Report of Geotechnical Investigation
Trinity Apartments: Site 1 (Mullan Road)
Missoula, Montana

Tetra Tech Project No. 117-8751001
July 2, 2020

PRESENTED TO

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1.0 EXECUTIVE SUMMARY

The proposed Trinity Apartments project in Missoula, Montana is an affordable housing project which includes the construction of apartment complexes at two separate sites. The first site (Mullan Road) is located at 2440 Mullan Road, adjacent to the east side of the Missoula County Detention Center. The second site (Cooley Street) encompasses the 1600 block of Cooley Street. This report addresses the Mullan Road site.

Proposed construction at the Mullan Road site will consist of two four-story slab-on-grade buildings containing approximately 130 apartments in total. The larger of the two apartment buildings will be situated on the north side of the development, while the smaller building will be constructed to the south near Mullan Road. There will also be an approximate 8,000 square foot, 1½-story slab-on-grade Navigation Center designated as commercial space connecting the two apartment buildings on the north and east sides. New at grade paved parking and driving lanes will also be constructed, and will connect with West Broadway, Maple Street, and Mullan Road.

Much of the proposed site is covered by grasses or weeds and a thin layer of topsoil. The southern edge of the site is surfaced by concrete sidewalk or asphalt pavement, however. Beneath the topsoil horizon or pavement section, the soil profile encountered in the borings generally consists of varying thicknesses of fine-grained silty or clayey deposits, which extended to depths of 9 feet or less. Below the fine-grained soil, or in some cases beneath the topsoil, discontinuous seams of sand were encountered. The sand extended to depths of 2.8 to 8 feet, and beyond the maximum depth explored in borehole BH-2 (10.5 feet). Medium dense to very dense alluvial gravel was encountered below the silty, clayey, or sandy soils, and extended beyond the maximum depth explored in all of the boreholes in which it was encountered (maximum depth of 26 feet). Undocumented fill was encountered to a depth of approximately 5.5 feet in borehole BH-10, and to a depth of approximately 1 foot in BH-15. Groundwater was encountered at depths of 17.0 to 18.3 feet in nine (9) of the exploratory borings (BH-7, BH-8, BH-10 through BH-14, BH-16, and BH-18) at the time of the field exploration (May and June 2020).

Preliminary site grading plans were not provided at the time of report preparation, however, based on the current relatively flat site topography it is anticipated that site grading will be minimal to level the site for construction of the additions and provide positive drainage away from the new structures and surrounding finished grades. Pockets of existing fill within the new building footprints should be removed in its entirety. Any fine-grained silty or clayey deposits or sand seams encountered at the prospective foundation elevations must be removed in their entirety and replaced with properly compacted engineered gravel fill.

A conventional spread footing foundation bearing on the natural alluvial gravel or, where necessary a zone of compacted engineered gravel fill extending to the natural gravel, is recommended to support the anticipated structural loads. Column footings and strip footings placed on the natural gravel can be designed for an allowable bearing pressure of 5,000 pounds per square foot (psf). Imported fill must meet the gradation requirements specified herein. The on-site gravel is suitable for use as backfill along foundation walls, fill under the pavement section, as over-lot fill for site grading, and as engineered fill provided any deleterious materials or debris are removed. The gravel must be placed under controlled moisture and density conditions in accordance with requirements provided in the Site Grading section below. Based on the drilling information, some oversize cobbles and boulders should be anticipated, which is common to the alluvial gravel in the Missoula Valley. These oversize materials must be removed prior to placement as compacted structural or engineered gravel fill.

This executive summary has been prepared solely to provide a general overview and should not be relied upon for any purpose except for that for which it was prepared. The full geotechnical report must be referenced for information about findings, recommendations and other concerns.

2.0 PURPOSE AND SCOPE OF STUDY

Tetra Tech conducted a field exploration program consisting of drilling nineteen (19) exploratory borings to obtain information on subsurface soil conditions for Site 1 (Mullan Road) of the proposed Trinity Apartments project in Missoula, Montana. The geotechnical study was performed in accordance with Tetra Tech's proposal and scope of work dated May 13, 2020, and Work Authorization from Trinity Apartments, LLLP dated May 14, 2020.

Results of the field investigation and laboratory tests were analyzed to characterize site material properties. This report summarizes the field data and presents conclusions and recommendations for design and construction of the proposed building foundations, pavement sections and planned site grading based on the proposed construction and subsurface conditions encountered. The report also includes design parameters and a discussion of geotechnical engineering considerations related to construction.

3.0 PROPOSED CONSTRUCTION

Proposed construction at the Mullan Road site will consist of two four-story slab-on-grade buildings containing approximately 130 apartments in total. At the time of the field investigation, two potential layouts were being considered for the development. Since that time, a final layout has been chosen, and is shown on Drawing 1001-2 in Appendix A. The larger of the two apartment buildings will be situated on the north side of the development, while the smaller building will be constructed to the south near Mullan Road. There will also be an approximate 8,000 square foot, 1½-story slab-on-grade Navigation Center designated as commercial space. The Navigation Center will connect the two apartment buildings on the north and east sides. Originally, below grade parking was to be included as part of the four-story structure, however, that has been eliminated as all parking needs will be accommodated by at grade parking around the perimeter of the buildings. The parking and driving lanes surrounding the buildings will also connect with West Broadway, Maple Street, and Mullan Road. Preliminary structural loads were not available at the time of report preparation.

Existing topography across the site is relatively flat, with a maximum elevation difference on the order of 3 feet. Preliminary site grading plans were not provided at the time of report preparation, but grading is anticipated to consist of minimal cuts and fills of less than 2 to 3 feet to level the site for construction of the proposed structures and provide drainage away from the new structure foundations.

If the above proposed construction and site grading will be significantly different from that described, Tetra Tech should be notified to re-evaluate the geotechnical recommendations and perform additional analysis as required.

4.0 FIELD EXPLORATION

The subsurface field exploration was conducted on May 28th through June 2nd, 2020, consisting of nineteen (19) boreholes spaced throughout the proposed site at the locations shown on Drawing No. 1001-1 (Locations of Exploratory Borings) in Appendix A to explore subsurface conditions. At the time of drilling, two potential layouts were being considered for the apartment complex, and both layouts were investigated during the field exploration. The two potential layouts were provided by Trinity Apartments, LLLP, and locations of the exploration borings were determined and staked in the field by Tetra Tech. Prior to

mobilization, Tetra Tech contacted Montana One Call to request the location and clearance of public underground utilities before performing drilling.

Tetra Tech's drilling subcontractor (O'Keefe Drilling) advanced the borings with a truck-mounted Mobile B-61 drill rig equipped with 8-inch outside diameter, continuous flight, hollow stem augers. Tetra Tech's field engineer provided technical oversight during the field investigation, logged the borings, and handled samples. The borings were reclaimed by backfilling with auger cuttings and capped with asphalt patch where borings extended through existing pavement.

Samples of the subsurface materials were obtained with 2-inch outside diameter split-spoon samplers. Split-spoon samplers were driven into the various strata using a 140-pound hammer falling 30 inches. The number of blows required to advance the sampler each of three successive 6-inch increments was recorded. When using the split-spoon sampler, the total number of blows required to advance the sampler the second and third 6-inch increments is the penetration resistance (N value), as described by ASTM International (ASTM) Method D1586. Penetration resistance values generally indicate the relative density or consistency of the subsurface soils. Bulk samples of soil were obtained from the hollow-stem auger cuttings at select locations. Relatively undisturbed subsurface samples were obtained by hydraulically pushing a 3-inch I.D. thin walled Shelby Tube sampler.

Boring logs were prepared noting the borehole location, equipment and drill methods used, subsurface profile and descriptions per ASTM D2487, and groundwater conditions. Boring depths are referenced to the existing ground surface elevation. Depths at which the samples were obtained along with the penetration resistance values are shown on the logs of exploratory borings, presented in Appendix B (Figures 1 through 19).

5.0 INFILTRATION TESTING

Four (4) infiltration tests were conducted on June 4, 2020 within the footprint of the proposed development at the Mullan Road site at the locations of boreholes BH-5, BH-9, BH-15, and BH-17 (see Drawing 1001-1, Appendix A). The infiltration tests were performed following the procedures outlined in Appendix C of the Montana DEQ Circular 8, with the exception of casing diameter. Open-ended 3-inch diameter PVC pipe was installed in the previously mentioned boreholes to depths of approximately 9 feet below existing grade following completion of drilling. The percolation tests were performed through the open-ended pipe within the subsurface materials encountered in each respective borehole. Results of the infiltration testing are presented in Appendix D.

6.0 LABORATORY TESTING

Samples obtained during the field exploration were taken to Tetra Tech's laboratory, where they were observed and visually classified in accordance with ASTM D2488, which is based on the Unified Soil Classification System. Representative samples were selected for testing to determine the physical properties of the soils in general accordance with ASTM or other approved procedures. The following list describes laboratory testing performed for this investigation, and their purpose:

Tests Conducted:	**To Determine:**
Natural Moisture Content	Moisture content representative of field conditions at the time samples were collected.
Grain-size Distribution	Size and distribution of soil particles (i.e., clay, silt, sand, and gravel).
Atterberg Limits	The effect of varying water content on the consistency of fine-grained soils.
Moisture-Density Relationship	The optimum moisture content for compacting soil and the maximum dry unit weight (density) for a given compactive effort.
California Bearing Ratio	The capacity of a subgrade or subbase to support a pavement section designed to carry a specific traffic load.
Water Soluble Sulfate Content	Potential of soils to deteriorate normal strength concrete.
Resistivity and pH	The combination of these characteristics determines the potential of soil to corrode metal.

Field and laboratory test results are presented on Figures 20 through 26 in Appendix C. This data, along with the field information, were used to prepare the exploration boring logs on Figures 1 through 19 in Appendix B.

7.0 SITE CONDITIONS

The proposed Trinity Apartments project at the Mullan Road site is located at 2440 Mullan Road. The site is currently vacant, with no apparent history of previous development on the site. The site is approximately 5.2 acres in total, and is bordered to the north by Rangitsch Brothers RV & Manufactured Home Center and to the east by Dollar Car Rental and West Broadway Street. South of the property is Mullan Road and existing parking and an access drive for the Missoula County Detention Center, and to the west is the Missoula County Detention Center campus.

The proposed site is currently vegetated with native grasses and weeds throughout much of the property, with the southern edge of the development site containing several trees and landscaped grasses near the existing sidewalk and asphalt parking. Current topography across the property is relatively flat, with a maximum elevation difference on the order of 3 to 4 feet across the site. There are, however, several mounds of probable fill on the order of 4 to 5 feet tall placed at the northwest corner of the site.

7.1 SEISMIC DESIGN PARAMETERS

National Seismic Hazard Maps prepared by the USGS depict probabilistic strong ground motions and spectral accelerations with 10, 5, and 2 percent probabilities of exceedance in any 50-year period for the conterminous United States. International Building Code (IBC) 2015 design criteria are based on a 2 percent probability of exceedance, or in other words, a 98 percent probability of not being exceeded in a 50-year period. Based on the Applied Technology Council (ATC) Hazards by Location application which queries applicable data from USGS, the site modified peak ground acceleration at the project site in Missoula, Montana having a 2 percent probability of exceedance in any 50-year period is estimated to be 0.232g.

The USGS database presents spectral response acceleration data in bedrock for short (0.2 second) periods (S_s) and for long (1 second) periods (S_1) for similar probability and 50-year return periods. According to IBC 2018 design procedures, these acceleration data are then adjusted upward or amplified depending on soil classification to reflect magnification effects as the earthquake wave energies pass from bedrock into soil. The values are then reduced by a factor that accounts for partial damping of the wave energy by the structure. The final values obtained (known as S_{DS} and S_{D1}) become the basis for the structural design and in this case, at the project site, are estimated as 0.385g (S_{DS}) and 0.160g (S_{D1}). The data is summarized in the table below.

The methods of IBC 2018 require that the properties of the soil at the proposed building site be classified as one of several site classes. The seismic design parameters for this site include a seismic zone soil profile type of (C), in accordance with the above referenced standard. Site Class C corresponds to a very dense soil profile with average undrained shear strengths greater than 2,000 pounds per square foot (psf) and standard penetration resistance values averaging greater than 50 blows per foot in the upper 100 feet. This classification is based on the laboratory test data, exploratory boring information, and knowledge of the local geology.

Earthquake and Site-Specific Seismic Design Parameters

Latitude (North)	Longitude (West)	PGA	S_s	S_1	Site Class	F_{PGA}	F_a	F_v	PGA_M	S_{DS}	S_{D1}
46.88226085	-114.0246672	0.193	0.481	0.145	C	1.2	1.2	1.655	0.232	0.385	0.160

Notes:
PGA = Peak Ground Acceleration
S_1 = 1.0 sec. Spectral Acceleration Coefficient
F_v = 1.0 sec. Spectral Acceleration Site Coefficient
A_s = Acceleration Coefficient
Time period = 50 years
S_s = 0.2 sec. Spectral Acceleration Coefficient
F_a = 0.2 sec. Spectral Acceleration Site Coefficient
F_{PGA} = Peak Ground Acceleration Site Coefficient
Return period = 2%

8.0 SUBSURFACE CONDITIONS

Much of the proposed site is covered by grasses or weeds and a thin layer of topsoil. The southern edge of the site is surfaced by concrete sidewalk or asphalt pavement, however. Beneath the topsoil horizon or pavement section, the soil profile encountered in the borings generally consists of varying thicknesses of fine-grained silty or clayey deposits, which extended to depths of 9 feet or less. Below the fine-grained soil, or in some cases beneath the topsoil, discontinuous seams of sand were encountered. The sand extended to depths of 2.8 to 8 feet, and beyond the maximum depth explored in borehole BH-2 (10.5 feet). Medium dense to very dense alluvial gravel was encountered below the silty, clayey, or sandy soils, and extended beyond the maximum depth explored in all of the boreholes in which it was encountered (maximum depth of 26 feet). Undocumented fill was encountered to a depth of approximately 5.5 feet in borehole BH-10, and to a depth of approximately 1 foot in BH-15.

The boring logs should be referenced for complete descriptions of the soil types and their estimated depths. A characterization of the subsurface profile includes grouping soils with similar physical and engineering properties into a number of distinct layers. The representative subsurface layers at the site are presented below, starting at the ground surface.

8.1 PAVEMENT SECTION

Borehole BH-19 was drilled through the existing pavement located at the southern edge of the property. The pavement section encountered consisted of 3 inches of asphalt covering 1.4 feet of base course

material. The base course visually classified as poorly graded gravel with sand and sand according to ASTM D2488.

8.2 FILL

A layer of uncontrolled fill was encountered in boreholes BH-10 and BH-15 below a thin layer of topsoil. The fill extended to a depth of approximately 5.5 feet below existing grade in BH-10, and visually classified as clayey sand according to ASTM D2488. In BH-10, asphalt pieces were encountered within the fill material near a depth of approximately 3 feet. The fill encountered in BH-15 visually classified as poorly graded gravel with sand and extended to an approximate depth of 1 foot. Standard Penetration Test (SPT) blow counts (N Values) recorded in the fill ranged from 11 to 41 blows per foot, indicating a medium dense to dense relative density. The natural moisture content of tested split spoon samples ranged from 4 to 6 percent at the time of drilling.

8.3 SILT

Silt was encountered below a thin layer of topsoil in boreholes BH-1 through BH-4, extending to depths of 4 to 9 feet. The silt visually classified as silt with sand according to ASTM D2488, and contained occasional gravel throughout. SPT N values recorded in the silt ranged from 8 to 46 blows per foot, indicating a medium stiff to hard soil stratum. The natural moisture content of tested split spoon samples ranged from 4 to 9 percent at the time of drilling.

