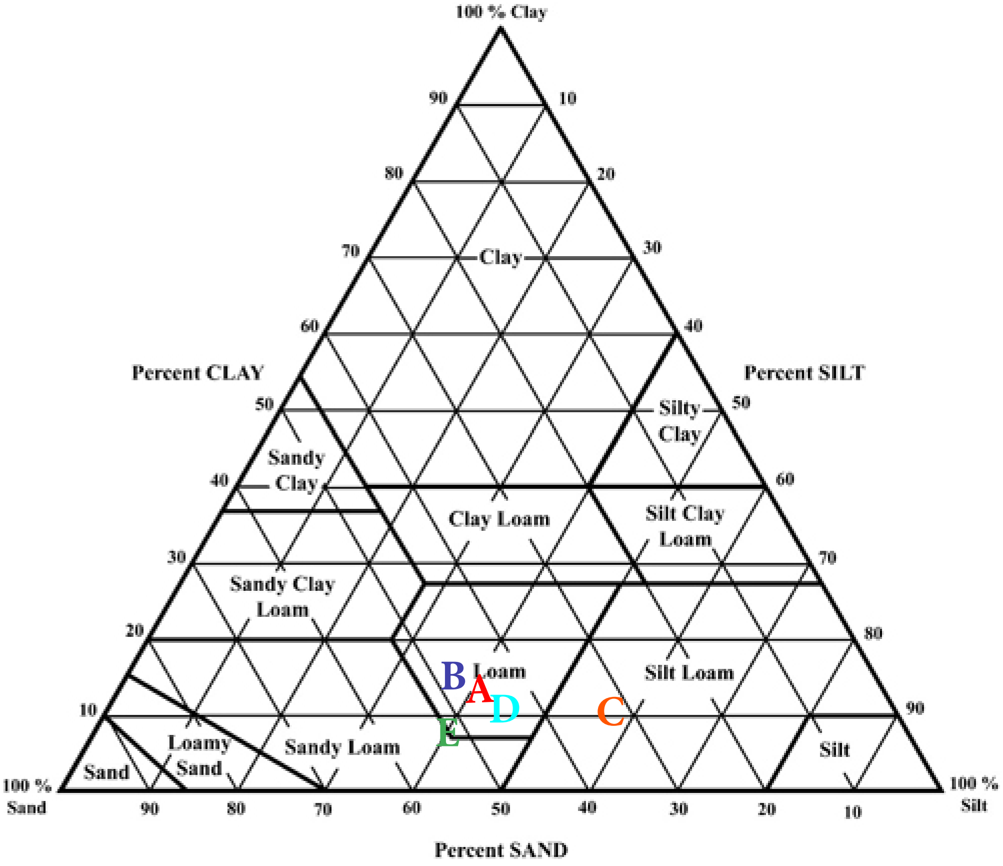
PROJECT LOCATION MIssoula



BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
● **TP-01**	**0.0**	**SANDY SILT(ML)**	**26**	**22**	**4**	**1.22**	**48.15**
☒ **TP-06**	**0.0**	**SANDY SILT(ML)**	**NP**	**NP**	**NP**	**0.73**	**99.41**
▲ **TP-07**	**0.0**	**SANDY SILT with GRAVEL(ML)**	**NP**	**NP**	**NP**	**1.72**	**25.51**
★ **TP-09**	**0.0**	**SANDY SILT(ML)**	**NP**	**NP**	**NP**	**0.87**	**25.71**
⊙ **TP-10**	**0.0**	**SILTY SAND with GRAVEL(SM)**	**NP**	**NP**	**NP**	**0.33**	**99.11**

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **TP-01**	**0.0**	**19**	**0.079**	**0.012**	**0.002**	**4.4**	**36.4**	**43.7**	**15.6**
☒ **TP-06**	**0.0**	**19**	**0.148**	**0.013**	**0.001**	**9.4**	**37.8**	**33.0**	**19.8**
▲ **TP-07**	**0.0**	**12.5**	**0.103**	**0.027**	**0.004**	**15.5**	**27.2**	**45.7**	**11.6**
★ **TP-09**	**0.0**	**12.5**	**0.082**	**0.015**	**0.003**	**5.7**	**35.2**	**44.8**	**14.4**
⊙ **TP-10**	**0.0**	**19**	**0.745**	**0.043**	**0.008**	**23.0**	**37.1**	**33.7**	**6.2**

U.S.D.A. Textural Classification



A = TP-01 0 ft: Loam

B = TP-06 0 ft: Gravelly Loam

C = TP-07 0 ft: Gravelly Silt Loam

D = TP-09 0 ft: Loam

E = TP-10 @ 0 ft: Gravelly Sandy Loam

Lorenzen Soil Mechanics, Inc.

Crestview Development

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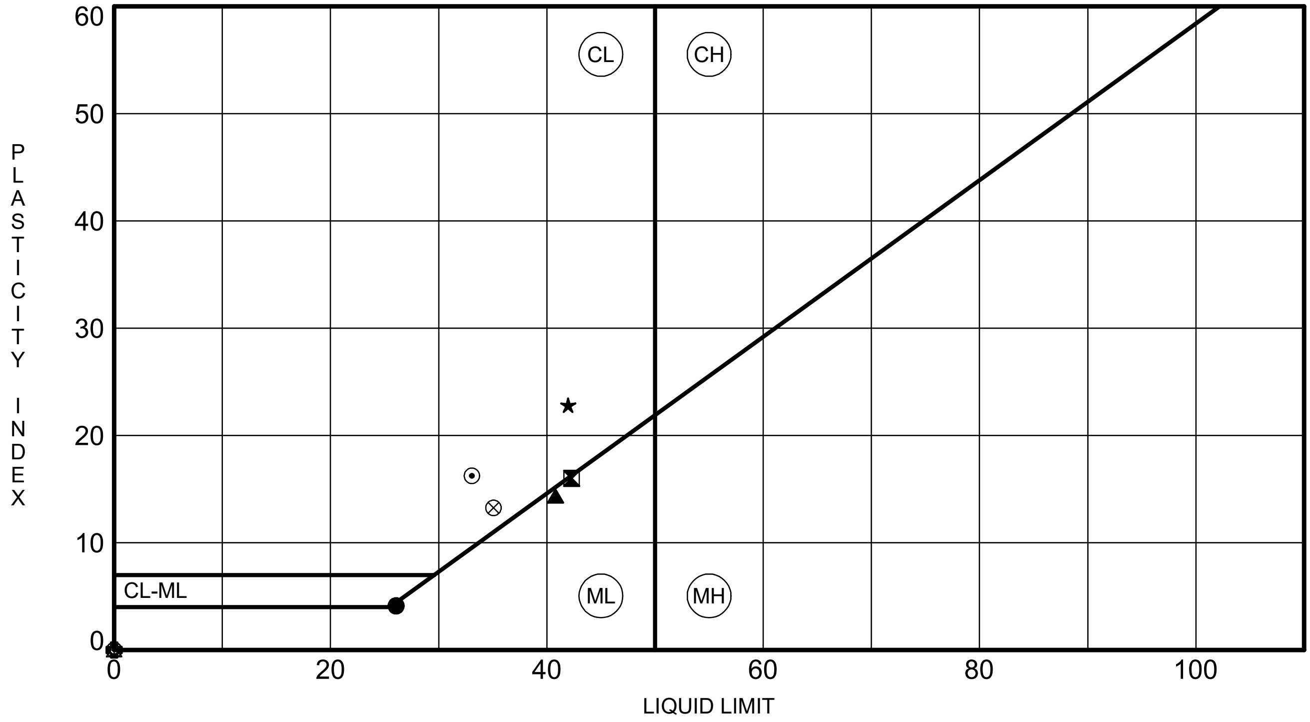
ATTERBERG LIMITS' RESULTS

CLIENT Professional Consultants Inc.

