| THE CHURCH OF **JESUS CHRIST** OF LATTER-DAY SAINTS | Geotechnical Evaluation Report |
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# Geotechnical Evaluation Report

PROPOSED SEMINARY BUILDING
WEST HAVEN JUNIOR HIGH SCHOOL

2078 SOUTH 2700 WEST

WEST HAVEN, UTAH

Prepared For:

The Church of Jesus Christ of Latter-day Saints
Utah North PM Office
435 North Wall Avenue, Suite D
Ogden, Utah 84404

Attention: Brian Childs

| AGEC Applied GeoTech<br>Project No. 1220786 | **Applied Geotechnical Engineering Consultants, Inc.**<br>January 9, 2023 | PROFESSIONAL ENGINEER 1/9/2023 No. 177892 JAY R. MCQUIVEY STATE OF UTAH |
|---|---|---|

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## EXECUTIVE SUMMARY

1. Approximately 1½ to 2 feet of fill and/or topsoil overlying silt and silty sand was encountered in the borings. The silt and silty sand contain some clay layers. This interlayered soil extends to a depth of approximately 7 feet below the ground surface. Sand was encountered below the interlayered soil and extends to a depth of approximately 10½ to 11 feet. It is underlain by clay in Boring B-1. The clay that extends to the maximum depth of Boring B-1, approximately 20½ feet.

   CPT soundings encountered predominantly silt and silty sand to a depth of approximately 7 feet underlain by sand to a depth of approximately 9½ feet. Clay was encountered between depths of about 9½ and 27 feet. Silt and clay were encountered between depths of approximately 27 and 36 feet. Predominantly sand was encountered from about 36 feet to the maximum depth of the CPT, approximately 40 feet, where practical refusal was met.

2. Subsurface water was encountered at depths of approximately 2½ to 3 feet based on measurements taken on January 5, 2023.

3. In our professional opinion, the site is suitable for the proposed development. However, the sand below the subsurface water level, extending from depths of approximately 3 to 11 feet below the ground surface, is potentially susceptible to liquefaction. Due to the relatively shallow depth of subsurface water and soil susceptible to liquefaction, it is our professional opinion that loss of foundation support is a potential risk if footings are supported too close to the liquefiable soil. There is a potential for liquefaction-induced settlement on the order of 1½ inches. Ground improvement such as aggregate piers extending to a depth of approximately 10 feet may be used to mitigate the liquefaction hazard at this site.

4. The proposed building may be supported on spread footings bearing on soil improved using aggregate piers or on compacted structural fill extending down to the improved soil. Where aggregate piers are used, the allowable bearing pressure would be determined by the aggregate pier designer.

5. The upper natural soil generally consists of silt and silty sand with some clay layers. Groundwater was found at a relatively shallow depth. Construction equipment access difficulties will likely be encountered for rubber-tired construction equipment, particularly where fill and topsoil removal extends near the subsurface water level. Placement of approximately 1½ to 2 feet of granular borrow will likely be needed to provide construction equipment access over the upper natural soil where it is very moist to wet.

6. Geotechnical information related to foundations, subgrade preparation, seismicity and liquefaction and materials is included in the report.

## INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed seminary building near West Haven Junior High School at 2078 South 2700 West in West Haven, Utah. The report is prepared for The Church of Jesus Christ of Latter-day Saints.

## AUTHORIZATION

Notice to proceed was given by email from Brian Childs of The Church of Jesus Christ of Latter-day Saints on December 1, 2022.

## PROJECT DESCRIPTION, PURPOSE OF EVALUATION, AND SCOPE OF WORK

This report has been prepared to provide geotechnical design information for the proposed seminary building. The report presents the subsurface conditions encountered at the site, laboratory test results and recommendations for foundation support and pavement. The study was conducted in general accordance with the scope of services outlined in our proposal dated September 21, 2022.

Field exploration was conducted to obtain information on the subsurface conditions. Samples obtained from the field investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil. Information obtained from the field and laboratory was used to define conditions at the site for our engineering analysis and to develop recommendations for the proposed foundations and pavement.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report.

Figures 1 and 2 are included with the report and present the locations of the borings and cone penetration test, logs of subsurface conditions encountered in the borings, legend and notes of borings and the results of laboratory testing. The results of the CPT are included in the appendix. Laboratory test results are summarized on Table I.

## DESIGN CRITERIA

We understand that the seminary building will be a single-story, wood-frame structure with a slab-on-grade floor.

We understand that wall loads will be between 2,000 and 4,000 pounds per lineal foot and column loads will be between 10,000 and 60,000 pounds.

We understand that paved parking and drive areas are planned. We have assumed the following traffic conditions for the pavement analysis:

| Pavement Area | Equivalent Single 18 kip Axle Loads |
|---|---|
| Parking | 6 per week |
| Drive Lanes | 15 per week |

A 40-year pavement life is assumed for the pavement design.

If the proposed construction or design criteria are different from those described above, we should be notified so that we can reevaluate the recommendations given.

**SITE CONDITIONS**

The site is located at approximately latitude 41.2302 degrees north and longitude 112.0407 degrees west.

The site consists of a vacant lot within the Fairhaven Phase 2 residential development. Subdivision improvements including roads and utilities have been constructed but the subject lot and the adjacent lots are vacant.

The site is relatively flat with a gentle slope down to the south. The site has an approximate elevation of 4,260 feet based on the USGS 7½ minute quadrangle map.

The site appears to be free of significant vegetation and was mostly snow covered at the time of our field study. There appears to be some fill spread over the eastern portion of the site.

Asphalt-paved roads with concrete curb and gutter are on the north and east sides of the site. There are homes to the north, vacant lots to the east and south and a junior high school to the west.

**FIELD STUDY**

Two borings were drilled and cone penetration test (CPT) soundings obtained on December 13, 2022. The approximate locations of the borings and CPT are shown on Figure 1. The borings were logged and soil samples obtained by a geologist from AGEC. Logs of the subsurface conditions encountered in the borings are graphically shown on Figure 2. The results of the CPT are included in the appendix.

## SUBSURFACE WATER AND SUBSURFACE SOIL CONDITIONS

Approximately 1½ to 2 feet of fill and/or topsoil overlying silt and silty sand was encountered in the borings. The silt and silty sand contain some clay layers. This interlayered soil extends to a depth of approximately 7 feet below the ground surface. Sand was encountered below the interlayered soil and extends to a depth of approximately 10½ to 11 feet. It is underlain by clay in Boring B-1. The clay that extends to the maximum depth of Boring B-1, approximately 20½ feet.

CPT soundings encountered predominantly silt and silty sand to a depth of approximately 7 feet underlain by sand to a depth of approximately 9½ feet. Clay was encountered between depths of about 9½ and 27 feet. Silt and clay were encountered between depths of approximately 27 and 36 feet. Predominantly sand was encountered from about 36 feet to the maximum depth of the CPT, approximately 40 feet, where practical refusal was met.

