To whom it may concern,

The project design and development program for the West End Homes major subdivision has gone through several changes since the project's inception. The Executive Summary provided in this Geotechnical Report does not reflect the changes to Lot counts, proposed open spaces, and roads. Please find the correct project description below:

The West End Homes Subdivision is a major subdivision which proposes 260 lots to be utilized for residential purposes which will offer homes using production building methodology at a significantly discounted price point for cost-burdened residents of Montana. Please see the Regulating Plan included in the Master Site Plans attached in Section A of this submittal. Lots will predominantly be utilized for single family homes. The project will include the optimization of the T4 Transects to provide a variety of housing types. Roughly 65% of the homes will be considered "missing middle" housing. The property is located directly adjacent to the west of the intersection of Flynn Lane and England Boulevard. The site is currently utilized for agricultural use. The proposed lots will be connected to the City of Missoula water and sewer systems. The project is set to occur in nine different phases.

The property is located adjacent to Flynn Lane. Half road improvements are proposed along Flynn Lane for the property's entire road frontage. The continuation of England Boulevard has been proposed within the subdivision as part of the BUILD Grant. Five different entrances to the subdivision are proposed off of Flynn Lane; Camden Street, Bellflower Way, Mariposa Drive, Burnet Drive, and England Boulevard. Tansy Lane, Dougherty Drive, Bellflower Way, and Barberry Street will connect to England Boulevard. The subdivision will have seven streets that serve resident access throughout the subdivision and provide access to the entrances described above. There are seven proposed alleys/rear lanes within the subdivision to further serve as access to homes for residents. Please see the Street Atlas included in the Master Site Plans attached in Section A of this submittal.

There are no existing non-motorized facilities on the proposed subdivision property. There are non-motorized facilities along Flynn Lane and England Boulevard adjacent to the subject property. These non-motorized facilities will be expanded to the proposed subdivision in the form of sidewalks and bicycle lanes in accordance with Mullan Traditional Neighborhood Development Form Base Code (MTNDFBC) Section 6.3. Sidewalks are also proposed on both sides of the proposed England Boulevard extension as well as the entrance roads from Flynn Lane. This will provide pedestrian facilities for access to the residential lots in accordance with MTNDFBC Section 6.3. The proposed alleys will adhere to all stipulations covered in MTNDFBC Section 6.3. In addition to providing non-motorized access to the existing facilities, the proposed facilities will provide access throughout the subdivision to both residences and proposed open spaces. Please see the Street Atlas included in the Master Site Plans attached in Section A of this submittal.

1817 South Ave West, Suite A, Missoula, MT 59801
› 406.721.0142 › Fax: 406.721.5224 › imegcorp.com

Lastly, an important factor included with this development is the large dedication of over 26 acres of open space for a City park and the Open Space Lots throughout the subdivision. The proposed Open Space Lots will not be maintained by the City, but will offer recreation spaces for residents in the area. For more information regarding the specifics for transect zone allocation or overall development programming please see the Regulating Plan attached in the Master Site Plans included in Section A of this submittal.

Report of Geotechnical Investigation Evergreen Housing Solutions Missoula, Montana

Tetra Tech Project No. 117-8960001
October 26, 2021

PRESENTED TO

Wishcamper Development
Justin Metcalf
131 South Higgins, Suite P-1
Missoula, Montana 59802

PRESENTED BY

Tetra Tech
2525 Palmer Street, Suite 2
Missoula, MT 59808

P +1-406-543-3045
F +1-406-543-3088
tetratech.com

Prepared by:

Marco Fellin, P.E.
Senior Geotechnical Engineer

Reviewed by:

Jeremy Dierking, P.E.
Senior Geotechnical Engineer

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APPENDIX

Appendix

- Miscellaneous Figures and Details
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- Classification of Soils for Engineering Purposes
- Montana Guideline for Construction and Materials Requirements for Pavement Sections
- Drawing No. 8960001 – Locations of Exploratory Borings and Infiltration Testing
- Logs of Exploration Borings - Figures 1 through 9
- Laboratory Data - Figures 10 through 1
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1. EXECUTIVE SUMMARY

The proposed subdivision will include 179 lots with single-family homes of varying sizes, and is within the current Missoula Build Grant boundary. The site will be bordered to the north by Camden Street, to the south by England Boulevard, to the east by Flynn Lane, and to the west by Dougherty Drive. A large grass open space area is proposed in the northwest corner of the development, south of England Boulevard. Two smaller open spaces and four connector roads will be constructed within the development boundaries.

Beneath a thin topsoil layer, the subsurface profile encountered in the borings was varied and discontinuous across the site. In general, silt, clayey sand, silty sand, and poorly graded gravel with clay and sand were encountered beneath the topsoil extending to depths on the order of 11 feet. Subsurface water was not encountered in any of the borings at the time of the field exploration (June 2021). Footings constructed on the natural subgrade should be supported on; a high strength Mirafi 380i geotextile fabric placed on the subgrade, a minimum 1-foot of crushed concrete below the footings.

New pavements constructed on the natural subgrade should be supported on; a high strength Mirafi 380i geotextile fabric placed on the subgrade, a minimum 8-inch granular subbase, a granular base course, and asphalt pavement.

This executive summary has been prepared solely to provide a general overview and should not be relied on for any purpose except for that for which it was prepared. Rely only on the full report for information about findings, recommendations and other concerns.

2. PURPOSE AND SCOPE OF STUDY

Tetra Tech conducted a field exploration program consisting of nine exploratory borings within the proposed new roadway and development extents. The investigation was conducted for the purpose of developing geotechnical recommendations for design and construction of building foundations, pavement sections and infiltration basins. The investigation was performed in accordance with Tetra Tech's proposal to Wishcamper Developers and Professional Services Agreement dated June 11, 2021.

Samples obtained during the field investigation were tested in Tetra Tech's laboratory to determine the physical and engineering characteristics of the on-site soils. Results of the field investigation and laboratory tests were analyzed to characterize site material properties for design of the proposed structures and roads. This report summarizes the field data and presents conclusions and recommendations for the building foundations and pavement sections 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. PROPOSED CONSTRUCTION

The proposed subdivision will include 179 lots with single-family homes of varying sizes, and is within the current Missoula Build Grant boundary. The site will be bordered to the north by Camden Street, to the south by England Boulevard, to the east by Flynn Lane, and to the west by Dougherty Drive. A large grass open space area is proposed in the northwest corner of the development, south of England Boulevard. Two smaller open spaces and four connector roads will be constructed within the development boundaries.

The proposed street construction will consist of two collector streets; England Blvd and Dougherty Drive. Road A, B, C, D, E and Camden Street are all considered local neighborhood streets. All lots except for Lots 42-45 will be accessed via an alley, or Rear Lane as shown on the site map, Drawing No. 8960001-1. Traffic along the collector roads is expected to be primarily be moderate, consisting of passenger cars, pickup trucks, school buses, garbage trucks, delivery trucks, snowplows, and occasional semi-tractor trailers. Traffic on the neighborhood streets will be light to moderate, consisting of less volume and thus a smaller percentage of truck traffic than the collector streets. The alley's or Rear Lane's will consist of passenger cars and sporadic small truck traffic, and garbage trucks. HDR is currently preparing traffic volume estimates. Once available, Tetra Tech should review the final traffic volumes to make adjustments to the pavement section recommendations as necessary.

The project terrain is generally relatively flat to slightly rolling. Cuts and fills on the order of 1 to 3 feet are anticipated along the alignment to grade the site to construct the road sections and residential units.

If project traffic, locations, or conditions are significantly different from those described above, Tetra Tech should be notified to re-evaluate the recommendations contained in this report.

4. FIELD EXPLORATION

The field exploration was conducted on June 17 and June 18 and consisted of nine borings at the locations shown on Drawing No. 8960001-1 to explore subsurface conditions. Three infiltration pipes were installed on June 17 and 18 in borings BH-1, BH-2, and BH-3. Three additional infiltration pipes were installed at the location of Borings BH-4, 5, and 7 on October 1, 2021. Infiltration testing at all six infiltration pipe locations was conducted on October 4, 2021.

The boring locations were chosen based on discussions with Wishcamper Developers and IMEG, and were marked in the field by Tetra Tech personnel based on the proposed site layout. Prior to mobilization, Tetra Tech contacted Montana One-Call to request the location and clearance of public underground utilities. Borings were advanced with a truck-mounted drill rig equipped with 8-inch outside-diameter hollow-stem augers. The borings were logged by a Tetra Tech representative. Elevations of the borings were obtained from a site topographic map developed by IMEG and are noted on the logs of the borings.

Samples of the subsurface materials were taken with 2-inch outside-diameter split-spoon samplers 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; the total number of blows required to advance the sampler the second and third 6-inch increments is the penetration resistance (N value). This is the standard penetration test described by ASTM International (ASTM) Method D1586. Penetration resistance values generally indicate the relative density or consistency of the soils. Disturbed bulk samples of soil were obtained from the hollow-stem auger cuttings at select locations. Sample depths and penetration resistance values were recorded on the field logs and are shown on the logs of exploratory borings.

5. 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 engineering and physical properties of the soils in general accordance with ASTM or other approved procedures. The following list describes the laboratory testing performed for this investigation.

Tests Conducted:	To Determine:
Grain-size Distribution	Size and distribution of soil particles (i.e., clay, silt, sand, and gravel).
Natural Moisture Content	Moisture content representative of field conditions at the time samples were taken.
Atterberg Limits	The effect of varying water content on the consistency of fine-grained soils.

Tests Conducted:	To Determine:
Moisture-Density Relationship	The optimum moisture content for compacting soil and the maximum dry 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.
pH/Resistivity	The combination of these characteristics determines the potential of soil to corrode metal.

Field and laboratory test results are presented graphically on Figures 10 through 19 in the Appendix. This data and the field information were used to prepare the exploratory boring logs on Figures 1 through 9.

6. SITE CONDITIONS

The proposed development extends through an agricultural field north of England Boulevard. The overall site generally slopes down to the west and south, with and elevation difference on the order of 7 feet across the site; from 3,168.1 feet at Boring BH-2 to 3,161.3 feet at Boring BH-4.

7. SUBSURFACE CONDITIONS

Beneath a thin topsoil layer, the subsurface profile encountered in the borings was varied and discontinuous across the site consisting of interbedded silts, clays, sands, and gravels. In general, the softer and looser silt, clayey sand, and silty sand were encountered beneath the topsoil extending to depths on the order of 6.5 to 10.2 feet. The upper layers were underlain by dense to very dense poorly graded gravel with silt and sand. 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.

7.1 Silt and Clay

Silt and clay were encountered in eight of the borings, extending to depths ranging from 2 to 8.5 feet. The natural moisture content in the silt and clay varied from 3 to 24 percent. Penetration resistance values in the clay ranged from 1 to 16 blows per foot, indicating a soft to stiff soil stratum.

Representative samples of the clay obtained from boreholes BH-1, BH-3 and BH-4 classified as sandy lean clay and sandy silty clay, respectively, according to the ASTM classification system (Figures 10, 12 and 13). Laboratory testing determined the clay has liquid limits ranging from 20 to 30 percent and plasticity indices ranging from 4 to 11. Moisture-density relationship testing indicates a maximum dry density of 117.7 pounds per cubic foot (pcf) and an optimum moisture content of 12.7 percent (Figures 16).