8.4 CLAY

Below a thin layer of topsoil or fill, clay was encountered in 10 of the borings (BH-5, BH-7, BH-8, BH-11, BH-12, and BH-14 through BH-18). N Values recorded in the clay varied from 3 to 40, indicative of a soft to hard stratum. The clay was determined to have a visual classification of sandy, silty clay, and extended to depths of 1.2 to 5.3 feet below existing grade. Gradation analysis performed on a representative bulk sample of the clay from BH-5 (0.5 – 4.0 feet) determined a classification of sandy, silty clay, confirming its respective visual classification (Figure 21, Appendix B). Fines content (percent passing No. 200 sieve) of the tested sample was 54 percent, and Atterberg limit testing determined a liquid limit of 23 percent and plasticity index of 7. Natural moisture content of tested split spoon samples of the clay ranged from 6 to 23 percent at the time of drilling.

Results of moisture-density relationship testing (Proctor) performed on a disturbed bulk sample of the clay from borehole BH-5 (0.5 – 4.0 feet) indicate a maximum dry density of 118.2 pounds per cubic foot (pcf) at an optimum moisture content of 11.3 percent (Figure 24, Appendix B). A California Bearing Ratio (CBR) test performed on the same bulk sample of the clay indicates a CBR value on the order of 6 percent (Figure 26, Appendix B).

Analytical chemical testing performed on the clay material resulted in a pH value of 8.05 with a minimum resistivity value of 3,300 ohm-cm. This combination of pH and resistivity suggests the potential of corrosion of buried metal in this material is mild to moderate. An approved bituminous or polymeric coating, or cathodic protection should be considered for all galvanized steel with the potential to be exposed to these materials. Use of bituminous or polymeric coating for buried galvanized steel posts or other steel structures is not required in circumstances where steel elements are in connection with a cathodic protection grid.

Testing of water-soluble sulfates is currently being performed and the results will be forwarded upon completion.

8.5 SAND

Below the topsoil horizon or fine-grained silt or clay deposits in boreholes BH-2, BH-3, BH-4, BH-6, BH-9, BH-11, BH-13, discontinuous seams of sand were encountered. SPT N values recorded in the sand strata ranged from 6 to 39 blows per foot, indicating a loose to dense relative density. The sand was heterogeneous in nature, containing varying percentages of silt and clay. Visual classifications of the material according to ASTM D2488 in the various boreholes included: poorly graded sand with silt, silty sand, silty, clayey sand, and clayey sand. In addition to the varying characteristics of the sand, depth ranges at which it was encountered also widely varied. The sand was encountered from depths ranging from just below the topsoil horizon to 7 feet, and generally extended to depths of 2.8 to 8 feet, and beyond the maximum depth explored in BH-2 (10.5 feet).

The natural moisture content of tested split spoon samples of the sand ranged from 3 to 8 percent at the time of drilling. Gradation analysis performed on a relatively undisturbed sample of the sand from borehole BH-4 from a depth of 7 to 8 feet determined a soil classification of silty sand (Figure 20, Appendix B). The analysis determined the material had a fines content of approximately 37 percent. Atterberg limit testing performed on the material indicates the soil is non-plastic.

8.6 GRAVEL

Natural alluvial gravel was encountered in all the boreholes with the exception of BH-2. Depths at which the gravel was encountered varied from 1.2 to 9 feet below existing grade, and extended beyond the maximum depths explored (maximum depth of 26 feet). The gravel was generally encountered at shallower depths progressing to the south, with several exceptions. SPT N values recorded in the gravel ranged from 18 to greater than 50 blows per foot, indicating a medium dense to very dense relative density. The moisture content of tested split spoon samples varied from approximately 1 to 6 percent at the time of drilling.

Visual classification of the alluvial gravel according to ASTM D2488 varied across the site, with classifications of poorly graded gravel with silt and sand, poorly graded gravel with sand, and poorly graded gravel with clay and sand determined in the various boreholes. Gradation analysis performed on disturbed bulk samples collected from material recovered at the surface from auger cuttings from borehole BH-6 (5 – 10 feet) and BH-8 (10 – 15 feet) classified as well graded gravel with silt and sand and poorly graded gravel, respectively (Figures 22 and 23, Appendix B). Fines contents in the tested samples varied from 1 to 12 percent. Atterberg limit testing performed on the sample from BH-6 determined the fine-grained portion of the material was non-plastic, while similar testing performed on the sample from BH-8 determined the fine-grained portion of the material had a liquid limit of 22 percent and plasticity index of 5.

Results of moisture-density relationship testing (Proctor) performed on the disturbed bulk sample of the gravel from borehole BH-6 (5 – 10 feet) indicate a rock corrected maximum dry density of 140.4 pounds per cubic foot (pcf) at a rock corrected optimum moisture content of 5.0 percent (Figure 25, Appendix B).

8.7 GROUNDWATER

Groundwater was encountered at depths of 17.0 to 18.3 feet in nine (9) of the exploratory borings (BH-7, BH-8, BH-10 through BH-14, BH-16, and BH-18) at the time of the field exploration (May and June 2020). The borings were backfilled immediately after drilling. Typically, groundwater elevations fluctuate with seasonal precipitation and local irrigation practices. Numerous factors contribute to groundwater fluctuations, and evaluation of such factors is beyond the scope of this report.

9.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

9.1 SITE GRADING

The proposed Trinity Apartment complex at the Mullan Road site will be comprised of two four-story slab-on-grade apartment buildings, a 1½-story slab-on-grade Navigation Center, and a parking area and driving lane surrounding the new development. Preliminary site grading plans were not provided at the time of report preparation, however, based on the current relatively flat site topography it is anticipated that site grading will be minimal to level the site for construction of the additions and provide positive drainage away from the new structures and surrounding finished grades. All existing fill within the new building or pavement area footprints should be removed in its entirety. Foundation excavations will generally extend through fine-grained silt and clay, sand seams, or alluvial gravel soils. Any sand, silt, or clay seams encountered at the prospective footing elevations must be removed in their entirety and replaced with properly compacted engineered gravel fill. Excavation of the soil to the proposed depths can be accomplished with conventional heavy-duty earth excavating equipment. Occasional cobbles should be anticipated during excavation by the contractor.

The on-site natural gravel soils are suitable for use as backfill along foundation walls, structural or engineered gravel fill below foundations and floor slabs, and as over-lot fill, provided oversize cobbles greater than 3-inch size and any deleterious material is removed and it is placed under controlled moisture and density conditions. Imported gravel can also be used as structural and engineered gravel fill to raise site grades or foundation backfill when placed in uniform lifts under controlled moisture and density conditions. The recommendations contained in this report assume that structural and engineered gravel fill will be placed according to the specifications presented herein. On-site silty, clayey, or sandy soils should not be used as backfill beneath structure footprints or along foundation walls, but may be used for over-lot fill or beneath pavements, provided any organics or deleterious material is removed and the material is placed under controlled moisture and density conditions. If site grading significantly differs from what is described herein, the recommendations of this report must be reviewed and revised as necessary to reflect the final grading plan.

Depending on the season and precipitation patterns, based on the information obtained at the time of drilling, the natural moisture content in the excavated material may be higher or lower than the optimum moisture content. Moisture conditioning will be required to adjust the natural moisture content of the soils to within 2 percent of optimum moisture to achieve proper compaction. Unless the soils are processed to adjust the moisture content, it will be difficult to achieve compaction when placed as fill.

In addition, depending on the time of construction, natural moisture conditions and precipitation will influence the mobility of construction equipment. The use of low ground pressure, track-mounted excavation equipment should be anticipated by the contractor since tracks will exert lower ground pressures than pneumatic tires. In fine-grained subgrade soils such as those encountered near surface at this project, pneumatic-tired equipment will rut the subgrade and reduce its shear strength.

Freezing temperatures have the potential to impact construction. Prolonged periods of cold weather in the months of December through February may be difficult for construction since it is difficult to properly install concrete in subfreezing temperatures. Fill should not be placed during freezing temperatures, especially during winter months unless construction practices are altered to adjust to these conditions. Under no circumstances should foundations be constructed on frozen materials.

Site grading plans must include drainage features to rapidly drain surface run-off away from the site. All grades must provide effective drainage away from the facility structures during and after construction. Water permitted to pond next to structures can result in greater soil movements than those discussed in

this report. These greater movements can result in unacceptable differential movements and piping connection problems. Estimated movements described in this report are based on effective drainage for the life of each structure and cannot be relied upon if effective drainage is not maintained.

Careful attention should be given to weather conditions during preparation of the subgrade to prevent excess moisture from collecting on or penetrating and possibly saturating the subgrade before and after compaction. The subgrade should be temporarily sloped to provide drainage into a low area of the excavation and excess water should be pumped from the excavation into a nearby drainage sump. In the event that areas of subgrade become excessively saturated, the wet area should be excavated, replaced with moisture conditioned soil, and compacted. Such collection and discharge must be in compliance with the Contractor's site-specific storm water pollution prevention plan (SWPPP).

Design and construction criteria presented below should be observed for site preparation purposes and when preparing project documents for construction. Construction details should be considered when preparing project documents.

1. All existing asphalt, concrete, existing fill, topsoil, organic material, and any other deleterious material should be removed from the proposed construction areas in their entirety, and the subsequent excavations backfilled in accordance with the recommendations below. Following stripping, topsoil can be reused for general landscaping and site grading purposes outside the limits of the construction areas.

2. Prior to placing new site grading fill, the stripped subgrade should be moisture conditioned, compacted, and proof-rolled with large compaction equipment. If loose or soft areas are encountered during the proof-rolling, the soft or loose soil should be over-excavated, replaced, and compacted in accordance with the specification in Item 3 below.

3. All fill and backfill should be approved by the geotechnical engineer, moisture-conditioned to within 2 percent of optimum moisture content and placed in uniform lifts of suitable thickness for the compaction equipment. It should then be compacted to the following minimum dry densities as determined by ASTM D698.

Location	ASTM D698 (%)
Below Foundations	98
Below Floor Slabs and Flatwork	98
Below Paved Areas	95
Foundation Wall Backfill	98
Utility Trench Backfill	95
All Other Fill	95

4. Imported granular material or on-site gravel used as structural or engineered gravel fill below foundations, floor slabs, pavements, or as backfill should meet the following grading requirements and be placed and compacted in accordance with Item 3 above.

Sieve and Screen Size	Percent Passing
3-Inch	90 – 100
No. 4	25 – 50
No. 40	10 – 20
No. 200	0 – 15

5. The on-site natural gravel soils are suitable for use as backfill along foundation walls, structural or engineered gravel fill below the foundation, and as over-lot fill, provided oversize cobble and boulders and any deleterious material greater than 3-inch size is removed and it is placed under controlled moisture and density conditions.

6. The on-site silty, clayey, and sandy soils are not suitable for use beneath structure footprints or along foundation walls, but may be used as general over-lot fill, provided any organics and deleterious material is removed and it is placed under controlled moisture and density conditions.

7. The contractor is responsible for providing safe working conditions in connection with underground excavations. Temporary construction excavations which workers will enter will be governed by OSHA guidelines 29 CFR 1926, Subpart P. For planning purposes, subsoils encountered in the exploratory borings classify as Type C.

8. Site grading must be developed and maintained during and after construction to rapidly drain surface and tank roof run-off well away from the site and all foundations.

9. To the greatest extent practical, do not allow lawn irrigation, or the placement of lawn irrigation system lines within 10 feet of the building. Downspouts from roof drains should be discharged at least 10 feet from the building. The ground surface adjacent to the exterior foundations should be sloped to drain away from the foundation in all directions. A minimum slope of at least 6 inches in the first 10 feet is recommended.

9.2 FOUNDATIONS

The proposed Mullan Road site for the Trinity Apartments project is underlain by varying depths of fine-grained silty and clayey deposits and discontinuous sand seams or occasional pockets of uncontrolled fill covering medium dense to very dense natural alluvial gravels. Based on the depths at which these soils were encountered within the vicinity of the new building footprints (average depth of 3.5 feet, maximum depth of 8 feet), it is recommended that they be removed in their entirety down to the underlying natural gravel, and where necessary, replaced with compacted engineered gravel fill to footing elevations to provide a relatively uniform bearing platform for the new building foundations.

9.2.1 Spread Footings

Based on the subsurface conditions encountered within the exploration borings, conventional spread footings bearing on the natural alluvial gravel or compacted engineered gravel fill extending to the natural gravel are recommended to support the structural loads. In order to provide a uniform bearing condition beneath all footings, the subgrade at footing elevation should be proof rolled to identify any soft zones prior to placement of concrete formwork.

Calculations indicate continuous strip footings and column footings bearing on the natural gravel or, where necessary, compacted engineered gravel fill extending to the natural gravel, can be proportioned for an allowable bearing pressure of 5,000 psf. Settlement analysis using the previously described bearing pressures and theory of elasticity principles determined the total settlement for strip and column footings supported on the natural gravel or compacted engineered gravel fill is estimated to be approximately 1 inch or less, which is within the tolerable limit for the type of construction proposed. Differential settlement across the new building is estimated to be approximately one-half of the total settlement.

The lateral resistance of spread footings is controlled by a combination of sliding resistance between the footing and the foundation materials and passive earth pressure against the side of the footing. Criteria for calculating the lateral resistance are presented below.

The following design and construction criteria should be observed for a conventional spread footing foundation. Construction details should be considered when preparing project documents.

1. Interior and exterior footings should be supported on the natural medium dense to very dense alluvial gravel or, where necessary, a zone of compacted engineered gravel fill (conforming to the requirements of Item 4 in the *Site Grading* section) extending to the natural gravel, and designed for a maximum allowable bearing pressure of 5,000 psf for strip footings and column footings, provided settlements as outlined above are acceptable.

2. All loose or soft areas and silty, clayey, or sandy seams encountered at footing elevation should be removed in their entirety below footing elevation to intersect the underlying natural gravel. The resulting excavation should then be backfilled with engineered gravel fill, compacted in accordance with Item 3 in *Site Grading*. The zone of engineered gravel fill beneath footings should extend a minimum of 1 foot laterally beyond the outside edges of footings for each foot of depth of engineered gravel fill below the footings (minimum of 2 feet). This provides a uniform layer of competent gravel upon which to support structural footing loads.

3. Exterior footings or footings below unheated areas should be placed at least 42 inches below grade for frost protection.

4. The minimum width of column footings should be at least 24 inches and at least at least 16 inches for continuous spread footings, or in accordance with applicable building codes, whichever is more restrictive.

5. Footing lateral loads may be resisted by friction between the footing base and supporting soil, and lateral bearing pressure against the sides of footings. For design purposes, a friction coefficient of 0.52 for the natural gravel and 0.47 for engineered gravel fill should be used. A lateral bearing pressure of 550 psf per foot of depth for the natural gravel and 480 psf per foot of depth for engineered gravel fill is appropriate. These values include a safety factor of approximately 1.5.

6. Concrete in contact with the soil should be designed using Type I-II cement.

7. Tetra Tech's geotechnical engineer should observe all footing excavations prior to placement of concrete forms and a representative of the geotechnical engineer should test the placement of all fill and backfill.

9.2.2 Floor Slabs

Performance of slab-on-grade concrete construction is dependent upon a relatively uniform subgrade beneath the slab. Floor slabs should be supported on the natural gravel or a minimum of 12 inches of engineered gravel fill compacted in accordance with Item 3 in the *Site Grading* section. In areas where existing fill is encountered, it should be removed in its entirety and replaced with compacted engineered gravel fill. It is also customary to provide a gravel-leveling course beneath floor slabs. This is normally a construction convenience rather than a structural requirement, and acts as a capillary break. The following recommendations should be considered for concrete slab-on-grade construction.

1. Floor slabs should be supported on the natural gravel or a minimum of 12 inches of compacted engineered gravel fill. In preparation for construction of the floor slabs, the subgrade should be scarified to a depth of 6 inches and compacted in accordance with Item 3 in *Site Grading*.