Subsurface water was encountered at depths of approximately 2½ to 3 feet based on measurements taken on January 5, 2023. Fluctuations in the subsurface water level will occur over time. An evaluation of the fluctuations in the subsurface water level is beyond the scope of this report.

A description of the soil encountered in the borings follows:

> Fill - The fill consists of lean clay with gravel. It is very moist to wet and dark brown.
>
> Topsoil - The topsoil consists of lean clay to silty sand. It is very moist to wet, dark brown and contains roots.
>
> Lean Clay - The clay is soft, wet and grayish brown.

Silt and Silty Sand - The silt and sand are interlayered and contain occasional lean clay layers. The interlayered soil is loose to medium dense, very moist to wet and brown.

Poorly-graded Sand - The sand is medium dense, wet and brown.

## LABORATORY TESTING

### A. General

A laboratory testing program was conducted to determine engineering characteristics of the subsurface soil. Results of the laboratory tests are summarized on Table I and are included on the boring logs.

### B. Gradation Analysis

One sample of clay was tested in the laboratory for percent passing the No. 200 sieve. The sample of clay tested was found to have 99 percent passing the No. 200 sieve.

Four samples of the interlayered soil were tested in the laboratory for percent passing the No. 200 sieve. Samples tested were generally found to have 22 to 33 percent passing the No. 200 sieve except for a test representing a clay layer, which was found to have 92 percent passing the No. 200 sieve.

A sample of the sand tested in the laboratory was found to have 2 percent passing the No. 200 sieve.

### C. Atterberg Limit Tests

No Atterberg limit tests were conducted for this study.

### D. Natural In-Place Moisture and Density Tests

A sample of clay tested in the laboratory was found to have a natural moisture content of 29 percent and a natural dry density of 93 pounds per cubic foot (pcf).

Samples of the interlayered soil tested in the laboratory were found to have natural moisture contents of 14 to 22 percent and natural dry densities of 104 to 116 pcf.

A sample of the sand tested in the laboratory was found to have a natural moisture content of 19 percent and a natural dry density of 98 pcf.

### E. Consolidation Tests

Two consolidation tests were conducted on samples of the upper interlayered soil. The test results indicate that the soil will compress a small to moderate amount with the addition of light to moderate loads. Results of these consolidation tests are presented on Figures 3 and 5.

A consolidation test was conducted on a sample of the lean clay from a depth of 14 feet. The test results indicate that the soil will compress a small to moderate amount with the addition of light to moderate loads. Results of the consolidation test are presented on Figure 4.

### F. Unconfined Compressive Strength Tests

No unconfined compressive strength tests were conducted for this study.

## G. Chemical Tests

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. The sample tested was found to have less than 0.1 percent water soluble sulfates. The test results indicate that the sample tested has a negligible sulfate attack potential on concrete. No special cement type is required for concrete placed in contact with the natural soil based on the results of this test.

## H. Topsoil

A sample of topsoil obtained from Boring B-1 was submitted to a subcontract laboratory for topsoil evaluation. Topsoil testing was not completed by the time of this report and the results will be provided when they become available.

# FINDINGS AND RESULTS

Approximately 1½ to 2 feet of fill and/or topsoil overlying silt and silty sand was encountered in the borings. The silt and silty sand contain some clay layers. This interlayered soil extends to a depth of approximately 7 feet below the ground surface. Sand was encountered below the interlayered soil and extends to a depth of approximately 10½ to 11 feet. It is underlain by clay in Boring B-1. The clay that extends to the maximum depth of Boring B-1, approximately 20½ feet.

CPT soundings encountered predominantly silt and silty sand to a depth of approximately 7 feet underlain by sand to a depth of approximately 9½ feet. Clay was encountered between depths of about 9½ and 27 feet. Silt and clay were encountered between depths of approximately 27 and 36 feet. Predominantly sand was encountered from about 36 feet to the maximum depth of the CPT, approximately 40 feet, where practical refusal was met.

Subsurface water was encountered at depths of approximately 2½ to 3 feet based on measurements taken on January 5, 2023.

Logs of the borings are presented on Figure 2. The elevations of the borings are indicated on the logs and reference a benchmark with an assumed elevation of 100 feet. The benchmark is a sewer manhole cover at the approximate location shown on Figure 1.

The soils are identified by visual and laboratory classifications based on the Unified Soil Classification System. A chart for the Unified Soil Classification System is included in the appendix.

## RECOMMENDATIONS AND CONCLUSIONS

### A. General

In our professional opinion, the site is suitable for the proposed development. However, the sand below the subsurface water level, extending from depths of approximately 3 to 11 feet below the ground surface, is potentially susceptible to liquefaction. Due to the relatively shallow depth of subsurface water and soil susceptible to liquefaction, it is our professional opinion that loss of foundation support is a potential risk if footings are supported too close to the liquefiable soil. There is a potential for liquefaction-induced settlement on the order of 1½ inches. Ground improvement such as aggregate piers extending to a depth of approximately 10 feet may be used to mitigate the liquefaction hazard at this site.

The proposed building may be supported on spread footings bearing on soil improved using aggregate piers or on compacted structural fill extending down to the improved soil. Where aggregate piers are used, the allowable bearing pressure would be determined by the aggregate pier designer.

**B. Temporary Excavations**

Temporary excavations in the natural soil may be sloped at 1½ horizontal to 1 vertical or flatter. The temporary excavation slopes indicated assume that the excavation is dewatered. Flatter slopes may be needed if there is water seepage into the excavation.

**C. Utility Trenches**

Utility trenches that do not extend below the original free water level may be backfilled with the natural soil exclusive of organics, debris and other deleterious material or may be backfilled with imported fill meeting project specifications. Utility trenches that extend below the original free water level should be backfilled with free-draining gravel.

Utility trench backfill should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D 1557, except below the building area where it should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557 and should meet the material recommendations given for structural fill.

**D. Site Grading**

We anticipate that the main floor elevation will be within approximately 2 feet of existing grade.

If the site is raised on the order of 3 feet or more above the original grade, the site grading fill should be placed at least 2 to 4 months prior to construction of elements of the building that are sensitive to differential settlement. The settlement due to the load of the fill should be monitored to determine when the significant portion of the settlement has occurred and construction may proceed.

1. Subgrade Preparation

Prior to placing grading fill or base course, the unsuitable fill, organics, topsoil, debris and other deleterious materials should be removed.

The upper natural soil generally consists of silt and silty sand with some clay layers. Groundwater was found at a relatively shallow depth. Construction equipment access difficulties will likely be encountered for rubber-tired construction equipment, particularly where fill and topsoil removal extends near the subsurface water level. Placement of approximately 1½ to 2 feet of granular borrow will likely be needed to provide construction equipment access over the upper natural soil where it is very moist to wet. Consideration may be given to placing a support fabric below the granular borrow.