7.2 Sand and Gravel

Sand and gravel were encountered at depths ranging from 1 to 8.5 feet and extended to depths beyond the maximum depth explored (15.5 feet). The natural moisture contents in the sand and gravel ranged from 2 to 9 percent. Penetration resistance values in the sand and gravel ranged from 16 to greater than 50 blows per foot indicating a medium dense to very dense soil stratum. A representative sample of the gravel obtained from boring BH-9 classified as clayey gravel with sand, according to the ASTM classification system (Figure 15). Laboratory testing determined the clay fraction has a liquid limit of 26 percent and a plasticity index of 12. A representative sample of the sand obtained from borings BH-3 and BH-7 classified as silty, clayey sand, and silty sand respectively, according to the ASTM classification system (Figures 11 and 14). Laboratory testing determined the clay fraction has a liquid limit of 22 to 26 percent and a plasticity index of 6 to 12. Moisture-density relationship testing indicates a rock-corrected maximum dry density of 119.4 to 134.8 pounds per cubic foot (pcf) and a rock-corrected optimum moisture content of 11.1 to 9.3 percent (Figures 17 and 18). California Bearing Ratio (CBR) testing indicates the sand has a CBR value of 8 percent (Figure 19).

The combination of pH (6.89) and resistivity (19,266 ohm-cm) indicates the potential of corrosion of buried metal is low. Water soluble sulfate testing is currently in progress and will be forwarded upon completion.

7.3 Groundwater

Subsurface water was not encountered in any of the borings at the time of the field exploration (June 2021). 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.

7.4 Percolation Testing

Tetra Tech performed six percolation tests following procedures outlined in Appendix A of Montana DEQ Circular 4. Tetra Tech installed a 4-inch PVC pipe through the hollow stem augers to depths of approximately 7.5 to 11.5 feet, removed the auger from the borehole, and performed infiltration testing through the open-ended and perforated pipe. The tests were performed in poorly graded gravel with silt and sand at the bottom of the borings. The bottom 1 foot of pipe contained infiltration holes, and pea gravel was placed on the bottom 4 inches of the boring below the pipe, as well as around the bottom 1.5 feet of pipe. Table 7-1 below summarizes the percolation test results. Percolation test field reports are included at the end of the Appendix.

Table 7-1: Percolation Test Results

Test Location	Soil Type (USCS)	Depth (ft)	Percolation Rate (mpi)
BH-1	GP-GM	9.42	0.0195
BH-2	GP-GM	11.33	0.1479
BH-3	GP-GM	11.5	0.1183
BH-4	GP-GM	7.42	0.0933
BH-5	GP-GM	7.17	0.0961
BH-7	GP-GM	1.17	0.0448

8. ENGINEERING ANALYSIS AND RECOMMENDATIONS

8.1 Site Grading

The on-site soils are suitable for use as backfill along foundation walls, below pavements, and as over-lot fill, provided any deleterious material is removed and it is placed under controlled moisture and density conditions as referenced in Item 3 below.

The design and construction criteria presented below should be observed for site preparation purposes and when preparing project documents.

1) All topsoil, vegetation, or any other deleterious material should be removed from beneath the proposed building footprints and pavements in their entirety, and the subsequent excavations backfilled in accordance with 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 specifications as determined by ASTM D698.

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

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

Sieve or Screen size	Percent Passing
3-Inch	100
No. 4	25 – 50
No. 200	0 – 8

5) 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.

6) Site grading must be developed and maintained during and after construction to rapidly drain surface and roof run-off away from foundation and subgrade soils.

7) 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.

8.2 Foundations

8.2.1 Spread Footings

Based on the variable and compressible subsurface conditions encountered within the borings at anticipated foundation depths, a foundation system consisting of conventional spread footings bearing on a minimum of one foot of compacted engineered crushed concrete fill is recommended to support the proposed structures. The gradation of the crushed concrete should be 1.5-inch minus. The zone of engineered fill will provide a uniform bearing platform for foundations. The crushed concrete fill should be underlain by a Mirafi 380i high-strength separation/stabilization geotextile. The crushed concrete has the capacity to absorb significant amounts of moisture should it be present in the subgrade, and is less affected by moisture than crushed gravel. In addition, the crushed concrete will harden to some extent over time due to the concrete fines in the mix re-hydrating, resulting in a very solid foundation for footings. Alternatively, a pit-run material meeting the gradation requirements under Site Grading can be utilized below the footings.

Calculations indicate continuous spread footings bearing on the zone of crushed concrete fill can be proportioned for an allowable bearing pressure of 2,500 psf. Based on the theory of elasticity, and assuming a bearing pressure of 2,500 psf, the total settlement beneath continuous and spread footings will be approximately 1 inch or less. Differential settlement 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. The following construction details should be considered when preparing the project documents.

1) In preparation for construction of footings, the subgrade should subexcavated to a depth of 1 foot below proposed footing elevation. The zone of subexcavation should extend a minimum of 1 foot outside the edges of the footing. Compact the subgrade with a walk-behind smooth drum roller in static mode to level the surface and to achieve a minimum of 95 percent compaction. Should excessively soft areas of subgrade be encountered at the bottom of the subexcavation, they should be overexcavated an additional foot.
2) The crushed concrete should be a 1.5-inch or smaller product, having a maximum of 15 percent passing the No. 200 screen. Suppliers in Missoula manufacture several products, including 3 inch minus, 1.5 inch minus, and ¾ inch minus.
3) Place a layer of Mirafi 380i high strength geotextile per manufacturers recommendations.
4) Place 1 foot of crushed concrete fill (or 2 feet in soft areas), and compact using the static mode of a walk-behind or equivalent smooth drum roller to a density of 95 percent of the maximum dry density.
5) Footings supported on a zone of 1 foot of crushed concrete can be designed for a maximum allowable bearing pressure of 2,500 psf.
6) Exterior footings should be placed at least 42 inches below final exterior grade for frost protection.
7) The minimum width of column footings should be at least 24 inches and at least 16 inches for continuous spread footings, or in accordance with applicable building codes, whichever is more restrictive.
8) 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 0.40 for the crushed concrete, and a lateral bearing pressure of 200 psf per foot of depth for the variable silt, sand, and clayey soils is appropriate.
9) 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.

8.2.2 Floor Slabs

Performance of slab-on-grade construction is dependent on having a relatively uniform subgrade beneath the slab. Floor slabs should be supported on a zone of at least 1 foot of engineered gravel fill placed and compacted in accordance with Item 3 in the *Site Grading* section. It is also customary to provide a gravel-leveling course beneath floor slabs to act as a capillary break, which can be considered a part of the 1 foot of gravel fill.

The following recommendations should be considered for concrete slab-on-grade construction.

1) Floor slabs should be supported on a minimum of 1 foot of engineered gravel fill placed and compacted in accordance with item 3 in the *Site Grading* section. A 1.5-inch minus crushed concrete product can be substituted for the engineered gravel fill if desired.
2) Place a layer of Mirafi 280i medium strength separation/stabilization geotextile between the subgrade and the engineered fill per manufacturers recommendations.
3) A minimum 4-inch thick layer of free-draining gravel should be placed between the floor slabs and the 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 percent passing the No. 200 sieve. This layer can be included as part of the engineered gravel fill layer. This layer can be considered part of the 1 foot of gravel fill.

4) 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.

5) 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.

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

7) Concrete floor slabs supported on the gravel fill, as described above should be designed using a modulus of subgrade reaction of 300 pounds per cubic inch (pci). Crushed concrete can be used in lieu of gravel fill, meeting the requirements discussed under Spread Footing Foundations.

8.2.3 Exterior Concrete Flatwork

A minimum of 6 inches of crushed concrete base course should be placed beneath flatwork, placed and compacted in accordance with Item 3 in the *Site Grading* section. A Mirafi 280i separation geotextile should be placed on the subgrade prior to placing the 6-inch gravel fill layer. 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.

8.3 Pavement Section

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. Back-calculated field CBR values from Dynamic Cone Penetrometer (DCP) testing performed for the overall Mullan Build Grant project, including within this project area (Mullan Build Grant Geotechnical Report dated July 17, 2020) , were generally on the order of 3 or greater in the top 18 inches of subgrade, with values of 2 and lower recorded in isolated areas, and below 18 inches in most of the locations tested. A CBR test performed on the clayey gravel layer in BH-9 resulted in a CBR of 8, which is considered a moderate strength subgrade for supporting pavements. Based on the lab testing indicated the majority of the subgrade contains a significant amount of silty and clay fines, previous DCP testing results, and the loose to soft worst-case in-place relative densities of the subgrade soils, a CBR value of 3 percent was used for the predominant native silt and clay subgrade types, which is considered a low strength subgrade soil for supporting pavements under controlled placement conditions.

We understand that cuts and fills on the order of 1 to 3 feet could be required to grade the roadway sections. In addition, we understand cut soils will be utilized in fill sections. As discussed under Items 2 and 3 below, the subgrade will be compacted, then proof-rolled to identify soft or loose areas. Areas of the subgrade that are soft or loose will be sub-excavated and mitigated under the direction of a Tetra Tech engineer. The pavement thickness design was developed using the methods presented in the AASHTO *Guide for Design of Pavement Structures*, 1993.

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

1) All topsoil and organic matter should be removed from the proposed construction locations.

2) In preparation of the roadway subgrade, in cut areas, the subgrade should be moisture-conditioned to within 2 percent of optimum moisture content and compacted to 95 percent of the dry density as determined by ASTM D698.

3) Proof roll the existing subgrade with a fully-loaded 10 cubic-yard dump truck to identify any localized loose or soft areas. Tetra Tech will evaluate soft or loose areas to determine the appropriate remedy. In general, localized loose or soft areas should be over-excavated a minimum depth of 12 inches and replaced with Mirafi 380i placed at the bottom of the excavation, then engineered gravel fill compacted in accordance with Item 2 above.

4) Use of a high-strength geotextile separator is recommended to be placed at subgrade elevation over the entire road, shoulder and curb width to prevent intrusion of the natural fine-grained soils into the subbase, improve constructability, and provide added design strength for the pavement section. Mirafi 380i or equivalent should be used.

5) A minimum 8 inches of granular subbase should be placed beneath the pavement section. The subbase should be compacted to 95 percent of ASTM D698 specifications. The subbase gravel should meet the following gradation:

Sieve or Screen size	Percent Passing
3-Inch	100
No. 4	25 – 50
No. 200	0 – 8

6) Native soils used as fill should be moisture-conditioned and placed in maximum 8-inch loose lifts and compacted in accordance with Item 2 above.

Traffic data is currently being prepared by HDR, and is not available at the time of this report submittal. For estimating purposes, Tetra Tech has provided representative pavement sections versus an estimated number of ESAL's. Tetra Tech estimated an ESAL truck factor of 0.6 for the average truck to travel the roadways over the 20-year design life.

We understand most of the roads in the development will be paved following construction of the homes. However, we also understand some of the homes might be constructed, or might be finished, following construction of the paved roads. For estimating purposes, Table 8-1 includes the addition of 550 ESAL's for each of 5 homes constructed for each of the major collector roadway segments within the subdivision, assuming each roadway segment will service the construction of an estimated 20 new homes during construction. The estimate of 550 ESAL's per home is based on published data on the average number of heavy construction trucks that are required to construct an average-size single family residence.

The minimum pavement thicknesses were determined based on the number of ESAL's per day over the 20-year design life, and the MDT Pavement Design manual minimum pavement recommendations for thickness versus ESAL's per day.

Table 8-1. Recommended Pavement Section Thicknesses

Section	ADT - vpd	ADT per Lane	ADT - 20 yr per lane	Percent Trucks	Truck ESAL Factor	ESAL's 20-year	ESAL for 20 yr + 5 home count of 550/home (2,750)	Pavement Thickness	Base Thickness (MDT Grade 6A)	Pit Run Subbase Thickness
Collector Streets	15,000	7,500	54,750,000	3	0.6	985,500	988,250	4	10	8
Main Subdivision Streets	5,000	2,500	18,250,000	3	0.6	328,500	331,250	3	8	8
Alleys-Rear Lanes	1,000	500	3,650,000	1	0.6	21,900	24,650	3	6	8

9. 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 our 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, our personnel are available for consultation.

