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GEOTECHNICAL INVESTIGATION
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

IGES Project No. 01855-011

November 8, 2017

Prepared for:

Watts Enterprises

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APPENDICES

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF WORK

This report presents the results of a geotechnical investigation conducted for the *Trappers Ridge at Wolf Creek* residential subdivision, located in Eden, Utah. The purpose of our investigation was to assess the nature and engineering properties of the subsurface soils at the project site and to provide recommendations for the design and construction of foundations, grading, and drainage. Geologic hazards have been assessed for the property in a previous submittal (IGES, 2017a, b); subsurface data collected from this study was reviewed to assess agreement with our previous findings and conclusions with respect to geologic hazards. The scope of work completed for this study included literature review, subsurface exploration, engineering analyses, and preparation of this report.

Our services were performed in accordance with our proposal to Watts Enterprises (Client), dated May 1, 2017. The recommendations presented in this report are subject to the limitations presented in the "Limitations" section of this report (Section 6.1).

1.2 PROJECT DESCRIPTION

The project site is located within the town of Eden, Utah (see Figure A-1, *Site Vicinity Map,* in Appendix A). The project area includes all of Phase 7, which incorporates 20 single-family residential lots, plus Telluride Road and a portion of Big Horn Parkway (those portions within Phase 7). The project area also includes the remaining residential lots for Phases 5 and 6, including Lots 70, 74, 76, 77, 79, 111, 112, 114, 115, 116, 117, 118, and 119, a total of 13 lots. Phases 5 and 6 are largely built-out; interior roadways and joint utilities are complete.

Construction plans were not available for our review; however, we assume that the new homes will be one- or two-story structures, founded on conventional shallow spread footings with slab-on-grade flooring. The single-family homes are expected to have basements, unless groundwater or other adverse geologic conditions preclude the practical construction of basements.

2.0 METHODS OF STUDY

2.1 LITERATURE REVIEW

Pertinent publications relating to geology and geologic hazards, as well as aerial imagery, were reviewed as a part of the geologic hazard assessment (IGES, 2017a, 2017b).

2.2 FIELD INVESTIGATION

Subsurface soils were investigated by excavating ten test pits at representative locations across the project area. The approximate location of the test pits is illustrated on the *Geotechnical Map* (Figure A-2 in Appendix A). The soil types were visually logged at the time of our field work in general accordance with the *Unified Soil Classification System* (USCS). Soil classifications and descriptions are included on the test pit logs, Figures A-3 through A-12 in Appendix A. A key to USCS symbols and terminology is presented as Figure A-13.

2.3 LABORATORY TESTING

Samples retrieved during the subsurface investigation were transported to the IGES laboratory for evaluation of engineering properties. Specific laboratory tests included:

- Atterberg Limits (ASTM D4318)
- Grain-Size Distribution (ASTM D6913)
- % Fines (ASTM D1140)
- Load to prevent swell
- Direct Shear Test (ASTM D3080)
- In situ Moisture Content & Dry Density (ASTM D7263 and D2216)
- Soluble Sulfate, Soluble Chloride, pH and Resistivity

Results of the laboratory testing are discussed in this report and presented in Appendix B. Some test results, including moisture content, grain-size distribution, and Atterberg Limits, have been incorporated into the test pit logs (Figures A-3 through A-12).

3.0 GEOLOGIC CONDITIONS

3.1 SITE RECONAISSANCE AND LITERATURE REVIEW

Geologic conditions from site reconnaissance and literature review have been previously assessed and documented in IGES, 2017a and 2017b.

3.2 GEOLOGIC FINDINGS FROM SUBSURFACE OBSERVATIONS

The test pits were observed in the field to contain shallow landslide deposits that included both translational slides with a basal slide plane and earthflow-type deposits that did not exhibit a basal slide plane. In general, the translational slide deposits were observed in the westernmost lots in Phases 5 and 6, while the earthflow-type deposits were observed in the Phase 7 lots.

In TP-9 and TP-10, the basal slide plane was observed to be at a depth of approximately 7.5 to 11.5 feet below existing grade, depending on the thickness of the undocumented fill found at the surface. This slide plane material was approximately 1.5 to 3 feet thick and consisted of an olive gray to medium light gray fat clay that exhibited a glassy sheen and abundant slickensides, with occasional quartzite cobbles and pinhole voids. The slide plane was underlain by colluvial deposits that consisted of moderate reddish brown clayey sand with gravel gradational to fat clay with gravel, with the uppermost portion of the unit containing inclusions of the overlying slide plane material.

In the Phase 7 area, the landslide deposits were observed to be up to 13 feet thick, and consisted of a dark reddish brown gravelly fat clay that contained occasional slickensides. Quartzite clasts within the deposits constituted as much as 40% of the unit, and were highly variable in size, ranging up to as much as 3 feet in diameter. No distinct slide plane was observed at the basal contact between these deposits and the underlying alluvial/colluvial deposits, which consisted of moderate reddish brown to dark yellowish orange sandy fat clay with gravel.

The subsurface findings appear to be consistent with the most recent geologic map that covers the project area (Coogan and King, 2016), with the translational slide deposits representing younger landslide deposits in the northwestern part of the property, and the earthflow-type deposits representing older gravelly colluvium deposits that have been transported downslope. Stability of the landslide deposits is addressed in Section 4.3 of this report, and recommendations for mitigation of the landslide deposits are found in Section 5.2 of this report.

3.3 SEISMICITY

Following the criteria outlined in the 2015 International Building Code (IBC, 2015), spectral response at the site was evaluated for the *Maximum Considered Earthquake* (MCE) which equates to a probabilistic seismic event having a two percent probability of exceedance in 50 years (2PE50). Spectral accelerations were determined based on the location of the site using the *U.S.*

Seismic "DesignMaps" Web Application (USGS, 2012/15); this software incorporates seismic hazard maps depicting probabilistic ground motions and spectral response data developed for the United States by the U. S. Geological Survey as part of NEHRP/NSHMP (Frankel et al., 1996). These maps have been incorporated into both *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* (FEMA, 1997) and the *International Building Code* (IBC) (International Code Council, 2015).

Table 3.3
Short- and Long-Period Spectral Accelerations for MCE

Parameter	**Short Period (0.2 sec)**	**Long Period (1.0 sec)**
MCE Spectral Response Acceleration (g)	$S_S = 0.892$	$S_1 = 0.301$
MCE Spectral Response Acceleration Site Class D (g)	$S_{MS} = S_sF_a = 1.020$	$S_{M1} = S_1F_v = 0.541$
Design Spectral Response Acceleration (g)	$S_{DS} = S_{MS} * {}^2/_3 = 0.680$	$S_{D1} = S_{M1} * {}^2/_3 = 0.361$

To account for site effects, site coefficients that vary with the magnitude of spectral acceleration and *Site Class* are used. Site Class is a parameter that accounts for site amplification effects of soft soils and is based on the average shear wave velocity of the upper 100 feet; based on our field exploration and our understanding of the geology in this area, the subject site is appropriately classified as Site Class D (*stiff soil*). Based on IBC criteria, the short-period (F_a) coefficient is 1.143 and the long-period (F_v) site coefficient is 1.798. Based on the design spectral response accelerations for a *Building Risk Category* of I, II or III, the site's *Seismic Design Category* is D. The short- and long-period *Design Spectral Response Accelerations* are presented in Table 3.3; a summary of the *Design Maps* analysis is presented in Appendix C. The *peak ground acceleration* (PGA) may be taken as $0.4 * S_{MS}$.

4.0 GENERALIZED SITE CONDITIONS

4.1 SITE RECONNAISSANCE

Mr. Peter E. Doumit, P.G., C.P.G., of IGES conducted reconnaissance of the site and the immediate adjacent properties on May 10, 2017, as part of the geologic hazard assessment for the subject property. The site reconnaissance was conducted with the intent to assess the general geologic conditions present across the properties, with specific interest in the undeveloped lots and those areas identified in the geologic literature and aerial imagery reviews as potential geologic hazard areas (if identified). Additionally, the site reconnaissance provided the opportunity to geologically map the surficial geology of the area. Aside from the extensive human-disturbed areas, the local geology was observed to be consistent with that as-mapped and described by Coogan and King (2016).