PROJECT NAME Clearview

PROJECT NUMBER BE22

PROJECT LOCATION MIssoula



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**TP-01**	**0.0**	**26**	**22**	**4**		**SILTY CLAY(CL-ML)**
⊠	**TP-02**	**5.8**	**42**	**26**	**16**	**84**	**SILT with SAND(ML)**
▲	**TP-02**	**7.8**	**41**	**26**	**15**	**87**	**SILT(ML)**
★	**TP-04**	**10.0**	**42**	**19**	**23**		**LEAN CLAY(CL)**
⊙	**TP-05**	**3.0**	**33**	**17**	**16**		**LEAN CLAY(CL)**
✿	**TP-06**	**0.0**	**NP**	**NP**	**NP**		**SANDY SILT(ML)**
○	**TP-07**	**0.0**	**NP**	**NP**	**NP**		**SANDY SILT(ML)**
△	**TP-09**	**0.0**	**NP**	**NP**	**NP**		**SANDY SILT(ML)**
⊗	**TP-09**	**3.0**	**35**	**22**	**13**	**88**	**LEAN CLAY(CL)**
⊕	**TP-10**	**0.0**	**NP**	**NP**	**NP**		**SANDY SILT(ML)**

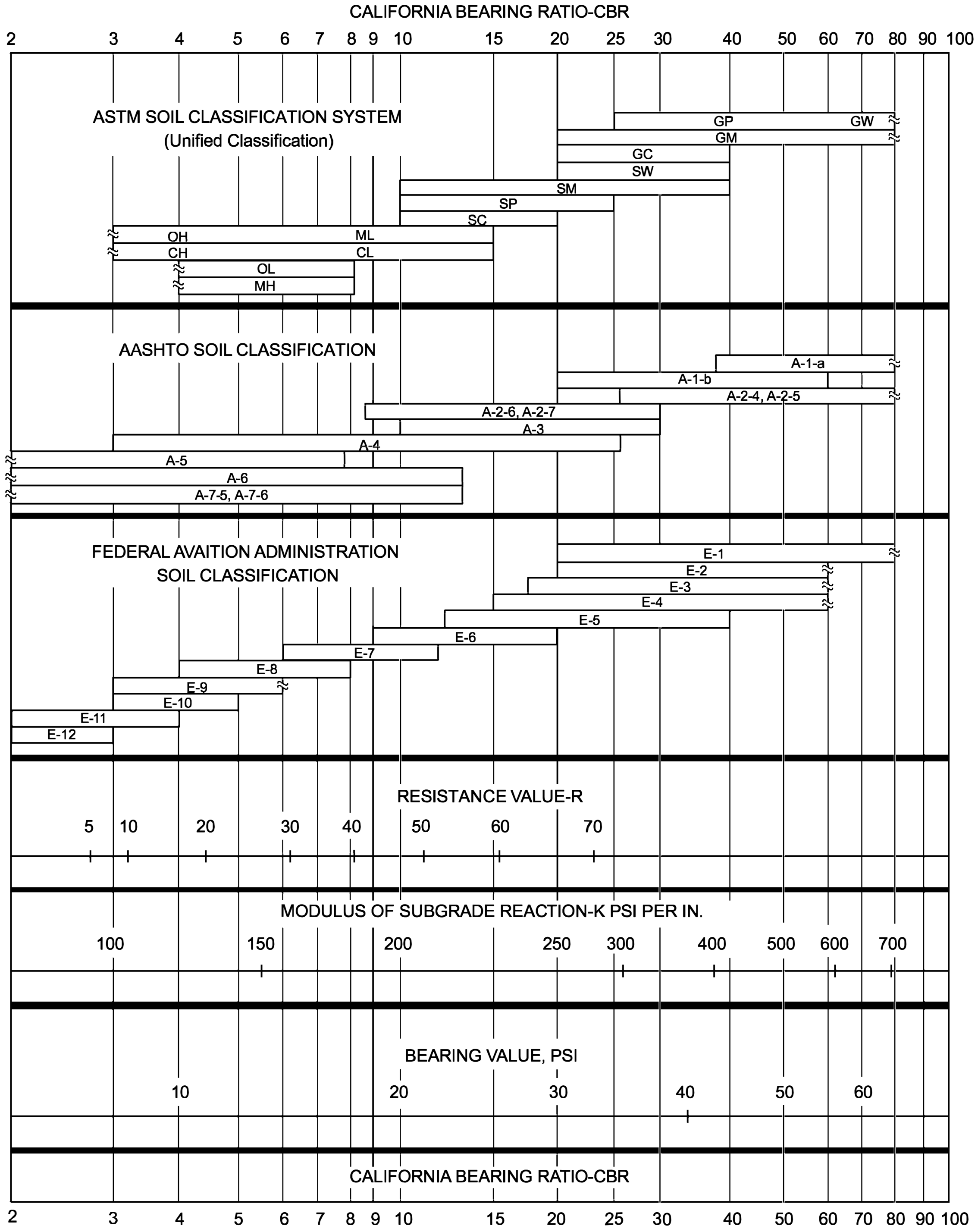
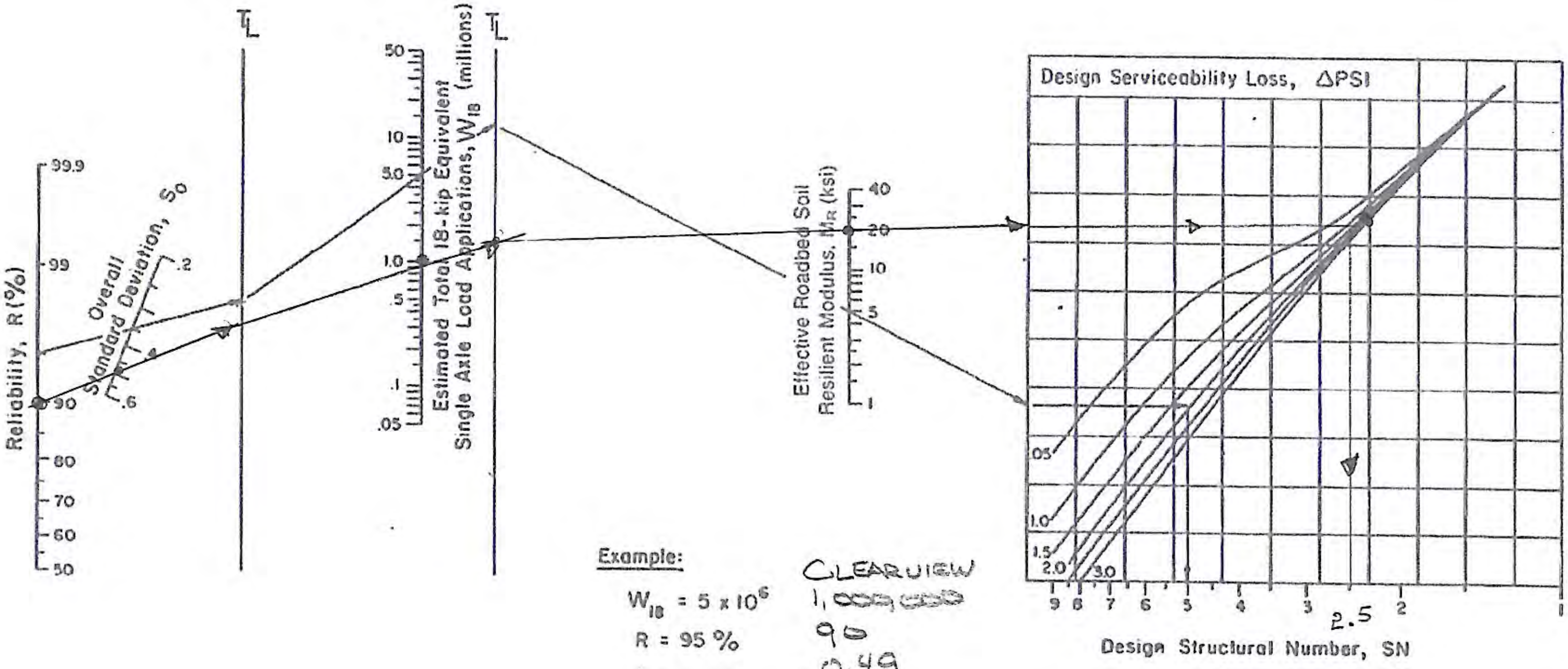


Figure 14.2-A — R-VALUE CORRELATION CHARTS

NOMOGRAPH SOLVES:

$$\log_{10}W_{18} = Z_R*S_o + 9.36*\log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2 - 1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32*\log_{10}M_R - 8.07$$



Example: CLEARVIEW

W_{18} = 5 x 10^6 1,000,000

R = 95 % 90

S_o = 0.35 0.49

M_R = 5000 psi 20,000 psi

ΔPSI = 1.9 2.0

Solution: SN = 5.0

Figure 3.1. Design Chart for Flexible Pavements Based on Using Mean Values for Each Input