2. A minimum 4-inch thick layer of free-draining gravel should be placed between the slabs and the natural gravel or structural gravel fill as a leveling course. This material should consist of minus 3/4-inch aggregate with less than 60 percent passing the No. 4 sieve and less than 10 passing the No. 200 sieve. This layer can be included as part of the engineered gravel fill layer.

3. To reduce the effects of differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints, which allow unrestrained vertical movement. Floor slab control joints should be used to reduce damage due to shrinkage cracking. The requirements for slab reinforcement should be established by the designer based on experience and the intended slab use.

4. In addition, all electrical and/or mechanical lines which pass through the floor slab should also be provided with a positive bond break so that they can move independently from the floor slab.

5. Floor slabs should not be placed on frozen subgrade or frozen engineered gravel fill.

6. Concrete floor slabs supported on compacted gravel as described above should be designed using a modulus of subgrade reaction of 300 pounds per cubic inch (pci).

9.2.3 Exterior Concrete Flatwork

Natural soil and/or fill disturbed by construction activities should be moisture conditioned and compacted in accordance with Item 3 in the *Site Grading* section, then proof rolled to identify any localized loose or soft areas. Localized loose or soft areas should be over-excavated to a minimum depth of 12 inches and replaced with engineered gravel fill and compacted in accordance with Item 3 in the *Site Grading* section. A minimum of 6 inches of engineered gravel fill should be placed beneath flatwork, placed and compacted in accordance with Item 3 in the *Site Grading* section. Flatwork at door openings intended for egress or ingress into the buildings must be tied to the foundation or underlain by engineered gravel fill to reduce the magnitude of differential movement between the slab and structure. In addition, placement of landscaping adjacent to the building is discouraged due to the potential to induce water into these subgrade soils or fill by the irrigation system.

9.3 PAVEMENTS

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils and the traffic loadings. A uniformly compacted subgrade is vital for good pavement performance.

Pavement design procedures are based on strength properties of the subgrade and pavement materials, along with the design traffic conditions. For pavement thickness design, soils are represented by means of a California Bearing Ratio (CBR) value. Laboratory testing determined a CBR value on the order of 6 percent for the natural sandy, silty clay subgrade, which is considered a low strength subgrade soil for supporting pavements under controlled placement conditions.

Traffic in the parking areas and driving lanes is expected to be light, consisting of passenger cars, pickup trucks, and occasional small delivery trucks. It is anticipated the pavement can be divided into one category of traffic intensity for design equal to a maximum 10 estimated ESAL's per day or less. If anticipated traffic loads differ from what is described above, Tetra Tech should be notified to re-evaluate these recommendations. Pavement section thicknesses recommended below for the anticipated traffic conditions were developed using the methods outlined in the AASHTO 1993/1998 design manual.

The design and construction criteria presented below should be observed for the pavement; construction details should be considered when preparing project documents.

1. All existing asphalt, concrete, demolition debris, existing fill, topsoil, organic material, and any other deleterious material should be removed from the proposed construction locations.

2. In preparation of the roadway subgrade, the subgrade should be scarified to a depth of 8 inches, moisture-conditioned to within 2 percent of optimum moisture content, and re-compacted in accordance with Item 3 in *Site Grading*.

3. Proof roll the existing subgrade with a fully-loaded 10 cubic-yard dump truck to identify any localized loose or soft areas. Localized loose or soft areas should be over-excavated a minimum depth of 12 inches and replaced with engineered gravel fill and compacted in accordance with Item 3 in *Site Grading*.

4. The following flexible pavement section or an approved equivalent should be used for the parking areas and driving lane pavements. Guideline specifications for construction and materials selection, based on the Montana Department of Transportation (MDT) Standard Specifications for Road and Bridge Construction, are included in Appendix A. As an alternative, the Montana Public Works guideline specifications may also be used.

Material	Standard-Duty Asphalt Thickness (inches)
Asphalt Concrete Surfacing	3
¾ or 1½ inch Crushed Aggregate Base Course (MDT Type B, Grade 2)	6
Subbase (to meet engineered gravel fill specifications in this report)	6
Total	**15**

10.0 CONTINUING SERVICES

Two additional elements of geotechnical engineering service are important to the successful completion of this project.

1. **Consultation with Tetra Tech during the design phase.** This is essential to ensure that the intent of the recommendations is incorporated in design decisions related to the project and that changes in the design concept consider geotechnical aspects.

2. **Observation and monitoring during construction.** Tetra Tech should be retained to observe the earthwork phases of the project, including the site grading and excavations, to determine that the subsurface conditions are compatible with those described in our analysis. In addition, if environmental contaminants or other concerns are discovered in the subsurface, Tetra Tech personnel are available for consultation.

11.0 LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering practices in the region where the work was conducted. The conclusions and recommendations submitted in this report are based upon project information provided to Tetra Tech, data obtained from the exploratory borings drilled at the locations indicated. The nature and extent of subsurface variations across the site may not become evident until construction. Tetra Tech should be on site during construction, to verify that actual subsurface conditions are consistent with those described herein.

This report has been prepared exclusively for the client. This report and the data included herein shall not be used by any third party without the express written consent of both the client and Tetra Tech. Tetra Tech is not responsible for technical interpretations by others. As the project evolves, Tetra Tech should provide continued consultation and field services during construction to review and monitor the implementation of the recommendations and verify that the recommendations have been appropriately interpreted. Significant design changes may require additional analysis or modifications of the recommendations presented herein. Tetra Tech recommends on-site observation of excavations and foundation bearing strata and testing of fill by a representative of the geotechnical engineer.

APPENDIX A

Important Information about Your Geotechnical Engineering Report
(Published by ASFE/GBA)

Tetra Tech Boring Log Descriptive Terminology Key to Soil and Rock Symbols and Terms

Classification of Soils for Engineering Purposes

Montana Guideline for Construction and Materials Requirements for Pavement Sections

Locations of Exploratory Borings (Drawing No. 1001-1)

Preliminary Site Layout (Provided by Intrinsik Architecture) (Drawing No. 1001-2)

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the Geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A Geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting Geotechnical engineer indicates otherwise, *your Geotechnical engineer report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified:
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their reports' development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by Geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no Geotechnical engineer, no matter how qualified, and not subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be fare more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their Geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a Geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a Geotechnical engineering report whose adequacy may have been affected by time.* Speak with the Geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as flood, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the*

geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plants based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evalution of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE as developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

Published by

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Tetra Tech Boring Log Descriptive Terminology
Key to Soil Symbols and Terms

05/06/20

TETRA TECH

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	Well-graded gravels, gravel sand mixtures, little or no fines.
				GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	Silty gravels, gravel-sand-silt mixtures.
				GC	Clayey gravels, gravel-sand-clay mixtures.
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	Well-graded sands, gravelly sands, little or no fines.
				SP	Poorly graded sands, gravelly sands, little or no fines.
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	Silty sands, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixures.
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
				OL	Organic silts and organic silty clays of low plasticity.
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				PT	Peat and other highly organic soils.

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Notes

See Soil Boring Information Special Provision.

SPT (Standard Penetration Test-ASTM D1586):The number of blows falling 2.5 ft (750 mm) used to drive a 2 in (50 mm) O.D. Split Spoon sampler for a total of 1.5 ft (0.45 m) of penetration.Written as follows:first 0.5 ft (0.15 m) - second 0.5 ft (0.1 (ex: 1-3-9)
Note: if the number of blows exceeds 50 before 0.5 ft (0.15 m) of penetration is achieved, the actual penetration rounded to the nearest 0.1 ft (0.03 m) follows the number of blows in parentheses (ex: 12-24-50 (0.09 m), 34-50 (0.4 ft), or 100 (0.3 ft)).WR denotes a zero blow count with the weight of the rods only.WH denotes a zero blow count with the weight of the rods plus the weight of the hammer.

MC=Moisture Content, LL=Liquid limit, PL=Plastic Limit
-200%=percent soil passing 200 sieve, DD=Dry Density

Soil Classifications are Based on the Unified Soil Classification System, ASTM D2487 and D2488. Also included are the AASHTO group classifications (M145). Descriptions are based on visual observation, except where they have been modified to reflect results of laboratory tests as deemed appropriate.

Order of Descriptors

- Group Name
- Consistency or Relative Density
- Moisture Condition
- Color
- Particle size descriptor(s) (coarse grained soils only)
- Angularity of coarse grained soils
- Other relevant notes

Criteria For Descriptors

Consistency of Fine Grained Soils

Consistency	N-Value (uncorrected)
Very Soft	< 2
Soft	2 - 4
Medium Stiff	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	> 30

Apparent Density of Coarse Grained Soils

Relative Density	N-Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

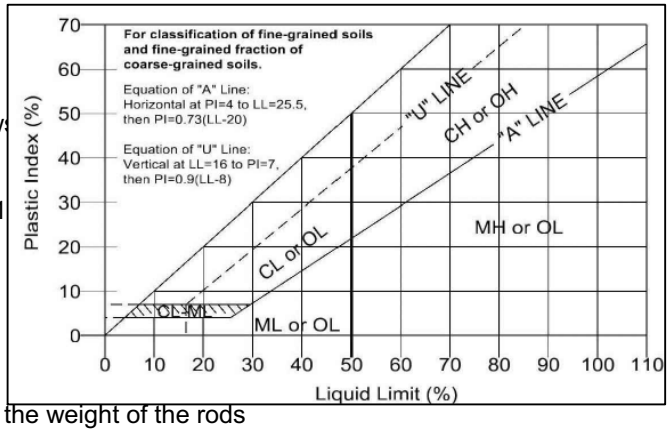
Moisture Condition

Dry	-Absence of moisture, dusty, dry to the touch.
Moist	-Damp, but no visible water.
Wet	-Visible free water.

Definition of Particle Size Ranges

Soil Component	Size Range
Boulder	> 12 in (300 mm)
Cobble	3 in (75 mm) - 12 in (300 mm)
Gravel	No. 4 Sieve (4.75 mm) to 3 in (75 mm)
Sand	No. 200 (0.075 mm) to No. 4 Sieves (4.75 mm)
Silt	< No. 200 Sieve (0.075 mm)*
Clay	< No. 200 Sieve (0.075 mm)*

*Atterberg limits and chart below to differentiate between silt and clay.



Angularity of Coarse-Grained Particles

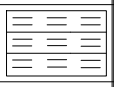
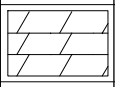
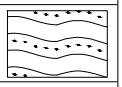
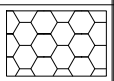
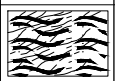
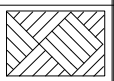
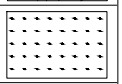
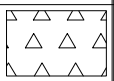
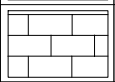
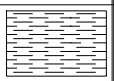
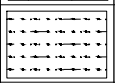
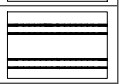
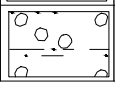
Angular	-Particles have sharp edges and relative plane sides with unpolished surfaces.
Subangular	-Particles are similar to angular description, but have rounded edges.
Subrounded	-Particles have nearly plane sides, but have no edges.
Rounded	-Particles have smoothly curved sides and well-rounded corners and edges.

Example soil description: Sandy FAT CLAY (CH), soft, wet, brown. (A-7)

Tetra Tech Boring Log Descriptive Terminology
Key to Rock Symbols and Terms

05/06/20

TETRA TECH

Rock Type	Symbol	Rock Type	Symbol	Rock Type	Symbol
Argillite		Dolomite		Quartzite	
Basalt		Gneiss		Rhyolite	
Bedrock (other)		Granitic		Sandstone	
Breccia		Limestone		Schist	
Claystone		Siltstone		Shale	
		Conglomerate			

Order of Descriptors

- Rock Type
- Color
- Grain size (if applicable)
- Stratification/Foliation (as applicable)
- Field Hardness
- Other relevant notes

Criteria For Descriptors

Grain Size

Description	Characteristic
Coarse Grained	-Individual grains can be easily distinguished by eye
Fine Grained	-Individual grains can be distinguished with difficulty

Stratum Thickness

Thickly Bedded	3-10 ft (1-3 m)
Medium Bedded	1-3 ft (300 mm - 1 m)
Thinly Bedded	2-12 in (50-300 mm)
Very Thinly Bedded	< 2 in (50 mm)

Rock Field Hardness

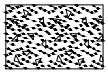
Very Soft	-Can be carved with knife. Can be excavated readily with point of rock hammer. Can be scratched readily by fingernail.
Soft	-Can be grooved or gouged readily by knife or point of rock hammer. Can be excavated in fragments from chips to several inches in size by moderate blows of the point of a rock hammer.
Medium	-Can be grooved or gouged 0.05 in (2 mm) deep by firm pressure of knife or rock hammer point. Can be excavated in small chips to pieces about 1 in (25 mm) maximum size by hard blows of the point of a rock hammer.
Moderately hard	-Can be scratched with knife or pick. Gouges or grooves to 0.25 in (6 mm) can be excavated by hard blow of rock hammer. Hand specimen can be detached by moderate blows.
Hard	-Can be scratched with knife or pick only with difficulty. Hard hammer blows required to detach hand specimen.
Very Hard	-Cannot be scratched with knife or sharp rock hammer point. Breaking of hand specimens requires several hard blows of a rock hammer.

Notes:

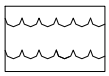
UCS = Unconfined Compressive Strength obtained from laboratory testing at the given depth.

See Soil Boring Information Special Provision.

Miscellaneous Soil/Rock Symbols and Terms

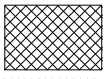
 Concrete

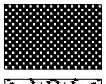
 Asphalt

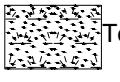
 Water

 Boulders and Cobbles

 Coal

 Fill

 Millings

 Topsoil

Explanation of Text Fields in Boring Logs:

Material Description: Lithologic Description of soil or rock encountered.

Remarks: Comments on drilling, including method, bit type, and problems encountered.

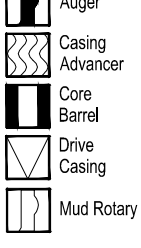
Unless stated on logs as being surveyed by district survey, all locations are considered approximate.

General Notes

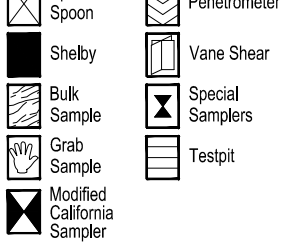
- Descriptions on these boring logs apply only at the specific boring, and at the time the time the borings were made. These logs are not warranted to be representative of subsurface conditions at other locations or times.
- Water level observations apply only at the specific boring, and at the time the borings were made. Due to the variability of groundwater measurements given the type of drilling used, and the stratification of the soil in the boring, these logs are not warranted to be representative of groundwater conditions at other locations or times.
- Other terms may be used as descriptors, as defined by the profession.

-Soil and Rock descriptions are based on visual observation, except where they have been modified to reflect results of laboratory tests as deemed appropriate.

Operation Types:



Sample Types:



Example Rock Log

SANDSTONE, gray, fine grained, thickly bedded, hard field hardness.