The remaining undeveloped Phase 5 lots were all observed to have a notable approximately east-west trending break in slope near the middle of the lots, with the northern part of the lots being between 5 and 10 feet lower in elevation than the southern part of the lots. A secondary review of historic Google Earth images following the site reconnaissance showed this break in slope to coincide with previous Phase 5 construction roads. This break in slope corresponds to the contact between the alluvium and colluvium and older landslide block mapped by Coogan and King (2016), and may have been the feature used to delineate the contact. The Phase 5 lots were all bordered on the north by a small east-west trending gully that contained slowly running water at the time of the site reconnaissance. Much of the northern part of these lots also contained cattails, reeds, and other hydrophilic plants, as well as some mature trees, indicating the sustained presence of shallow groundwater in these areas. The lots were observed to generally have irregular ground surfaces that were gently sloping to the north. Scattered subangular to subrounded boulders and cobbles up to 5 feet in diameter were observed. These rocks consisted predominantly of pink to white banded to pebbly quartzite, though some pale reddish brown fine-grained, well-cemented sandstone and rare black and white speckled diorite were also observed. Construction debris, including concrete blocks, wood pieces, and other items, were also commonly found on the lots.

The remaining undeveloped Phase 6 lots were found largely to be sloping gently to the southwest, with an elevation change of at most approximately 12 feet from northeast to southwest. An uneven ground surface, the product of human disturbance, was found to be covered largely in grass across the property. Scattered across the rest of the property are angular to subangular cobbles and boulders that are variable in size, but are most commonly between 3 and 5 inches in diameter. The rock clasts present on the surface are predominantly white to purple to pink banded amorphous to pebbly quartzite. Rare orange quartzitic sandstone, dark gray micritic limestone, and blocks of concrete were also found in areas, and represent non-native materials. Similar to what was observed on the undeveloped Phase 5 lots, the northeastern side of the Phase 6 lots exhibited a southeast-trending break in slope that was subsequently found to correspond to previous excavation roads and activities, based upon a secondary review of historic Google Earth imagery. Surficial soil appeared to be a clayey sand with gravel, and commonly exhibited desiccation cracks with 2- to 4-inch spacing. No standing or running water was observed across these lots, and no hydrophilic plants were observed.

The Phase 7 property was observed to have an extension of Big Horn Parkway pass as a gravel road east-west through the property. North of the gravel road, the ground surface was found to have a gentle, consistent slope to the south covered in low-lying vegetation and scattered white to pink feldspathic quartzite cobbles and boulders up to 4 feet in diameter, though the mode rock size was between 8 and 12 inches in diameter. The western side of the property north of the gravel road exhibited abundant cattails. Aside from the detention basin found in the northeastern part of the property, the ground north of the gravel road was observed to have little human disturbance. South of the gravel road, the ground surface was highly irregular due to numerous piles of boulders, soil, and construction debris that had been dumped in this area. The most irregular ground including a significant break in slope was observed in the southwestern part of the property near Lots 148 and 149, and a small break in slope was observed to roughly parallel the gravel road immediately south of the road. In both cases, subsequent secondary review of historic Google Earth images indicate that these were a product of previous construction activities, and do not represent natural landslide-related features. Standing water was observed in the detention pond and in a small pond found near the east-central margin of the property.

4.2 SUBSURFACE CONDITIONS

On June 20 and 21, 2017, ten exploration test pits were excavated at representative locations across the subject properties (Figure A-2). The test pits were generally excavated to depths ranging between 10 and 13 feet below existing grade with the aid of a Caterpillar 315C tracked excavator. Detailed logs for the test pits are presented in Figures A-3 through A-12. The subsurface conditions observed are summarized in the following paragraphs.

4.2.1 Earth Materials

Undocumented Fill: Fill material was identified in TP-5, 9 and 10, but is likely present elsewhere as a result of mass-grading for the greater Trappers Ridge at Wolf Creek development. Where identified, undocumented fill generally consisted of sandy lean clay with gravel (CL).

A/B Soil Horizon: Where identified, the topsoil layer generally underlies undocumented fill, indicating that clearing/grubbing of the lots did not occur prior to placement of fill. This topsoil unit was found to be approximately 0.5 to 1.5 feet thick. Topsoil generally consisted of fat clay with gravel (CH), and contained abundant roots and other organic components. The topsoil often had a loamy appearance. Topsoil was identified in TP-7, 9, and 10.

<u>Shallow Landslide</u>: This unit was found as two distinct types: a heavily slickensided fat clay with gravel (CH) underlying the topsoil in TP-9 and TP-10, being between 1.5 and 3 feet thick; and an occasionally slickensided gravelly fat clay (CH) up to 13 feet thick, observed in TP-1 through TP-5. In general, the shallow landslide unit represents past, wide-spread shallow surficial landslides that are mapped in this area.

<u>Alluvium/Colluvium</u>: This unit was observed to the maximum depths of exploration in all the test pits. The unit generally consisted of clayey sand with gravel (SC) and clayey gravel with sand (GC), grading to sandy fat clay with gravel (CH), or in some cases transitioning to fat clay with little or no coarse component. This unit was generally medium-dense and *massive* (no evident bedding or other depositional structures).

4.2.2 Groundwater

Groundwater seepage was encountered in TP-7 through 10, generally at a depth of 10 to 13 feet, although seepage was observed as shallow as 3 feet in TP-10. The seepage likely represents a localized perched condition and not a regional piezometric surface. Nonetheless, seepage will likely impact construction in the vicinity of TP-7 through TP-10, and may impact other areas of the project area depending on local conditions, the time of year, and weather.

4.2.3 Strength of Earth Materials

Four samples of the prevailing clayey soils were tested in our laboratory to assess the engineering characteristics of site soils. A *Direct Shear* test (ASTM D3080) was completed on four relatively 'undisturbed' tube samples. The soils tested classified as Fat CLAY with sand (CH), gradational to Lean CLAY (CL). The test results are summarized in the following table:

Table 4.2.3
Summary of Direct Shear Tests

Sample Location	Depth (ft)	Soil Type	Friction Angle (deg.)	Cohesion (psf)
TP-2	3	Fat CLAY (CH)	26	204
TP-2	9	Lean CLAY (CL)	20	465
TP-5	3	Fat CLAY (CH)	14	336
TP-9	5.5	Fat CLAY (CH)	17	254

The preceding values presented in Table 4.2.3 are peak values. Comprehensive test results are presented in Appendix B.

4.2.4 Expansive/Frost Susceptible Soils

Expansive soils generally consist of clay soils that exhibit significant swelling when wetted. Expansive soils typically consist of Fat CLAY (CH), have a "greasy" luster and are brown in color.

Expansive soils can potentially damage foundation elements, crack concrete slabs, and create excess stress in the proposed structures. Although soils classifying as fat clay are often associated with expansive soils, soil classification alone cannot predict the expansive characteristics of clay soils.

Soils classifying as Fat Clay and Elastic Silt have been identified onsite; as such, the potential for expansive soils impacting appurtenant structures or flatwork is moderate. Furthermore, soils of this type are often more susceptible to frost heave. Proper control of drainage can minimize the impacts of expansive soils, and can also minimize the impact of frost heave.

4.3 STABILITY OF NATURAL SLOPES

4.3.1 Slope Stability

The site is located within the foothills, on gently sloping terrain (about 8.7H:1V in the vicinity of Phase 7); furthermore, current plans do not call for grading that would significantly alter the current over-all gradient of the development; most grading for the various home sites will result in local minor grade changes (small cuts and fills to create a level pad for home construction). However, the area has been subject to shallow, surficial landslides in the past.

The stability of the prevailing natural slope has been assessed in accordance with methodology set forth in Blake et al. 2002 with respect to a representative cross-section identified in plan-view on Figure A-2. The stability of the slope was modeled using SLIDE, a computer application incorporating (among others) Spencer's Method of analysis. Calculations for stability were developed by searching for the minimum factor of safety for a translational-type failure occurring through surficial soils (landslide deposits) and the underlying alluvium (note that in our analysis, we model the weaker landslide material only and are forcing a translational slide approximately 8 feet below existing grade). Analysis was performed for both the static and seismic (pseudo-static) cases.