Todd Lorenzen
2/18/23

MONTANA WELL LOG REPORT	**Other Options**
This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.	**Return to menu** **Plot this site in State Library Digital Atlas** **Plot this site in Google Maps** **View scanned well log (12/19/2016 2:19:03 PM)**

Site Name: SCHWARTZ, JEREMY
GWIC Id: 290624

Section 1: Well Owner(s)

1) SCHWARTZ, JEREMY (WELL)
2420 SOUTH HILLS DRIVE
MISSOULA MT 59803 [11/05/2014]

Section 2: Location

Township	Range	Section	Quarter Sections
12N	19W	6	SW¼ SE¼

County	Geocode
MISSOULA	

Latitude	Longitude	Geomethod	Datum
46.8215066204	-114.0328964015	TRS-SEC	NAD83

Ground Surface Altitude	Ground Surface Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Wednesday, November 5, 2014

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	140	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	140	6	0.25		WELDED	STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
100	120	6	20	3/16 X 1	HOLTE PERFORATOR SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	0	BENTONITE	Y

Section 7: Well Test Data

Total Depth: 140
Static Water Level: 60
Water Temperature:

Air Test *

_20_ gpm with drill stem set at _140_ feet for _2_ hours.
Time of recovery _0.33_ hours.
Recovery water level _60_ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	1	SOIL
1	50	SAND AND GRAVEL
50	70	SAND AND CLAY
70	80	SAND, GRAVEL AND WATER
80	90	CLAY
90	107	BROWN SHALE AND WATER
107	120	SAND, GRAVEL AND WATER
120	135	SHALE
135	140	SAND, GRAVEL AND WATER

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: RANDAL KOTECKI
Company: JEROMES DRILLING CO
License No: WWC-600
Date Completed: 11/5/2014

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View scanned well log (2/13/2009 8:48:29 AM)

Site Name: DUNCAN BONNIE & PAT
GWIC Id: 153248

Section 1: Well Owner(s)

1) DUNCAN, BONNIE/PAT (MAIL)
108 WOODBINE
MISSOULA MT 59803 [11/04/1999]
2) DUNCAN, BONNIE/PAT (MAIL)
PO BOX 2802
MISSOULA MT 59806 [11/21/1995]

Section 2: Location

Township	Range	Section	Quarter Sections
12N	19W	5	NW¼ SE¼ SE¼ NW¼

County	Geocode
MISSOULA	

Latitude	Longitude	Geomethod	Datum
46.8285	-114.0149	NAV-GPS	NAD27

Ground Surface Altitude	Ground Surface Method	Datum	Date
3465			11/4/1999

Measuring Point Altitude	MP Method	Datum	Date Applies
3467.3			11/4/1999 1:20:00 PM

Addition	Block	Lot

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Tuesday, November 21, 1995

Section 6: Well Construction Details

There are no borehole dimensions assigned to this well.

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	400	6				STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
315	340	6		3/16X1	HOLTE PERFORATOR SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	0	BENTONITE	

Section 7: Well Test Data

Total Depth: 400
Static Water Level: 140
Water Temperature:

Air Test *

25 gpm with drill stem set at _ feet for 4 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

PUMP CONTROLLED BY POWER SWITCH NEXT TO WELL. REDOX METER NOT FUNCTIONING

Section 9: Well Log

Geologic Source

120SNGR - SAND AND GRAVEL (TERTIARY)

From	To	Description
0	2	SOIL
2	140	CLAY & SILT & GRAVEL
140	400	GRAVEL & COBBLES & CLAY LAYERS

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

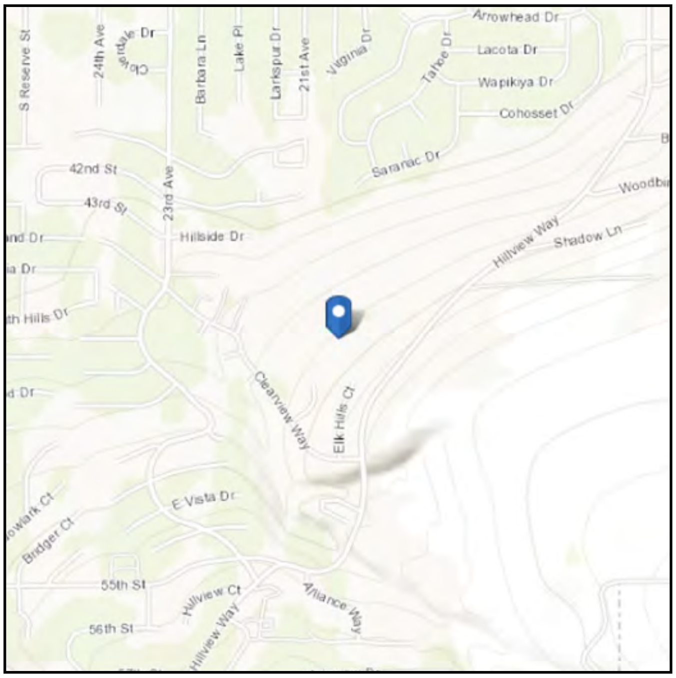
Name:
Company: JEROMES DRILLING CO
License No: WWC-249
Date Completed: 11/21/1995

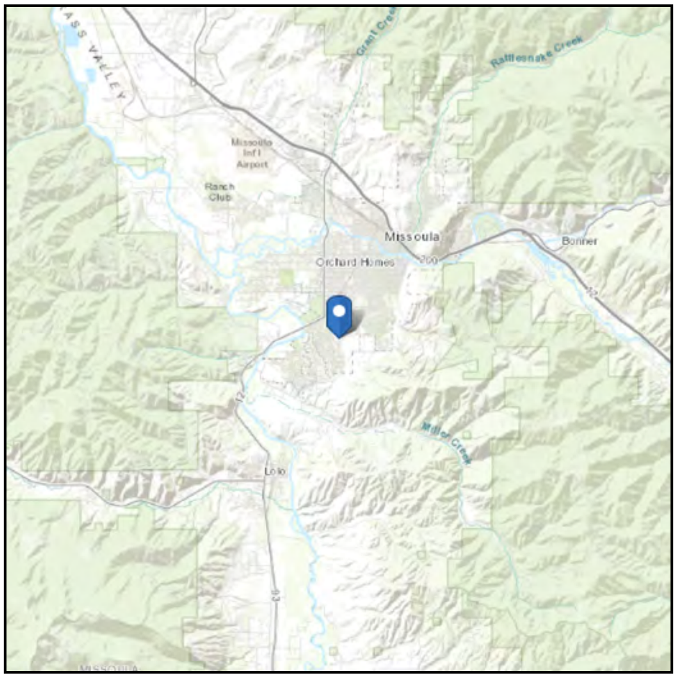
ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-22
Risk Category: II
Soil Class: C - Very Dense Soil and Soft Rock

Latitude: 46.825816
Longitude: -114.02931
Elevation: 3369.14 ft (NAVD 88)





Seismic

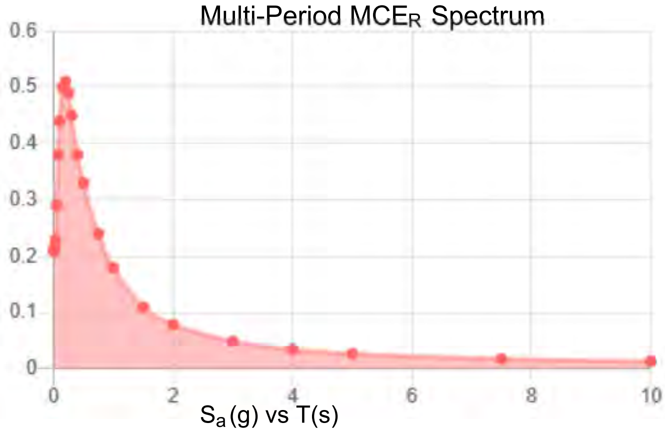
C - Very Dense Soil and Soft Rock

Site Soil Class:

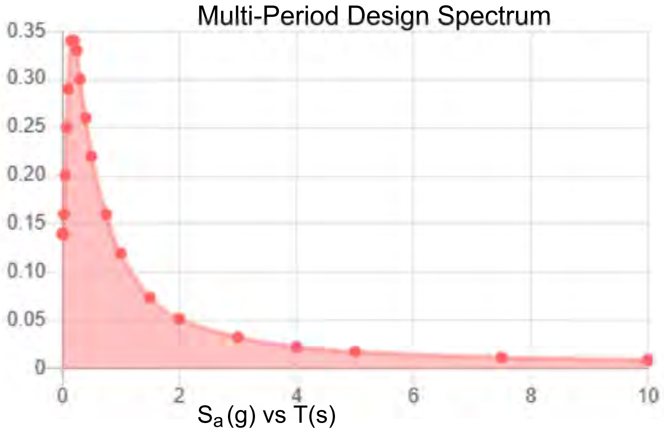
Results:

PGA $_M$:	0.19	T_L :	6
S_{MS} :	0.46	S_S :	0.42
S_{M1} :	0.18	S_1 :	0.12
S_{DS} :	0.31	V_{S30} :	530
S_{D1} :	0.12		

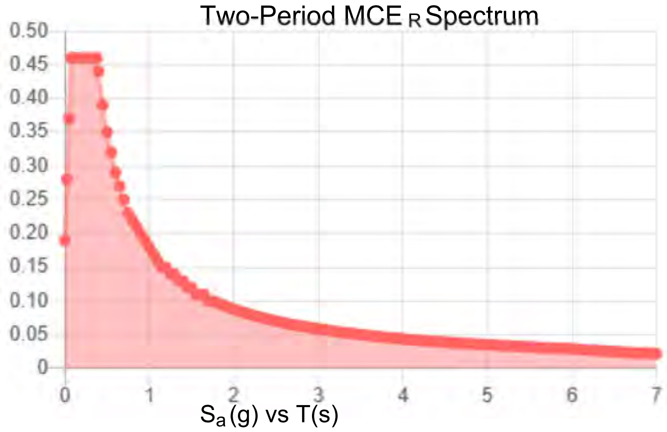
Seismic Design Category: B



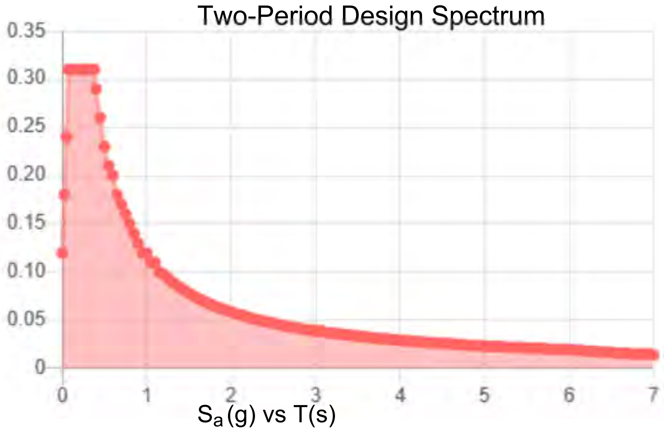
Multi-Period MCE$_R$ Spectrum



Multi-Period Design Spectrum



Two-Period MCE $_R$ Spectrum



Two-Period Design Spectrum

MCE$_R$ Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: **Tue Jan 17 2023**

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

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APPENDIX B. PHOTOGRAPHS

Description: TP-01 Stake location. View is to the west toward the TP-02 location with excavator.

Description: TP-01 Location. View is to the north.

Description: TP-01 Location. View is to the east.

Description: TP-01 Jar sample from the ground surface.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-01 Jar sample from 1.5 feet.

Description: TP-01 Jar sample from 3 feet. Army Corps of Engineers Cone Penetrometer was pushed XX inched under a 320 psi loading.

Description: TP-01 jar sample from 6.5 feet.

Description: TP-01 Jar sample from 8 feet.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-01 Excavated to 8 feet.

Description: TP-01 Excavated to 8 feet.

Description: TP-01 Spoils pile from above 8 feet.

Description: TP-01 Piezometer is being backfilled. View is to the north.

Description: TP-02 Location. View is to the northwest.

Description: TP-02 Location. View is to the east.

Description: TP-02 Location. Cone penetrometer was pushed XX inches under a 320 psi loading. View is to the northeast.

Description: TP-02 Jar ample from the ground surface. Orange paint is from the underground utility locator identifying there are no communications utilities at that location.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-02 Jar sample from 1.5 feet.

Description: TP-02 Jar sample from 3 feet. Cone penetrometer was pushed XX inches under a 320 psi loading.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-02 Location. Boulder was taken out of the excavation.

Description: TP-02 Ashy silt layer was encountered.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-02 Jar sample from 3.5 feet and from 5.75 feet.

Description: TP-02 Jar sample from 8 feet.

Description: TP-02 Excavated to 8 feet.

Description: TP-02 Excavated to 8 feet.

Description: TP-02 spoils pile from above 8 feet.

Description: TP-02 Piezometer being backfilled. View is to the northwest.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-02 Stake location. View is to the south toward the TP-03 location with excavator.

Description: TP-03 Location. View is to the southeast.

Description: TP-03 Location. Boulders are near ground surface.

Description: TP-03 Location. View is to the southwest.

Description: TP-03 Location. View is to the northwest.

Description: TP-03 Jar sample from the ground surface.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-03 Jar sample from 1 foot.

Description: TP-03 Jar sample from 3 feet. Cone penetrometer was pushed XX inches under a 320 psi loading.

Description: TP-03 Jar sample from 5.75 feet.

Description: TP-03 Jar sample from 8 feet.

Description: TP-03 Excavated to 8 feet.

Description: TP-03 Excavated to 8 feet.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-03 Spoils pile from above 8 feet.

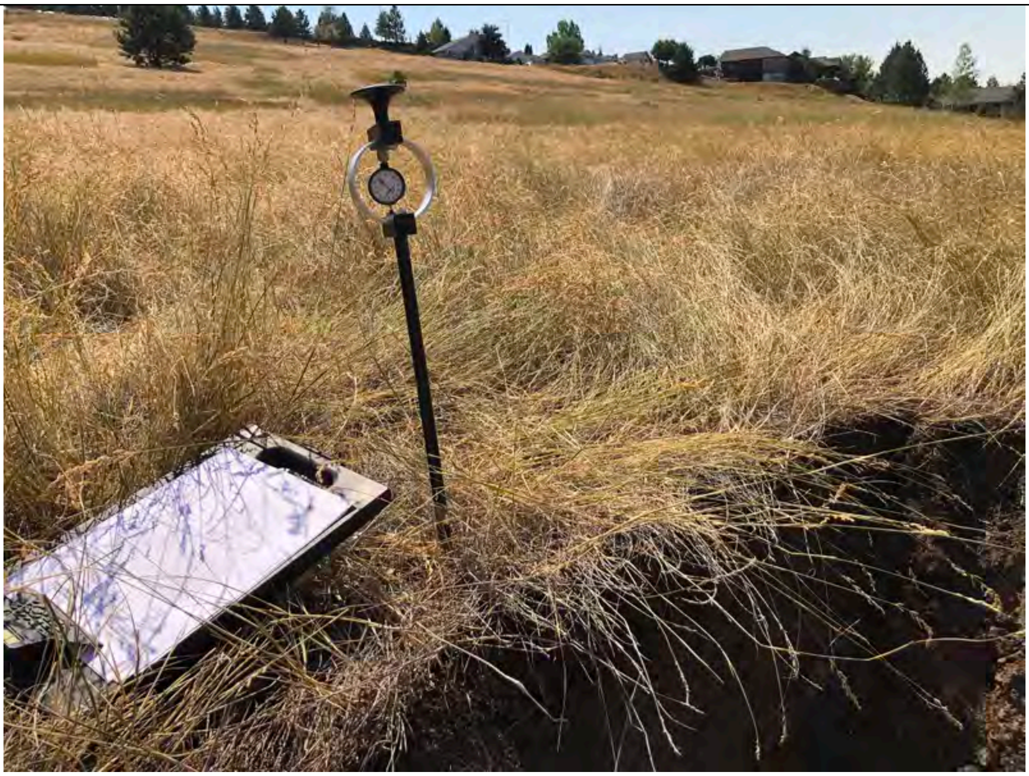
Description: TP-04 Stake Location. View is to the southwest toward the TP-06 location with excavator.

Description: TP-04 Location. View is to the north.

Description: TP-04 Location. View is to the east.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-04 Location. View is to the south.



Description: TP-04 Cone penetrometer was pushed XX inches under a 320 psi loading. View is to the south.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-04 Jar sample from the ground surface.

Description: TP-04 Jar sample from 1.5 feet.