10. 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 and 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 our 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. On-site observation of excavations and foundation bearing strata and testing of fill by a representative of the geotechnical engineer is recommended.

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.

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8811 Colesville Road/Suite G106/Silver Spring, Maryland 20910/(301)565-2733

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

12/06/12

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

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

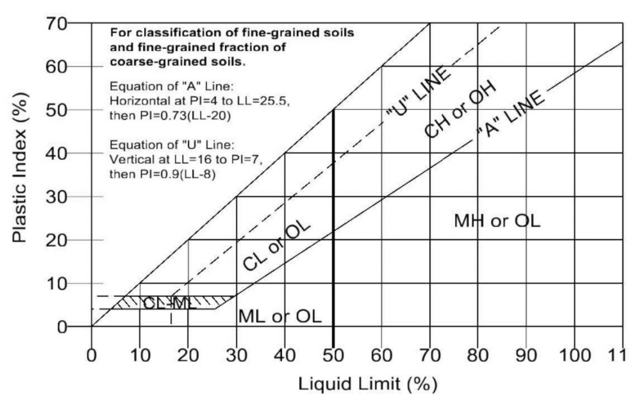
Moisture Condition

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.



Notes

See Soil Boring Information Special Provision.

SPT (Standard Penetration Test-ASTM D1586):
The number of blows of a 140 lb (63.6 kg) hammer 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 (0.15 m) - third 0.5 ft (0.15 m) (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.

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

12/06/12

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: Auger; Casing Advancer; Core Barrel; Drive Casing

Sample Types: Split Spoon; Shelby; Bulk Sample; Grab Sample; Cone Penetrometer; Vane Shear; Special Samplers; Testpit

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.

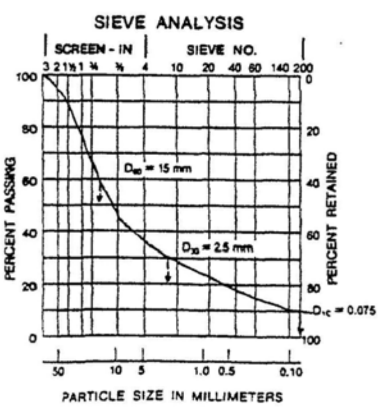
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

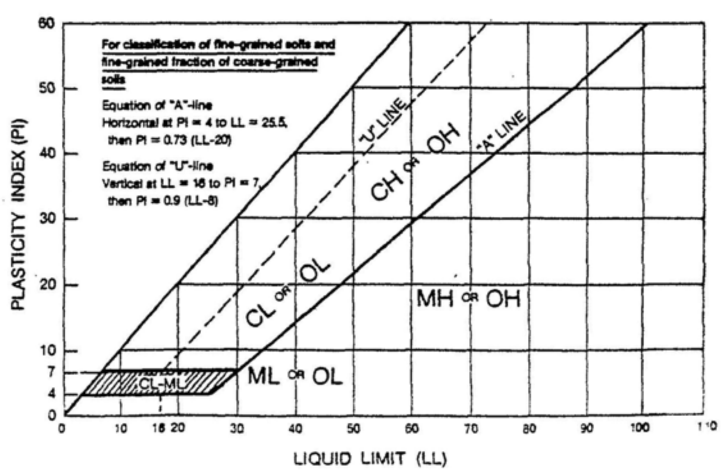
[N] PI ≥ 4 and plots on or above "A" line.

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

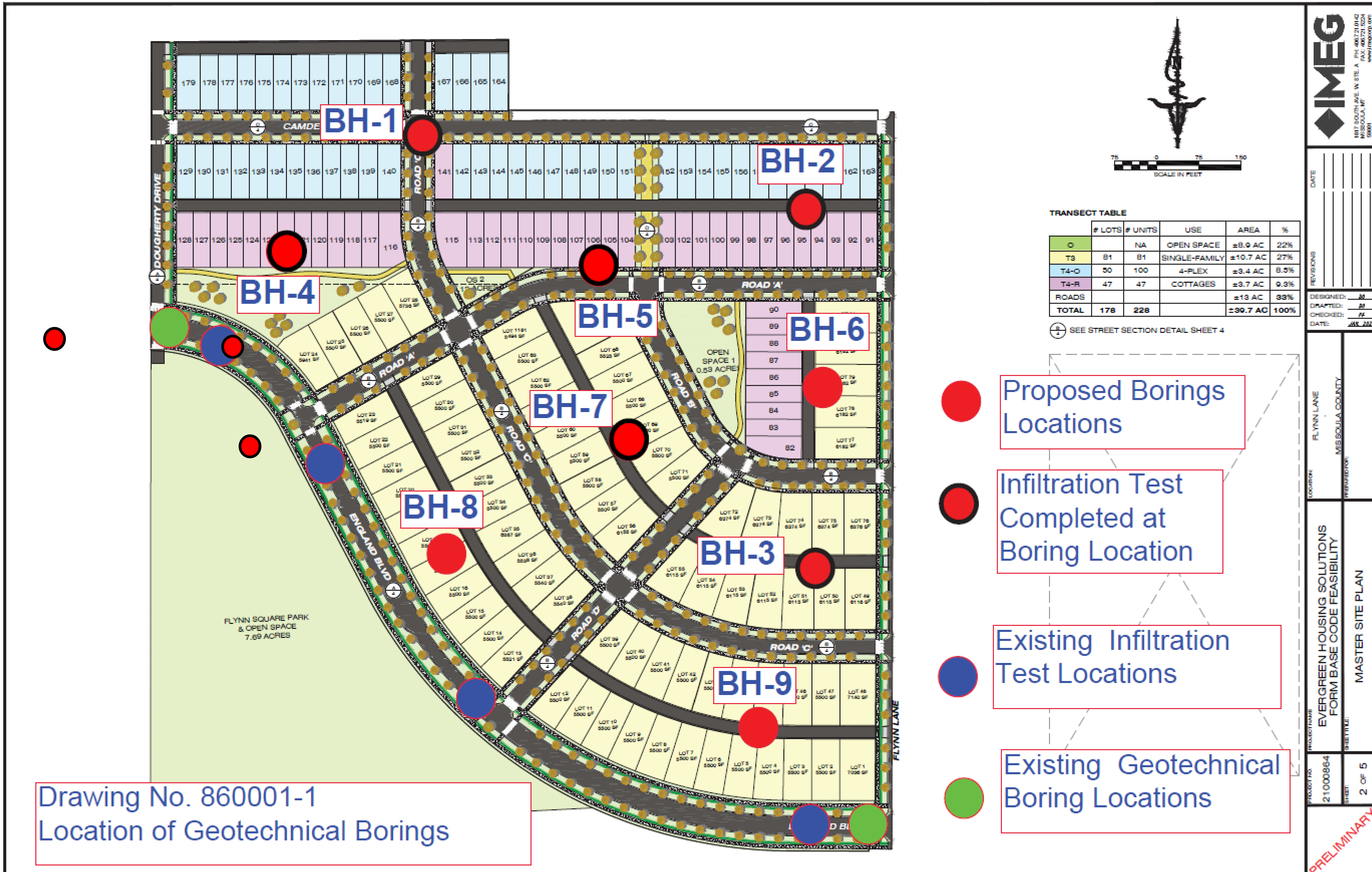
[P] PI plots on or above "A: line.

[Q] PI plots below "A: line.





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



TRANSECT TABLE

	# LOTS	# UNITS	USE	AREA	%
O		NA	OPEN SPACE	±8.9 AC	22%
T3	81	81	SINGLE-FAMILY	±10.7 AC	27%
T4-O	50	100	4-PLEX	±3.4 AC	8.5%
T4-R	47	47	COTTAGES	±3.7 AC	9.3%
ROADS				±13 AC	33%
TOTAL	178	228		±39.7 AC	100%

SEE STREET SECTION DETAIL SHEET 4

Drawing No. 860001-1
Location of Geotechnical Borings

2525 Palmer Street Suite 2
Missoula, MT 59808
Phone: 406-543-3045
Fax:

Figure No. 1

LOG OF BORING

Boring BH-1

TETRA TECH

Project: BUILD Grant - Flynn Lane	**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 47.275273 E: -114.006672	
Project Number: 117-8960001	**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83	**Top of Boring Elevation:** 3162.7 ft
Date Started: 6/17/18 / **Date Finished:** 6/17/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings	
Driller: O'Keefe **Logger:** Andrew Warren	**Location:**		

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
			53		2 - 2 - 2		TOPSOIL, slightly moist to moist, dark brown.		19					
			100		0 - 2 - 5		Sandy CLAY (CL), moist to very moist, brown to tan, medium plasticity.	2.3 *3160.4*	22	30	19	46		
5 *3157.7*			87		4 - 4 - 5		Silty SAND (SC), loose to medium dense, slightly moist, tan/brown, fine to medium grained, subangular to subrounded, low plasticity.	3.3 *3159.4*	4					Installed 4" PVC to 9.6' over 6" layer of pea gravel, with the borehole annulus backfilled with pea gravel extending 1.6' upward from the bottom of the pipe and the remainder with auger cuttings (bottom 1' of pipe was slotted).
			60		8 - 12 - 14				3					
10 *3152.7*			87		4 - 16 - 29		Poorly-Graded GRAVEL with silt and sand (GP-GM), medium dense to dense, slightly moist, light brown to brown, fine to coarse grained, subangular to subrounded.	8.0 *3154.7*	2					
								10.5 *3152.2*						

Boring Depth: 10.5 ft, *Elevation: 3152.2 ft*

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

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Missoula, MT 59808
Phone: 406-543-3045
Fax:

Figure No. 2

LOG OF BORING

Boring BH-2

TETRA TECH

Project: BUILD Grant - Flynn Lane	**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 46.900413 E: -114.055949	
Project Number: 117-8960001	**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83	**Top of Boring Elevation:** 3168.1 ft
Date Started: 6/17/18 / **Date Finished:** 6/17/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings	
Driller: O'Keefe **Logger:** Andrew Warren	**Location:**		

Depth (ft) / Elev. (ft)	Recovery (%)	RQD (%)	Blow Count	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
	100		2 - 2 - 1	TOPSOIL, moist, dark brown.	0.6 / 3167.5	14					
				Poorly-Graded SAND (SP), moist, tan/brown, fine to medium grained, subangular.	1.1 / 3167.0						
	53		3 - 6 - 10	Sandy CLAY (CL), soft, very moist, dark brown, medium plasticity.	1.9 / 3166.2	6					
5 / 3163.1	47		6 - 9 - 7	Sandy GRAVEL with silt (GP), medium dense, moist, brown, fine to coarse grained, subangular.	3.8 / 3164.3	5					Installed 4" PVC to 11.2' over 6" layer of pea gravel, with the borehole annulus backfilled with pea gravel extending 1.2' upward from the bottom of the pipe and the remainder with auger cuttings (bottom 1' of pipe was slotted).
	87		2 - 3 - 3	Poorly-Graded GRAVEL with silt and sand (GP-GM), medium dense, slightly moist to moist, brown to multi-colored, fine to coarse grained, subangular to subrounded.	6.5 / 3161.6	18					
10 / 3158.1	80		2 - 14 - 33	Sandy SILT (CH), medium stiff to hard, moist, tan/brown, low plasticity, stringers of silty sand.		16					
				Poorly-Graded GRAVEL with silt and sand (GP-GM), dense, slightly moist, light brown, fine to coarse grained, subangular to subrounded.	10.2 / 3157.9						
					11.9 / 3156.2						

Boring Depth: 11.9 ft, *Elevation: 3156.2 ft*

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

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Missoula, MT 59808
Phone: 406-543-3045
Fax:

Figure No. 3

LOG OF BORING

Boring BH-3

TETRA TECH

Project: BUILD Grant - Flynn Lane		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 46.898667 E: -114.055965
Project Number: 117-8960001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 3166.9 ft
Date Started: 6/17/18	**Date Finished:** 6/17/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:**	

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		0 - 1 - 1		Very moist, dark brown.	1.3 / *3165.6*	20					
			100		0 - 0 - 0		Silty, Clayey SAND (SC-SM), very loose, very moist to wet, brown to gray, fine to medium grained, subrounded to subangular, trace organics present to approximately 4 ft.	4.0 / *3162.9*	22	24	16	47		
5 / *3161.9*			100				Sandy CLAY (CL), very soft, moist, tan/brown, fine to medium grained, subrounded to subangular.	6.0 / *3160.9*		24	16	59		
			87		2 - 3 - 4		Silty SAND (SM), loose to dense, moist, tan/brown, fine to medium grained, subrounded to subangular.	9.5 / *3157.4*	17					Installed 4" PVC to 11.5' over 6" layer of pea gravel, with the borehole annulus backfilled with pea gravel extending 1.5' upward from the bottom of the pipe and the remainder with auger cuttings (bottom 1' of pipe was slotted).
10 / *3156.9*			20		15 - 22 - 24		Poorly-Graded GRAVEL with silt and sand (GP-GM), dense, slightly moist, light brown to multi-colored, fine to coarse grained, subrounded to subangular.	12.1 / *3154.8*	9					

Boring Depth: 12.1 ft, *Elevation: 3154.8 ft*

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

2525 Palmer Street Suite 2
Missoula, MT 59808
Phone: 406-543-3045
Fax:

Figure No. 4

LOG OF BORING

Boring BH-4

TETRA TECH

Project: BUILD Grant - Flynn Lane	**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 46.900364 E: -114.059843	
Project Number: 117-8960001	**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83	**Top of Boring Elevation:** 3161.3 ft
Date Started: 6/18/18 **Date Finished:** 6/18/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings	
Driller: O'Keefe **Logger:** Andrew Warren	**Location:**		

Depth (ft) / Elev. (ft)	Recovery (%)	RQD (%)	Blow Count	Material Description	Depth (ft) / Elev. (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
	67		1 - 2 - 1	TOPSOIL, moist to very moist.		24					
	80		0 - 2 - 6	Sandy, Silty CLAY (CL-ML), medium stiff to hard, slightly moist, tan/brown, low plasticity, seams of silty sand.	2.5 / 3158.8	11	20	16	57		
5 / 3156.3	100										
	73		9 - 20 - 30	Poorly-Graded GRAVEL with silt and sand (GP-GM), dense to very dense, slightly moist, light brown to multi-colored, fine to coarse grained, subangular to subrounded, occasional cobbles.	6.5 / 3154.8	4					
10 / 3151.3	77		24 - 37 - 50/0.3ft			2					
15 / 3146.3	67		26 - 36 - 43			5					
				Boring Depth: 15.5 ft, *Elevation: 3145.8 ft*	15.5 / 3145.8						

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

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Figure No. 5

LOG OF BORING

Boring BH-5

TETRA TECH

Project: BUILD Grant - Flynn Lane	**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 46.900392 E: -114.057398	
Project Number: 117-8960001	**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83	**Top of Boring Elevation:** 3164.5 ft
Date Started: 6/18/18 **Date Finished:** 6/18/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings	
Driller: O'Keefe **Logger:** Andrew Warren	**Location:**		

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
			60		2 - 2 - 1		TOPSOIL, moist to very moist, dark brown.		17					
			80		0 - 0 - 0		Sandy SILT (ML), very soft to very stiff, slightly moist to very moist, tan/brown, low plasticity, very moist from 2.3 to approximately 3.8 ft, occasional silty sand seams.	2.3 / *3162.2*	20					
5 / *3159.5*			87		3 - 5 - 5				13					
			80		4 - 7 - 23				10					
10 / *3154.5*			80		14 - 25 - 30		Poorly-Graded GRAVEL with silt and sand (GP-GM), medium dense to very dense, moist, light brown to multi-colored, fine to coarse grained, subrounded to subangular, occasional cobbles.	8.1 / *3156.4*	3					
15 / *3149.5*			60		11 - 9 - 12			15.5 / *3149.0*	4					

Boring Depth: 15.5 ft, *Elevation: 3149.0 ft*

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: BUILD Grant - Flynn Lane		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 46.899564 E: -114.056011
Project Number: 117-8960001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 — **Top of Boring Elevation:** 3166.3 ft
Date Started: 6/17/18	**Date Finished:** 6/17/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:**	

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		2 - 1 - 1		TOPSOIL, moist, dark brown.		20					
			33		0 - 1 - 1		Clayey GRAVEL with sand (GC), very loose, moist, brown, fine to medium grained, subrounded.	1.5 / *3164.8*	12					
5 / *3161.3*			73		5 - 5 - 7		Gravelly SILT with sand (ML), stiff, slightly moist to moist, tan/brown, low plasticity.	4.0 / *3162.3*	4					
			67		6 - 6 - 6				3					
10 / *3156.3*			67		26 - 29 - 28		Poorly-Graded GRAVEL with silt and sand (GP-GM), medium dense to very dense, slightly moist, light brown to multi-colored, fine to coarse grained, subrounded to subangular.	8.5 / *3157.8*	3					
15 / *3151.3*			53		15 - 14 - 14				3					
							Boring Depth: 15.5 ft, *Elevation: 3150.8 ft*	15.5 / *3150.8*						

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

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Figure No. 7

LOG OF BORING

Boring BH-7

TETRA TECH

Project: BUILD Grant - Flynn Lane	**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 46.899559 E: -114.056044	
Project Number: 117-8960001	**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83	**Top of Boring Elevation:** 3164.0 ft
Date Started: 6/17/18 — **Date Finished:** 6/17/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings	
Driller: O'Keefe **Logger:** Andrew Warren	**Location:**		

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		2 - 1 - 1		TOPSOIL, slightly moist to moist, dark brown.	1.0 / 3163.0	17					
			80		1 - 1 - 2		Silty SAND with gravel (SM), very loose, moist, dark brown to brown, fine to medium grained, subangular.	3.5 / 3160.5	12			32		
5 / 3159.0			67		2 - 3 - 2		Poorly-Graded SAND with silt (SP-SM), loose, slightly moist to moist, tan/brown, fine to medium grained, subangular to subrounded, occasional gravel.	6.5 / 3157.5	7					
			53		14 - 16 - 19		Poorly-Graded GRAVEL with silt and sand (GP-GM), dense, slightly moist, light brown to multi-colored, fine to coarse grained, subangular to subrounded.		5					
10 / 3154.0			47		16 - 32 - 24				4					
15 / 3149.0			47		20 - 45 - 32			15.5 / 3148.5	2					

Boring Depth: 15.5 ft, *Elevation: 3148.5 ft*

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

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Figure No. 8

LOG OF BORING

Boring BH-8

TETRA TECH

Project: BUILD Grant - Flynn Lane	**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 46.89889 E: -114.05846	
Project Number: 117-8960001	**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83	**Top of Boring Elevation:** 3162.6 ft
Date Started: 6/17/18 **Date Finished:** 6/17/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings	
Driller: O'Keefe **Logger:** Andrew Warren	**Location:**		

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		2 - 1 - 1		TOPSOIL, slightly moist to moist, dark brown.	1.2 / *3161.4*	19					
			67		2 - 2 - 2		Clayey SAND with gravel (SC), very loose, moist, dark brown to brown, fine to medium grained, subrounded.	2.5 / *3160.1*	11					
5 / *3157.6*			88				Sandy SILT (ML), soft, slightly moist, tan/brown, low plasticity.	5.7 / *3156.9*						
			60		16 - 32 - 25		Poorly-Graded GRAVEL with silt and sand (GP-GM), very dense, slightly moist, light brown to multi-colored, fine to coarse grained, subrounded to subangular, occasional cobbles.		3					
10 / *3152.6*			27		14 - 34 - 45				2					
15 / *3147.6*			47		15 - 18 - 21			15.5 / *3147.1*	2					

Boring Depth: 15.5 ft, *Elevation: 3147.1 ft*

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

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Figure No. 9

LOG OF BORING

Boring BH-9

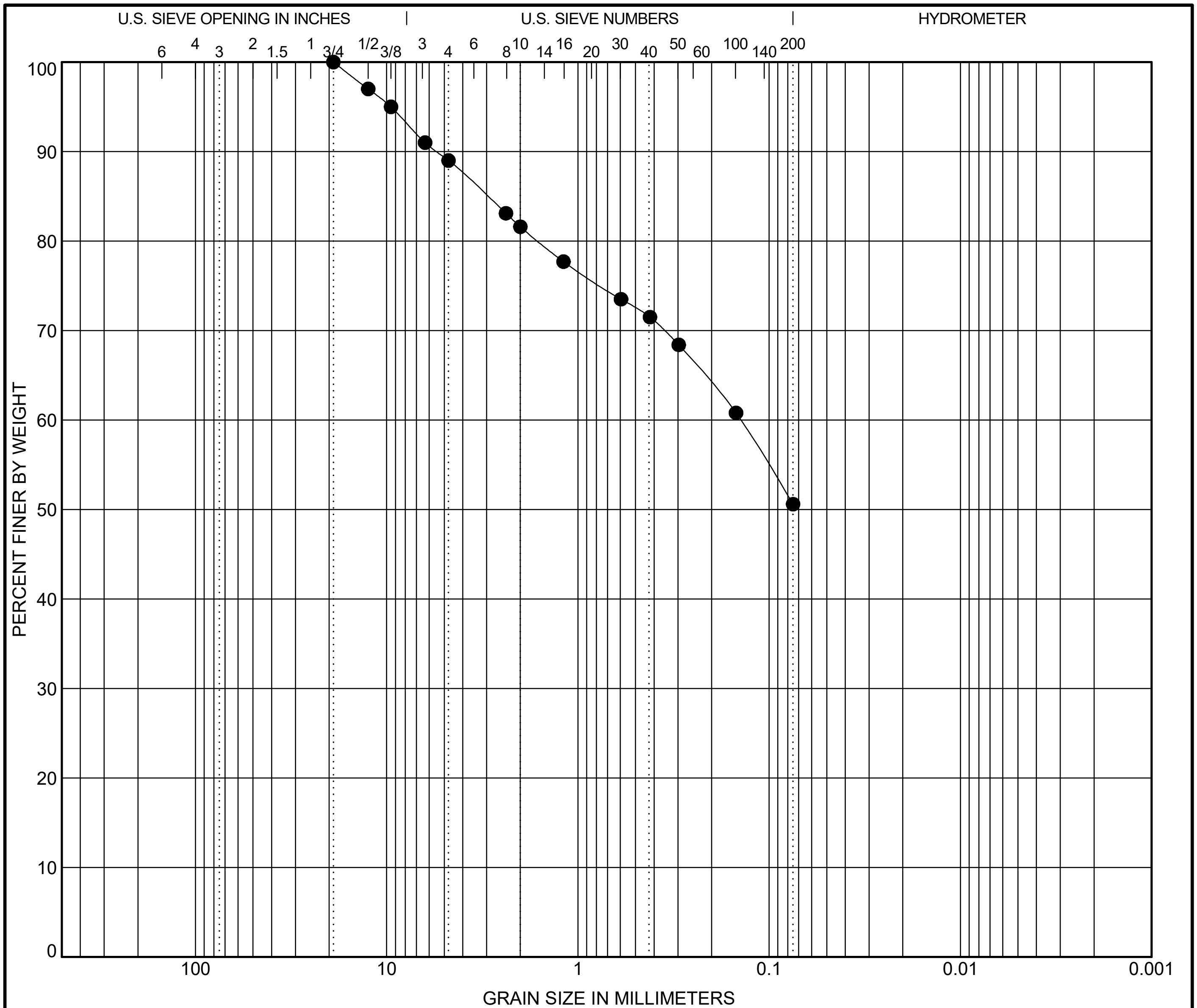
TETRA TECH

Project: BUILD Grant - Flynn Lane		**Rig:** Mobile B-61 **Hammer:** Auto	**Boring Location Coordinates** N: 46.898655 E: -114.055981
Project Number: 117-8960001		**Boring Diameter:** 8 in	**System:** Decimal Degrees **Datum:** NAD83 **Top of Boring Elevation:** 3164.7 ft
Date Started: 6/17/18	**Date Finished:** 6/17/18	**Drilling Fluid:** None	**Abandonment Method:** Backfilled with Cuttings
Driller: O'Keefe **Logger:** Andrew Warren		**Location:**	