Groundwater, e.g. a piezometric groundwater surface, was not encountered during our subsurface investigation; however, seepage was noted in four of the ten test pits excavated for this project, which most likely represents localized perched groundwater conditions. Accordingly, groundwater was not modeled in our limit-equilibrium analysis. Saturated parallel seepage has been modeled in a separate analysis (see Section 4.3.2).

Soil strength parameters were selected based on soil types observed, local experience, correlation with index properties (Atterberg Limits, clay content), and the results of laboratory strength testing (see Section 4.2.3). Based on this assessment, the following soil strength parameters were selected for this analysis:

Table 4.3.1a
Soil Strength Parameters

Earth Materials	Friction angle (degrees)	Cohesion (psf)	Unit Weight (pcf)
Landslide Deposits	20	300	115
Alluvium	20	300	115

Pseudo-static (seismic screening) analysis of the proposed slope was performed in general conformance with Blake et al. 2002, ASCE 7-10 and AASHTO LRFD for Bridge Design Specifications. The design seismic event was taken as the ground motion with a 2 percent probability of exceedance in 50 years (2PE50). Based on information provided on the USGS website ground motion calculator, the Peak Ground Acceleration (PGA) associated with a 2PE50 event is estimated to be 0.408g. Half of the PGA, (0.204g), was taken as the horizontal seismic coefficient (k_h) (Hynes and Franklin, 1984), and used in the pseudo-static seismic screen analysis. The results of the analyses have been summarized in Table 4.3.1b.

Table 4.3.1b
Results of Slope Stability Analyses

Section	Static Factor of Safety	Pseudo-Static Factor of Safety
Existing Condition	4.50	1.70

The results of the analysis indicated the existing conditions meet the minimum required factors-of-safety of 1.5 and 1.0 for both the static and seismic (pseudo-static) case, respectively. A summary of the slope stability analysis is presented in Appendix D.

4.3.2 Surficial Stability

Stability of the over-all development area (Phases 5, 6, and 7) was also assessed utilizing an infinite slope stability model, assuming a conservative worse-case scenario with saturation within the upper 6 feet resulting in parallel seepage, and a pre-existing landslide shearing surface under residual strength conditions (assumed friction angle of 20 degrees and zero cohesion). The prevailing gradient has been modeled as 7 degrees (approximately 8.7H:1V). Based on this analysis, a static factor-of-safety of 1.59 results. This model represents a worse-case scenario where the upper landslide mass is saturated, e.g. during peak snow melt and spring run-off, and would be considered a transient condition. The model also assumes a discrete basal shear surface under residual strength conditions; this is likely a conservative assumption, as subsurface data suggests that the landslide could have been an earth flow (not translational), and consequently residual strength conditions are not likely to control the stability of the area.

Based on our infinite slope model, and the foregoing discussion, IGES considers the potential for surficial slope instability on this site to be low. Sample calculations are presented in Appendix D.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL CONCLUSIONS

Based on the results of our field observations, laboratory testing, and previously completed geologic hazard assessments (IGES, 2017a and 2017b), the subsurface conditions are considered suitable for the proposed improvements provided that the recommendations presented in this report are incorporated into the design and construction of the project.

Supporting data upon which the following recommendations are based have been presented in the previous sections of this report. The recommendations presented herein are governed by the physical properties of the earth materials encountered in the subsurface explorations. If subsurface conditions other than those described herein are encountered in conjunction with construction, and/or if design and layout changes are initiated, IGES must be informed so that our recommendations can be reviewed and revised as deemed necessary.

5.2 GEOLOGIC CONCLUSIONS AND RECOMMENDATIONS

Based upon the data collected and reviewed as part of this assessment in collaboration with the data collected as part of the geologic hazard assessment (IGES, 2017b), IGES makes the following updated conclusions regarding the geological hazards present at the remaining undeveloped lots of the Trappers Ridge Phases 5, 6, and 7 properties:

- **The remaining undeveloped lots of the Trappers Ridge Phases 5, 6, and 7 properties are underlain by various types of shallow landslide deposits that have the potential to adversely affect the development as currently proposed if no mitigation practices are implemented. However, these landslide deposits have been modeled to be stable under current conditions, and the properties are considered buildable from a geologic perspective if the mitigation practices recommended in this report are implemented.**

- Given the presence and nature of the landslide deposits, the landslide hazard risk is considered to be moderate. This risk can be further reduced to low with the implementation of appropriate mitigation practices.

- All other conclusions identified in IGES (2017b) regarding geologic hazards associated with the properties are to be considered valid.

Given the conclusions listed above, IGES makes the following recommendations:

- In those areas where shallow rotational landsliding in encountered, it is recommended that the slide plane material be overexcavated and replaced with structural fill across the entire building footprint of a specific lot. This situation is most likely to be encountered in Lots 74, 76, 77, and 79, but could be encountered on any lot.

- An IGES geologist or geotechnical engineer should observe the foundation excavations for all lots to assess that the excavation has been taken to an appropriate depth, and to further evaluate whether geologic conditions warrant further mitigation practices.

- It is recommended that the landscaping for this development consist of xeriscape, drip irrigation, etc. so as to minimize the amount of water introduced into the subsurface in these areas. Landscaping that requires intensive watering (e.g. grass or hydrophilic plants) should be avoided or minimized.

- It is critical to minimize the introduction of water into the subsurface to limit the potential for activation of new landslides or the re-activation of existing landslides. To this end, the inclusion of passive land drains as a part of the civil plans would be beneficial if localized perched groundwater is encountered (only applicable to Phase 7). On-site sewage or storm-drain disposal should not be allowed.

- Given the presence of localized shallow perched groundwater conditions, basements are not recommended for this property unless foundation drains are part of the design.

- All other recommendations identified in IGES (2017b) should be considered valid.

5.3 EARTHWORK

5.3.1 General Site Preparation and Grading

Below proposed structures, fills, and man-made improvements, all vegetation, topsoil, debris and undocumented fill should be removed. Any existing utilities should be re-routed or protected in place. The exposed native soils should then be proof-rolled with heavy rubber-tired equipment such as a scraper or loader. Any soft/loose areas identified during proof-rolling should be removed and replaced with structural fill. All excavation bottoms should be observed by an IGES representative during proof-rolling or otherwise prior to placement of engineered fill to evaluate whether soft, loose, or otherwise deleterious earth materials have been removed, and to assess compliance with the recommendations presented in this report.

5.3.2 Excavations

Soft, loose, or otherwise unsuitable soils beneath structural elements, hardscape or pavements may need to be over-excavated and replaced with structural fill. If over-excavation is required, the excavations should extend one foot laterally for every foot of depth of over-excavation. Excavations should extend laterally at least two feet beyond flatwork, pavements, and slabs-on-grade. Structural fill should consist of granular materials and should be placed and compacted in accordance with the recommendations presented in this report.

Prior to placing engineered fill, all excavation bottoms should be scarified to at least 6 inches, moisture conditioned as necessary at or slightly above optimum moisture content (OMC), and compacted to at least 90 percent of the maximum dry density (MDD) as determined by ASTM D-1557 (Modified Proctor).

5.3.3 Excavation Stability

The contractor is responsible for site safety, including all temporary trenches excavated at the site and the design of any required temporary shoring. The contractor is responsible for providing the "competent person" required by Occupational Safety and Health (OSHA) standards to evaluate soil conditions. For planning purposes, Soil Type C is expected to predominate at the site (sands and gravels), although Type C soils will likely be exposed locally (cohesive clays). Close coordination between the competent person and IGES should be maintained to facilitate construction while providing safe excavations.