TETRA TECH

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 – 83

(Based on Unified Soil Classification System)

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

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

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

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

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

[E] $Cu = D_{60}/D_{10}$ $Cc=(D_{30})^2 / (D_{10} \times D_{90})$

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

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

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

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

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

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

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

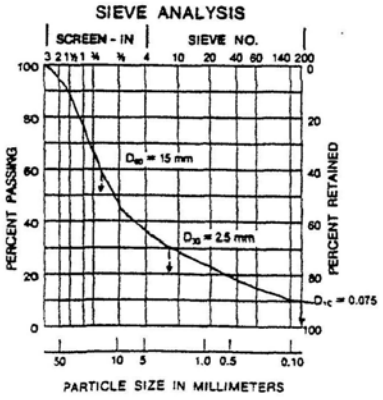
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

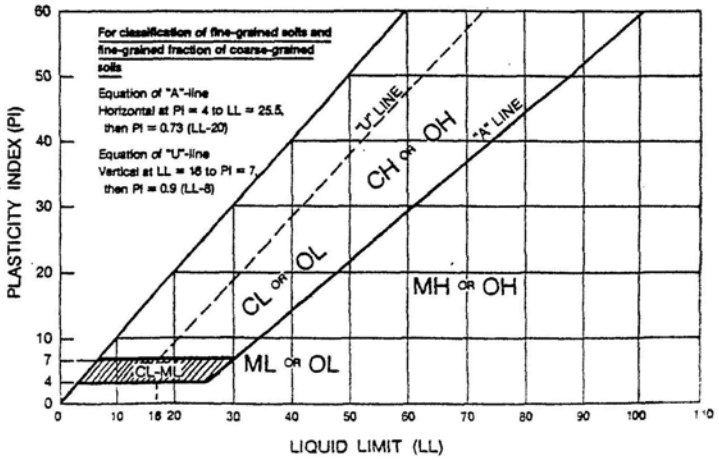
[N] PI ≥ 4 and plots on or above "A" line.

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

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

[Q] PI plots below "A: line.





$C_u = \frac{D_{50}}{D_{1e}} = \frac{15}{0.075} = 200$ $C_c = \frac{(D_{30})2}{D_{12} \times 10_{36}} + \frac{(2.5)-}{0.075 \times 15} = 5.6$

MONTANA GUIDELINE CONSTRUCTION AND MATERIALS REQUIREMENTS FOR PAVEMENT SECTIONS

1. Minimum Density Requirements

Material	Percent of Maximum	Method
Asphaltic concrete surfacing or base	97 or 92	ASTM D1559 (Marshall)* ASTM D2041
Crushed or uncrushed granular base course	95	ASTM D698
Subgrade (top 6 inches)**	95	ASTM D698

* 50 blows each end of specimen; sampled from truck at time of production.
** For all alternatives. Clay soils should be compacted at moisture contents within +/- 2 percent of optimum.

Maximum lift thickness should be 3 inches for asphaltic concrete and 8 to 12 inches for granular base course. Minimum lift thickness for gravel should be twice the maximum size of aggregate.

2. Aggregate Base Course Grading Requirements

Screen or Sieve Size	3/4-Inch Crushed Leveling Course (Crushed Top Surfacing, Type A, Grade 2) - % passing	1-1/2-Inch Crushed Base Course (Crushed Base Course, Type B, Grade 2) - % passing	3-Inch Uncrushed Subbase Course (Crushed Base Course, Type A, Grade 2) - % passing
3-inch			100
1-1/2-inch		100	
3/4-inch	100		
No. 4	40 - 70	25 - 55	25 - 60
No. 10	25 - 55		
No. 200	2 - 10	0 - 8	0 - 12
Mechanically fractured faces, one or more on plus No. 4 aggregate - % minimum	50	50	No requirement

In addition to the grading requirements shown, aggregate quality should conform to the following Montana Department of Highway Specifications, 1995 edition, or to Montana Public Works Standard Specifications.

Material	MHD Specification
3/4-inch crushed leveling course (Crushed Top Surfacing, Type A, Grade 2)	M701.02 (E)
1-1/2-inch crushed base course (Crushed Base Course, Type B, Grade 2)	M701.02 (D)
3-inch uncrushed subbase course (Crushed Base Course, Type A, Grade 2), with crushing not a requirement	M701.02 (C)

3. Asphaltic Concrete Aggregate Production Grading Requirements

Screen or Sieve Size	Asphaltic Concrete Surfacing or Base (Plant Mix, Grade B) - % Passing	Job Mix Tolerance - % Passing
1-1/2-inch		
1-inch		
3/4-inch	100	
1/2-inch	86 - 90	+/-7
3/8-inch	75 - 79	+/-7
No. 4	51 - 57	+/-7
No. 10	32 - 40	+/-6
No. 40	14 - 16	+/-4
No. 200	4.5 - 6.5	+/-1.5

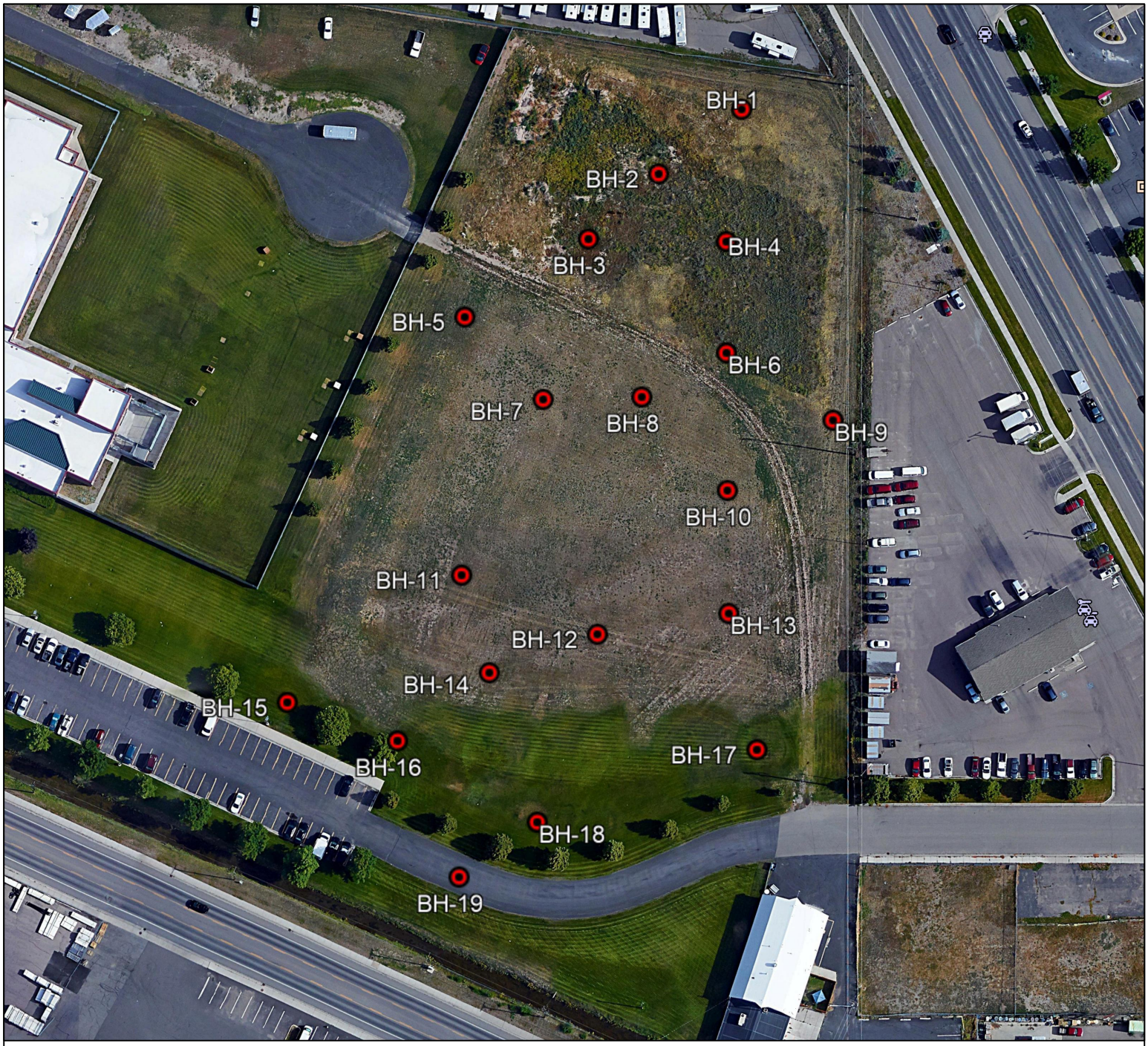
In addition to the grading requirements shown, the aggregate quality should conform to the applicable portions of the Montana Public Works Standard Specifications or the Montana Department of Highways Specifications, Article 30.02 and M-701.03 (A) and (B), and should have a retained coating of at least 95 percent when tested for stripping in accordance with ASTM D1664.

4. Asphaltic concrete mix designs should be submitted by the contractor, and should meet the following requirements:

Property	Test Method	Asphaltic Concrete	
		Surfacing	Base
Stability, pounds, minimum	ASTM D1559*	1200	800
Flow, 1/100-inch units	ASTM D1559*	8 - 18	8 - 20
Air voids, percent	ASTM D3203	3 - 5	3 - 8
Voids in mineral aggregate (VMA), percent, minimum	Asphalt Institute Manual MS-2	14	12 or 14**
Immersion-compression retained strength, percent	ASTM D1075	70	70

* 50 blows each end of specimen

** Mixes using 1-1/2-inch maximum size aggregate require a minimum of 12 percent VMA and mixes using 3/4-inch maximum size aggregate require a minimum of 14 percent VMA.



N

0 100 200 400

SCALE IN FEET

TETRA TECH

www.tetratech.com

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Legend

Borehole Location

Trinity Apartments: Site 1 (Mullan Road)
Missoula, Montana
Subsurface Investigation

Locations of Exploratory Borings

End Client: Trinity Apartments, LLLP	Tetra Tech Project No.: 117-8751001
	Drawn By: AW / Approved By: JD
Date: July 2, 2020	Drawing No.: 1001-1

1 / A100 SCHEMATIC SITE PLAN
1" = 30'-0"

SITE INFORMATION

NUMBER OF DWELLINGS
(70) ONE-BEDROOM WORKFORCE RESIDENCES
(23) TWO-BEDROOM WORKFORCE RESIDENCES
(5) THREE-BEDROOM WORKFORCE RESIDENCES
(2) FOUR-BEDROOM APARTMENT FLAT RESIDENCES
(30) ONE-BEDROOM PERMANENT SUPPORTIVE RESIDENCES
TOTAL: 130 RESIDENCES

PARKING REQUIRED:
DWELLINGS LESS THAN 850 SF: 123 x 1 = 123 SPACES REQUIRED
DWELLINGS 850 -1999 SF: 7 x 1.5 = 10.5 SPACES REQUIRED
TOTAL REQUIRED (DWELLINGS): 134 SPACES

TOTAL REQUIRED FOR NAVIGATION CENTER: 42 SPACES

TOTAL PROVIDED ON SITE: 212 SPACES
TOTAL REQUIRED ON SITE: 176 SPACES

SITE AND BUILDING LAYOUT SHOWN PRELIMINARILY AND IS SUBJECT TO CHANGE

intrinsik
ARCHITECTURE
INCORPORATED
111 North Tracy ● Bozeman, Montana ● 59715 ● Ph: 406.582.8988 ● Fax: 406.582.8911

PRELIMINARY NOT FOR CONSTRUCTION

No.	Description	Date

revisions

MISSOULA, MONTANA

address

TAM

TRINITY MISSOULA
MULLAN SITE

project code

A100

SITE PLAN

2020-06-18

sheet

Drawing No. 1001-2

Y:\Projects\TAM - Trinity\DRAWINGS\REVIT\TAM-MULLAN-SITE 06 17.rvt

APPENDIX B

Logs of Exploratory Borings (Figures 1 through 19)

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Figure No. 1

LOG OF BORING

Boring BH-1

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.883003 **Coordinates** E: -114.02433
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 105.5 ft
Date Started: 5/28/20	**Date Finished:** 5/28/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			100		6 - 11 - 14		TOPSOIL, moist.	0.3 *105.2*						
							SILT with sand (ML), medium stiff to very stiff, slightly moist to moist, brown, low plasticity, some gravel.		9					
			80		10 - 11 - 10									
5 *100.5*			87		6 - 6 - 7				9					
			67		3 - 3 - 5									
								9.0 *96.5*						
10 *95.5*			50		9 - 40 - 50/0.4ft		Poorly-Graded GRAVEL with silt and sand (GP-GM), very dense, slightly moist, light brown, fine to coarse grained, subangular to subrounded.	10.4 *95.1*						

Boring Depth: 10.4 ft, *Elevation: 95.1 ft*

Water Level Observations		Remarks:
During Drilling: Not Encountered		
After Drilling: Not Recorded	**After Drilling:** Not Recorded	

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Figure No. 2

LOG OF BORING

Boring BH-2

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.882878 **Coordinates** E: -114.024601
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 103.2 ft
Date Started: 5/28/20	**Date Finished:** 5/28/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
							TOPSOIL, moist.	0.3 *102.9*						
			40		8 - 18 - 28		SILT with sand (ML), medium stiff to hard, slightly moist, brown, low plasticity, Some gravel from 0.5 to 2 ft, grades to nearly no gravel by 4.5 ft.		8					
			87		13 - 11 - 11									
5 *98.2*			73		5 - 4 - 4									
							Poorly-Graded SAND with silt (SP-SM), loose, slightly moist, light tan/brown, fine to medium grained, subrounded.	5.8 *97.4*						
			73		3 - 2 - 4				3					
10 *93.2*			73		4 - 4 - 5									
							Boring Depth: 10.5 ft, *Elevation: 92.7 ft*	10.5 *92.7*						

Water Level Observations		Remarks:
During Drilling: Not Encountered	**After Drilling:** Not Recorded	
After Drilling: Not Recorded		

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Figure No. 3

LOG OF BORING

Boring BH-3

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.883006 **Coordinates** E: -114.024661
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 101.4 ft
Date Started: 5/28/20	**Date Finished:** 5/28/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			100		5 - 10 - 10		TOPSOIL, moist.	0.3 *101.1*						
			73		10 - 9 - 5		SILT with sand (ML), stiff to very stiff, slightly moist, brown, low plasticity, occasional gravel, grades to silty sand.		4					
5 *96.4*			100				Silty SAND (SM), medium dense, slightly moist, brown, fine grained, subrounded.	4.0 *97.4*						
			40		29 - 36 - 36		Poorly-Graded GRAVEL with silt and sand (GP-GM), very dense, slightly moist, light brown, fine to coarse grained, subrounded to subangular.	5.7 *95.7*						
10 *91.4*			47		11 - 15 - 20				1					
			88		33 - 50/0.3ft				2					
							Boring Depth: 14.8 ft, *Elevation: 86.6 ft*	14.8 *86.6*						

Water Level Observations		Remarks:
▽ During Drilling: Not Encountered	▽ After Drilling: Not Recorded	
▼ After Drilling: Not Recorded		

TT LOG OF BORING - MDT_REVISED_2009+.GDT - 07/01/20 12:39 - N:\GEOTECH\REPORTS\REPORT 2020\TRINITY APARTMENTS\LAB_LOGS\MULLAN ROAD SITE\TRINITY APARTMENTS BORING LOGS - MULLAN ROAD.GPJ

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Figure No. 4

LOG OF BORING

Boring BH-4

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.882752 **Coordinates** E: -114.024398
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 104.1 ft
Date Started: 5/28/20	**Date Finished:** 5/28/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			87		6 - 10 - 12		TOPSOIL, moist.	0.3 *103.8*						
							SILT with sand (ML), very stiff to hard, slightly moist, brown, low plasticity, occasional gravel, grades to silty sand.		7					
			87		20 - 20 - 18									
5 *99.1*			87		12 - 11 - 7				6					
			90				Silty SAND (SM), medium dense, slightly moist, brown, fine to medium grained, subangular to subrounded.	7.0 *97.1*		NV	NP	37		
			60		16 - 33 - 32			8.0 *96.1*	2					
10 *94.1*							Poorly-Graded GRAVEL with silt and sand (GP-GM), very dense, slightly moist, light brown, fine to coarse grained, subrounded to subangular.							
15 *89.1*			54		25 - 48 - 50/0.3ft									
							Boring Depth: 15.3 ft, *Elevation: 88.8 ft*	15.3 *88.8*						