Depth (ft) / *Elev. (ft)*	Recovery (%)	RQD (%)	Blow Count	Material Description	Depth (ft) / *Elev. (ft)*	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests
	60		2 - 1 - 1	TOPSOIL, slightly moist to moist, dark brown.	1.5 / *3163.2*	17					
	60		2 - 2 - 4	Sandy SILT (ML), medium stiff to hard, slightly moist to moist, tan/brown, low plasticity, some sand lenses.	3.0 / *3161.7*	9					
							26	14	40		pH= 6.89 Resistivity= 19266 ohm-cm CBR= 8
5 / *3159.7*	67		4 - 3 - 5	Clayey GRAVEL with sand (GC), loose, slightly moist, light brown to multi-colored, fine to coarse grained, subrounded to subangular, occasional cobbles.	7.5 / *3157.2*	8					
	87		14 - 24 - 22	Poorly-Graded GRAVEL with silt and sand (GP-GM), dense, slightly moist, light brown to multi-colored, fine to coarse grained, subrounded to subangular, occasional cobbles.		5					
10 / *3154.7*	67		19 - 20 - 11			3					
15 / *3149.7*	60		9 - 11 - 23		15.5 / *3149.2*	3					

Boring Depth: 15.5 ft, *Elevation: 3149.2 ft*

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



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SIEVE SIZE	% PASSING
3/4 in	100
1/2 in	97
3/8 in	95
1/4 in	91
No. 4	89
No. 8	83.1
No. 10	81.6
No. 16	77.7
No. 30	73.5
No. 40	71.5
No. 50	68.4
No. 100	60.8
No. 200	50.6

Specimen Identification
BH-1 - (2.5 - 3 ft)

Classification	LL	PL	PI	Cc	Cu
SANDY LEAN CLAY(CL)					
	30	**19**	**11**		

% Gravel	% Sand	% Silt	% Clay
11	38	51	

D100	D60	D30	D10
19	0.141		

TETRA TECH

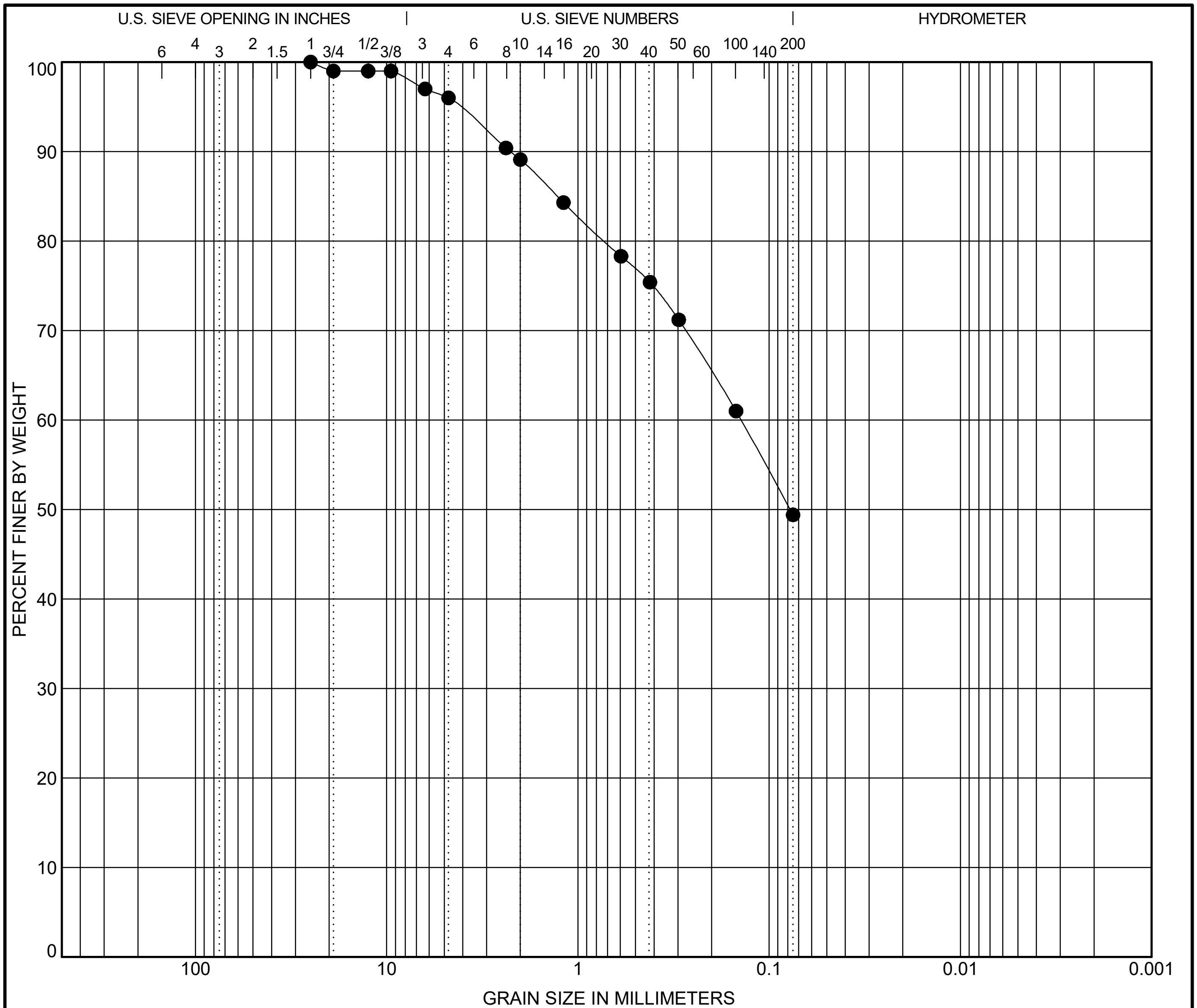
GRAIN SIZE DISTRIBUTION

Project: BUILD Grant - Flynn Lane

Location:

Number: 117-8960001

Figure No. 10



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SIEVE SIZE	% PASSING
1 in	100
3/4 in	99
1/2 in	99
3/8 in	99
1/4 in	97
No. 4	96
No. 8	90.4
No. 10	89.1
No. 16	84.3
No. 30	78.3
No. 40	75.4
No. 50	71.2
No. 100	61
No. 200	49.4

Specimen Identification
BH-3 - (2 - 5 ft)

Classification	LL	PL	PI	Cc	Cu
SILTY, CLAYEY SAND(SC-SM)					
	22	**16**	**6**		

% Gravel	% Sand	% Silt	% Clay
4	47	49	

D100	D60	D30	D10
25	0.14		

TETRA TECH

GRAIN SIZE DISTRIBUTION

Project: BUILD Grant - Flynn Lane

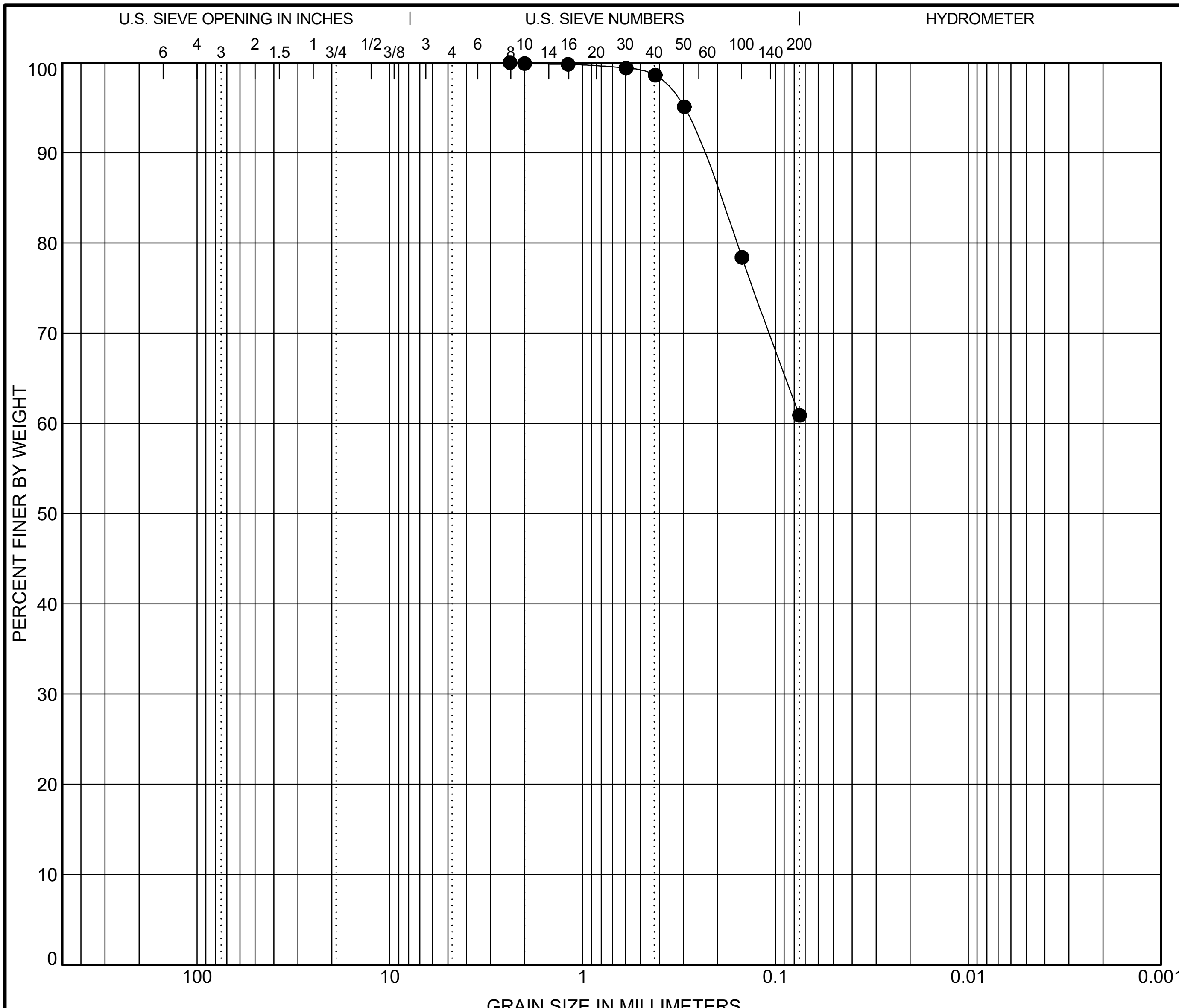
Location:

Number: 117-8960001

Figure No. 11

BUILD GRANT - FLYNN LANE BORING LOGS.GPJ ` 10-7-21 ` ` 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
No. 8	100
No. 10	99.9
No. 16	99.8
No. 30	99.4
No. 40	98.6
No. 50	95.1
No. 100	78.4
No. 200	60.9