Description: TP-04 Jar sample from 3.5 feet. Cone penetrometer was pushed XX inches under a 320 psi loading.

Description: TP-04 Jar sample from 6.75 feet.

Description: TP-04 Jar sample from 8.25 feet.

Description: TP-04 Jar sample from 10 feet.

Description: TP-04 Excavated to 10 feet.

Description: TP-04 Excavated to 10 feet.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-04 spoils pile from above 10 feet.

Description: TP-05 Stake location. View is to the west toward the TP-04 location with excavator.

Description: TP-05 Location. View is to the northeast.

Description: TP-05 Location. View is to the east.

Description: TP-05 Location. View is to the west.

Description: TP-05 Cone penetrometer was pushed XX inched under a 320 psi loading.

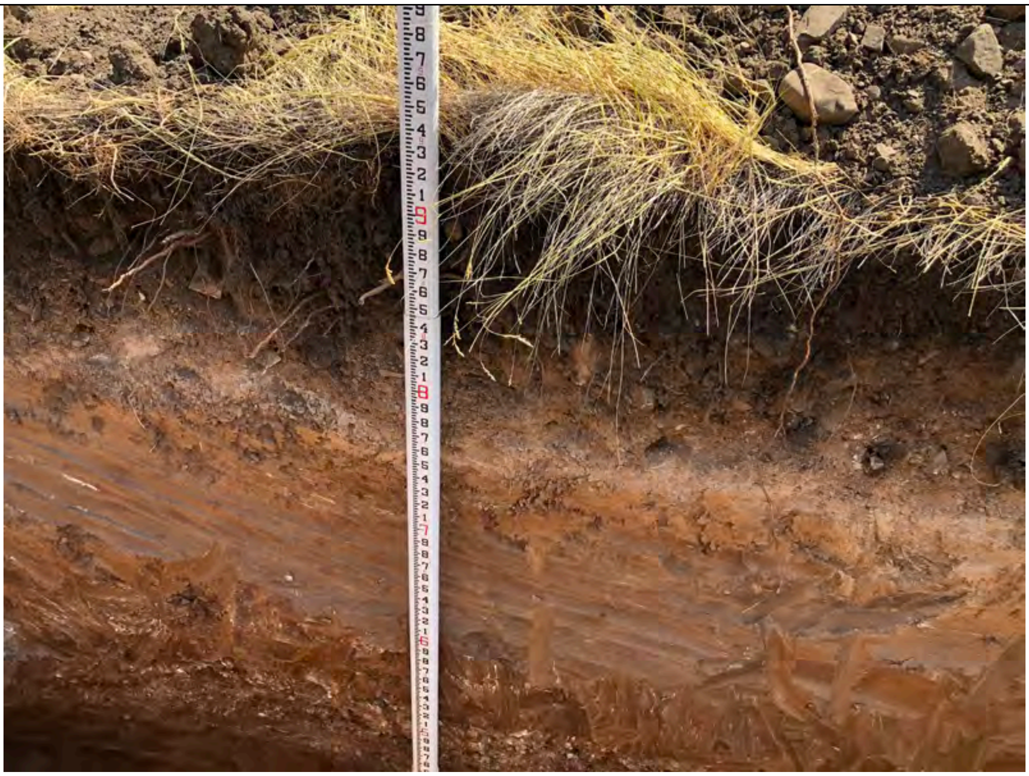
Description: TP-05 Jar sample from the ground surface.

Description: TP-05 Jar sample from 1.5 feet.

Description: TP-05 Jar sample from 3 feet. Cone penetrometer was pushed XX inches under a 320 psi loading.

Description: TP-05 Baggie sample from 7 feet. Sample appears to be lightly indurated conglomerate.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing



Description: TP-05 Excavated to 10 feet.

Description: TP-05 Excavated to 10 feet.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-05 Jar sample from 10 feet.

Description: TP-05 spoils from above 10 feet.

Description: TP-06 Location. View is to the north.

Description: TP-06 Location. View is to the north. Cone penetrometer (not shown) was pushed 3.25 inches at the ground surface under a 320 psi loading.

Description: TP-06 Location. View is to the south.

Description: TP-06 Jar sample from the ground surface.

Lorenzen Soil Mechanics, Inc.

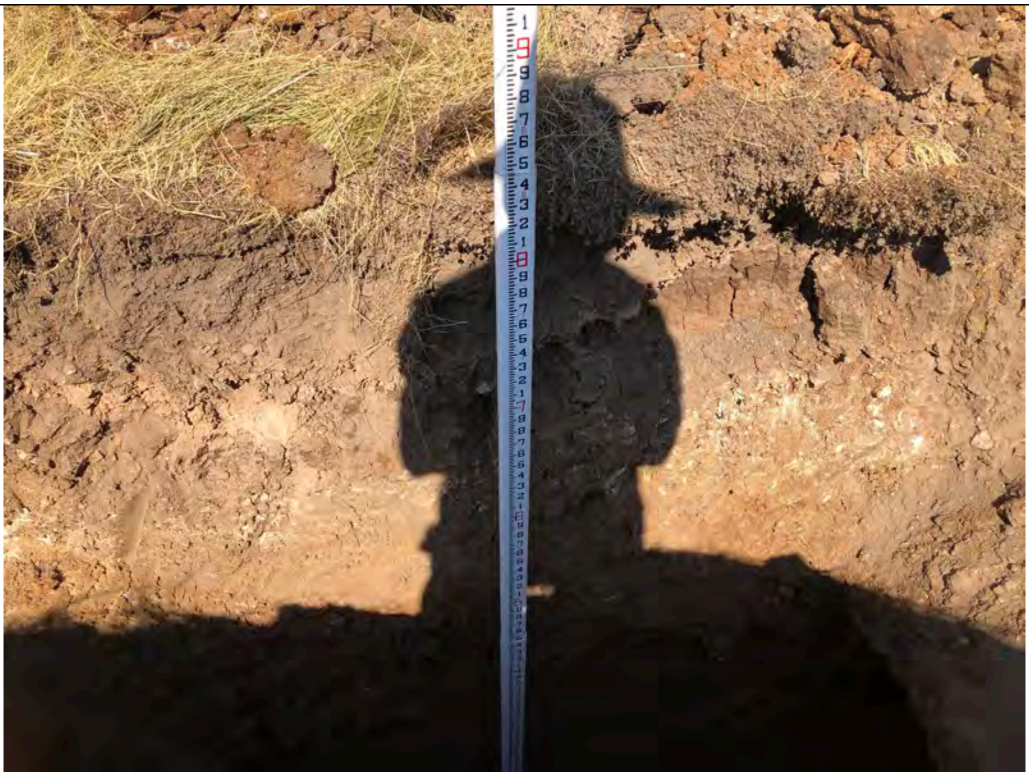
Project: Clearview Crossing

Description: TP-06 Jar sample from 2 feet.

Description: TP-06 Jar sample from 3.2 feet. Cone penetrometer was pushed 2.5 inches under a 320 psi loading.

Description: TP-06 Jar sample from 6 feet.

Description: TP-06 Jar sample from 8.25 feet.



Description: TP-06 Excavated to 8.25 feet.

Description: TP-06 Excavated to 8.25 feet.

Description: TP-06 Spoils pile from above 8.25 feet.

Description: TP-06 Groundwater encountered at 8 feet.

Description: TP-06 Piezometer installed to 8.25 feet. View is to the northwest.

Description: TP-07 Stake location. View is to the north.

Description: TP-07 Location. View is to the east. Cone penetrometer (not shown) was pushed 5 inches at the ground surface under a 320 psi loading.

Description: TP-07 Location. View is to the south.

Description: TP-07 Location. View is to the west.