Based on OSHA guidelines for excavation safety, trenches with vertical walls up to 5 feet in depth may be occupied. Where very moist soil conditions or groundwater is encountered, or when the trench is deeper than 5 feet, we recommend a trench-shield or shoring be used as a protective system to workers in the trench. As an alternative to shoring or shielding, trench walls may be laid back at one and one-half horizontal to one vertical (1.5H:1V) (33.7 degrees) in accordance with OSHA Type C soils. Trench walls may need to be laid back at a steeper grade pending evaluation of soil conditions by the geotechnical engineer. Soil conditions should be evaluated in the field on a case-by-case basis.

5.3.4 Structural Fill and Compaction

All fill placed for the support of structures, flatwork or pavements should consist of structural fill. Structural fill should consist of granular native soils, which may be defined as soils with less than 25% fines, 10-60% sand, and contain no rock larger than 4 inches in nominal size (6 inches in greatest dimension). Structural fill should also be free of vegetation and debris. All structural fill should be 1 inch minus material when within 1 foot of any base coarse material. Soils not meeting these criteria may be suitable for use as structural fill; however, such soils should be evaluated on a case by case basis and should be approved by IGES prior to use.

All structural fill should be placed in maximum 4-inch loose lifts if compacted by small hand-operated compaction equipment, maximum 6-inch loose lifts if compacted by light-duty rollers, and maximum 8-inch loose lifts if compacted by heavy duty compaction equipment that is capable of efficiently compacting the entire thickness of the lift. Additional lift thickness may be allowed by IGES provided the Contractor can demonstrate sufficient compaction can be achieved with a given lift thickness with the equipment in use. We recommend that all structural fill be compacted on a horizontal plane, unless otherwise approved by IGES. Structural fill underlying all shallow footings and pavements should be compacted to at least 95 percent of the MDD as determined by ASTM D-1557. **The moisture content should be at, or slightly above, the OMC for all structural fill**. Any imported fill materials should be approved prior to importing. Also, prior to placing any fill, the excavations should be observed by IGES to confirm that unsuitable materials have been removed. In addition, proper grading should precede placement of fill, as described in the General Site Preparation and Grading subsection of this report.

Specifications from governing authorities such as Weber County and/or special service districts having their own precedence for backfill and compaction should be followed where more stringent.

5.3.5 Oversize Material

Based on our observations, there is some potential for the presence of oversize materials (larger than 6 inches in greatest dimension), particularly in Phase 7. Large rocks, particularly boulders (>12 inches), may require special handling, such as segregation from structural fill, and disposal.

5.3.6 Utility Trench Backfill

Utility trenches should be backfilled with structural fill in accordance with Section 5.3.4 of this report. Utility trenches can be backfilled with the onsite soils free of debris, organic and oversized material. Prior to backfilling the trench, pipes should be bedded in and shaded with a uniform granular material that has a Sand Equivalent (SE) of 30 or greater. Pipe bedding may be water-densified in-place (jetting). Alternatively, pipe bedding and shading may consist of clean ¾-inch gravel. Native earth materials can be used as backfill over the pipe bedding zone. All utility trenches backfilled below pavement sections, curb and gutter, and hardscape, should be backfilled with structural fill compacted to at least 95 percent of the MDD as determined by ASTM D-1557. All other trenches should be backfilled and compacted to approximately 90 percent of the MDD (ASTM D-1557). However, in all cases the pipe bedding and shading should meet the design criteria of the pipe manufacturer. Specifications from governing authorities having their own precedence for backfill and compaction should be followed where they are more stringent.

5.4 FOUNDATION RECOMMENDATIONS

Based on our field observations and considering the presence of relatively shallow landslide deposits, we recommend that the footings for proposed structures be founded *entirely* on competent native soils (e.g. the footings should extend below the landslide deposits, when present); alternatively, the footings should be founded *entirely* on structural fill extending below the landslide deposits. Assuming the homes will have a basement level, we anticipate that the excavation for the basement level will remove most, if not all of the shallow landslide deposits, although We recommend that IGES assess the foundation excavation prior to the placement of steel or concrete, or placement of structural fill, to identify the extend of shallow landslide deposits, if present. Additional over-excavation may be required based on the actual subsurface conditions observed.

For single-family residential homes, shallow spread or continuous wall footings constructed entirely on competent native earth materials or entirely on a minimum of two feet of granular structural fill may be proportioned utilizing a maximum net allowable bearing pressure of **2,200 pounds per square foot (psf)**. The net allowable bearing value presented above is for dead load plus live load conditions. The minimum recommended footing width is 20 inches for continuous wall footings and 30 inches for isolated spread footings.

All conventional foundations exposed to the full effects of frost should be established at a minimum depth of 36 inches below the lowest adjacent final grade. Interior footings, not subjected to the full effects of frost (i.e., *a continuously heated structure*), may be established at higher elevations, however, a minimum depth of embedment of 12 inches is recommended for confinement purposes.

Foundation drains should be installed around below-ground foundations (e.g., basement walls) to minimize the potential for flooding from shallow groundwater, which may be present at various times during the year, particularly spring run-off.

5.5 SETTLEMENT

5.5.1 Static Settlement

Static settlements of properly designed and constructed conventional foundations, founded as described in Section 5.4, are anticipated to be on the order of 1 inch or less. Differential settlement is expected to be half of total settlement over a distance of 30 feet.

5.5.2 Dynamic Settlement

Dynamic settlement (or seismically-induced settlement) consists of dry dynamic settlement of unsaturated soils (above groundwater) and liquefaction-induced settlement (below groundwater). During a strong seismic event, seismically-induced settlement can occur within loose to moderately dense sandy soil due to reduction in volume during, and shortly after, an earthquake event. Settlement caused by ground shaking is often non-uniformly distributed, which can result in differential settlement.

Based on the subsurface conditions encountered, dynamic settlement arising from a MCE seismic event is expected to be low; for design purposes, settlement on the order of ½ inch over 40 feet may be assumed.

5.6 EARTH PRESSURES AND LATERAL RESISTANCE

Lateral forces imposed upon conventional foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footing and the supporting soils. In determining the frictional resistance against concrete, a coefficient of friction of 0.35 for clayey native soils should be used. If granular structural fill is placed under the structure, a coefficient of friction of 0.45 may be used.

Ultimate lateral earth pressures from *granular* backfill acting against retaining walls, temporary shoring, or buried structures may be computed from the lateral pressure coefficients or equivalent fluid densities presented in Table 5.6. These coefficients and densities assume no buildup of hydrostatic pressures. The force of water should be added to the presented values if hydrostatic pressures are anticipated.

Clayey soils drain poorly and may swell upon wetting, thereby greatly increasing lateral pressures acting on earth retaining structures; therefore, clayey soils should not be used as retaining wall backfill (this recommendation is particularly relevant for this project, as the prevailing clay soils classify as Fast CLAY). Backfill should consist of native granular soil with an Expansion Index (EI) less than 20.

Table 5.6
Lateral Earth Pressure Coefficients

Condition	Level Backfill		2H:1V Backfill	
	Lateral Pressure Coefficient	Equivalent Fluid Density (pcf)	Lateral Pressure Coefficient	Equivalent Fluid Density (pcf)
Active (Ka)	0.390	46.9	0.678	81.3
At-rest (Ko)	0.562	67.4	0.977	117.2
Passive (Kp)	2.56	307	—	—
*Seismic Active	0.154	18.5	0.296	35.5
*Seismic Passive	-0.349	-41.9	—	—

* Based on Mononobe-Okabe

Walls and structures allowed to rotate slightly should use the active condition. If the element is to be constrained against rotation (i.e., a basement wall), the at-rest condition should be used. These values should be used with an appropriate factor of safety against overturning and sliding. A value of 1.5 is typically used. Additionally, if passive resistance is calculated in conjunction with frictional resistance, the passive resistance should be reduced by ½.

For seismic analyses, the *active* earth pressure coefficient provided in the table is based on the Mononobe-Okabe pseudo-static approach and only accounts for the dynamic horizontal thrust produced by ground motion. Hence, the resulting dynamic thrust pressure *should be added* to the static pressure to determine the total pressure on the wall. The pressure distribution of the dynamic horizontal thrust may be closely approximated as an inverted triangle with stress decreasing with depth and the resultant acting at a distance approximately 0.6 times the loaded height of the structure, measured upward from the bottom of the structure.