Water Level Observations		Remarks:
▽ During Drilling: Not Encountered	▽ After Drilling: Not Recorded	
▼ After Drilling: Not Recorded		

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Figure No. 5

LOG OF BORING

Boring BH-5

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.882558 **Coordinates** E: -114.025123
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 101.0 ft
Date Started: 5/28/20	**Date Finished:** 5/28/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
							TOPSOIL, moist.	0.3 *100.7*						
			87		7 - 15 - 21		Sandy, Silty CLAY (CL-ML), medium stiff to hard, slightly moist, brown, low plasticity, occasional gravel 0.3 ft to 1 ft.		23	16		54		pH= 8.05 Resistivity= 3,300 ohm-cm
			60		6 - 4 - 4				6					CBR= 6
5 *96.0*			47		28 - 22 - 16		Poorly-Graded GRAVEL with silt and sand (GP-GM), dense to very dense, slightly moist, light brown, fine to coarse grained, subrounded to subangular, occasional cobbles.	4.0 *97.0*	1					
			60		22 - 25 - 37									Installed solid PVC to 9 feet for future infiltration testing.
							Boring Depth: 9.0 ft, *Elevation: 92.0 ft*	9.0 *92.0*						

Water Level Observations		Remarks:
▽ During Drilling: Not Encountered	▽ After Drilling: Not Recorded	
▼ After Drilling: Not Recorded		

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Figure No. 6

LOG OF BORING

Boring BH-6

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.882538 **Coordinates** E: -114.024357
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 102.5 ft
Date Started: 5/28/20	**Date Finished:** 5/29/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			73		8 - 22 - 17		TOPSOIL, moist.	0.3 *102.2*						
			73		14 - 13 - 10		Silty, Clayey SAND (SC-SM), medium dense to dense, slightly moist, brown, low plasticity, occasional gravel 0.3 ft to 1 ft.		6					
5 *97.5*			47		13 - 23 - 26		Poorly-Graded GRAVEL with silt and sand (GP-GM), dense, slightly moist, light brown, fine to coarse grained, subrounded to subangular, occasional cobbles, disturbed bulk sample recovered at the surface from auger cuttings classified as well graded gravel with silt and sand (GW-GM).	4.5 *98.0*		NV	NP	12		
			38		32 - 50/0.3ft									
10 *92.5*			67		21 - 39 - 36				1					
			67		50/0.3ft									
							Boring Depth: 14.2 ft, *Elevation: 88.3 ft*	14.2 *88.3*						

Water Level Observations		Remarks:
▽ During Drilling: Not Encountered	▽ After Drilling: Not Recorded	
▼ After Drilling: Not Recorded		

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Figure No. 7

LOG OF BORING

Boring BH-7

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.882438 **Coordinates** E: -114.024849
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 99.7 ft
Date Started: 5/29/20	**Date Finished:** 5/29/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			87		4 - 14 - 8		TOPSOIL, moist.	0.3 *99.4*						
							Sandy, Silty CLAY (CL-ML), very stiff, slightly moist, brown, low plasticity, occasional gravel 0.3 ft to 1 ft.	2.0 *97.7*	1					
			47		28 - 23 - 28		Poorly-Graded GRAVEL with silt and sand (GP-GM), medium dense to very dense, slightly moist to wet, light brown, fine to coarse grained, subrounded to subangular, occasional cobbles, moist at approximately 15 ft.							
5 *94.7*			40		15 - 21 - 20									
			67		19 - 44 - 50				1					
10 *89.7*			73		35 - 48 - 50				1					
15 *84.7*			53		27 - 18 - 12				6					
20 *79.7*			53		8 - 12 - 13									
25 *74.7*			20		12 - 17 - 27			25.5 *74.2*						

Boring Depth: 25.5 ft, *Elevation: 74.2 ft*

Water Level Observations		Remarks:
During Drilling: 18.1 ft *(81.6 ft)*	**After Drilling:** Not Recorded	
After Drilling: Not Recorded		

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Figure No. 8

LOG OF BORING

Boring BH-8

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.882416 **Coordinates** E: -114.024798
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 100.4 ft
Date Started: 5/29/20	**Date Finished:** 5/29/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			87		4 - 12 - 14		TOPSOIL, moist.	0.3 *100.1*						
							Sandy, Silty CLAY (CL-ML), very stiff to hard, slightly moist to moist, brown, low plasticity.		4					
			73		7 - 8 - 32			3.0 *97.4*						
5 *95.4*			60		14 - 27 - 28		Poorly-Graded GRAVEL with sand (GP), medium dense to very dense, slightly moist to wet, light brown, fine to coarse grained, subrounded to subangular, occasional cobbles, moist at approximately 14.5 ft.							
			73		20 - 32 - 40				1					
10 *90.4*			80		19 - 38 - 49					22	17	1		
15 *85.4*			71		39 - 50/0.2ft				3					
20 *80.4*			53		9 - 10 - 14									
25 *75.4*			47		8 - 11 - 13			25.5 *74.9*						

Boring Depth: 25.5 ft, *Elevation: 74.9 ft*

Water Level Observations		Remarks:
During Drilling: 18.3 ft *(82.1 ft)*	**After Drilling:** Not Recorded	
After Drilling: Not Recorded		

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Figure No. 9

LOG OF BORING

Boring BH-9

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88245 **Coordinates** E: -114.02408
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 102.8 ft
Date Started: 6/1/20	**Date Finished:** 6/1/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			67		6 - 7 - 12		TOPSOIL, slightly moist.	0.2 *102.6*						
							Clayey SAND (SC), medium dense to dense, slightly moist, dark brown, fine grained sand, fine grained gravel.		8					
			87		18 - 16 - 16									
5 *97.8*			80		6 - 5 - 5		Silty SAND (SM), loose, slightly moist, brown, fine grained, occasional gravel.	4.0 *98.8*	5					
			67		5 - 13 - 26		Poorly-Graded GRAVEL with sand (GP), very dense, slightly moist, gray, medium grained, subrounded.	8.0 *94.8*						Installed solid PVC to 9 feet for future infiltration testing.
							Boring Depth: 8.7 ft, *Elevation: 94.1 ft*	8.7 *94.1*						

Water Level Observations		Remarks:
During Drilling: Not Encountered		
After Drilling: Not Recorded	After Drilling: Not Recorded	

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Figure No. 10

LOG OF BORING

Boring BH-10

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88224 **Coordinates** E: -114.02436
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 100.7 ft
Date Started: 6/1/20	**Date Finished:** 6/1/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			67		4 - 5 - 6		TOPSOIL, slightly moist.	0.5 *100.2*						
			67		11 - 14 - 27		FILL, Clayey SAND (SC), dense to medium dense, slightly moist, dark brown, fine grained, scattered gravel, asphalt at 3.0', more gravelly with depth.		4					
5 *95.7*			80		8 - 6 - 6				6					
								5.5 *95.2*						
			40		12 - 12 - 16		Poorly-Graded GRAVEL with sand (GP), medium dense to very dense, slightly moist to wet, gray to red, fine to coarse grained, subrounded to subangular, gravels to 2" in auger cuttings, coarse sand below water table.							
10 *90.7*			80		14 - 23 - 32.				1					
15 *85.7*			75		19 - 25 - 50/0.2ft				4					
20 *80.7*			60		11 - 31 - 47									
25 *75.7*			73		39 - 15 - 18			26.0 *74.7*						

Boring Depth: 26.0 ft, *Elevation: 74.7 ft*

Water Level Observations		Remarks:
After Drilling: Not Recorded	**During Drilling:** 18.3 ft *(82.4 ft)*	
	After Drilling: Not Recorded	

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Figure No. 11

LOG OF BORING

Boring BH-11

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88207 **Coordinates** E: -114.02513
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 99.3 ft
Date Started: 6/1/20	**Date Finished:** 6/1/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			93		4 - 5 - 5		TOPSOIL, slightly moist.	0.5 *98.8*						
							Sandy, Silty CLAY (CL-ML), stiff to medium stiff, slightly moist, dark brown, low plasticity, fine sand.	1.5 *97.8*	4					
			87		4 - 4 - 4		Clayey SAND (SC), loose, slightly moist, dark brown, fine grained.							
5 *94.3*			73		5 - 10 - 13		Poorly-Graded GRAVEL with sand (GP), medium dense to very dense, slightly moist to wet, gray to red, subrounded to subangular, gravels to 2" in auger cuttings, coarse sand lenses below water table.	5.0 *94.3*						
			75		12 - 50/0.3ft				2					
10 *89.3*			0		50									
15 *84.3*			56		16 - 50/0.4ft				5					
20 *79.3*			67		11 - 13 - 14									
25 *74.3*			53		6 - 9 - 11			26.0 *73.3*						

Boring Depth: 26.0 ft, *Elevation: 73.3 ft*

Water Level Observations		Remarks:
After Drilling: Not Recorded	**During Drilling:** 17.0 ft *(82.3 ft)*	
	After Drilling: Not Recorded	

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Figure No. 12

LOG OF BORING

Boring BH-12

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88192 **Coordinates** E: -114.02476
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 100.2 ft
Date Started: 6/1/20	**Date Finished:** 6/1/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			80		3 - 2 - 2		TOPSOIL, slightly moist.	0.7 *99.5*						
							Sandy, Silty CLAY (CL-ML), soft, slightly moist, dark brown, fine grained sand.	2.5 *97.7*						
			33		4 - 7 - 11		Poorly-Graded GRAVEL with sand (GP), medium dense to very dense, slightly moist to wet, brown to gray, fine to coarse grained, subrounded.							
5 *95.2*			53		32 - 34 - 37				2					
			60		9 - 15 - 38				1					
10 *90.2*			100		22 - 50/0.3ft									
15 *85.2*			73		18 - 31 - 31				4					
20 *80.2*			53		11 - 11 - 13									
25 *75.2*			53		7 - 12 - 18									
							Boring Depth: 26.0 ft, *Elevation: 74.2 ft*	26.0 *74.2*						

Water Level Observations		Remarks:
During Drilling: 17.5 ft *(82.7 ft)*	**After Drilling:** Not Recorded	
After Drilling: Not Recorded		

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Figure No. 13

LOG OF BORING

Boring BH-13

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88201 **Coordinates** E: -114.0243
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 100.6 ft
Date Started: 6/2/20	**Date Finished:** 6/2/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			93		7 - 9 - 5		TOPSOIL, slightly moist.	0.3 *100.3*						
							Clayey SAND (SC), medium dense, slightly moist, dark brown, fine grained, subrounded.							
			53		5 - 16 - 21			2.8 *97.8*						
5 *95.6*			75		16 - 31 - 50/0.2ft		Poorly-Graded GRAVEL with sand (GP), dense to very dense, slightly moist to wet, brown to gray, fine to coarse grained, subrounded to subangular, clay fines from 14.5-15.5 ft, coarse sand lens below water table, gravels to 2" in auger cuttings.		1					
			67		15 - 34 - 50									
10 *90.6*			80		28 - 40 - 50				3					
15 *85.6*			80		17 - 18 - 17				6					
20 *80.6*			73		7 - 8 - 50/0.1ft									
25 *75.6*			47		28 - 20 - 18			25.8 *74.8*						

Boring Depth: 25.8 ft, *Elevation: 74.8 ft*

Water Level Observations	
During Drilling: 17.8 ft *(82.8 ft)*	Remarks:
After Drilling: Not Recorded	**After Drilling:** Not Recorded

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Figure No. 14

LOG OF BORING

Boring BH-14

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88191 **Coordinates** E: -114.0251
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 99.5 ft
Date Started: 6/2/20	**Date Finished:** 6/2/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
							TOPSOIL, slightly moist.	0.5 *99.0*						
			53		6 - 11 - 10		Sandy, Silty CLAY (CL-ML), medium stiff, slightly moist, low plasticity, scattered gravels.	2.0 *97.5*	5					
5 *94.5*			33		13 - 50/0.4ft		Poorly-Graded GRAVEL with sand (GP), medium dense to very dense, slightly moist to wet, black to gray, fine to coarse grained, subrounded to angular, clay fines below 14 ft, multi-colored, gravels to 1-1/2" in auger cuttings , coarse sand and fine gravel below 19 ft.							
			13		47 - 50/0.3ft									
10 *89.5*			60		25 - 28 - 30				3					
15 *84.5*			100		12 - 14 - 12									
20 *79.5*			90		7 - 12 - 12			20.8 *78.7*						

Boring Depth: 20.8 ft, *Elevation: 78.7 ft*

Water Level Observations		Remarks:
During Drilling: 17.9 ft *(81.6 ft)*	**After Drilling:** Not Recorded	
After Drilling: Not Recorded		

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Figure No. 15

LOG OF BORING

Boring BH-15

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88183 **Coordinates** E: -114.02565
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 99.8 ft
Date Started: 6/2/20	**Date Finished:** 6/2/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
5 *94.8*			130		9 - 20		TOPSOIL, slightly moist.	0.5 *99.3*						
							FILL, Poorly-Graded GRAVEL with sand (GP), medium dense, slightly moist, gray, fine to medium grained, angular.	1.0 *98.8*						
			60		12 - 17 - 18		Sandy, Silty CLAY (CL-ML), slightly moist, dark brown, low plasticity.	1.5 *98.3*	2					
			67		6 - 9 - 18		Poorly-Graded GRAVEL with sand (GP), dense to very dense, slightly moist, gray, fine to coarse grained, subrounded to subangular, gravels to 1-1/2" in auger cuttings.		2					
			87		12 - 34 - 50									Installed solid PVC to 9 feet for future infiltration testing.
							Boring Depth: 9.0 ft, *Elevation: 90.8 ft*	9.0 *90.8*						

Water Level Observations		Remarks:
▽ During Drilling: Not Encountered	▽ After Drilling: Not Recorded	
▼ After Drilling: Not Recorded		

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Figure No. 16

LOG OF BORING

Boring BH-16

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88174 **Coordinates** E: -114.02534
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 100.8 ft
Date Started: 6/2/20	**Date Finished:** 6/2/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			120		5 - 6 - 6		TOPSOIL, slightly moist to very moist.	0.5 *100.3*						
							Sandy, Silty CLAY (CL-ML), soft, slightly moist to very moist, dark brown, low plasticity, fine sand.		19					
			60		2 - 1 - 2									
5 *95.8*			67		1 - 1 - 10			5.3 *95.5*						
							Poorly-Graded GRAVEL with sand (GP), medium dense to very dense, slightly moist to wet, gray to red, fine to coarse grained, subrounded to subangular, gravels to 1-1/2" in auger cuttings, coarse sand and fine gravel lenses below water table.		2					
			69		12 - 24 - 50/0.3ft									
10 *90.8*			87		27 - 34 - 36									
									4					
15 *85.8*			33		32 - 25 - 23									
20 *80.8*			60		5 - 8 - 11									
							Boring Depth: 21.0 ft, *Elevation: 79.8 ft*	21.0 *79.8*						

Water Level Observations		Remarks:
After Drilling: Not Recorded	During Drilling: 18.0 ft *(82.8 ft)*	
	After Drilling: Not Recorded	

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Figure No. 17

LOG OF BORING

Boring BH-17

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88174 **Coordinates** E: -114.02426
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 101.0 ft
Date Started: 6/1/20	**Date Finished:** 6/1/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			80		5 - 6 - 8		TOPSOIL, slightly moist.							
							Sandy, Silty CLAY (CL-ML), medium stiff to stiff, slightly moist, dark brown, low plasticity, fine sand.	1.0 *100.0*						
			67		3 - 1 - 7				16					
5 *96.0*			53		7 - 8 - 10		Poorly-Graded GRAVEL with sand (GP), medium dense to very dense, slightly moist, brown to gray, subrounded.	4.0 *97.0*	3					
			60		17 - 29 - 37									Installed solid PVC to 9 feet for future infiltration testing.
							Boring Depth: 9.0 ft, *Elevation: 92.0 ft*	9.0 *92.0*						