Description: TP-07 Jar sample from the ground surface.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

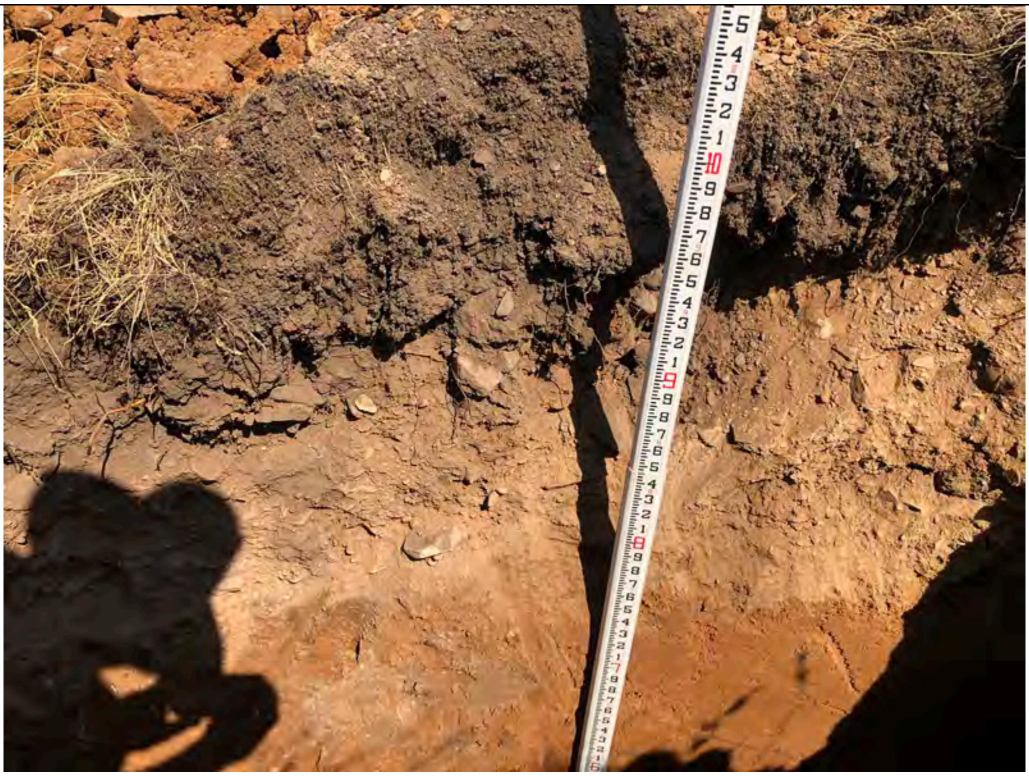
Description: TP-07 Jar sample from 1.5 feet.

Description: TP-07 Jar sample from 3.5 feet. Cone penetrometer was pushed 8.5 inches.

Description: TP-07 Jar sample from 6.75 feet.

Description: TP-07 Jar sample from 10 feet.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing



Description: TP-07 Excavated to 10 feet.

Description: TP-07 Excavated to 10 feet.

Description: TP-07 Spoils pile from above 10 feet. View is to the northeast.

Description: TP-07 Piezometer being backfilled. View is to the west.

Description: TP-08 Location. View is to the south. Cone penetrometer was pushed 1.5 inches under a 320 psi loading.

Description: TP-08 Location. View is to the southeast.

Description: TP-08 Location. View is to the east.

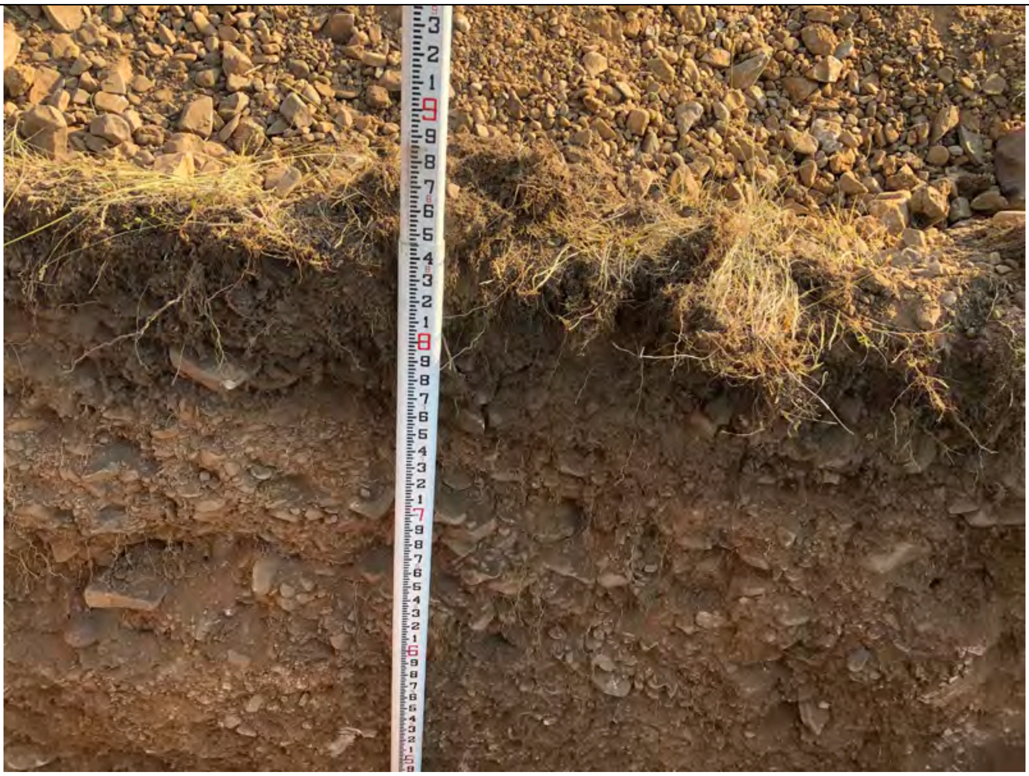
Description: TP-08 Location. View is to the south.

Description: TP-08 Jar sample from 1.5 feet. The jar sample photograph from the ground surface was not taken.

Description: TP-08 Jar sample from 3 feet. Cone penetrometer was pushed 0.5 inches under a 320 psi loading.

Description: TP-08 Jar sample from 6.5 feet.

Description: TP-08 Jar sample from 8.5 feet.



Description: TP-08 Excavated to 8.5 feet.

Description: TP-08 Excavated to 8.5 feet.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-08 Spoils pile from above 8.5 feet. View is to the south.

Description: TP-09 Stake location. View is to the southeast toward the TP-10 location with excavator.

Description: TP-09 Location. View is to the south.

Description: TP-09 Location. View is to the northeast.

Description: TP-09 Cone penetrometer was pushed 3.25 inches under a 320 psi loading.

Description: TP-09 Jar sample from the ground surface.

Description: TP-09 Jar sample from 1.5 feet.

Description: TP-09 Jar sample from 3 feet. Cone penetrometer was pushed 5.5 inches under a 320 psi loading.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-09 Jar sample from 6 feet.

Description: TP-09 Jar sample from 9.5 feet.

Description: TP-09 Excavated to 9.5 feet.

Description: TP-09 Excavated to 9.5 feet.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-09 Spoils pile from above 9.5 feet.   View is to the north.

Description: TP-09 Location. View is toward the east from near the horse barns.

Description: TP-10 Location. View is to the south

Description: TP-10 Location. Cone penetrometer was pushed 0.5 inches under a 320 psi loading. View is to the east.

Lorenzen Soil Mechanics, Inc.

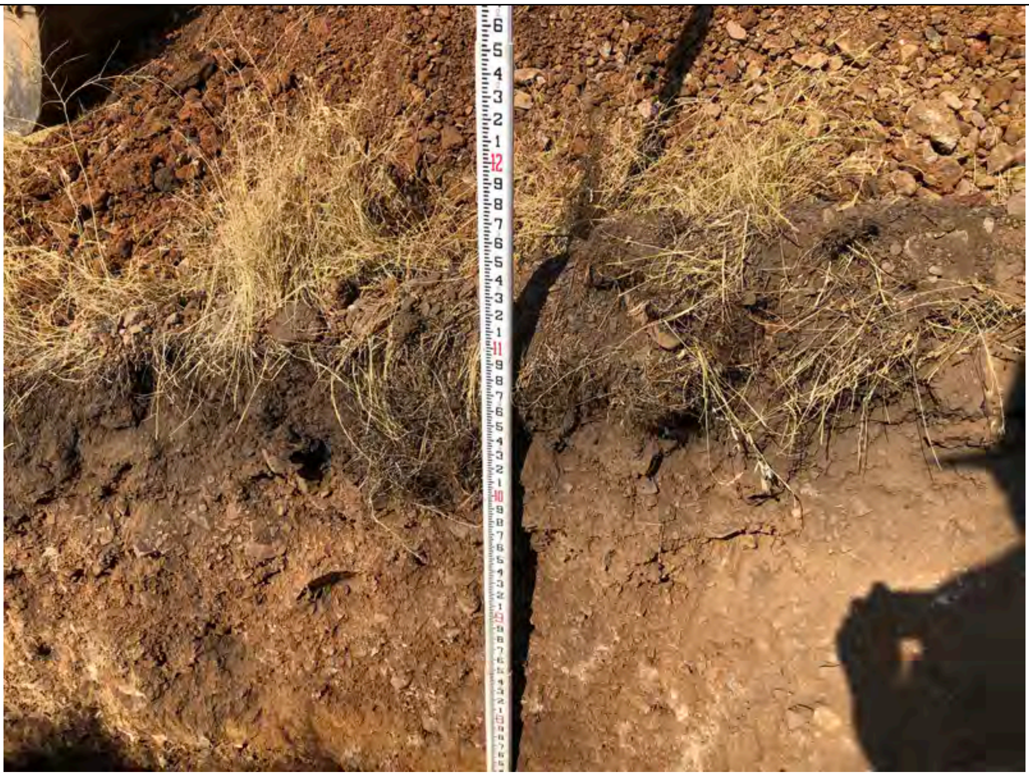
Project: Clearview Crossing

Description: TP-10 Jar sample from the ground surface.