2. Excavation

We anticipate that excavation at the site can be accomplished with typical excavation equipment. Care should be taken to avoid disturbing the natural soil to remain below building foundations.

Excavations that extend below the water level should be dewatered. The water level should be maintained below the base of the excavation during initial fill and concrete placement. Free-draining gravel with less than 5 percent passing the No. 200 sieve should be used for fill or backfill below the original water level. A filter fabric should be placed between the natural soil and free-draining gravel.

3. Cut and Fill Slopes

Permanent, unretained cut and fill slopes may be constructed at 2 horizontal to 1 vertical or flatter. Cut and fill slopes should be protected from erosion by revegetation or other methods. Surface drainage should be directed away from cut and fill slopes.

4. Materials

Listed below are materials recommended for imported structural fill:

| Fill to Support | Recommendations |
|---|---|
| Footings | Non-expansive granular soil<br>Passing No. 200 Sieve < 35%<br>Liquid Limit < 30%<br>Maximum size 4 inches |
| Floor Slab<br>(Upper 4 inches) | Sand and/or Gravel<br>Passing No. 200 Sieve < 5%<br>Maximum size 2 inches |
| Slab Support | Non-expansive granular soil<br>Passing No. 200 Sieve < 50%<br>Liquid Limit < 30%<br>Maximum size 6 inches |

The existing fill and natural soil with a relatively high silt or clay content and not meeting the recommendations given above for imported structural fill are not recommended for use as structural fill below the proposed building area. The natural sand that meets the recommendations given above for imported structural fill may considered for use as structural fill within the proposed building area or as site grading fill or backfill. Soil used as structural fill, site grading fill or backfill should be free of topsoil, organics, debris and other deleterious materials.

The use of onsite soil as fill will likely require moisture conditioning (wetting or drying of the soil) to facilitate compaction. Drying of the soil may not be practical during cold or wet times of the year.

Free-draining gravel with less than 5 percent passing the No. 200 sieve should be used as fill below the original free water level.

5. Compaction

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D 1557.

| Fill To Support | Compaction Criteria |
|---|---|
| Foundations | $\geq$ 95% |
| Concrete Slabs | $\geq$ 90% |
| Pavement | |
| Base Course | $\geq$ 95% |
| Fill placed below Base Course | $\geq$ 90% |
| Landscaping | $\geq$ 85% |
| Retaining Wall Backfill | 85 - 90% |

The moisture of the soil should be adjusted to within 2 percent of the optimum moisture content to facilitate compaction.

Fill materials placed for the project should be frequently tested for compaction. Full-time observation and testing should be provided for fill placed below the proposed building area. Fill should be placed in thin enough lifts to allow for proper compaction.

6. Drainage

The ground surface surrounding the proposed building should be sloped away from the building in all directions. Roof downspouts and drains should discharge beyond the limits of backfill.

## E. Foundations

1. Bearing Material

We anticipate that ground improvement measures such as aggregate piers will be used to mitigate the liquefaction hazard. Spread footings may bear on the improved soil or on compacted structural fill that extends down to the improved soil. The allowable bearing pressure and anticipated settlement for spread footings supported on the improved soil would be determined by the specialty contractor designing the aggregate pier system.

2. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

3. Foundation Base

The base of foundation excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

4. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

## F. Interior Concrete Slabs on Grade

1. Slab Support

   Concrete slabs may be supported on the undisturbed natural soil or on compacted structural fill that extends down to the undisturbed natural soil.

   The topsoil, unsuitable fill, organics, debris and other deleterious materials should be removed from below proposed slabs.

2. Underslab Sand and/or Gravel

   A 4-inch layer of free-draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below the concrete slabs for ease of construction and to promote even curing of the slab concrete.

3. Vapor Barrier

   A vapor barrier should be placed under the concrete floor slab if the floor will receive an impermeable floor covering. The barrier will reduce the amount of water vapor passing from below the slab to the floor covering.

4. Cement Type

   The natural soil tested in the laboratory was found to have a negligible sulfate attack potential on concrete. No special cement type is required for concrete placed in contact with the natural soil.

## G. Exterior Concrete Slabs-on-Grade (Sidewalks, Curbs, Gutters, Misc.)

1. Slab Support

   Exterior concrete slabs may be supported on the undisturbed natural soil or on properly compacted fill extending down to the undisturbed natural soil.

2. Concrete Type

The results of a water soluble content test conducted on the natural soil indicate that there is negligible water soluble sulfates in the natural soil. No special cement type is required for concrete placed in contact with the natural soil.

## H. Sliding Resistance of Soils

Lateral resistance for footings placed on compacted structural fill or the natural sand is controlled by sliding resistance between the footing and foundation soil. A friction coefficient of 0.45 may be used in design for ultimate lateral resistance. The passive resistance of the soil adjacent footings may also be considered in design for lateral resistance of footings.

## I. Lateral Earth Pressures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. The following values assume a horizontal surface adjacent the top and bottom of the wall.

| Soil Type | Active | At-Rest | Passive |
|---|---|---|---|
| Clay & Silt | 50 pcf | 65 pcf | 250 pcf |
| Sand & Gravel | 40 pcf | 55 pcf | 300 pcf |

Under seismic conditions, the equivalent fluid weight should be increased by 39 pcf for the active condition, increased by 24 pcf for the at-rest condition and decreased by 39 pcf for the passive condition. This assumes a peak horizontal ground acceleration of 0.64g for a 2 percent probability of exceedance in a 50-year period.

The values recommended above for active and passive conditions assume mobilization of the soil to achieve the soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

## J. Seismicity Hazard Concerns, Liquefaction, Seismicity and Faulting

1. Building Code Parameters

Listed below is a summary of the site parameters that may be used with the 2018 International Building Code:

| Description | Value[1] |
|---|---|
| Site Class | F[2] |
| $S_s$ - $MCE_R$ ground motion (period = 0.2s) | 1.27g |
| $S_1$ - $MCE_R$ ground motion (period = 1.0s) | 0.45g |
| $F_a$ - Site amplification factor at 0.2s | 1.2[3] |
| PGA - $MCE_G$ peak ground acceleration | 0.57g |
| $PGA_M$ - Site modified peak ground acceleration | 0.64g |

*[1]Values obtained from information provided by the Applied Technology Council at https://hazards.atcouncil.org*

*[2]Site Class F was selected based on a potential for liquefaction-induced settlement and potential for loss of foundation support to occur for foundations supported near the soil layers susceptible to liquefaction. Site Class E would be selected based on conditions encountered to a depth of approximately 50 feet where the liquefaction hazard is mitigated. It was assumed that conditions similar to the upper 50 feet continue to a depth of 100 feet.*

*[3]As per section 20.3.1 of ASCE 7-16, an exception for performing a site response analysis is given for structures having fundamental periods of vibration less than 0.5 seconds. In our professional opinion, the value of Fa given in Table 11.4-1 for Site Class E may be used if the exception indicated in 20.3.1 of ASCE 7-16 is appropriate or if the liquefaction hazard is mitigated using ground improvement such as aggregate piers.*

2. Faulting

There are no mapped active faults extending near or through the site. The closest mapped fault considered to be active is the Wasatch Fault located approximately 5.4 miles east of the site (UGS, 2023).