5.7 CONCRETE SLAB-ON-GRADE CONSTRUCTION

To minimize settlement and cracking of slabs, and to aid in drainage beneath the concrete floor slabs, all concrete slabs should be founded on a minimum 4-inch layer of compacted gravel overlying properly prepared subgrade. The gravel should consist of free-draining gravel or road base with a 3/4-inch maximum particle size and no more than 5 percent passing the No. 200 mesh sieve. The layer should be compacted to at least 95 percent of the MDD as determined by ASTM D-1557.

All concrete slabs should be designed to minimize cracking as a result of shrinkage. Consideration should be given to reinforcing the slab with a welded wire fabric, re-bar, or fibermesh. Slab reinforcement should be designed by the structural engineer; however, as a minimum, slab reinforcement should consist of 4’’×4’’ W2.9×W2.9 welded wire mesh within the middle third of the slab. We recommend that concrete be tested to assess that the slump and/or air content is in compliance with the plans and specifications. We recommend that concrete be placed in general accordance with the requirements of the American Concrete Institute (ACI). A Modulus of Subgrade Reaction of **260 psi/inch** may be used for design.

A moisture barrier (vapor retarder) consisting of 10-mil thick Visqueen (or equivalent) plastic sheeting should be placed below slabs-on-grade where moisture-sensitive floor coverings or equipment is planned. Prior to placing this moisture barrier, any objects that could puncture it, such as protruding gravel or rocks, should be removed from the building pad. Alternatively, the subgrade may be covered with 2 inches of clean sand**.**

5.8 MOISTURE PROTECTION AND SURFACE DRAINAGE

<u>During Construction</u>: Over-wetting the soils prior to, during, or after construction may result in softening and pumping, causing equipment mobility problems and difficulty in achieving compaction – this is particularly relevant where clay soils are identified at the surface. Every effort should be taken to ensure positive drainage away from roadway areas to reduce the potential for water to migrate below pavements and concrete flatwork. The recommended minimum slope is two percent (2%) in pavement areas. Moisture should not be allowed to infiltrate the soils in the vicinity of, or upslope from, the roadways.

<u>Residential Structures</u>: Moisture should not be allowed to infiltrate into the soils in the vicinity of the foundations. As such, the following design strategies to minimize ponding and infiltration near the home should be implemented:

- We recommend that hand watering, desert landscaping or Xeriscape be considered within 5 feet of the foundations.
- Roof runoff devices should be installed to direct all runoff a minimum of 10 feet away from structures.
- Irrigation valves shall be a minimum of five feet away from foundation walls and must not be placed within the basement backfill zone.
- The builder should be responsible for compacting the exterior backfill soils around the foundation – failure to compact basement backfill will result in long-term settlement and could facilitate the introduction of water to the foundation subgrade.
- The ground surface within 10 feet of the house should be constructed so as to slope a minimum of five percent away from the home (2 percent is acceptable for a relatively impermeable paved surface).
- Pavement sections should be constructed to divert surface water off of the pavement into storm drains.
- Parking strips and roadway shoulder areas should be constructed to prevent infiltration of water into the surrounding pavement.

Foundation Drainage: IGES recommends a foundation drainage system be incorporated into the design of the homes. The foundation drainage system should be designed in accordance with the guidelines presented in the 2012 *International Residential Code* (IRC), Section R405, *Foundation Drainage*.

5.9 SOIL CORROSION POTENTIAL

Laboratory testing of a representative soil sample indicated that the soil sample tested had a sulfate content of 21.7 ppm. Accordingly, the soils are classified as having a 'low potential' for deterioration of concrete due to the presence of soluble sulfate. As such, conventional Type II Portland cement may be used for all concrete in contact with site soils.

To evaluate the corrosion potential of ferrous metal in contact with onsite native soil a sample was tested for soil resistivity, soluble chloride and pH. The test indicated that the onsite soil tested has a minimum soil resistivity of 574 OHM-cm, soluble chloride content of 6.2 ppm and a pH of 5.5. Based on this result, the onsite native soil is considered to be *severely corrosive* to ferrous metal. Consideration should be given to retaining the services of a qualified corrosion engineer to provide an assessment of any metal that may be associated with construction of ancillary water lines and reinforcing steel, valves, and similar improvements in contact with native soils.

5.10 PAVEMENT SECTION DESIGN

5.10.1 Pavement Design

Within Phase 7, the upper 2 to 3 feet of existing subgrade generally consists of soil classifying as clayey gravel (GC); accordingly, based on our observations and soil type, for pavement design we have modeled a CBR of 15 in the vicinity of Phase 7. Anticipated traffic volumes were not available at the time this report was prepared; however, based on our understanding of the project development we assume traffic on the new roadway through Phase 7 would consist primarily of passenger cars with occasional heavy vehicles associated with construction, municipal waste collection, school buses, and similar. The following pavement designs have been developed for a 20-year design life assuming a 0 percent annual growth rate, and our assumed equivalent single axle load (ESAL) of 150,000 ESALs for interior roadways. Based on the information obtained and the assumptions listed above, a recommended pavement section is presented in Table 5.10.

The pavement section thickness presented in Table 5.10 assume that there is no mixing over time between the road base and the clayey subgrade. In order to prevent mixing or fines migration, and thereby prolong the life of the pavement section, we recommend that the owner give consideration to placing a filter fabric between the native soils and the road base, such as the Mirafi 140N or an IGES-approved equivalent.

Table 5.10
Conventional Pavement Design

Material Type	Total Section (in.)
Asphalt Concrete Pavement (inches)	3
Untreated Road Base (inches)	8
Subbase (inches) (min. CBR of 30)	6

During construction, a significant amount of heavy construction traffic occurs. Some distress may manifest on pavement sections during this initial construction time period. Maintenance may need to be performed after completion of construction.

As a minimum, the upper 4 inches of the pavement subgrade should be reworked in-place and compacted to at least 95% of the MDD with the moisture content at or slightly above the OMC as determined by ASTM D-1557 (highly organic earth materials that appear to be topsoil should not be left in-place or be allowed to be mixed-in with the reworked soil). Asphalt has been assumed to be a high stability plant mix and base course material composed of crushed stone with a minimum CBR of 70. Road base should be compacted to a minimum density of 95 percent as determined by ASTM D-1557 (Modified Proctor). Asphalt should be compacted to a minimum of 96 percent of the Marshall maximum density. Asphalt and aggregate base material should conform to local requirements. Subbase should be a coarse, granular pit-run material with a minimum CBR of 30.

Where Portland Cement Concrete (PCC) pavements are planned, such as near trash enclosures or other areas expected to support heavy truck traffic, the pavement is recommended to be a minimum of 5 inches in thickness. Concrete pavement should be underlain by a minimum 6 inches of aggregate base course.

If conditions vary significantly from our stated assumptions, IGES should be contacted so we can modify our pavement design parameters accordingly. Prior to placing the first course of aggregate, IGES should evaluate the pavement subgrade to assess whether the subgrade has been prepared in accordance with our recommendations, and to assess whether particularly soft, loose, or otherwise deleterious earth materials are present.

6.7.2 Pavement Construction

The preceding pavement design options meet AASHTO design guidelines; however, where particularly soft, pumping subgrade is encountered, difficulty may be encountered during construction, particularly with respect to stabilization of the pavement subgrade. If soft, pumping soils or mobility problems arise during construction, one of the following options may be implemented:

A. Where particularly soft subgrade is encountered, Mirafi RS380i reinforcement can be placed between the soft subgrade and 12 inches subbase. *The subbase should be compacted in two lifts*; some pumping/deflection may be noticed during compaction of the first lift, however upon placement of the final lift the 12 inches of subbase over 380i is expected to stabilize the subgrade.