Specimen Identification
BH-3 - (4 - 6 ft)

Classification	LL	PL	PI	Cc	Cu
SANDY LEAN CLAY(CL)					
	24	**16**	**8**		

% Gravel	% Sand	% Silt	% Clay
0	39	61	

D100	D60	D30	D10
2.38			

BUILD GRANT - FLYNN LANE BORING LOGS.GPJ ` 10-7-21 ` ` TT_US GRAIN SIZE (SIEVE DATA)

TETRA TECH

GRAIN SIZE DISTRIBUTION

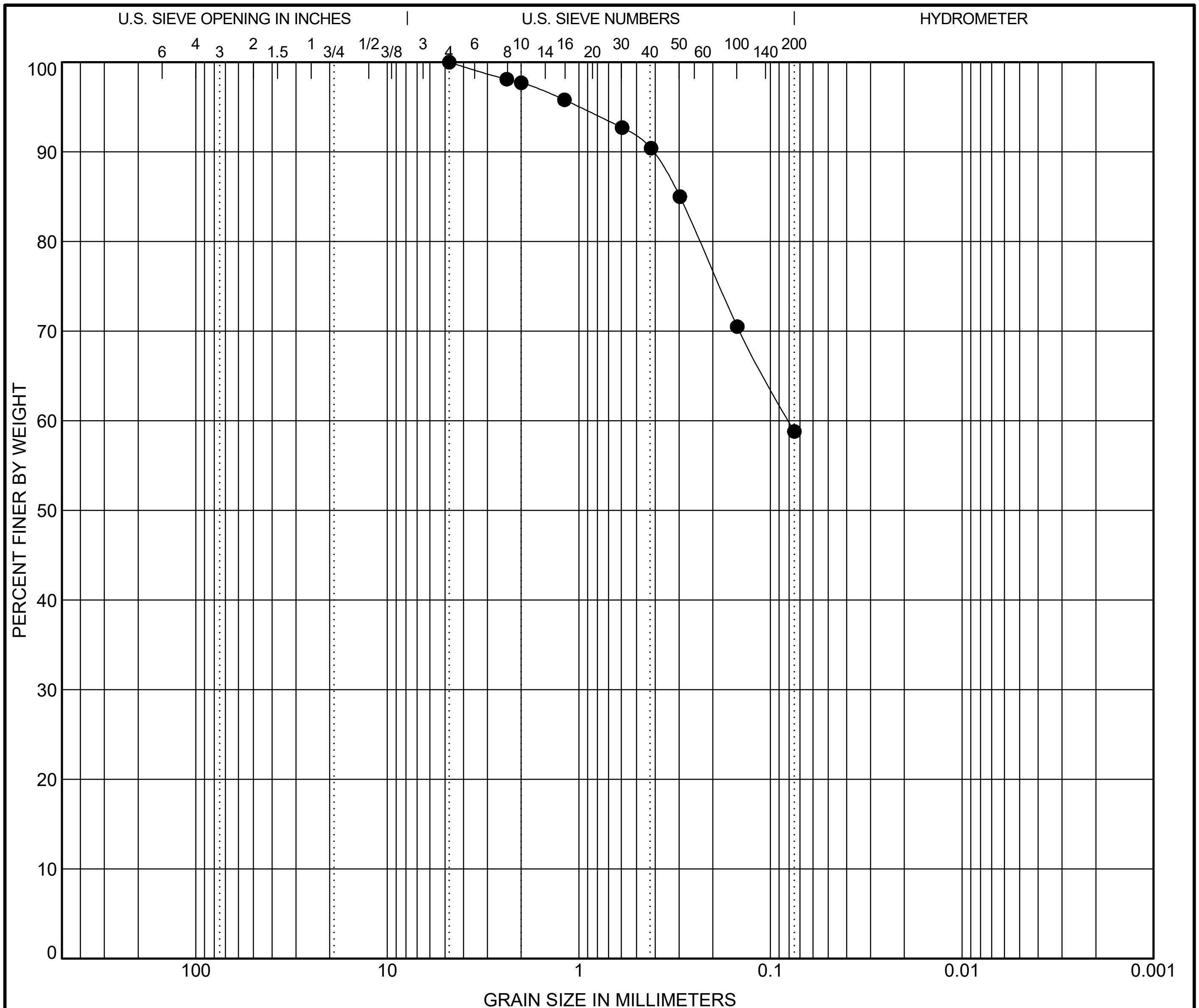
Project: BUILD Grant - Flynn Lane

Location:

Number: 117-8960001

Figure No. 12

Revised 1-23-08 (MAT)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SIEVE SIZE	% PASSING
No. 4	100
No. 8	98.1
No. 10	97.7
No. 16	95.8
No. 30	92.7
No. 40	90.4
No. 50	85
No. 100	70.5
No. 200	58.8

Specimen Identification
BH-4 - (3 - 6 ft)

Classification	LL	PL	PI	Cc	Cu
SANDY SILTY CLAY(CL-ML)					
	20	**16**	**4**		

% Gravel	% Sand	% Silt	% Clay
0	41	59	

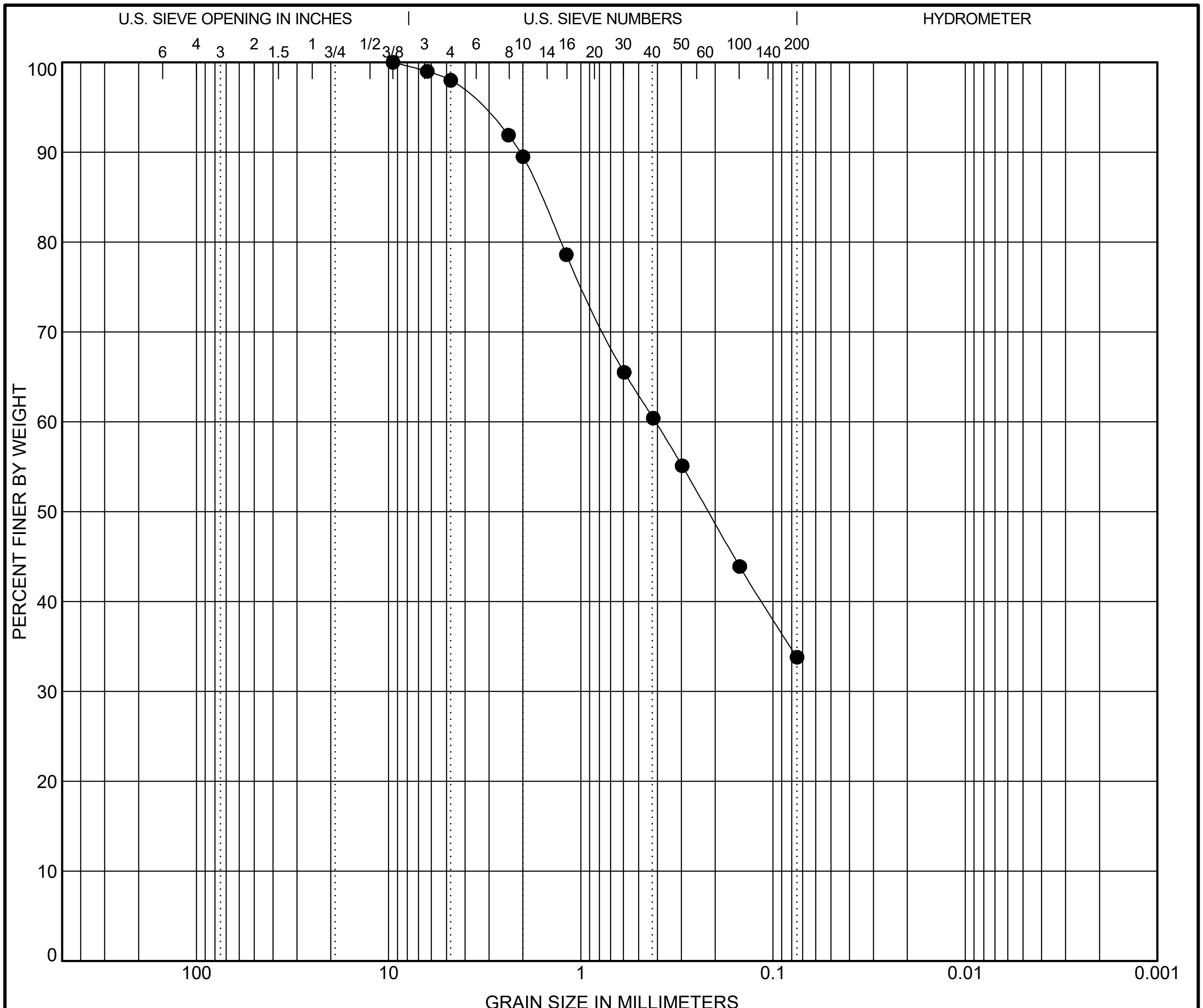
D100	D60	D30	D10
4.75	0.08		

GRAIN SIZE DISTRIBUTION

TETRA TECH

Project: BUILD Grant - Flynn Lane
Location:
Number: 117-8960001

Figure No. 13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SIEVE SIZE	% PASSING
3/8 in	100
1/4 in	99
No. 4	98
No. 8	91.9
No. 10	89.5
No. 16	78.6
No. 30	65.5
No. 40	60.4
No. 50	55.1
No. 100	43.9
No. 200	33.8

Specimen Identification
BH-7 - (2 - 3.5 ft)

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

% Gravel	% Sand	% Silt	% Clay
2	64	34	

D100	D60	D30	D10
9.5	0.409		

GRAIN SIZE DISTRIBUTION

TETRA TECH

Project: BUILD Grant - Flynn Lane

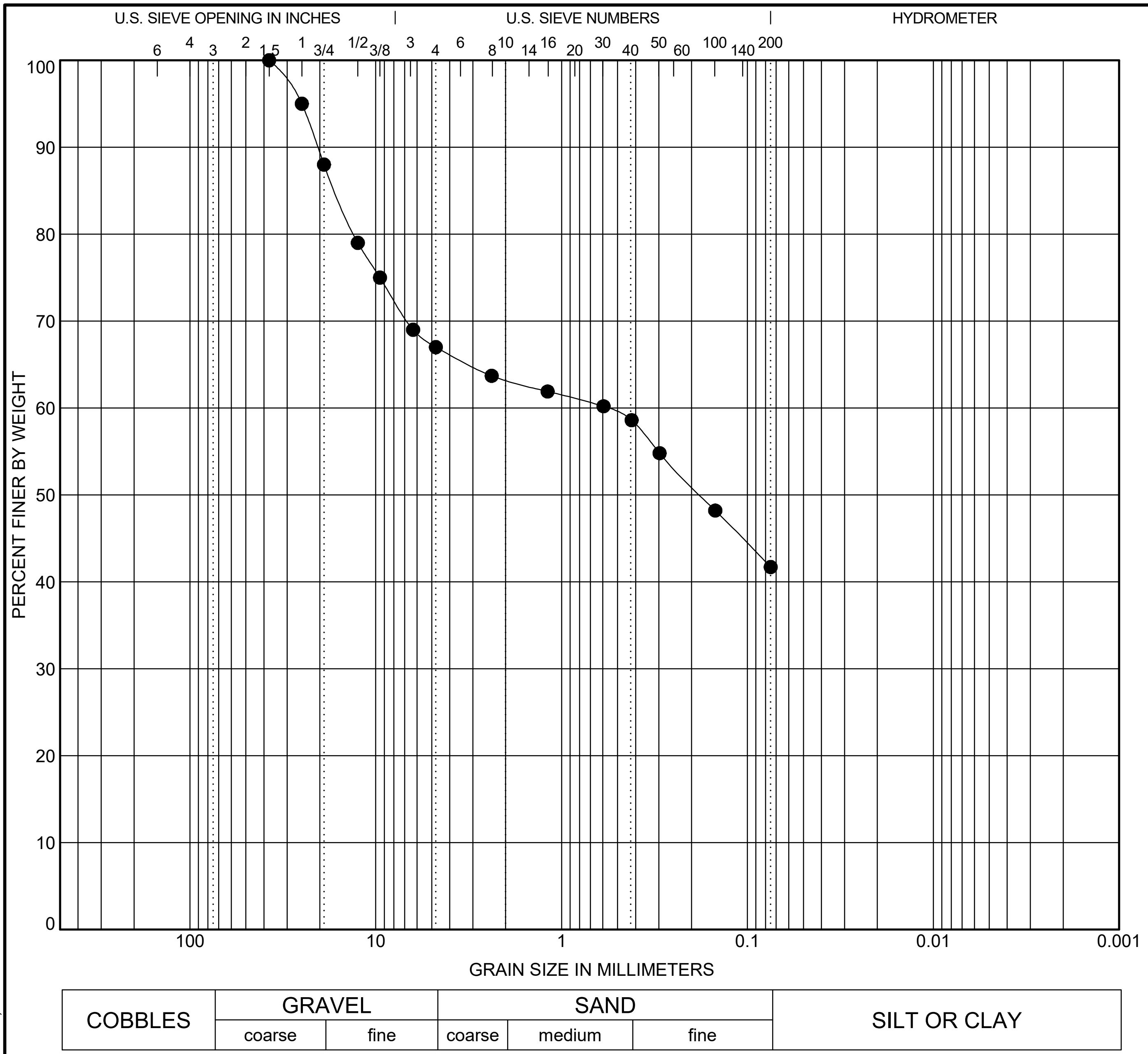
Location:

Number: 117-8960001

Figure No. 14

BUILD GRANT - FLYNN LANE BORING LOGS.GPJ ` 10-7-21 ` ` TT_US GRAIN SIZE (SIEVE DATA)

Revised 1-23-08 (MAT)



SIEVE SIZE	% PASSING
1.5 in	100
1 in	95
3/4 in	88
1/2 in	79
3/8 in	75
1/4 in	69
No. 4	67
No. 8	63.7
No. 16	61.9
No. 30	60.2
No. 40	58.6
No. 50	54.8
No. 100	48.2
No. 200	41.7

Specimen Identification
BH-9 - (3 - 7 ft)

Classification	LL	PL	PI	Cc	Cu
CLAYEY GRAVEL with SAND(GC)	**26**	**14**	**12**		

% Gravel	% Sand	% Silt	% Clay
33	25	42	

D100	D60	D30	D10
37.5	0.57		

TETRA TECH

GRAIN SIZE DISTRIBUTION

Project: BUILD Grant - Flynn Lane

Location:

Number: 117-8960001

Figure No. 15

BUILD GRANT - FLYNN LANE BORING LOGS.GPJ ` 10-7-21 ` ` TT_US GRAIN SIZE (SIEVE DATA)

Revised 1-23-08 (MAT)

Source of Material: **BH-1 (2.5 - 5 ft)**

Description of Material: **SANDY LEAN CLAY(CL)**

Test Method: **ASTM: 698A**

Hammer: __________

TEST RESULTS

Corrected Maximum Dry Density **117.7** pcf

Corrected Optimum Water Content **12.7** %

Rock Correction: 11% Oversize material on the #4 screen in accordance with ASTM D4718

GRADATION

% Gravel	% Sand	% Fines
11	**38**	**51**

ATTERBERG LIMITS

LL	PL	PI
30	**19**	**11**

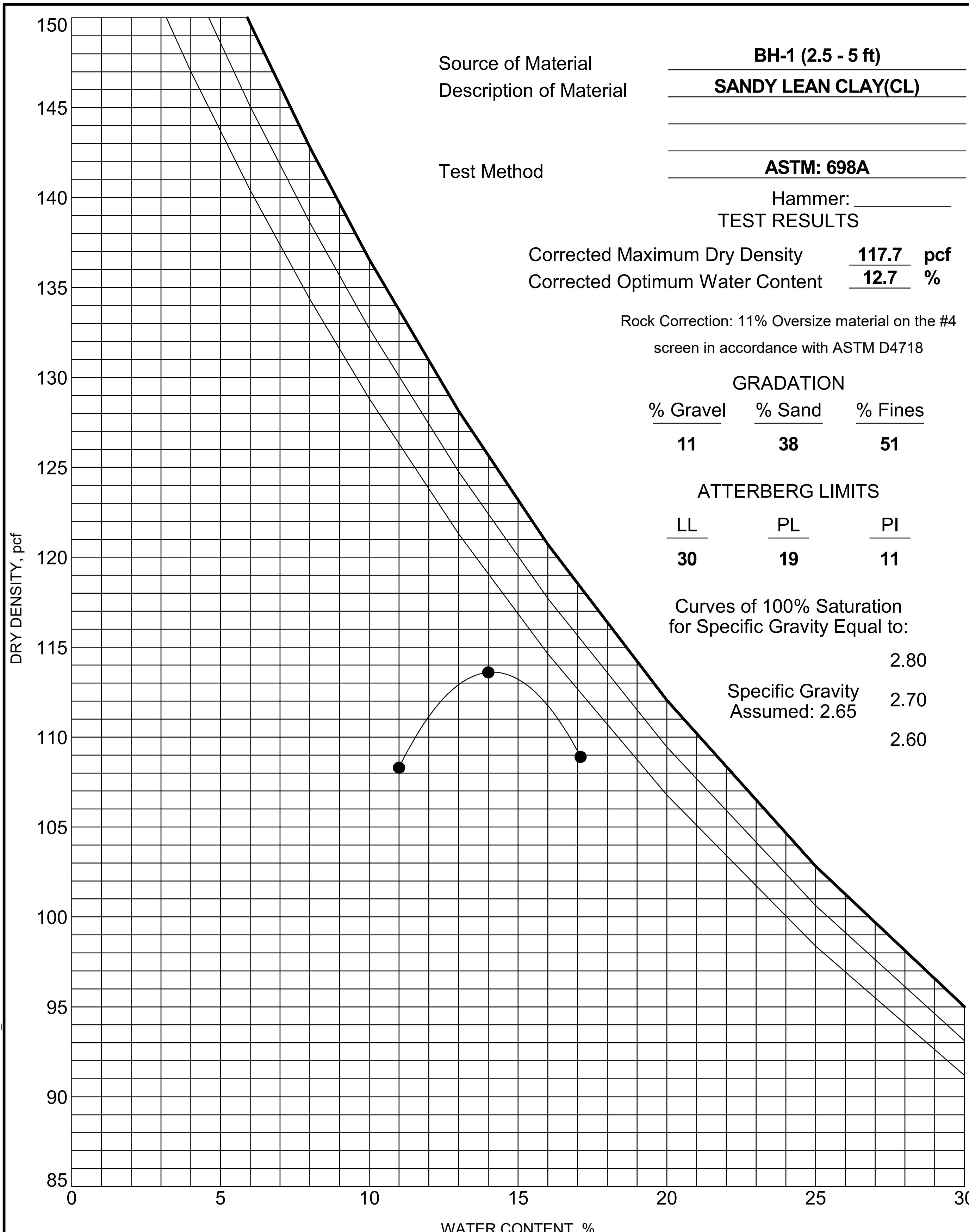
Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

Specific Gravity Assumed: 2.65



MOISTURE-DENSITY RELATIONSHIP

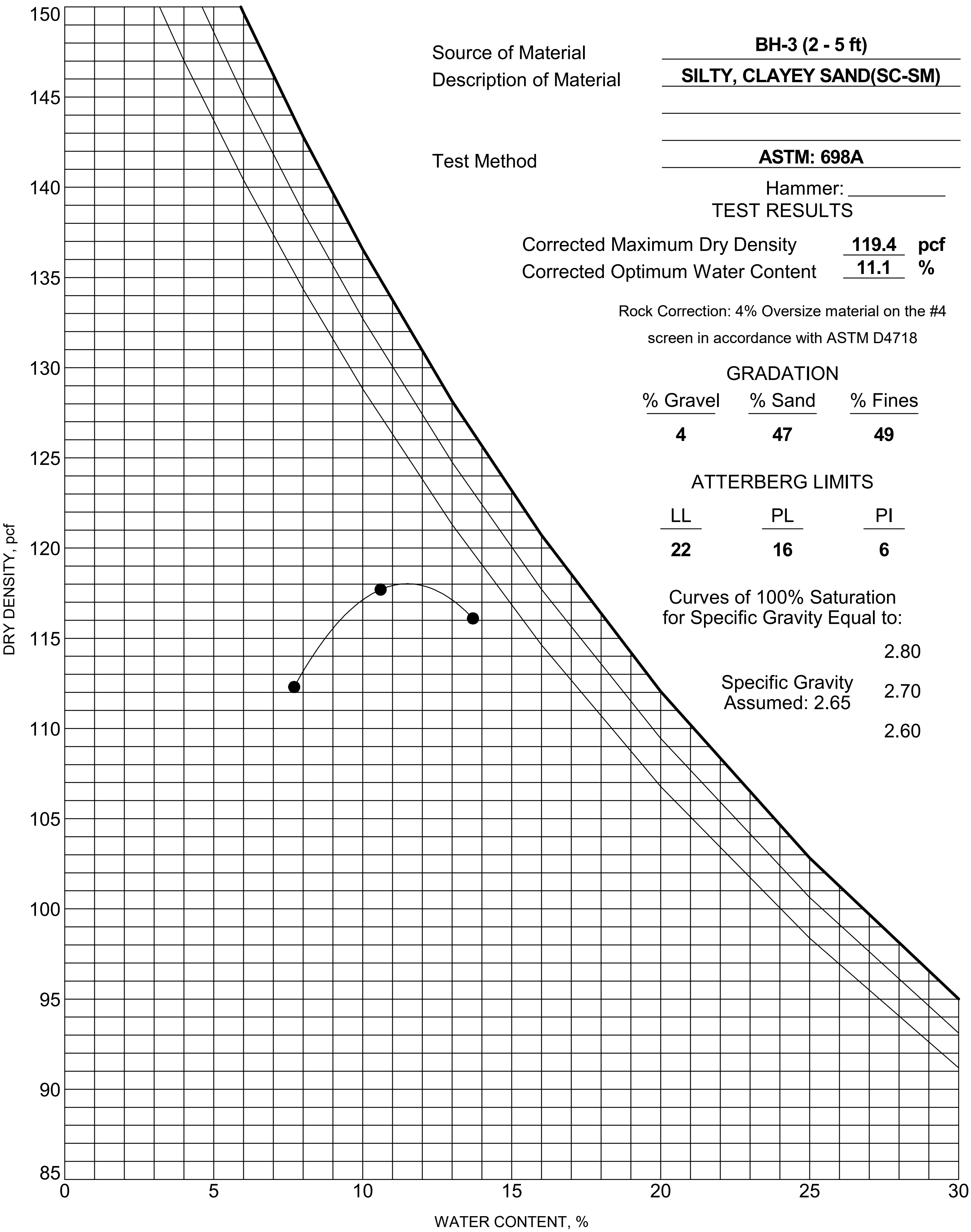
TETRA TECH

Project: BUILD Grant - Flynn Lane

Location:

Number: 117-8960001

Figure No. 16



Source of Material: **BH-3 (2 - 5 ft)**

Description of Material: **SILTY, CLAYEY SAND(SC-SM)**

Test Method: **ASTM: 698A**

Hammer: ___________

TEST RESULTS

Corrected Maximum Dry Density **119.4** pcf

Corrected Optimum Water Content **11.1** %

Rock Correction: 4% Oversize material on the #4 screen in accordance with ASTM D4718