3. Liquefaction

The site is located within an area mapped as have a "high" liquefaction potential (Anderson and others, 1994). The soil type most susceptible to liquefaction during a large magnitude earthquake is loose, clean sand. The liquefaction potential tends to decrease with an increase in fines content and density.

A site-specific evaluation of the liquefaction potential was conducted based on the CPT. The sand below the subsurface water level, extending from depths of approximately 3 to 11 feet below the ground surface, is potentially susceptible to liquefaction. Due to the relatively shallow depth of subsurface water and soil susceptible to liquefaction, it is our professional opinion that loss of foundation support is a potential risk if footings are supported too close to the liquefiable soil. There is a potential for liquefaction-induced settlement on the order of 1½ inches. Ground improvement such as aggregate piers may be used to mitigate the liquefaction hazard at this site.

## K. Pavement

Based on the subsurface soil conditions encountered, laboratory test results and the anticipated traffic described in the Proposed Construction section of the report, the following pavement support recommendations are given:

1. Subgrade Support

The near surface soil consists of silt, silty sand and lean clay layers. A CBR of 3 percent was assumed for the subgrade soil.

2. Pavement Thickness

The pavement thicknesses calculated are based on the subsurface soil conditions, traffic conditions given, a design life of 40 years and methods presented by AASHTO.

a) Parking Areas

A pavement section consisting of 3 inches of asphaltic concrete overlying 9 inches of base course is recommended. The base course thickness may be reduced to 6 inches where at least 6 inches of granular borrow is provided. Alternatively, a pavement section consisting of 5 inches of Portland cement concrete may be used.

b) Drive Lanes

A pavement section consisting of 3 inches of asphaltic concrete overlying 12 inches of base course is recommended. The base course thickness may be reduced to 6 inches where at least 7 inches of granular borrow is provided. Alternatively, a pavement section consisting of 5 inches of Portland cement may be used.

c) Trash Enclosure Approach Slab

A Portland cement concrete section consisting of 6½ inches of Portland cement concrete overlying 4 inches of base course is recommended.

3. Maintenance

Routine maintenance for pavements should be anticipated. Asphaltic concrete pavements are typically designed for a design life of 20 years. The pavement sections given above are based on the requested design traffic over a 40-year period. The pavement surface will experience wear and deterioration over time and will likely require placement of surface treatments and/or milling/overlay during the requested design life.

4. Pavement Materials and Construction

The pavement materials should meet project material and compaction specifications.

5. Jointing

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab. The joint spacings indicated should accommodate the contraction of the concrete and under these conditions steel reinforcing will not be required. The depth of joints should be approximately one-fourth of the slab thickness.

6. Testing

Pavement materials should be tested for conformance with project specifications. Compaction testing and concrete testing should be performed in accordance with project specifications.

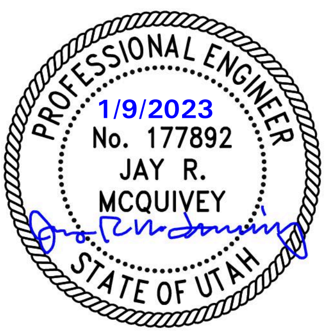
## L. Preconstruction Meeting

A preconstruction meeting should be held with representatives of the owner, project architect, geotechnical engineer, general contractor and earthwork contractor to review construction plans, specifications, methods and schedule.

**LIMITATIONS**

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled and CPT soundings at the approximate locations indicated on Figure 1 and the data obtained from laboratory testing. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the proposed construction, subsurface conditions or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate the recommendations given.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.




Jay R. McQuivey, P.E.

Reviewed by Douglas R. Hawkes, P.E., P.G.