Water Level Observations		Remarks:
During Drilling: Not Encountered	**After Drilling:** Not Recorded	
After Drilling: Not Recorded		

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Figure No. 18

LOG OF BORING

Boring BH-18

TETRA TECH

Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88156 **Coordinates** E: -114.02491
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 100.3 ft
Date Started: 6/2/20	**Date Finished:** 6/2/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
			87		7 - 9 - 15		TOPSOIL, slightly moist.							
							Sandy, Silty CLAY (CL-ML), slightly moist, dark brown, low plasticity, fine sand.	0.8 *99.5* 1.2 *99.1*	2					
			60		13 - 18 - 14		Poorly-Graded GRAVEL with sand (GP), medium dense to very dense, slightly moist to wet, gray to red, fine to coarse grained, subrounded to subangular, gravels to 2" in auger cuttings, medium grained sand and fine grained gravel below water table.							
5 *95.3*			60		7 - 10 - 19									
			78		20 - 50/0.4ft				2					
10 *90.3*			67		27 - 37 - 32									
15 *85.3*			67		19 - 23 - 17				5					
20 *80.3*			53		6 - 11 - 12			20.8 *79.5*						

Boring Depth: 20.8 ft, *Elevation: 79.5 ft*

Water Level Observations		Remarks:
During Drilling: 17.6 ft *(82.7 ft)*	**After Drilling:** Not Recorded	
After Drilling: Not Recorded		

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Figure No. 19

LOG OF BORING

Boring BH-19

TETRA TECH

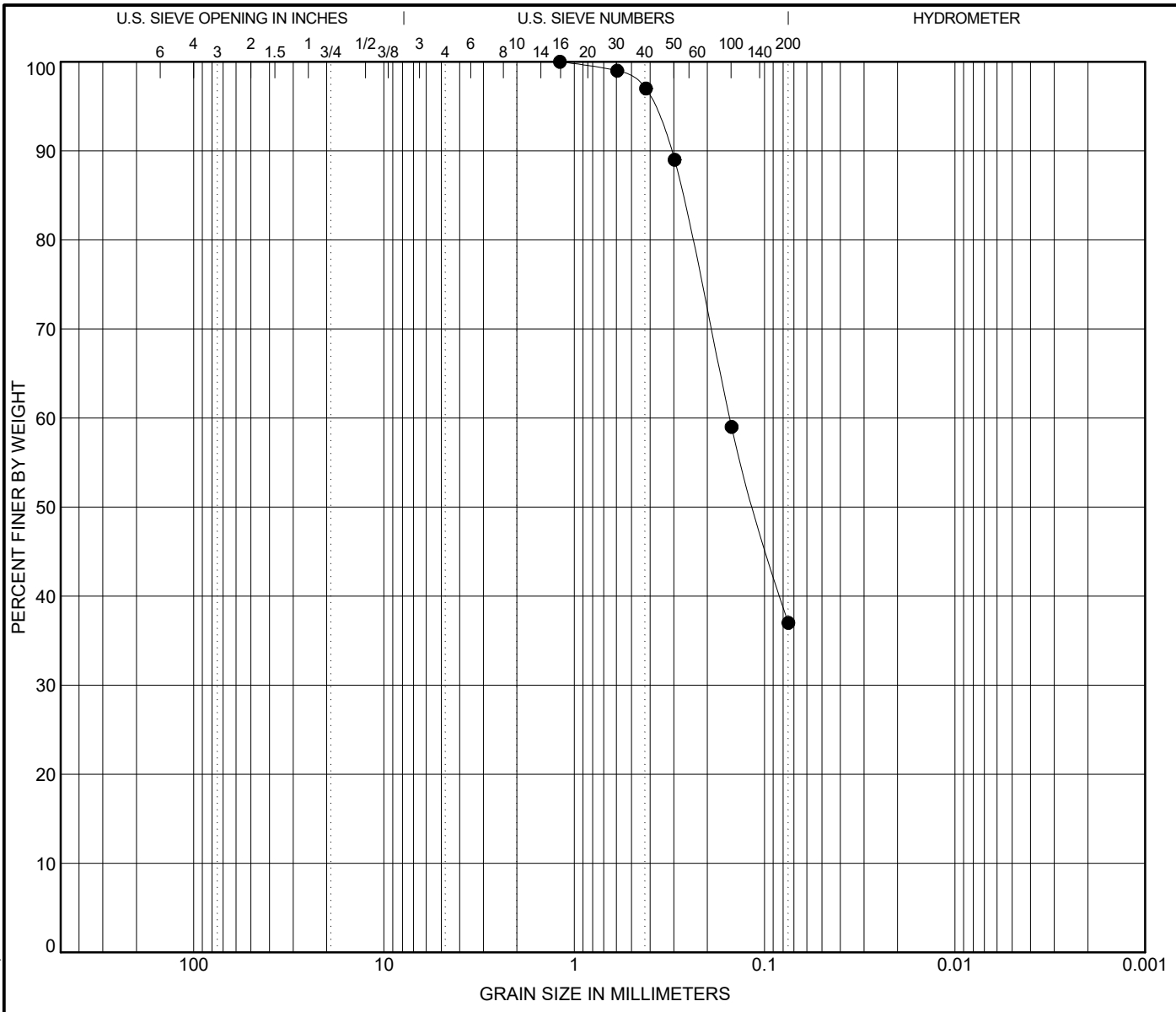
Project: Trinity Apartments - Site 1 (Mullan Rd)		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location** N: 46.88144 **Coordinates** E: -114.02516
Project Number: 117-8751001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 102.0 ft
Date Started: 6/2/20	**Date Finished:** 6/2/20	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Jim Pierce		**Location:** Refer to Site Map	

Depth (ft) / Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
							Asphalt.	0.3 *101.7*						
			73		13 - 18 - 25		BASE COURSE, Poorly-Graded GRAVEL with sand (GP), dense, slightly moist, brown, medium grained, subangular, 3/4-inch gravel.	1.7 *100.3*	3					
			73		22 - 35 - 34									
5 *97.0*			47		30 - 40 - 35		Poorly-Graded GRAVEL with clay and sand (GP-GC), very dense to medium dense, slightly moist, gray, fine to medium grained, subrounded, gravels to 1-1/2" in auger cuttings.		2					
			40		17 - 14 - 12									
							Boring Depth: 8.7 ft, *Elevation: 93.3 ft*	8.7 *93.3*						

Water Level Observations		Remarks:
During Drilling: Not Encountered	**After Drilling:** Not Recorded	
After Drilling: Not Recorded		

APPENDIX C

Laboratory Testing (Figures 20 through 26)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SIEVE SIZE	% PASSING
No. 16	100
No. 30	99
No. 40	97
No. 50	89
No. 100	59
No. 200	37

Specimen Identification
BH-4 - (7 - 8 ft)

Classification	LL	PL	PI	Cc	Cu
SILTY SAND(SM)	**NV**	**NV**	**NP**		

% Gravel	% Sand	% Silt	% Clay
0	63	37	

D100	D60	D30	D10
1.19	0.152		

TETRA TECH

GRAIN SIZE DISTRIBUTION

Project: Trinity Apartments - Site 1 (Mullan Rd)

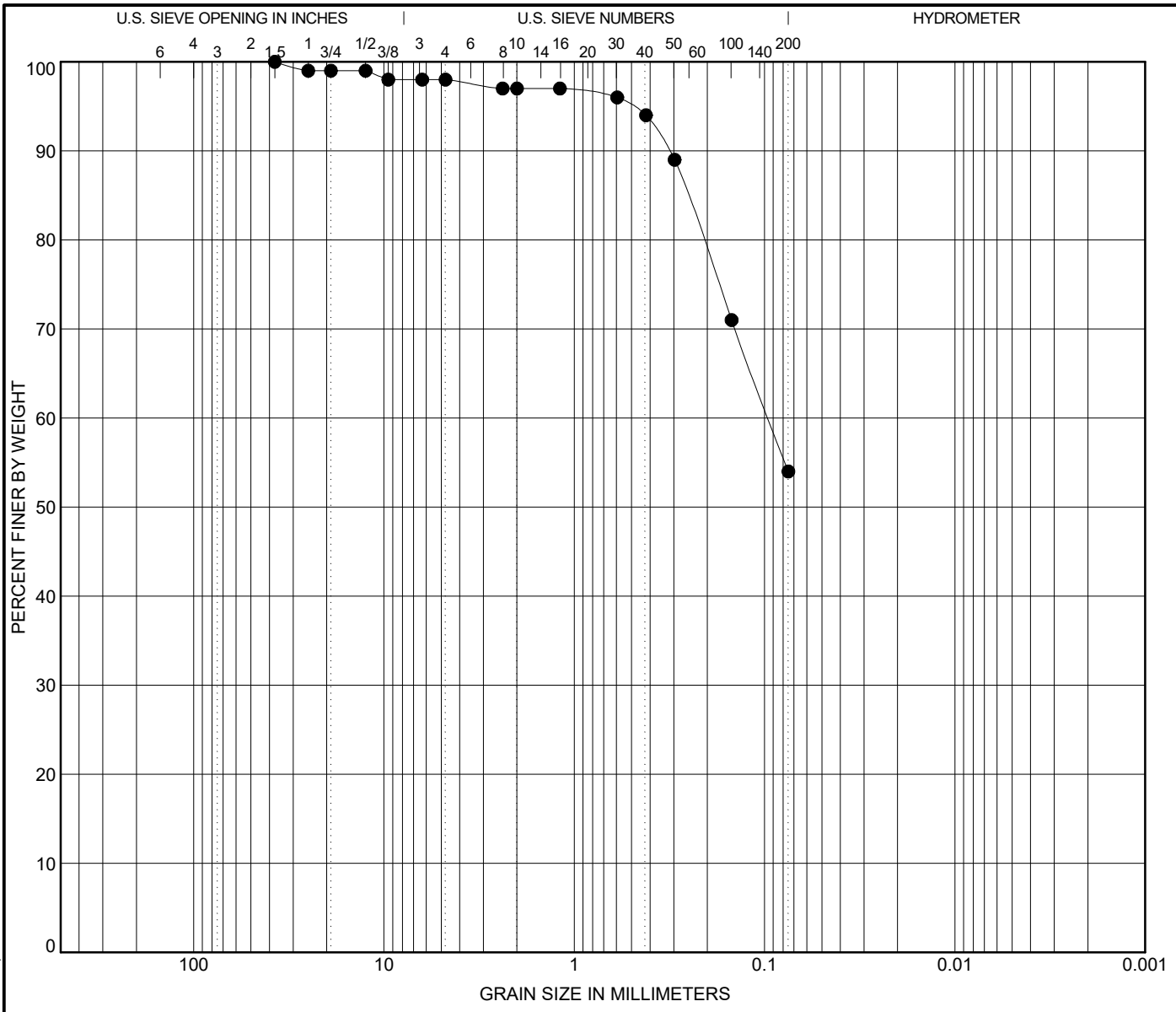
Location: Refer to Site Map

Number: 117-8751001

Figure No. 20

TRINITY APARTMENTS BORING LOGS - MULLAN ROAD.GPJ ` 07-02-20 ` ` TT_US GRAIN SIZE (SIEVE DATA)

Revised 1-23-08 (MAT)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SIEVE SIZE	% PASSING
1.5 in	100
1 in	99
3/4 in	99
1/2 in	99
3/8 in	98
1/4 in	98
No. 4	98
No. 8	97
No. 10	97
No. 16	97
No. 30	96
No. 40	94
No. 50	89
No. 100	71
No. 200	54

Specimen Identification
BH-5 - (0.5 - 4 ft)

Classification	LL	PL	PI	Cc	Cu
SANDY SILTY CLAY(CL-ML)	**23**	**16**	**7**		

% Gravel	% Sand	% Silt	% Clay
2	44	54	

D100	D60	D30	D10
37.5	0.096		

TETRA TECH

GRAIN SIZE DISTRIBUTION

Project: Trinity Apartments - Site 1 (Mullan Rd)

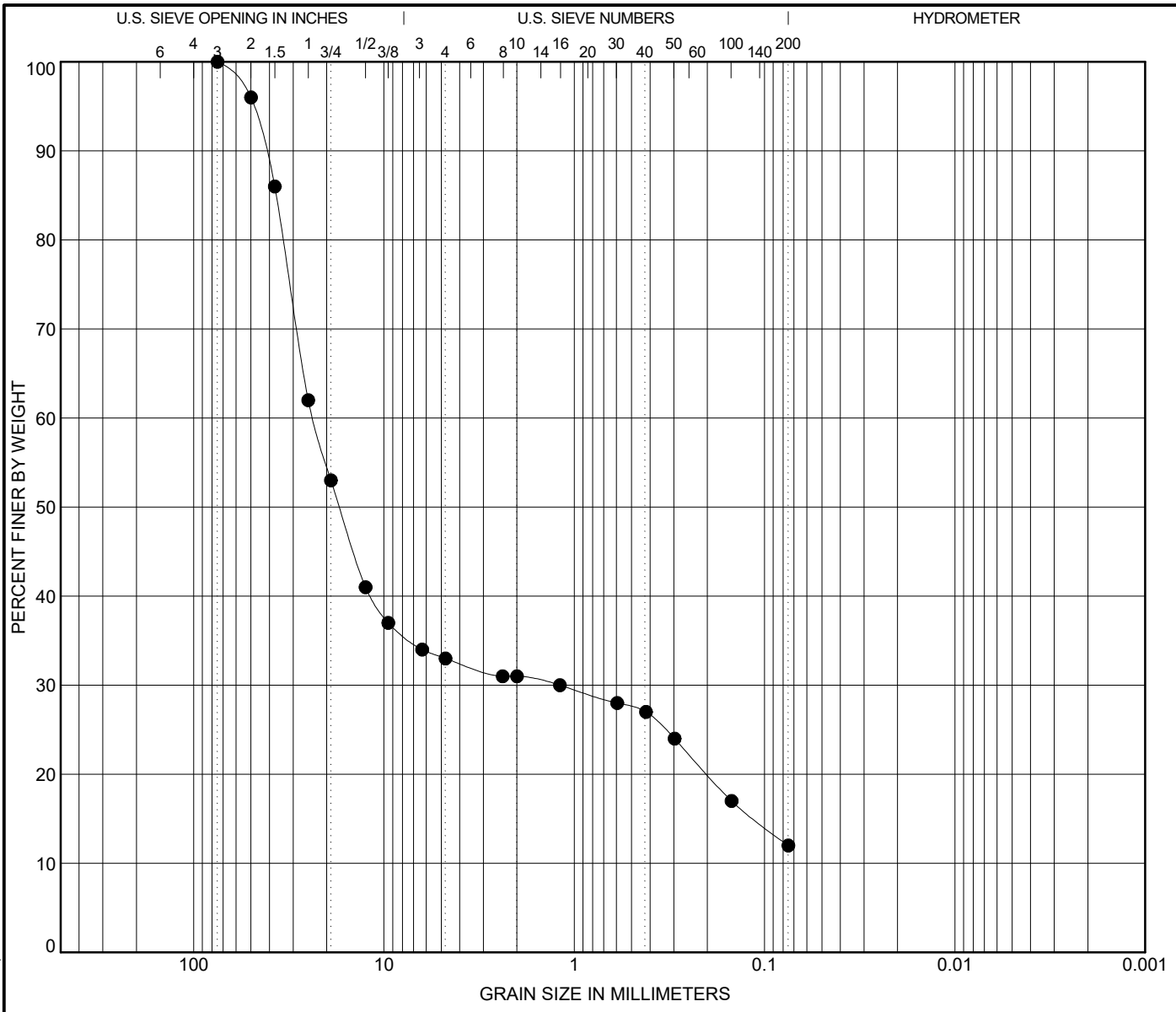
Location: Refer to Site Map

Number: 117-8751001

Figure No. 21

TRINITY APARTMENTS BORING LOGS - MULLAN ROAD.GPJ ` 07-02-20 ` ` TT_US GRAIN SIZE (SIEVE DATA)