Description: TP-10 Jar sample from 2 feet.

Description: TP-10 Jar sample from 3.5 feet. Cone penetrometer was pushed 0.5 inches under a 320 psi loading.

Description: TP-10 Jar sample from 6.5 feet.



Description: TP-10 Excavated to 11 feet.

Description: TP-10 Excavated to 11 feet.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-10 Jar sample from 11 feet.

Description: TP-10 Spoils pile from above 11 feet.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-10 Piezometer being backfilled. View is to the north.

Description: TP-10 Piezometer being backfilled. View is to the south.

Description: TP-01 Moisture content samples prior to being placed into the drying oven.

Description: TP-01 Moisture content samples after being taken out of the drying oven.

Description: TP-02 Moisture content samples prior to being placed into the drying oven.

Description: TP-02 Moisture content samples after being taken out of the drying oven.

Description: TP-03 Moisture content samples prior to being placed into the drying oven.

Description: TP-03 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

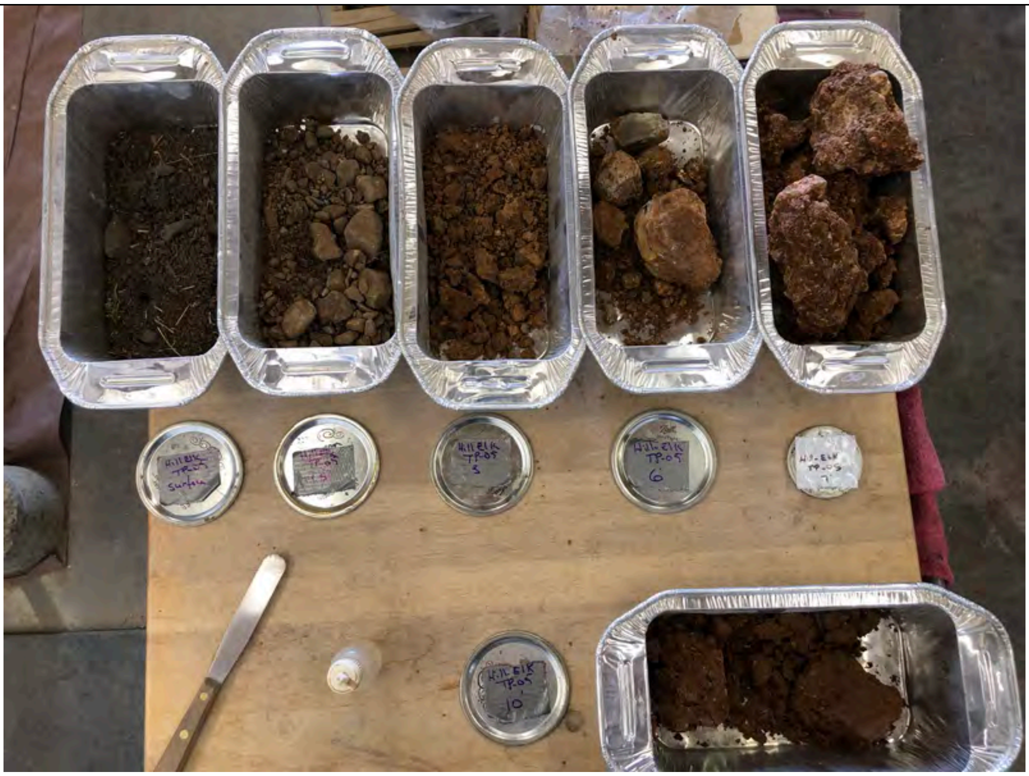
Project: Clearview Crossing

Description: TP-04 Moisture content samples prior to being placed into the drying oven.

Description: TP-04 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing



Description: TP-05 Moisture content samples prior to being placed into the drying oven.

Description: TP-05 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing

Description: TP-06 Moisture content samples prior to being placed into the drying oven.

Description: TP-06 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-07 Moisture content samples prior to being placed into the drying oven.

Description: TP-07 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

Project: Clearview Crossing

Description: TP-08 Moisture content samples prior to being placed into the drying oven.

Description: TP-08 Moisture content samples after being taken out of the drying oven.

Description: TP-09 Moisture content samples prior to being placed into the drying oven.

Description: TP-09 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

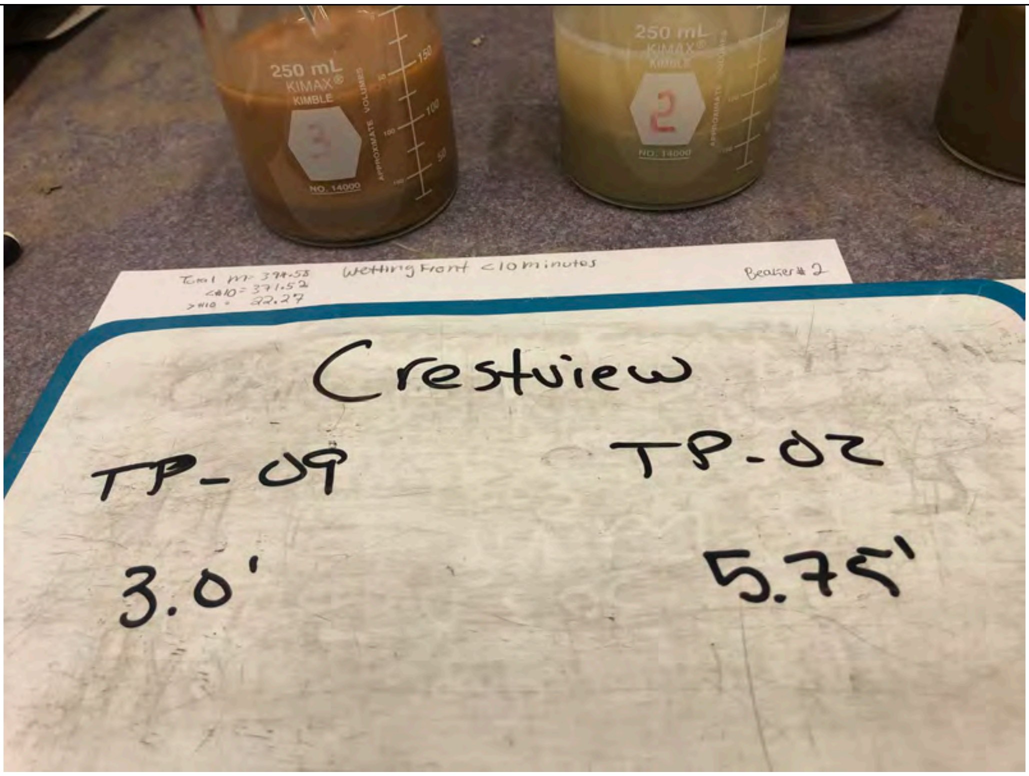
Project: Clearview Crossing

Description: TP-10 Moisture content samples prior to being placed into the drying oven.