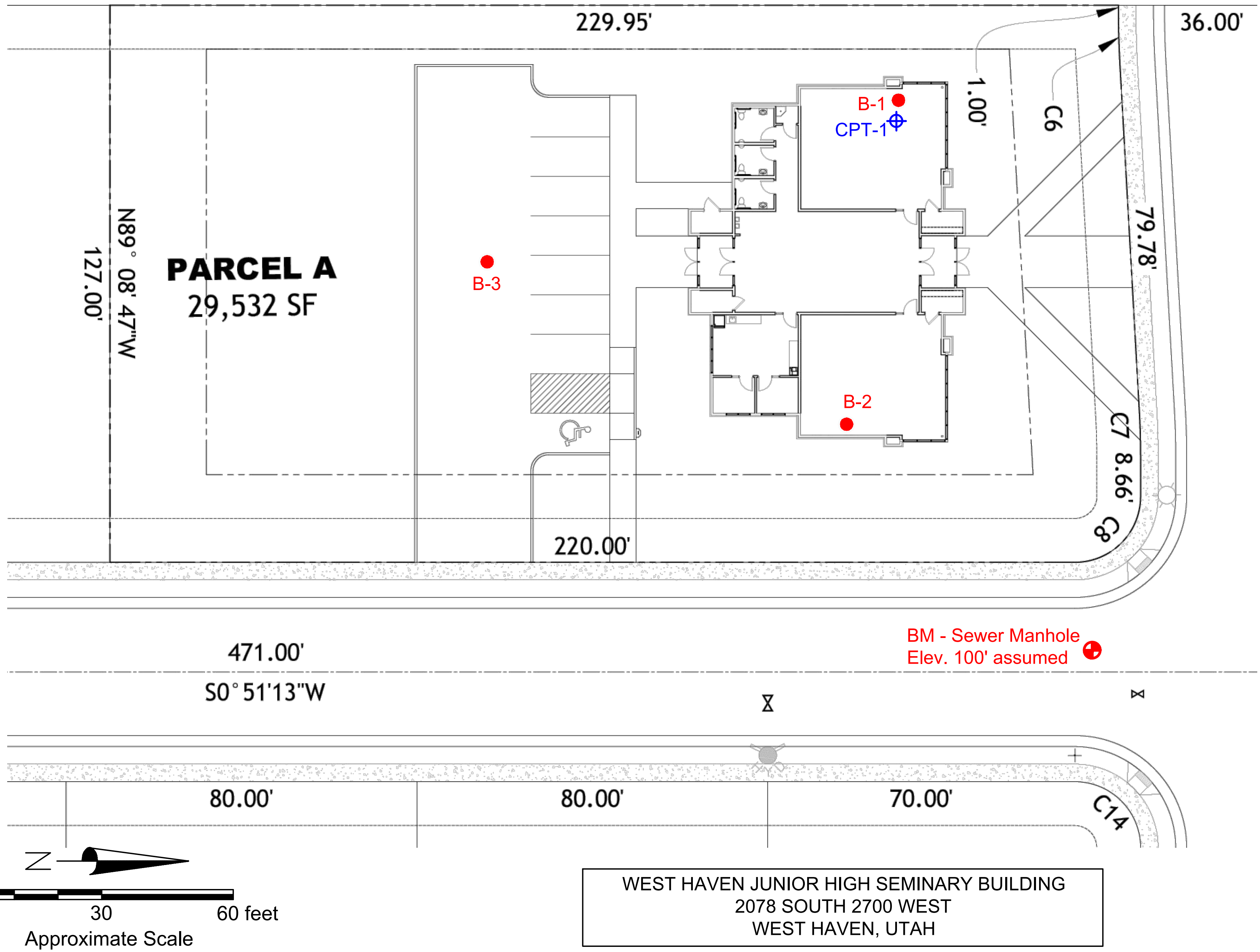
JRM/bw

## REFERENCES

American Society of Civil Engineers, 2017; Minimum design loads and associated criteria for buildings and other structures: ASCE/SEI 7-16, Reston, Virginia.

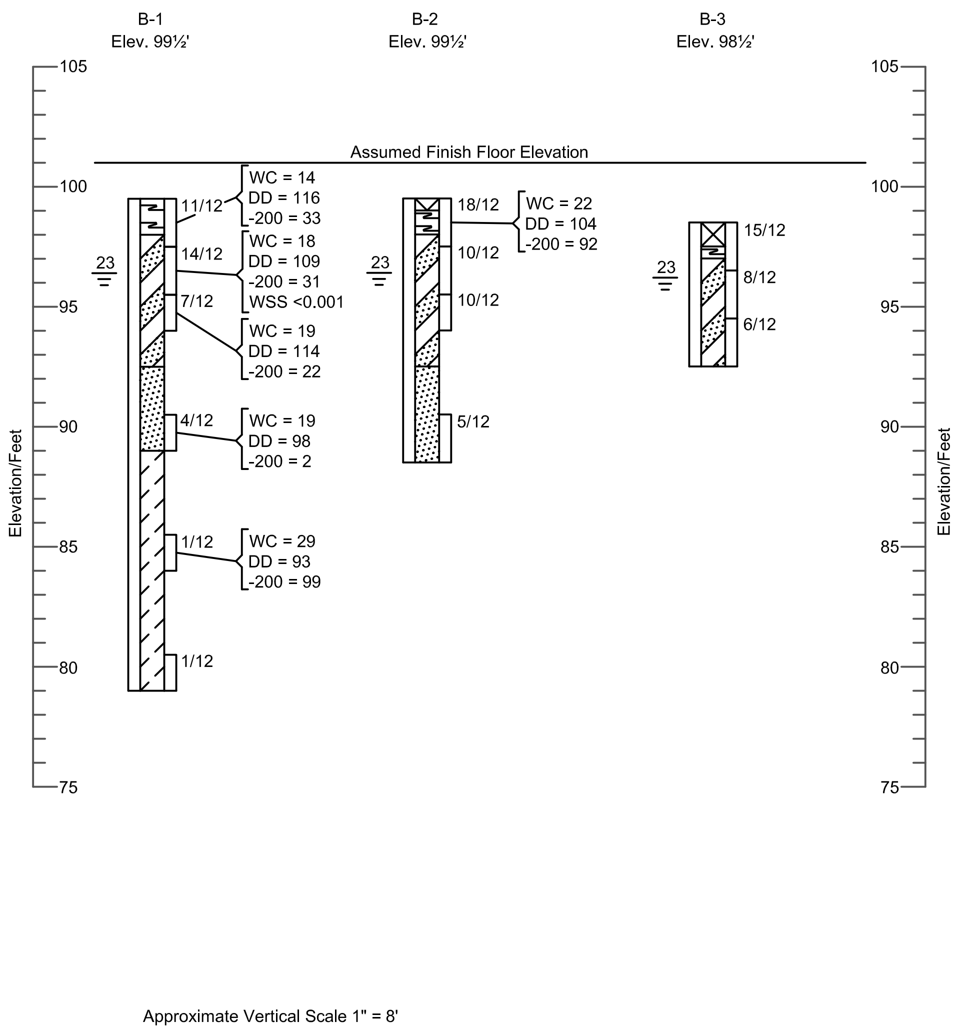
Anderson, L.R., Keaton, J.R., and Bay, J., 1994; Liquefaction Potential Map for Weber County, Utah; Utah Geological Survey Contract Report 94-1.

Utah Geological Survey, 2022; Utah Quaternary Fault and Fold Database, http://geology.utah.gov/apps/qfaults accessed January 5, 2023.




WEST HAVEN JUNIOR HIGH SEMINARY BUILDING
2078 SOUTH 2700 WEST
WEST HAVEN, UTAH

| | | | |
|---|---|---|---|
| 1220786 | AGEC | Exploratory Boring and CPT Locations | Figure 1 |




LEGEND:

Fill; lean clay with gravel, very moist to wet, dark brown.

Topsoil; lean clay to silty sand, very moist to wet, dark brown, roots.

Lean Clay (CL); soft, wet, grayish brown.

Silt and Silty Sand (ML/SM); interlayered, occasional lean clay layers, loose to medium dense, very moist to wet, brown.

Poorly-graded Sand (SP); medium dense, wet, brown.

10/12 California Drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound automatic hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates slotted 1½ inch PVC pipe installed in the boring to the depth shown.

23 Indicates the depth to free water and the number of days after drilling the measurement was taken.

NOTES:

1. The borings were drilled on December 13, 2022 with direct push.
2. The locations of the borings were measured approximately by pacing from features shown on the site plan provided.
3. The elevations of the borings were measured by automatic level and refer to the benchmark shown on Figure 1.
4. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the boring logs represent the approximate boundaries between material types and the transitions may be gradual.
6. The water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water will occur with time.
7. WC = Water Content (%);
DD = Dry Density (pcf);
-200 = Percent Passing the No. 200 Sieve;
WSS = Water Soluble Sulfates (%).