Revised 1-23-08 (MAT)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SIEVE SIZE	% PASSING
3 in	100
2 in	96
1.5 in	86
1 in	62
3/4 in	53
1/2 in	41
3/8 in	37
1/4 in	34
No. 4	33
No. 8	31
No. 10	31
No. 16	30
No. 30	28
No. 40	27
No. 50	24
No. 100	17
No. 200	12

Specimen Identification
BH-6 - (5 - 10 ft)

Classification	LL	PL	PI	Cc	Cu
WELL-GRADED GRAVEL with SILT and SAND(GW-GM)	**NV**	**NV**	**NP**	**1.06**	**412.71**

% Gravel	% Sand	% Silt	% Clay
67	21	12	

D100	D60	D30	D10
75	23.521	1.19	

TETRA TECH

GRAIN SIZE DISTRIBUTION

Project: Trinity Apartments - Site 1 (Mullan Rd)

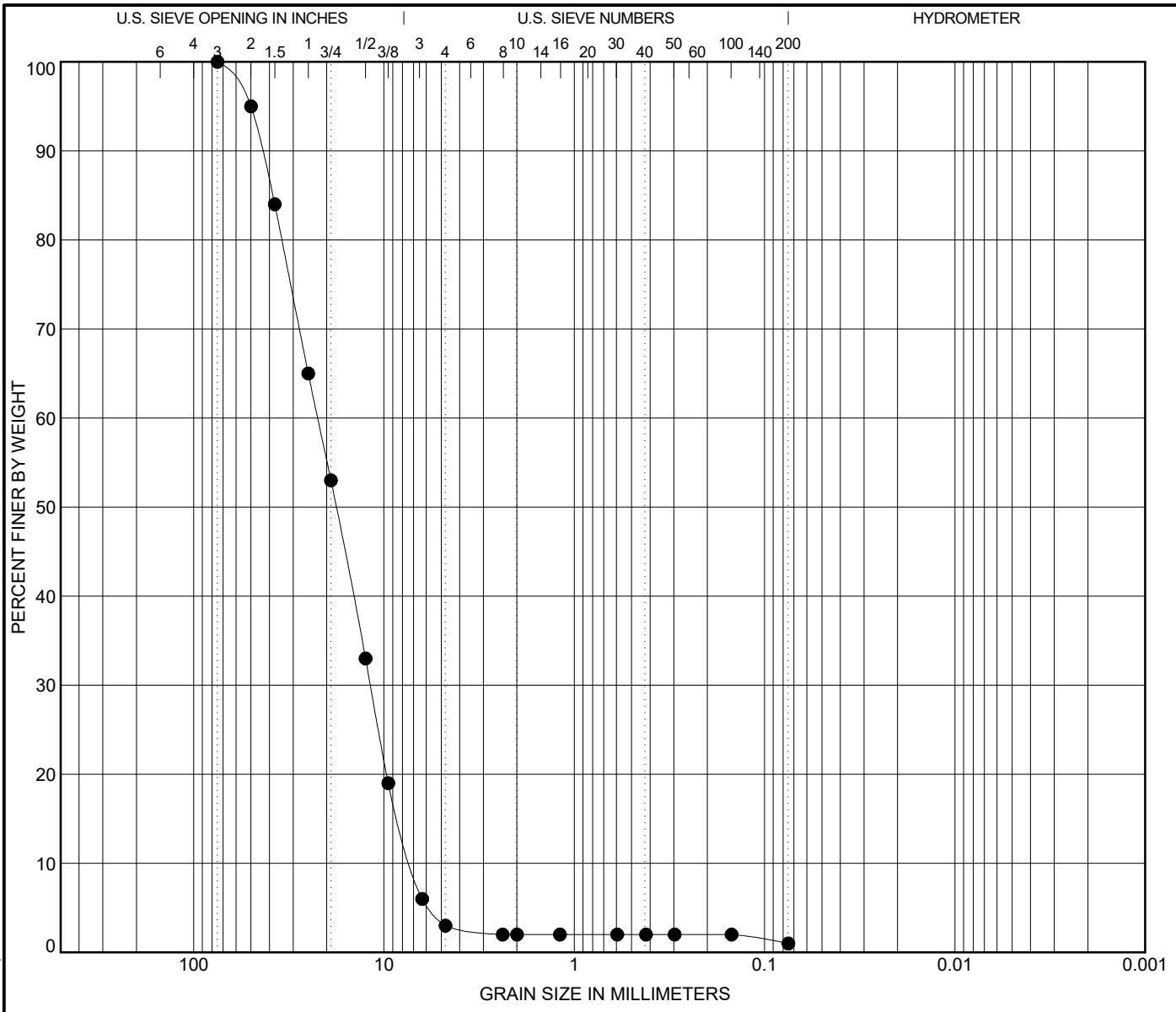
Location: Refer to Site Map

Number: 117-8751001

Figure No. 22

TRINITY APARTMENTS BORING LOGS - MULLAN ROAD.GPJ ` 07-02-20 ` ` TT_US GRAIN SIZE (SIEVE DATA)

Revised 1-23-08 (MAT)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SIEVE SIZE	% PASSING
3 in	100
2 in	95
1.5 in	84
1 in	65
3/4 in	53
1/2 in	33
3/8 in	19
1/4 in	6
No. 4	3
No. 8	2
No. 10	2
No. 16	2
No. 30	2
No. 40	2
No. 50	2
No. 100	2
No. 200	1

Specimen Identification
BH-8 - (10 - 15 ft)

Classification	LL	PL	PI	Cc	Cu
POORLY GRADED GRAVEL(GP)	**22**	**17**	**5**	**0.87**	**3.12**

% Gravel	% Sand	% Silt	% Clay
97	2	1	

D100	D60	D30	D10
75	22.299	11.786	7.149

TETRA TECH

GRAIN SIZE DISTRIBUTION

Project: Trinity Apartments - Site 1 (Mullan Rd)

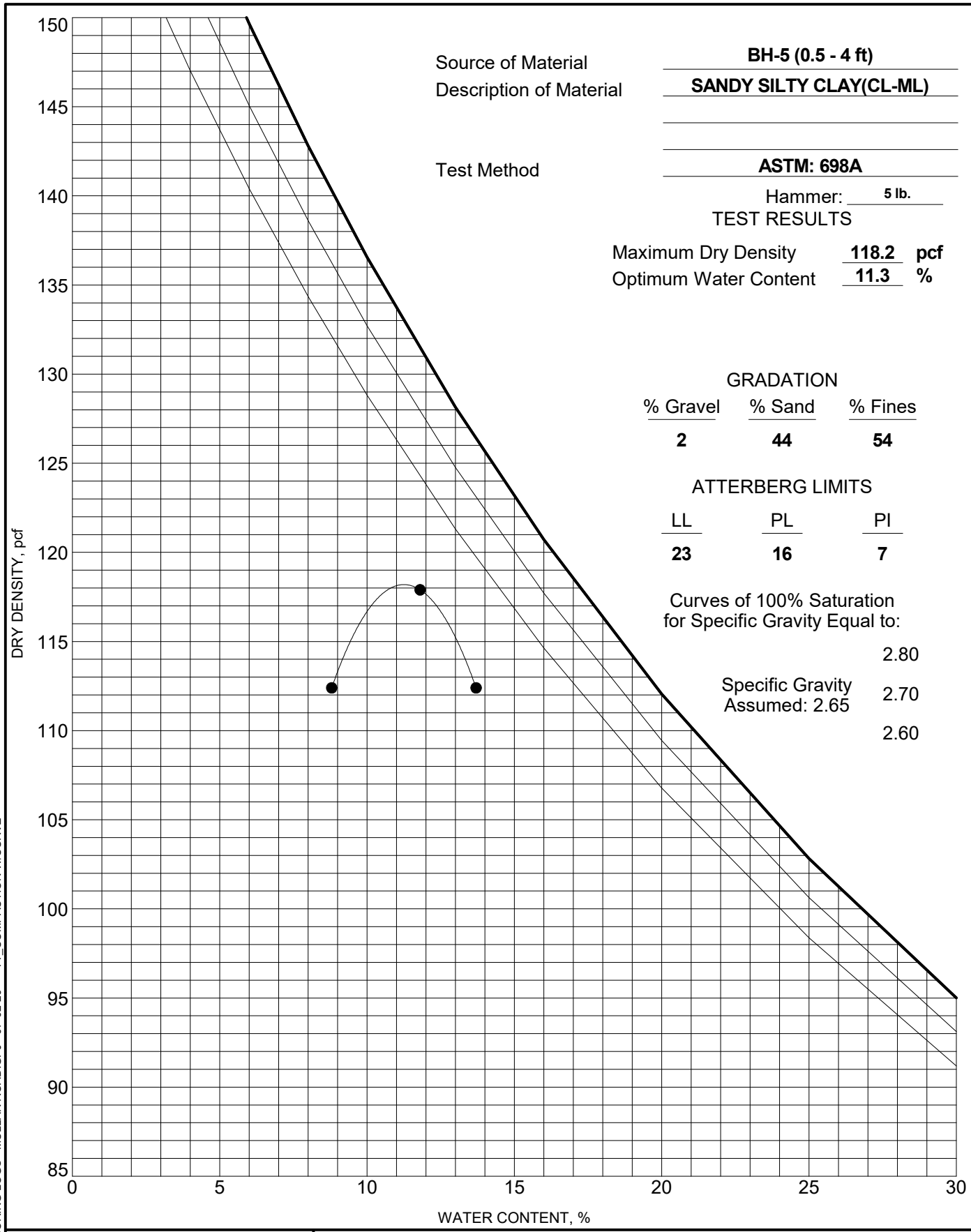
Location: Refer to Site Map

Number: 117-8751001

Figure No. 23

TRINITY APARTMENTS BORING LOGS - MULLAN ROAD.GPJ ` 07-02-20 ` ` TT_US GRAIN SIZE (SIEVE DATA)

Revised 1-23-08 (MAT)



Source of Material: **BH-5 (0.5 - 4 ft)**

Description of Material: **SANDY SILTY CLAY(CL-ML)**

Test Method: **ASTM: 698A**

Hammer: **5 lb.**

TEST RESULTS

Maximum Dry Density	**118.2**	**pcf**
Optimum Water Content	**11.3**	**%**

GRADATION

% Gravel	% Sand	% Fines
2	**44**	**54**

ATTERBERG LIMITS

LL	PL	PI
23	**16**	**7**

Curves of 100% Saturation for Specific Gravity Equal to:

Specific Gravity Assumed: 2.65

2.80

2.70

2.60

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP

Project: Trinity Apartments - Site 1 (Mullan Rd)

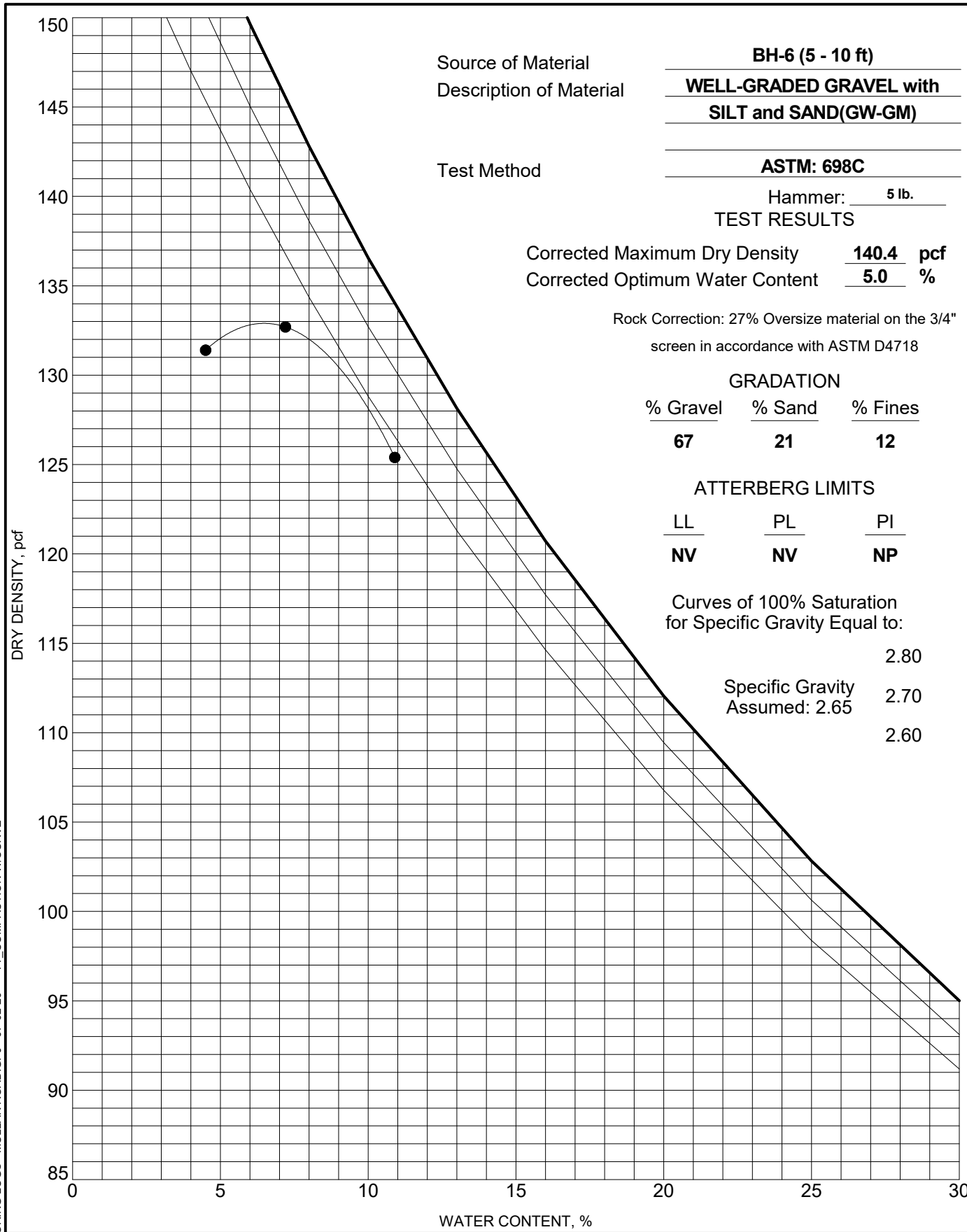
Location: Refer to Site Map

Number: 117-8751001

Figure No. 24

TRINITY APARTMENTS BORING LOGS - MULLAN ROAD.GPJ ` 07-02-20 ` ` TT_COMPACTION W/CURVE

Revised 1-23-08 (MAT)



Source of Material: **BH-6 (5 - 10 ft)**

Description of Material: **WELL-GRADED GRAVEL with SILT and SAND(GW-GM)**

Test Method: **ASTM: 698C**

Hammer: **5 lb.**

TEST RESULTS

Corrected Maximum Dry Density	**140.4**	**pcf**
Corrected Optimum Water Content	**5.0**	**%**

Rock Correction: 27% Oversize material on the 3/4" screen in accordance with ASTM D4718

GRADATION

% Gravel	% Sand	% Fines
67	**21**	**12**

ATTERBERG LIMITS

LL	PL	PI
NV	**NV**	**NP**

Curves of 100% Saturation for Specific Gravity Equal to:

Specific Gravity Assumed: 2.65

2.80

2.70

2.60

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP

Project: Trinity Apartments - Site 1 (Mullan Rd)

Location: Refer to Site Map

Number: 117-8751001

Figure No. 25

TRINITY APARTMENTS BORING LOGS - MULLAN ROAD.GPJ ` 07-02-20 ` ` TT_COMPACTION W/CURVE

Revised 1-23-08 (MAT)