B. Stabilization of soft or pumping subgrade can also be accomplished by using a clean, coarse angular material worked into the soft subgrade. We recommend the material be greater than 3 inches in nominal diameter, but less than 6 inches. Alternately, a locally available pit-run gravel may be suitable but should contain a high percentage of particles larger than 3 inches diameter and have less than 5 percent fines (material passing the No. 200 Sieve). A pit-run gravel may not be as effective as a coarse, angular material in stabilizing the soft soils and will likely require more material be placed. The stabilization material should be worked (pushed) into the soft subgrade soils until a relatively firm and unyielding surface is established. Once a relatively firm and unyielding surface is achieved, the area may be brought to final design grade using structural fill. Other earth materials not meeting aforementioned criteria may also be suitable; however, such material should be evaluated on a case-by-case basis and should be approved by IGES prior to use. If this method is utilized, the stabilization layer may be considered as part of the over-all pavement design and therefore the 6-inch subbase layer need not be placed over the stabilization layer.

C. Where soft soils are encountered, the Contractor should consider compaction using static methods (e.g., wheel-rolling with heavy earth-moving equipment such as a loader or scraper). Compaction over soft soils using vibratory methods often proves to be marginally effective.

5.11 CONSTRUCTION CONSIDERATIONS

5.11.1 Over-Size Material

Large rocks (up to 36 inches in diameter) were observed within the test pits; larger rocks may be present locally. As such, excavation of the lower levels may generate an abundance of over-size material that may require special handling, processing, or disposal.

5.11.2 Frost-Susceptible Soils

Much of the prevailing near-surface clay soils classify as Fat CLAY (CH) – soils of this type can be particularly susceptible to frost-heave. To minimize the deleterious effects of frost heave on flatwork, the following items may be considered:

- For pavement, additional over-excavation and replacement with relatively frost-free earth materials (e.g. roadbase or gravel). The level of over-excavation (e.g. 12”, 16”, 24”, etc.) would be dependent on the level of risk that is acceptable to the Owner vs. the cost of the additional work. Over-excavation and replacement with frost-free materials below *finish grade* need not exceed 30” for a reasonable level of frost protection, although frost could penetrate as deep as 48” or more under extreme conditions. This recommendation is especially pertinent if the Civil Engineer anticipates poor drainage under some pavement sections, as grading of the street will be largely constrained by the need to tie-into existing improvements.
- Designing the paved areas with good, positive drainage, and avoiding any areas of ponding, will reduce the likelihood of frost heave adversely impacting pavements or other appurtenant structures.

6.0 CLOSURE

6.1 LIMITATIONS

The concept of risk is a significant consideration of geotechnical analyses. The analytical means and methods used in performing geotechnical analyses and development of resulting recommendations do not constitute an exact science. Analytical tools used by geotechnical engineers are based on limited data, empirical correlations, engineering judgment and experience. As such the solutions and resulting recommendations presented in this report cannot be considered risk-free and constitute IGES's best professional opinions and recommendations based on the available data and other design information available at the time they were developed. IGES has developed the preceding analyses, recommendations and designs, at a minimum, in accordance with generally accepted professional geotechnical engineering practices and care being exercised in the project area at the time our services were performed. No warrantees, guarantees or other representations are made.

The information contained in this report is based on limited field testing and understanding of the project. The subsurface data used in the preparation of this report were obtained largely from the explorations made for this project. It is very likely that variations in the soil, rock, and groundwater conditions exist between and beyond the points explored. The nature and extent of the variations may not be evident until construction occurs and additional explorations are completed. If any conditions are encountered at this site that are different from those described in this report, IGES must be immediately notified so that we may make any necessary revisions to recommendations presented in this report. In addition, if the scope of the proposed construction or grading changes from those described in this report, our firm must also be notified.

This report was prepared for our client's exclusive use on the project identified in the foregoing. Use of the data, recommendations or design information contained herein for any other project or development of the site not as specifically described in this report is at the user's sole risk and without the approval of IGES, Inc. It is the client's responsibility to see that all parties to the project including the designer, contractor, subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

We recommend that IGES be retained to review the final design plans, grading plans and specifications to determine if our engineering recommendations have been properly incorporated in the project development documents. We also recommend that IGES be retained to evaluate construction performance and other geotechnical aspects of the project as construction initiates and progresses through its completion.

6.2 ADDITIONAL SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during the construction. IGES staff or other qualified personnel should be on site to verify compliance with these recommendations. These tests and observations should include at a minimum the following:

- Observations and testing during site preparation, earthwork and structural fill placement.
- Consultation as may be required during construction.
- Quality control on concrete placement to verify slump, air content, and strength.
- Quality control and testing during placement and compaction of asphalt.

We also recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience at (801) 748-4044.

7.0 REFERENCES

Blake, T.F., Hollingsworth, R.A. and Stewart, J.P., Editors (2002), Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for analyzing and mitigating landslide hazards in California: organized by the Southern California Earthquake Center.

Coogan, J.C., and King, J.K., 2016, Interim Geologic Map of the Ogden 30’ x 60’ Quadrangle, Box Elder, Cache, Davis, Morgan, Rich, and Summit Counties, Utah, and Uinta County, Wyoming: Utah Geological Survey Open-File Report 653DM, 1 Plate, 151 p., Scale 1:100,000.

Federal Emergency Management Agency [FEMA], 1997, *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures*, FEMA 302, Washington, D.C.

Frankel, A., Mueller, C., Barnard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S., and Hopper, M., 1996, *National Seismic-hazard Maps: Documentation*, U.S. Geological Survey Open-File Report 96-532, June.

Hynes, M.E. and A. G. Franklin (1984). “Rationalizing the Seismic Coefficient Method” Miscellaneous Paper GL-84-13, U.S. Army Waterways Experiment Station, Vicksburg, Miss.

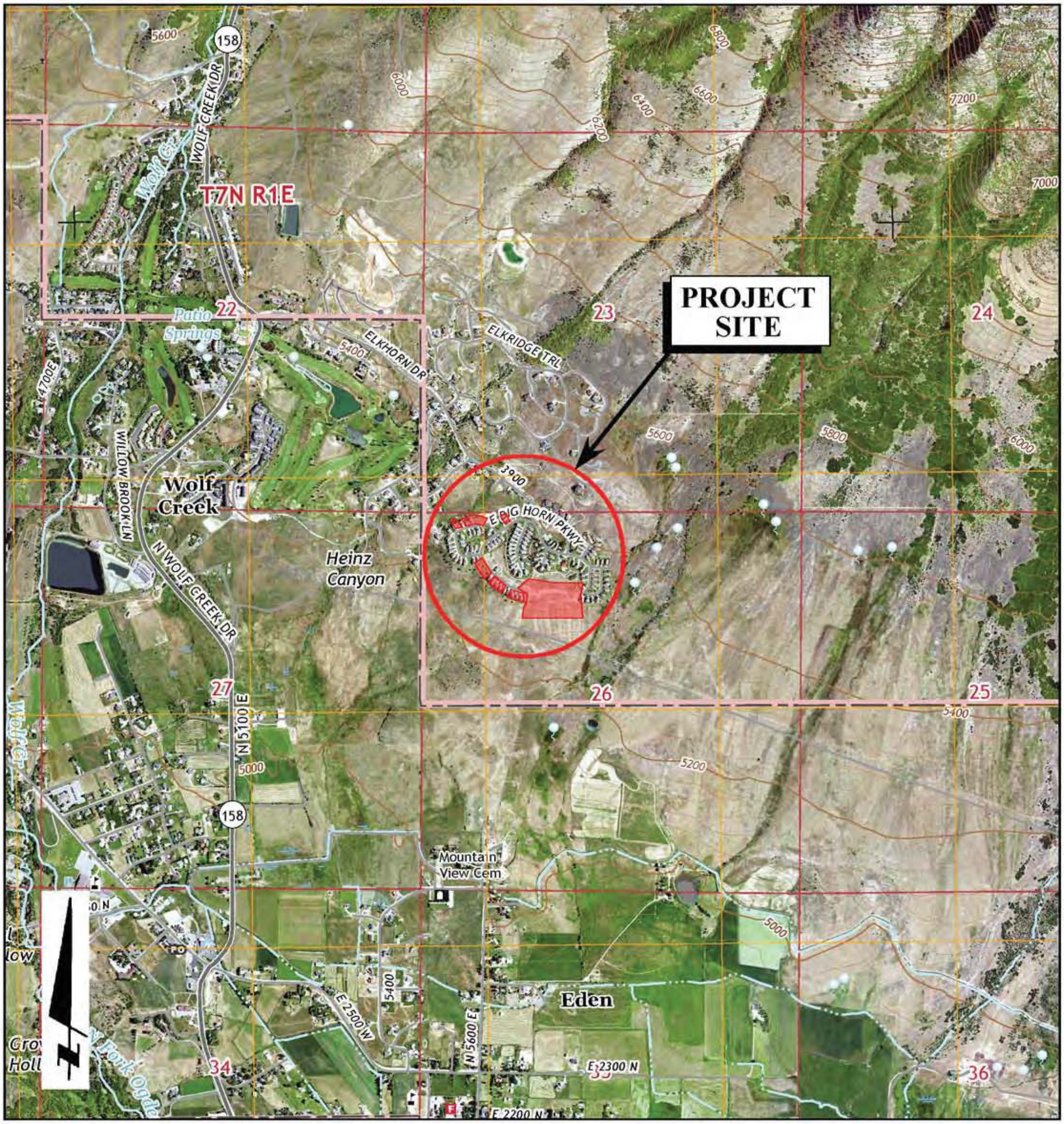
IGES, Inc., 2017a, Reconnaissance-Level Geologic Hazards Assessment, 5911 E. Bighorn Parkway, Lot 110 of the Trappers Ridge at Wolf Creek Subdivision, Phase 6, Eden, Utah, Project No. 01855-009, dated April 21, 2017.