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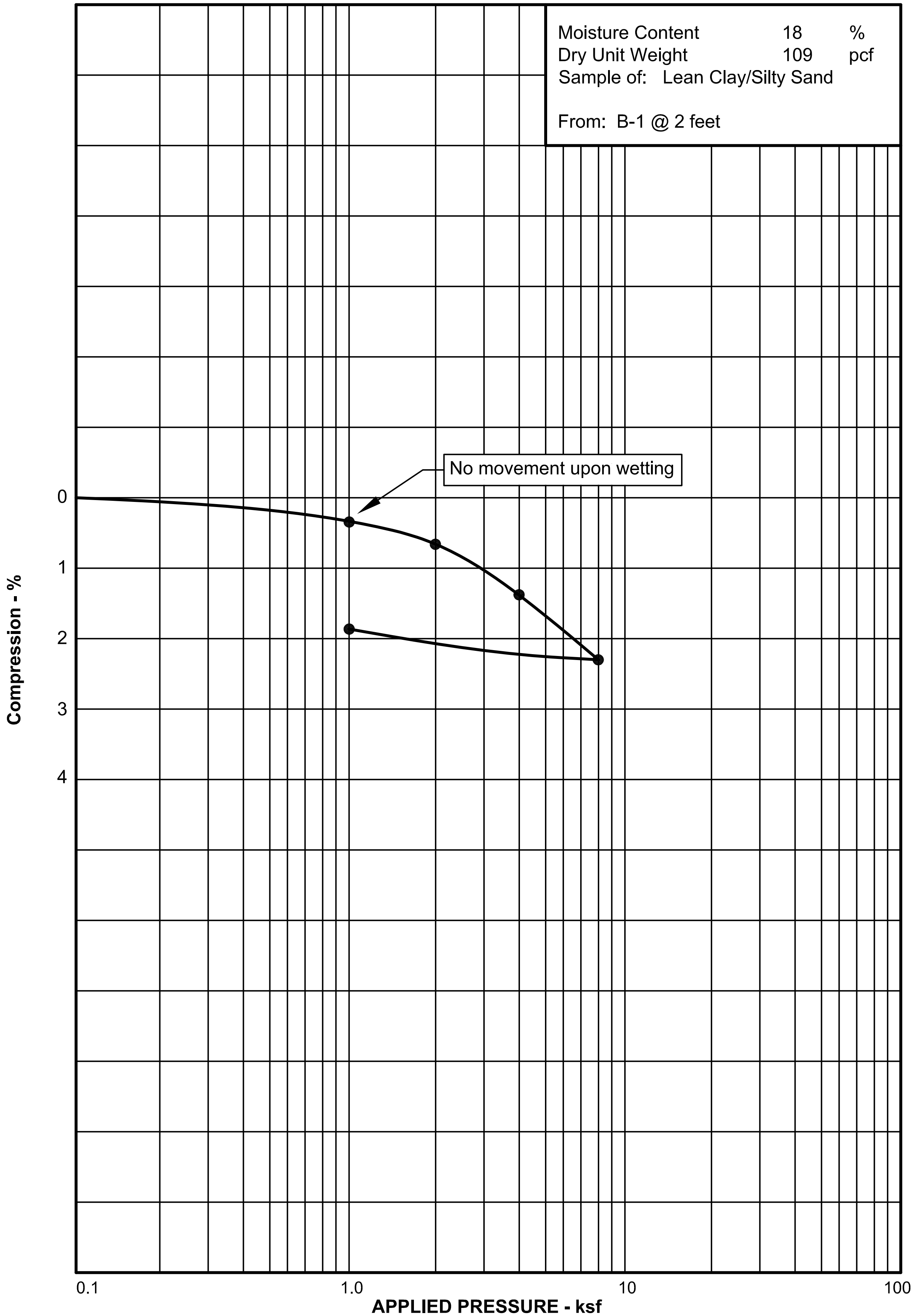
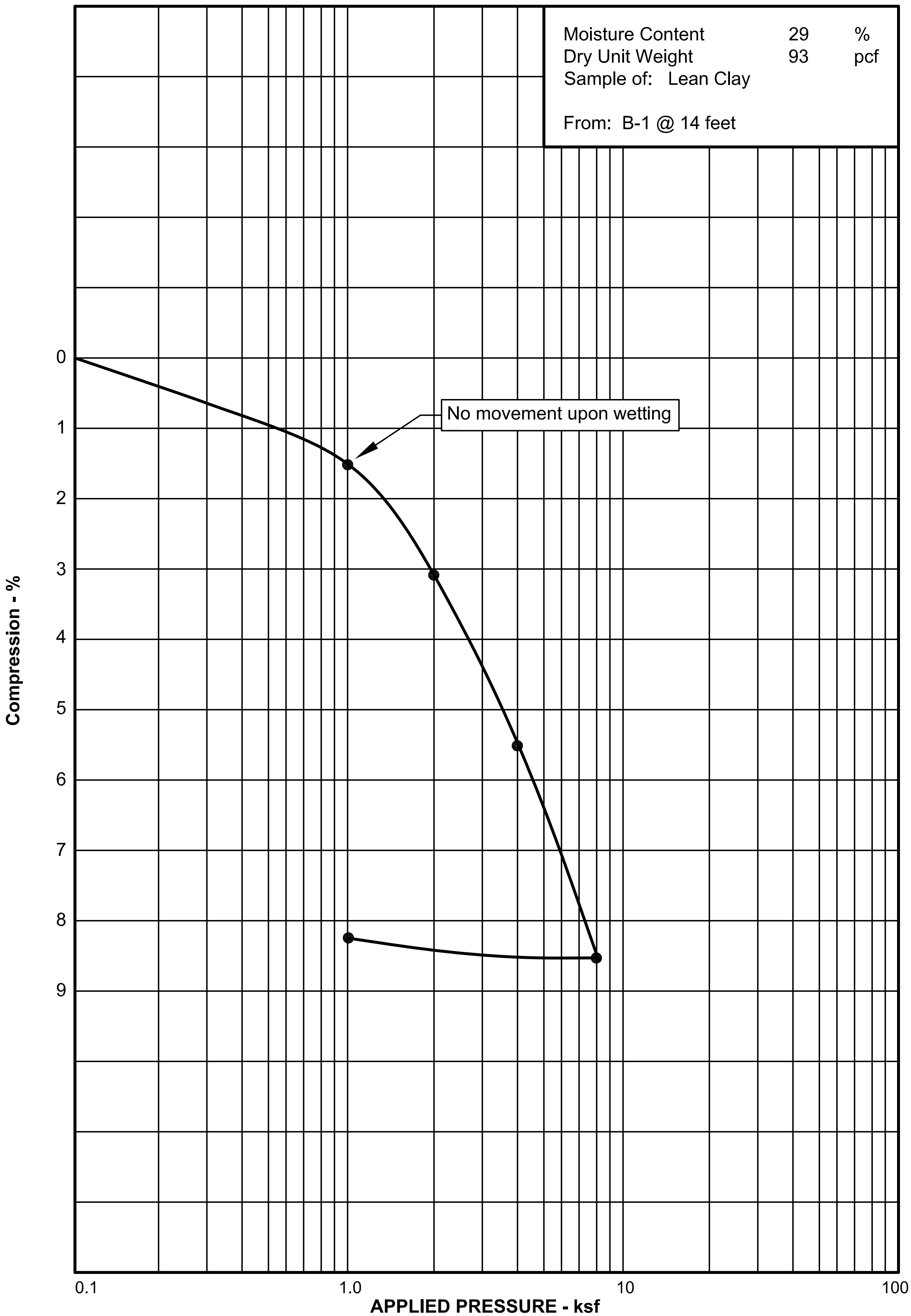