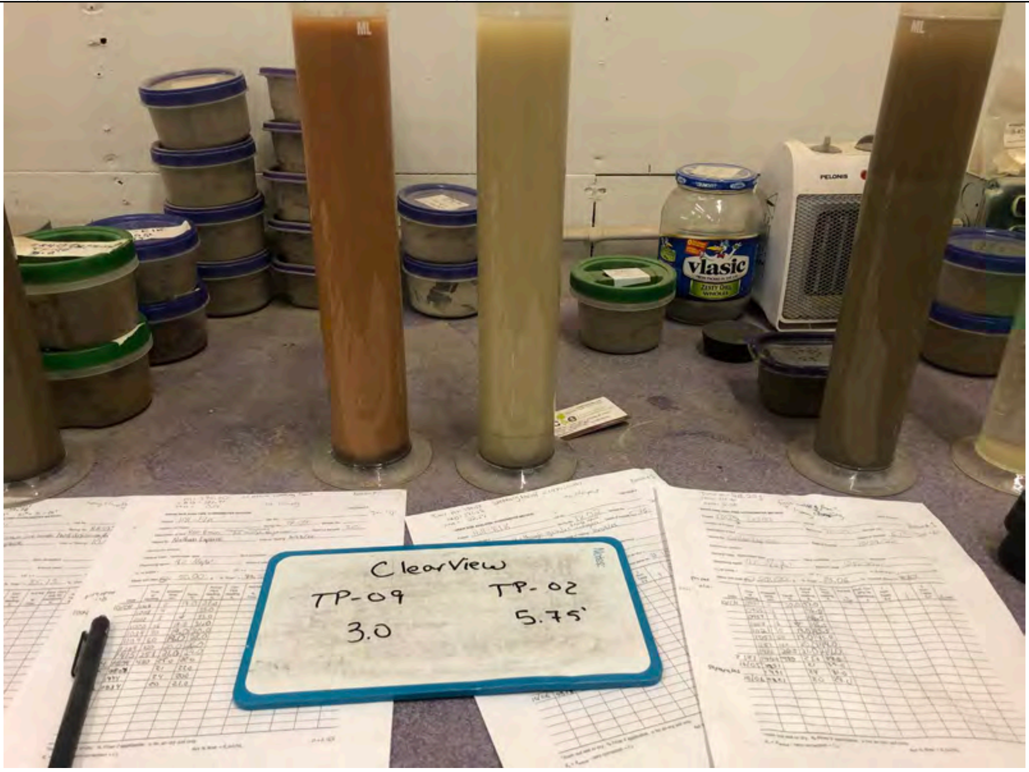
Description: TP-10 Moisture content samples after being taken out of the drying oven.

Lorenzen Soil Mechanics, Inc.

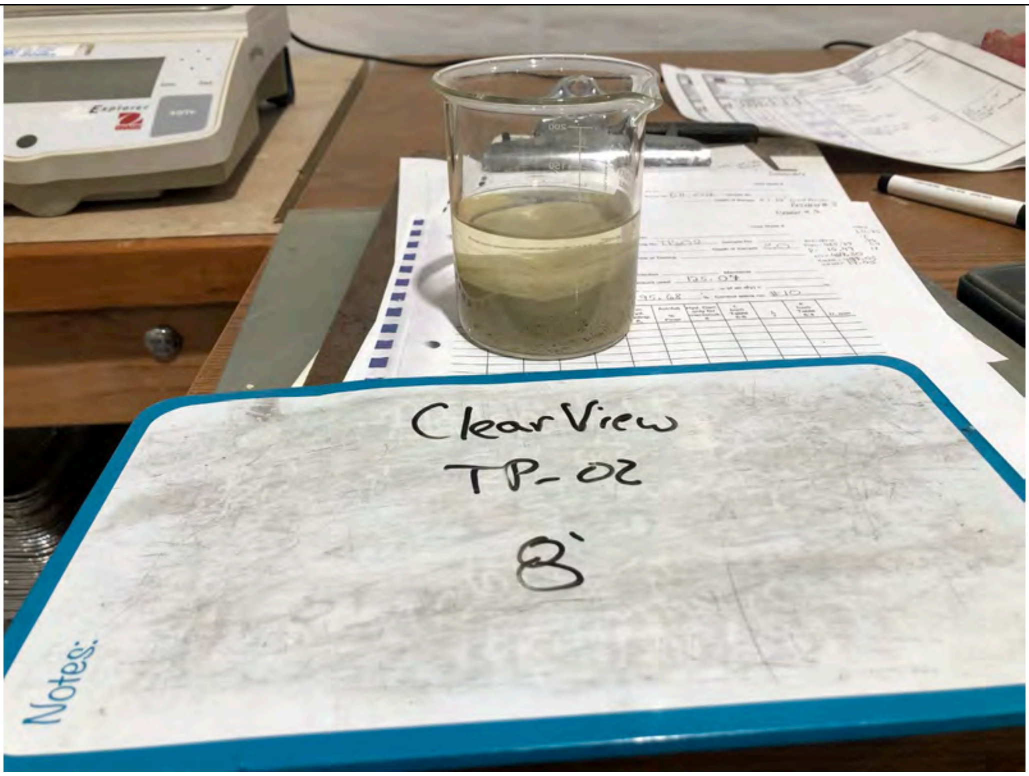
Project: Clearview Crossing



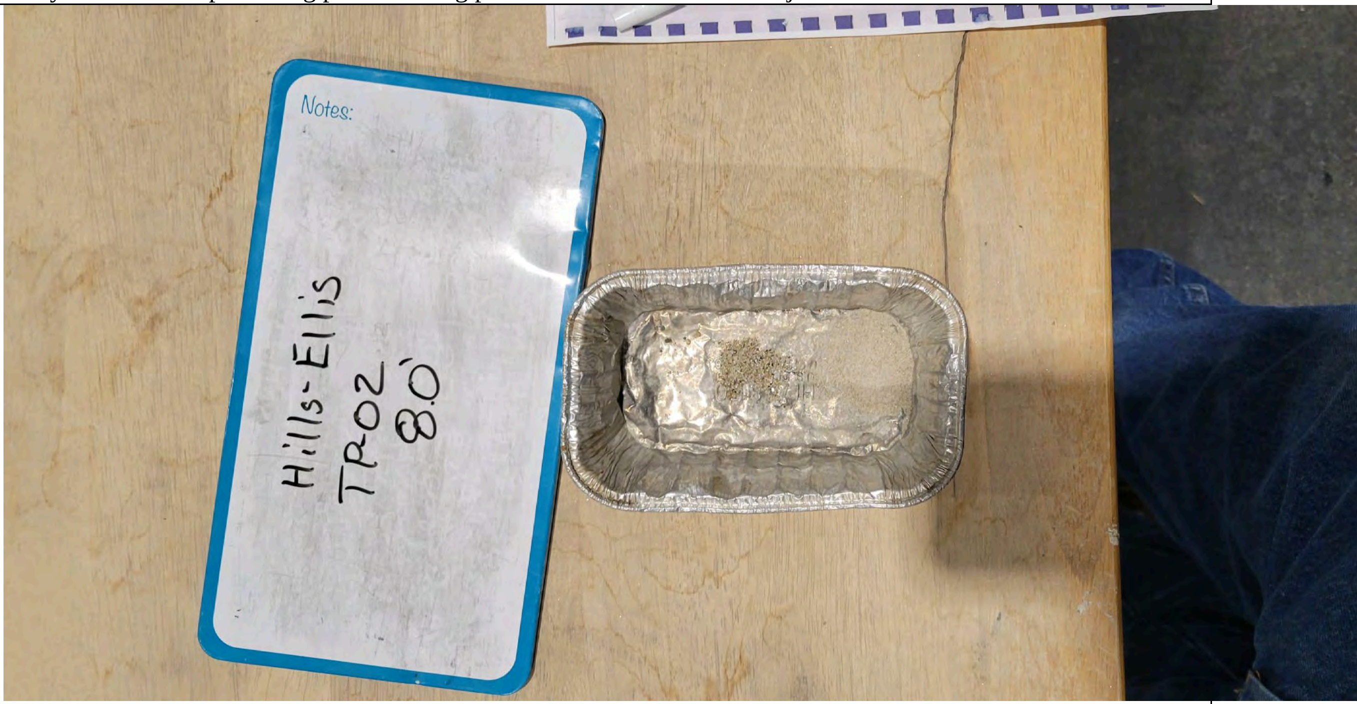
Description: Hydrometer samples curing prior to being placed into their sedimentation jars.



Description: Hydrometer samples in their sedimentation jars at 3 days.



Description: Hydrometer sample curing prior to being placed into its sedimentation jar.



Description: Hydrometer sample sieved following its -200 sieve wash.

Lorenzen Soil Mechanics, Inc.	Project: Clearview Crossing