IGES, Inc., 2017b, Reconnaissance-Level Geologic Hazards Assessment, Remaining Undeveloped Lots, Trappers Ridge at Wolf Creek Subdivision, Phases 5, 6, and 7, Eden, Utah, Project No. 01855-010, dated May 18, 2017.

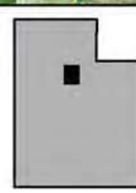
International Building Code [IBC], 2015, International Code Council, Inc.

U.S. Geological Survey, 2012/15, U.S. *Seismic “Design Maps” Web Application*, site: https://geohazards.usgs.gov/secure/designmaps/us/application.php, site accessed on July 20, 2012.

APPENDIX A



BASE MAP:
USGS Huntsville 7.5-Minute Quadrangle Topographic Map (2017)



MAP LOCATION

0' 1000' 2000'
SCALE 1:24,000

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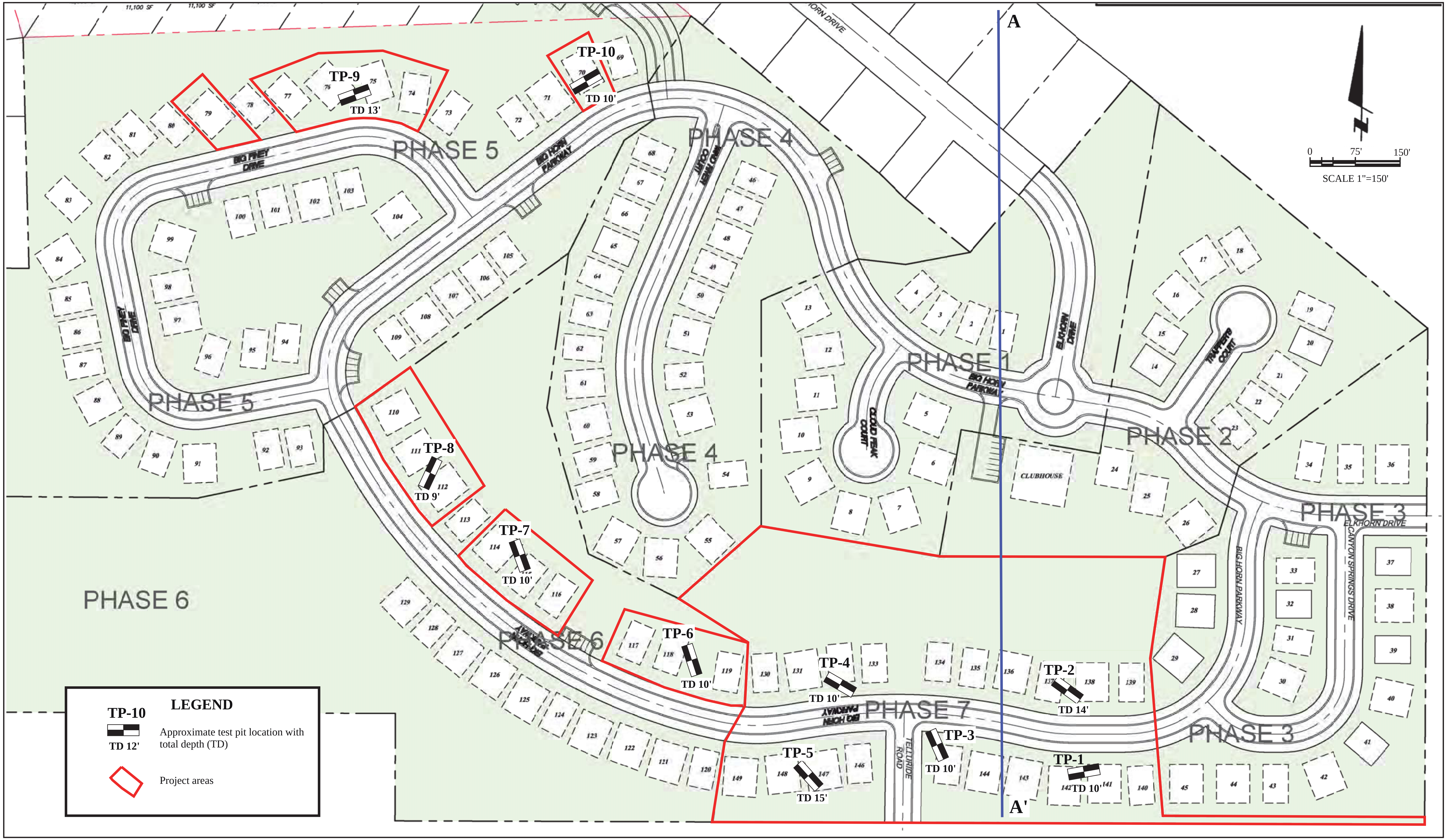
Geotechnical & Investigation
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

SITE VICINITY MAP

Figure

A-1



Basemap: Plan titled "Trappers Ridge at Wolf Creek, Open space Exhibit" submission date 12-18-15