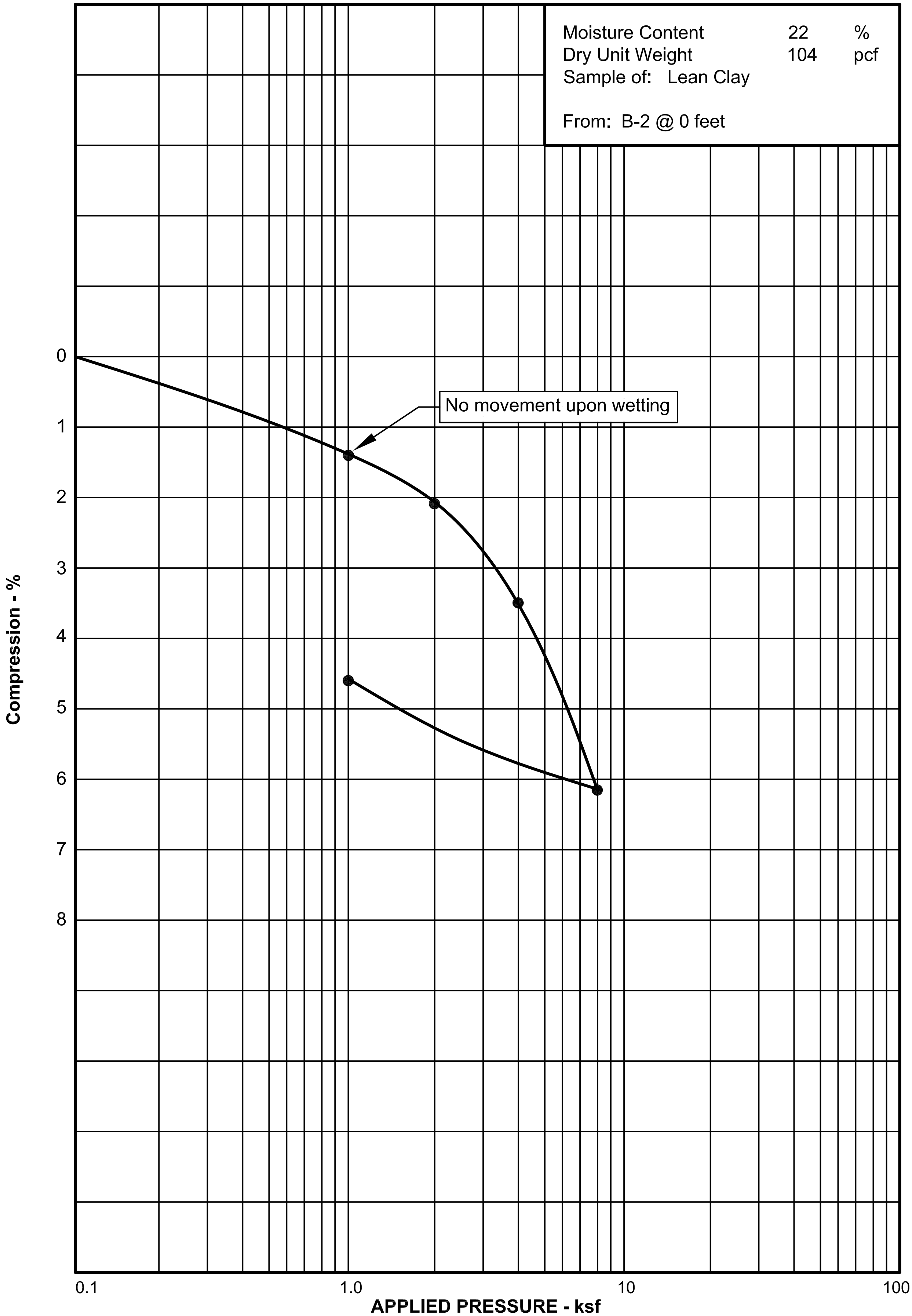

Project No. 1220786 **CONSOLIDATION TEST RESULTS** Figure 3

## Applied Geotechnical Engineering Consultants, Inc.




**Project No. 1220786** **CONSOLIDATION TEST RESULTS** **Figure 4**

## Applied Geotechnical Engineering Consultants, Inc.




Project No. 1220786

**CONSOLIDATION TEST RESULTS**

**Figure 5**

## APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I
## SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER: 1220786

| SAMPLE LOCATION | | NATURAL MOISTURE CONTENT (%) | NATURAL DRY DENSITY (PCF) | GRADATION | | | ATTERBERG LIMITS | | UNCONFINED COMPRESSIVE STRENGTH (PSF) | WATER SOLUBLE SULFATE (%) | SAMPLE CLASSIFICATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BORING | DEPTH (FEET) | | | GRAVEL (%) | SAND (%) | SILT/ CLAY (%) | LIQUID LIMIT (%) | PLASTICITY INDEX | | | |
| B-1 | 0 | 14 | 116 | | | 33 | | | | | Silty Sand |
| | 2 | 18 | 109 | | | 31 | | | | <0.001 | Lean Clay/Silty Sand |
| | 4 | 19 | 114 | | | 22 | | | | | Silty Sand |
| | 9 | 19 | 98 | | | 2 | | | | | Poorly-graded Sand |
| | 14 | 29 | 93 | | | 99 | | | | | Lean Clay |
| | | | | | | | | | | | |
| B-2 | 0 | 22 | 104 | | | 92 | | | | | Lean Clay |
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# APPENDIX