TETRA TECH

PROJECT:	Trinity Apartments - Site 1 (Mullan Rd)	**PROJECT NO:**	117-8751001
LOCATION:	BH-5	**WORK ORDER NO:**	1
MATERIAL:	Sandy, Silty Clay (CL-ML)	**LAB NO:**	1
SAMPLE SOURCE:	0.5 - 4.0 ft	**DATE SAMPLED:**	5/28/2020
REVIEWED BY:	AW		

CBR(CALIFORNIA BEARING RATIO) OF LABORATORY-COMPACTED SOILS(ASTM D1883)

COMPACTION(%) 95.5

PERCENT SWELL 0.50%

	BEFORE SOAK	AFTER SOAK
DRY DENSITY	112.9 lbs./cu.ft	114.3 lbs./cu.ft
PERCENT MOISTURE	10.8 %	13.6 %

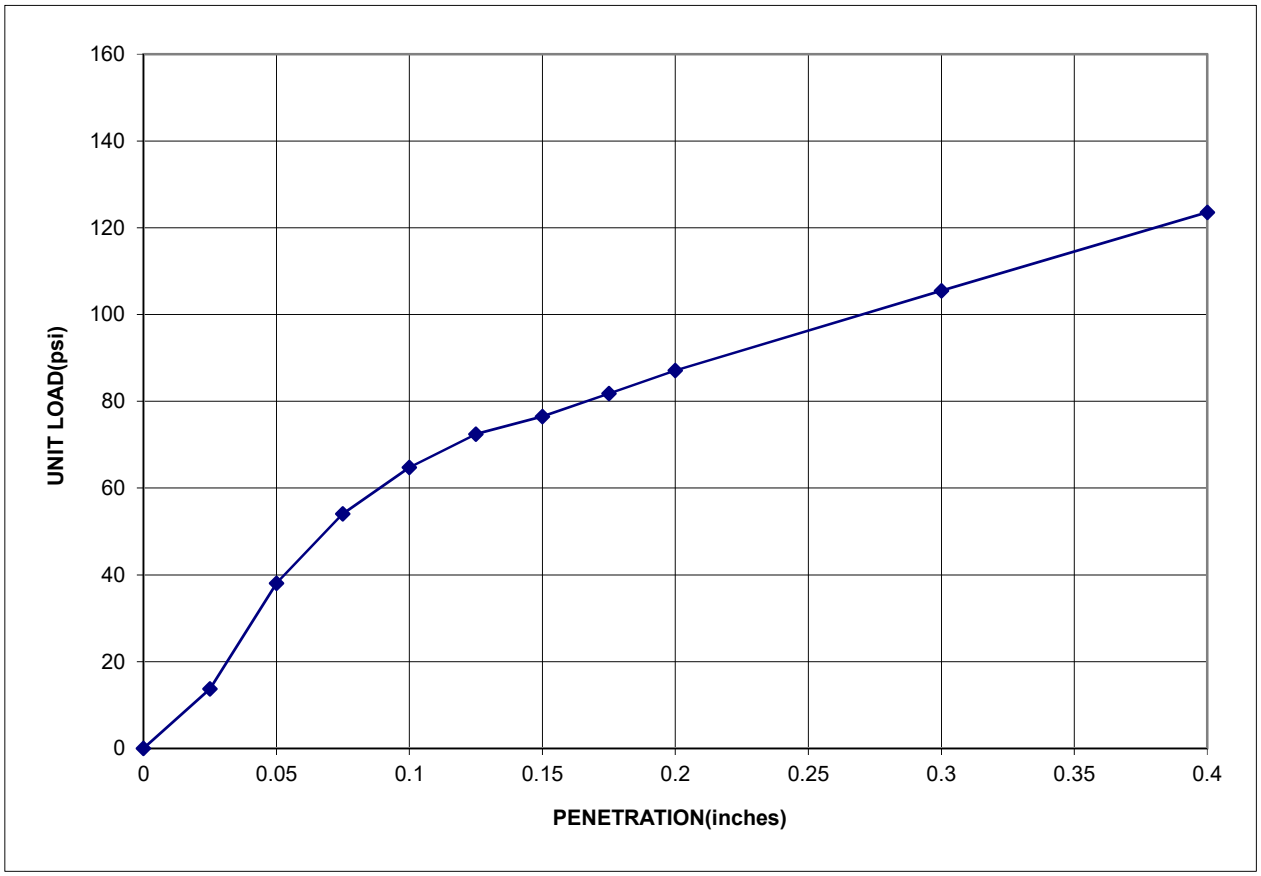
SURCHARGE WEIGHT 10 lbs.

PENETRATION	CORRECTED C B R
0.100	6
0.200	6

D 698C

DRY DENSITY(pcf) 118.2

MOISTURE(%) 11.3



CBR 6

FIGURE 26

APPENDIX D

Infiltration Testing Results

Project Name:	Trinity Apartments - Site 1 (Mullan Road)	**Tetra Tech Project No.:**	117-8751001
Test Location:	BH-5	**Soak Period Begin:**	9:36 AM; June 4, 2020
Hole Depth to Existing Ground:	9'	**Test Begin:**	3:39 PM; June 4, 2020
Hole Depth to Refernence Point:	9' 9.5"	**Tested By:**	J. Pierce

Infiltration Testing Results

Trial No.	Start Time	End Time	Time Interval (min)	Initial Distance Below Reference Point (in)	Final Distance Below Reference Point (in)	Drop in Water Level (inches)	Infiltration Rate (in/hr)
1	3:39 PM	3:50 PM	11	88.125	88.250	0.125	0.68
1	3:50 PM	4:00 PM	10	88.250	88.375	0.125	0.75
1	4:00 PM	4:10 PM	10	88.375	88.500	0.125	0.75
1	4:10 PM	4:20 PM	10	88.500	88.625	0.125	0.75
1	4:20 PM	4:30 PM	10	88.625	88.750	0.125	0.75
1	4:30 PM	4:40 PM	10	88.750	89.000	0.250	1.50
1	4:40 PM	4:50 PM	10	89.000	89.250	0.250	1.50
2	4:50 PM	5:01 PM	11	89.250	89.250	0.000	0.00
2	5:01 PM	5:10 PM	9	89.250	89.500	0.250	1.67
2	5:10 PM	5:20 PM	10	89.500	89.625	0.125	0.75
2	5:20 PM	5:30 PM	10	89.625	89.875	0.250	1.50
2	5:30 PM	5:40 PM	10	89.875	90.250	0.375	2.25
2	5:40 PM	5:50 PM	10	90.250	90.250	0.000	0.00
2	5:50 PM	6:00 PM	10	90.250	90.500	0.250	1.50
3	6:00 PM	6:11 PM	11	90.500	90.500	0.000	0.00
3	6:11 PM	6:21 PM	10	90.500	90.625	0.125	0.75
3	6:21 PM	6:31 PM	10	90.625	90.625	0.000	0.00
3	6:31 PM	6:41 PM	10	90.625	90.750	0.125	0.75
3	6:41 PM	6:50 PM	9	90.750	90.875	0.125	0.83
3	6:50 PM	7:00 PM	10	90.875	91.000	0.125	0.75
3	7:00 PM	7:10 PM	10	91.000	91.125	0.125	0.75

Measured Infiltration Rate (Average Rate of Last Trial): 0.54

Infiltration testing was performed according to the procedures outlined in Method B (Sections C.2 and C.3) of the Montana Department of Environmental Quality (DEQ) Circular DEQ-8, Appendix C

Tetra Tech
2525 Palmer Street, Suite 2; Missoula, MT 59808
Tel 406.543.3045 Fax 406.543.3088 tetratech.com

Project Name:	Trinity Apartments - Site 1 (Mullan Road)	**Tetra Tech Project No.:**	117-8751001
Test Location:	BH-9	**Soak Period Begin:**	9:44 AM; June 4, 2020
Hole Depth to Existing Ground:	9'	**Test Begin:**	3:42 PM; June 4, 2020
Hole Depth to Refernence Point:	9' 10"	**Tested By:**	J. Pierce

Infiltration Testing Results

Trial No.	Start Time	End Time	Time Interval (min)	Initial Distance Below Reference Point (in)	Final Distance Below Reference Point (in)	Drop in Water Level (inches)	Infiltration Rate (in/hr)
1	3:42 PM	3:53 PM	11	89.125	89.375	0.250	1.36
1	3:53 PM	4:03 PM	10	89.375	89.500	0.125	0.75
1	4:03 PM	4:13 PM	10	89.500	89.500	0.000	0.00
1	4:13 PM	4:22 PM	9	89.500	89.500	0.000	0.00
1	4:22 PM	4:32 PM	10	89.500	89.500	0.000	0.00
1	4:32 PM	4:42 PM	10	89.500	89.625	0.125	0.75
1	4:42 PM	4:52 PM	10	89.625	89.625	0.000	0.00
2	4:52 PM	5:02 PM	10	89.625	89.750	0.125	0.75
2	5:02 PM	5:12 PM	10	89.750	90.000	0.250	1.50
2	5:12 PM	5:23 PM	10	90.000	90.000	0.000	0.00
2	5:23 PM	5:33 PM	10	90.000	90.125	0.125	0.75
2	5:33 PM	5:42 PM	9	90.125	90.375	0.250	1.67
2	5:42 PM	5:52 PM	10	90.375	90.375	0.000	0.00
2	5:52 PM	6:02 PM	10	90.375	90.625	0.250	1.50
3	6:02 PM	6:12 PM	10	90.625	90.750	0.125	0.75
3	6:12 PM	6:22 PM	10	90.750	90.750	0.000	0.00
3	6:22 PM	6:32 PM	10	90.750	90.875	0.125	0.75
3	6:32 PM	6:42 PM	10	90.875	91.125	0.250	1.50
3	6:42 PM	6:52 PM	10	91.125	91.250	0.125	0.75
3	6:52 PM	7:02 PM	10	91.250	91.375	0.125	0.75
3	7:02 PM	7:13 PM	11	91.375	91.500	0.125	0.68

Measured Infiltration Rate (Average Rate of Last Trial): 0.74

Infiltration testing was performed according to the procedures outlined in Method B (Sections C.2 and C.3) of the Montana Department of Environmental Quality (DEQ) Circular DEQ-8, Appendix C

TETRA TECH

Tetra Tech
2525 Palmer Street, Suite 2; Missoula, MT 59808
Tel 406.543.3045 Fax 406.543.3088 tetratech.com

Project Name:	Trinity Apartments - Site 1 (Mullan Road)	**Tetra Tech Project No.:**	117-8751001
Test Location:	BH-15	**Soak Period Begin:**	10:10 AM; June 4, 2020
Hole Depth to Existing Ground:	9'	**Test Begin:**	3:46 PM; June 4, 2020
Hole Depth to Refernence Point:	9' 10.5"	**Tested By:**	J. Pierce

Infiltration Testing Results

Trial No.	Start Time	End Time	Time Interval (min)	Initial Distance Below Reference Point (in)	Final Distance Below Reference Point (in)	Drop in Water Level (inches)	Infiltration Rate (in/hr)
1	3:46 PM	3:56 PM	10	93.750	94.250	0.500	3.00
1	3:56 PM	4:07 PM	11	94.250	95.125	0.875	4.77
1	4:07 PM	4:17 PM	10	95.125	96.125	1.000	6.00
1	4:17 PM	4:27 PM	10	96.125	96.750	0.625	3.75
1	4:27 PM	4:37 PM	10	96.750	97.625	0.875	5.25
1	4:37 PM	4:47 PM	10	97.625	98.375	0.750	4.50
1	4:47 PM	4:57 PM	10	98.375	98.875	0.500	3.00
2	4:59 PM	5:09 PM	10	93.000	93.750	0.750	4.50
2	5:09 PM	5:19 PM	10	93.750	94.750	1.000	6.00
2	5:19 PM	5:28 PM	9	94.750	95.375	0.625	4.17
2	5:28 PM	5:38 PM	10	95.375	96.000	0.625	3.75
2	5:38 PM	5:48 PM	10	96.000	96.750	0.750	4.50
2	5:48 PM	5:58 PM	10	96.750	97.250	0.500	3.00
3	6:08 PM	6:18 PM	10	91.875	92.625	0.750	4.50
3	6:18 PM	6:28 PM	10	92.625	93.375	0.750	4.50
3	6:28 PM	6:38 PM	10	93.375	94.250	0.875	5.25
3	6:38 PM	6:48 PM	10	94.250	94.500	0.250	1.50
3	6:48 PM	6:58 PM	10	94.500	95.500	1.000	6.00
3	6:58 PM	7:08 PM	10	95.500	96.125	0.625	3.75

Measured Infiltration Rate (Average Rate of Last Trial): 4.25

Infiltration testing was performed according to the procedures outlined in Method B (Sections C.2 and C.3) of the Montana Department of Environmental Quality (DEQ) Circular DEQ-8, Appendix C

Tetra Tech
2525 Palmer Street, Suite 2; Missoula, MT 59808
Tel 406.543.3045 Fax 406.543.3088 tetratech.com

Project Name:	Trinity Apartments - Site 1 (Mullan Road)	**Tetra Tech Project No.:**	117-8751001
Test Location:	BH-17	**Soak Period Begin:**	10:04 AM; June 4, 2020
Hole Depth to Existing Ground:	9'	**Test Begin:**	2:04 PM; June 4, 2020
Hole Depth to Refernence Point:	9' 11"	**Tested By:**	J. Pierce

Infiltration Testing Results

Trial No.	Start Time	End Time	Time Interval (min)	Initial Distance Below Reference Point (in)	Final Distance Below Reference Point (in)	Drop in Water Level (inches)	Infiltration Rate (in/hr)
1	2:04 PM	2:07 PM	3	90.000	103.750	13.750	275.00
1	2:07 PM	2:10 PM	3	103.750	107.750	4.000	80.00
1	2:10 PM	2:13 PM	3	107.750	110.125	2.375	47.50
1	2:13 PM	2:16 PM	3	110.125	112.250	2.125	42.50
1	2:16 PM	2:19 PM	3	112.250	113.500	1.250	25.00
1	2:19 PM	2:22 PM	3	113.500	114.500	1.000	20.00
1	2:22 PM	2:25 PM	3	114.500	115.500	1.000	20.00
1	2:25 PM	2:28 PM	3	115.500	116.250	0.750	15.00
1	2:28 PM	2:31 PM	3	116.250	117.000	0.750	15.00
1	2:31 PM	2:34 PM	3	117.000	117.375	0.375	7.50
2	3:21 PM	3:36 PM	15	90.500	114.875	24.375	97.50
2	3:36 PM	3:49 PM	13	114.875	118.375	3.500	16.15
3	5:05 PM	5:13 PM	8	87.875	111.125	23.250	174.38
3	5:13 PM	5:25 PM	12	111.125	115.625	4.500	22.50
3	5:25 PM	5:34 PM	9	115.625	117.250	1.625	10.83
3	5:34 PM	5:43 PM	9	117.250	118.125	0.875	5.83
3	5:43 PM	5:54 PM	11	118.125	119.000	0.875	4.77
4	5:57 PM	6:03 PM	6	87.125	110.625	23.500	235.00
4	6:03 PM	6:14 PM	11	110.625	116.250	5.625	30.68
4	6:14 PM	6:25 PM	11	116.250	118.750	2.500	13.64

Measured Infiltration Rate (Average Rate of Last Trial): 67.77

Infiltration testing was performed according to the procedures outlined in Method B (Sections C.2 and C.3) of the Montana Department of Environmental Quality (DEQ) Circular DEQ-8, Appendix C

Tetra Tech
2525 Palmer Street, Suite 2; Missoula, MT 59808
Tel 406.543.3045 Fax 406.543.3088 tetratech.com