GRADATION

% Gravel	% Sand	% Fines
4	47	49

ATTERBERG LIMITS

LL	PL	PI
22	16	6

Curves of 100% Saturation for Specific Gravity Equal to:

Specific Gravity Assumed: 2.65

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP

Project: BUILD Grant - Flynn Lane

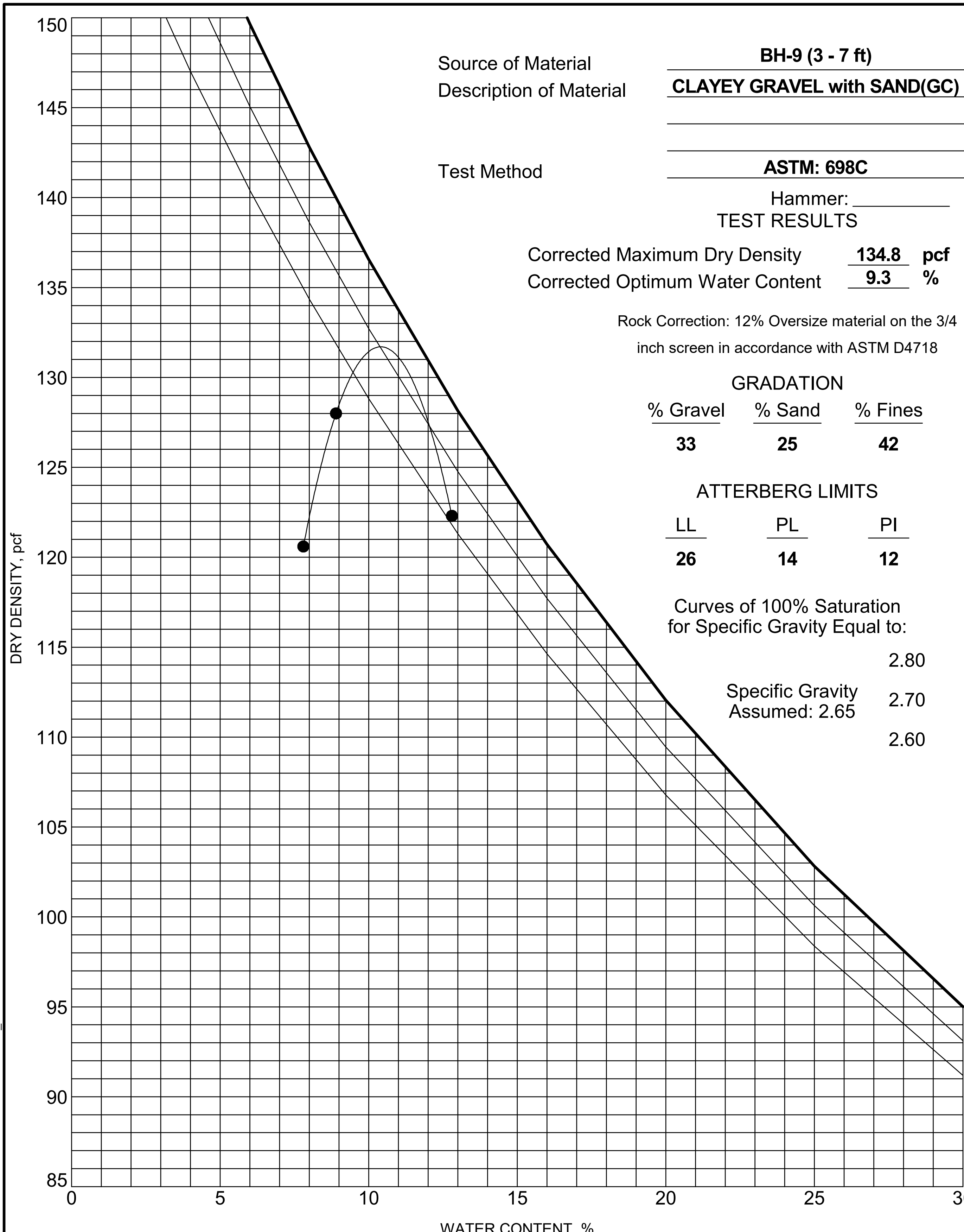
Location:

Number: 117-8960001

Figure No. 17

BUILD GRANT - FLYNN LANE BORING LOGS.GPJ ` 10-7-21 ` ` TT_COMPACTION W/CURVE

Revised 1-23-08 (MAT)



Source of Material	**BH-9 (3 - 7 ft)**
Description of Material	**CLAYEY GRAVEL with SAND(GC)**
Test Method	**ASTM: 698C**

Hammer: ___________

TEST RESULTS

Corrected Maximum Dry Density	**134.8**	**pcf**
Corrected Optimum Water Content	**9.3**	**%**

Rock Correction: 12% Oversize material on the 3/4 inch screen in accordance with ASTM D4718

GRADATION

% Gravel	% Sand	% Fines
33	**25**	**42**

ATTERBERG LIMITS

LL	PL	PI
26	**14**	**12**

MOISTURE-DENSITY RELATIONSHIP

TETRA TECH

Project: BUILD Grant - Flynn Lane

Location:

Number: 117-8960001

Figure No. 18

TETRA TECH

PROJECT:	Mullan Build	**PROJECT NO:**	0
LOCATION:	BH-9	**WORK ORDER NO:**	1
MATERIAL:	0	**LAB NO:**	1
SAMPLE SOURCE:	3-7 ft	**DATE SAMPLED:**	1/0/1900
REVIEWED BY:	0		

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

COMPACTION(%) 116.2

PERCENT SWELL 0.52%

PENETRATION	CORRECTED C B R
0.100	8
0.200	8

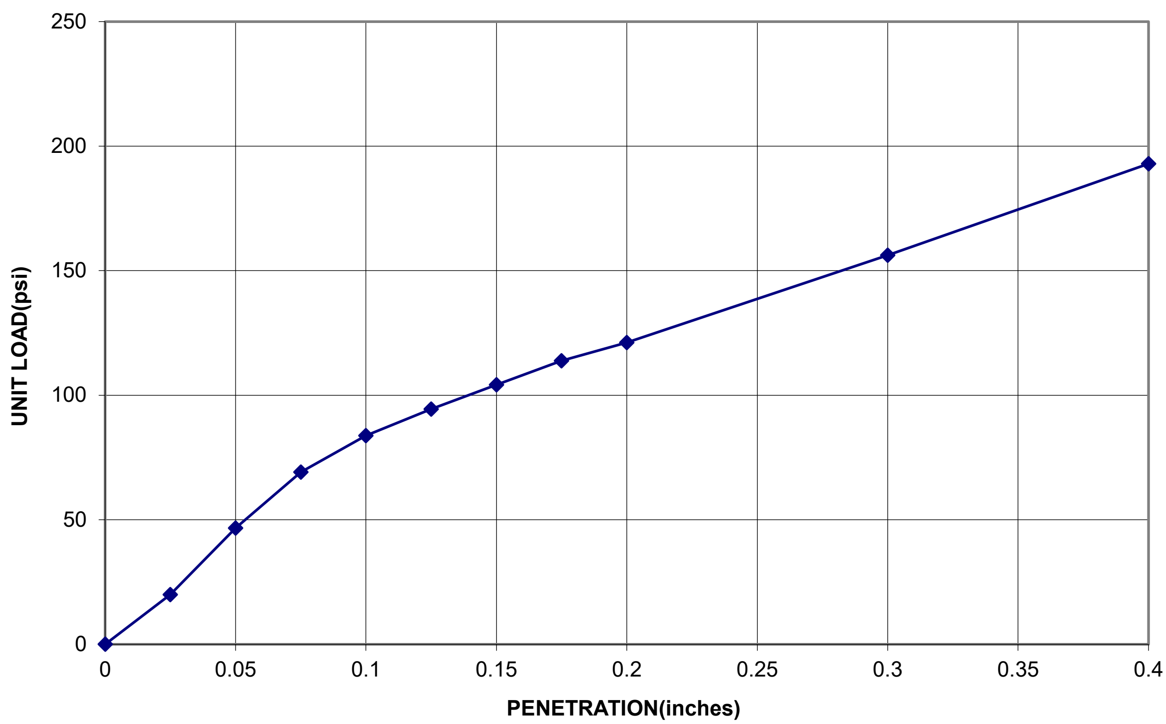
	BEFORE SOAK	AFTER SOAK
DRY DENSITY	124.1 lbs./cu.ft	125.1 lbs./cu.ft
PERCENT MOISTURE	9.3 %	11.2 %

D 698

DRY DENSITY(pcf) 106.8

MOISTURE(%) 18.2

SURCHARGE WEIGHT 10 lbs.



CBR 8

FIGURE 19

Bore Hole	Hole Depth	Test Date
BH-1	9' 5"	10/4/2021

Trial	Time of Reading (minutes)	Water Level from Bottom (ft)	Water Drop (in)	Percolation (mpi)
1	0	5		
	0.609	3	24	0.0254
2	0	5		
	0.469	3	24	0.0195
3	0	5		
	0.466	3	24	0.0194
4	0	5		
	0.46	3	24	0.0192
5	0	5		
	0.468	3	24	0.0195

Bore Hole	Hole Depth	Test Date
BH-2	11'4"	10/4/2021

Trial	Time of Reading (minutes)	Water Level from Bottom (ft)	Water Drop (in)	Percolation (mpi)
1	0	5		
	3.45	3	24	0.1438
2	0	5		
	3.38	3	24	0.1408
3	0	5		
	3.32	3	24	0.1383
4	0	5		
	3.55	3	24	0.1479

Bore Hole		Hole Depth	Test Date	
BH-3		12'	10/4/2021	

Trial	Time of Reading (minutes)	Water Level from Bottom (ft)	Water Drop (in)	Percolation (mpi)
1	0	5		
	2.98	3	24	0.1242
2	0	5		
	2.93	3	24	0.1221
3	0	5		
	2.87	3	24	0.1196
4	0	5		
	2.84	3	24	0.1183

Bore Hole	Hole Depth	Test Date
BH-4	7' 5"	10/4/2021

Trial	Time of Reading (minutes)	Water Level from Bottom (ft)	Water Drop (in)	Percolation (mpi)
1	0	5		
	2.382	3	24	0.0993
2	0	5		
	2.347	3	24	0.0978
3	0	5		
	2.274	3	24	0.0948
4	0	5		
	2.24	3	24	0.0933

	Bore Hole	Hole Depth	Test Date	
	BH-6	7' 2"	10/4/2021	

Trial	Time of Reading (minutes)	Water Level from Bottom (ft)	Water Drop (in)	Percolation (mpi)
1	0	5		
	0.873	3	24	0.0364
2	0	5		
	1.583	3	24	0.0660
3	0	5		
	1.473	3	24	0.0614
4	0	5		
	2.075	3	24	0.0865
5	0	5		
	2.062	3	24	0.0859
6	0	5		
	2.395	3	24	0.0998
7	0	5		
	2.178	3	24	0.0908
8	0	5		
	2.282	3	24	0.0951
9	0	5		
	2.306	3	24	0.0961

Bore Hole	Hole Depth	Test Date
BH-7	7' 2"	10/4/2021

Trial	Time of Reading (minutes)	Water Level from Bottom (ft)	Water Drop (in)	Percolation (mpi)
1	0	5		
	0.93	3	24	0.0388
2	0	5		
	0.83	3	24	0.0346
3	0	5		
	1.089	3	24	0.0454
4	0	5		
	1.097	3	24	0.0457
5	0	5		
	1.074	3	24	0.0448