## CONE PENETRATION TEST RESULT
## AND
## UNIFIED SOIL CLASSIFICATION SYSTEM CHART

AGEC
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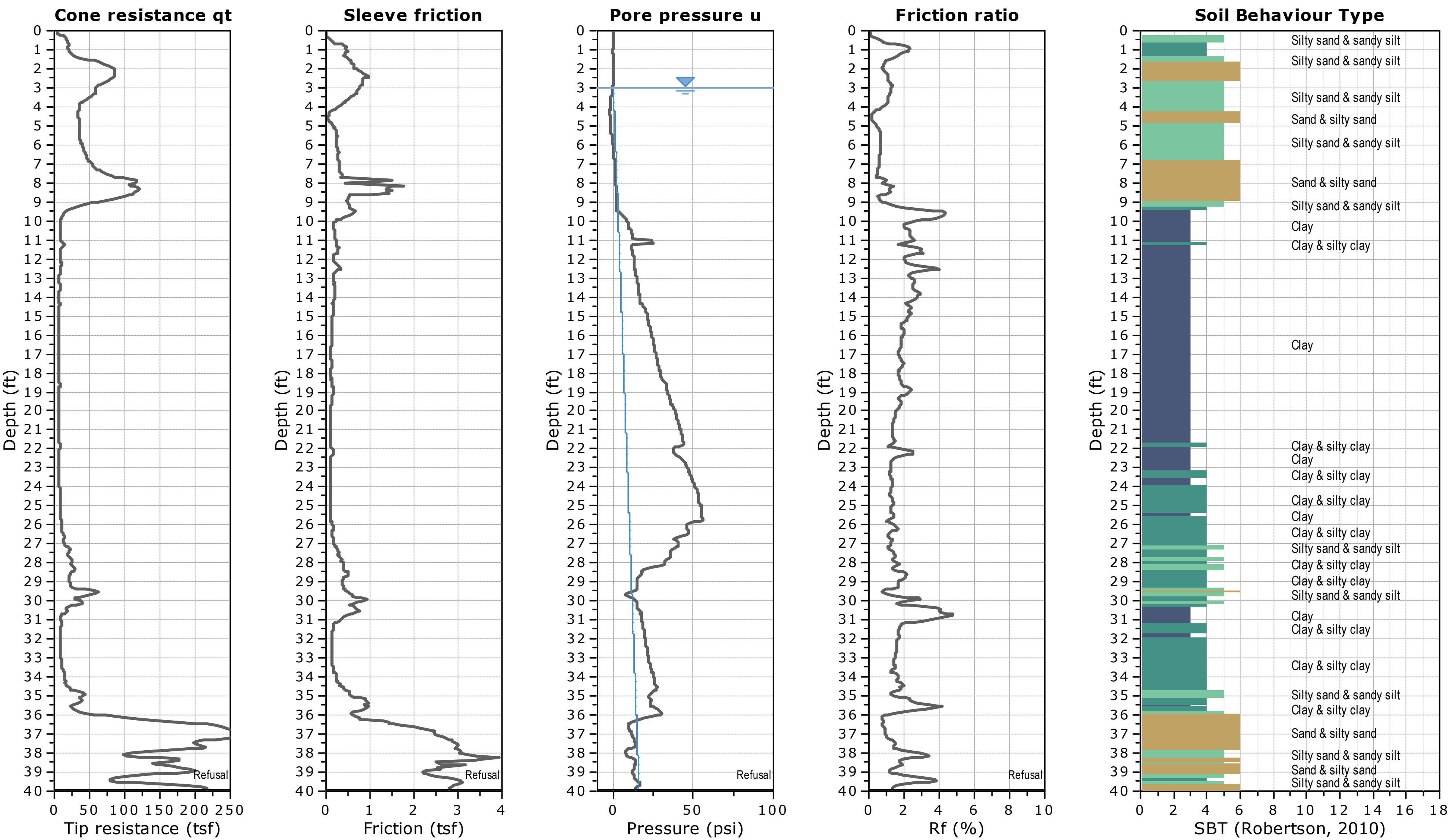
**600 W. Sandy Parkway**
Sandy, UT 84070

**CPT: CPT-1**
Total depth: 39.90 ft, Date: 12/13/2022
Surface Elevation: 99.50 ft
Coords: X:0.00, Y:0.00
Cone Type: Nova
Cone Operator: Nathan Salazar and Jason Staker

**Project: 1220786**
**Location: West Haven Jr. High Seminary**



# UNIFIED SOIL CLASSIFICATION SYSTEM

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A] | | | | Soil Classification: Group Symbol | Soil Classification: Group Name [B] |
|---|---|---|---|---|---|
| **Coarse Grained Soils:** More than 50% retained on No. 200 sieve | **Gravels:** More than 50% of coarse fraction retained on No. 4 sieve | **Clean Gravels:** Less than 5% fines [C] | $Cu \geq 4$ and $1 \leq Cc \leq 3$ [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 [C] | Fines classify as ML or MH | GM | Silty gravel [F,G,H] |
| | | | Fines classify as CL or CH | GC | Clayey gravel [F,G,H] |
| | **Sands:** 50% or more of coarse fraction passes No. 4 sieve | **Clean Sands:** Less than 5% fines [D] | $Cu \geq 6$ and $1 \leq Cc \leq 3$ [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 [D] | 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 [J] | CL | Lean clay [K,L,M] |
| | | | $PI < 4$ or plots below "A" line [J] | 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,P] |
| | | | | | Organic silt [K,L,M,Q] |
| **Highly organic soils:** | Primarily organic matter, dark in color, and organic odor | | | PT | Peat |

[A] Based on the material passing the 3-inch (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% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

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

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

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

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

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

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

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

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

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

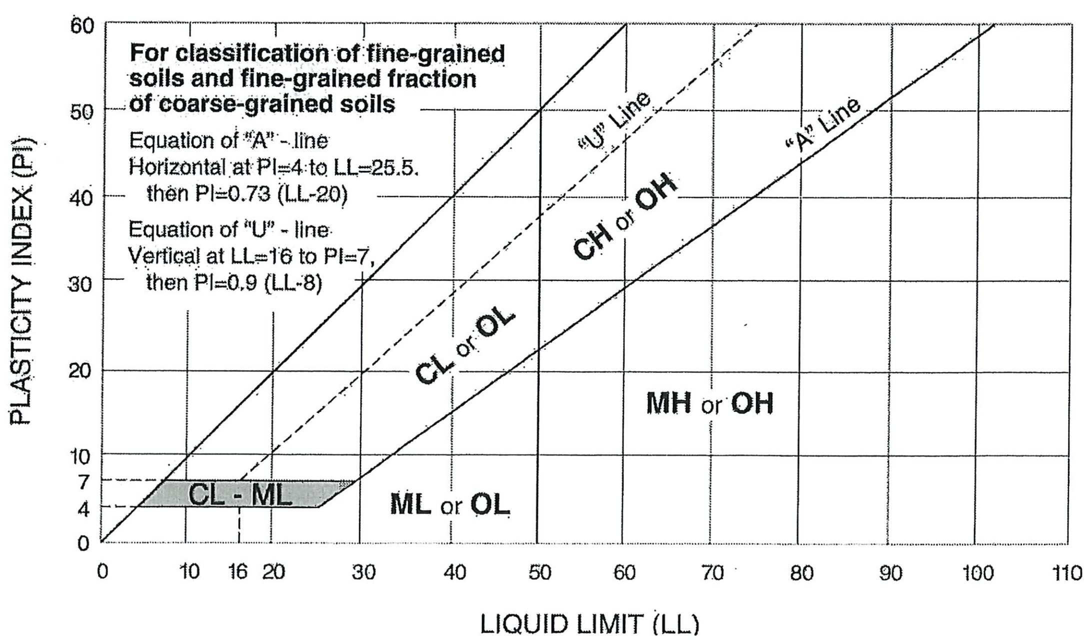
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ 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.

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