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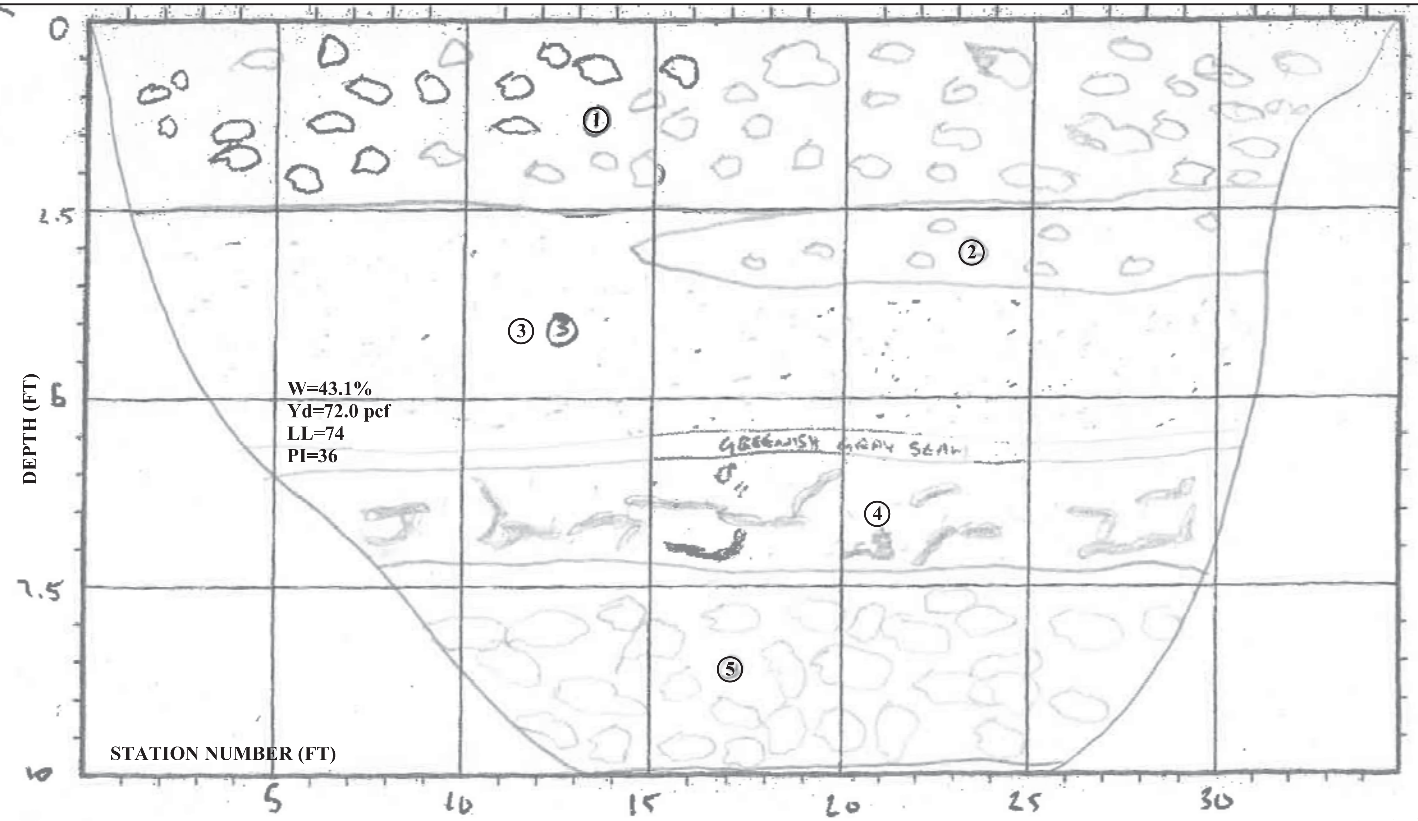
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

GEOTECHNICAL MAP

Figure A-2



LITHOLOGIC UNIT DESCRIPTIONS:

1) Clayey Gravel (GC): dark brown, medium-dense, moist, poorly-graded gravel, coarse-grained, 6" to 8" dia. nominal, cobbles to 10", trace boulders (>12"), angular to subangular, boulders measured to 4' in dia.
2) Fat Clay with gravel (CH): greenish gray, stiff, moist, high plasticity, gravel between 2" and 5" dia., angular to subangular gravel.
3) Fat Clay with sand (CH): moderate to reddish brown, stiff, moist, moderate plasticity, fine- to medium-grained sand, Atterberg Limits plots as elastic silt (MH).
4) Fat CLAY (CH), greenish-gray, stiff, moist, high plasticity.
5) Clayey Gravel (GC): reddish brown, dense, moist, coarse-grained gravel (4" to 7" dia.), angular to subangular, trace boulders to 3'.

DATE: 06/20/17
LOGGED BY: TQH
COORDINATES: N 41.31896, W111.80830
Total Depth: 10 feet
No Groundwater
100°E ←

SCALE: 1"=5' H 1"=2.5' V

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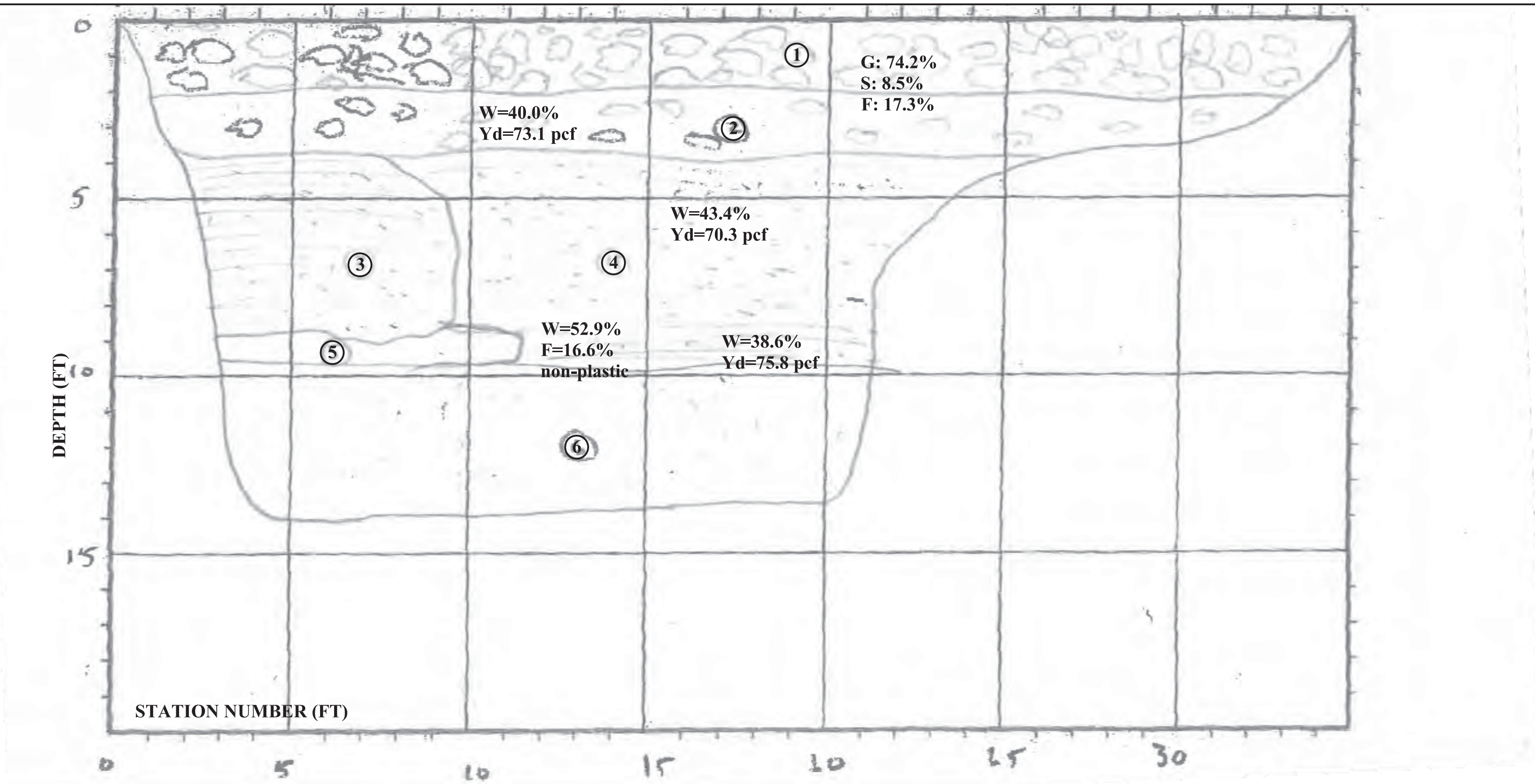
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

TEST PIT LOG TP-1

Figure

A-3



LITHOLOGIC UNIT DESCRIPTIONS:

1) Clayey Gravel (GC): moderate to dark brown, medium dense, dry to moist, coarse-grained gravel, angular to subangular, trace cobbles and boulders, 4" to 7" dia. gravel, 10" cobbles, one 5-foot boulder, trace well-graded sand.
2) Fat Clay with gravel (CH): greenish gray, stiff, moist, high plasticity, coarse-grained gravel, 4" to 6" dia. gravel, angular to subangular.
3) Lean Clay with sand (CL): light gray to tan, stiff, moist, fine- to medium-grained sand seams, reddish-brown oxidation staining throughout, low to moderate plasticity, at 5' depth increasing sand content and complete oxidation.
4) Clayey Sand (SC): orangish brown, medium dense, moist, well-graded sand, low plasticity fines, oxidized throughout, thinly laminated (2mm to 4mm).
5) Lean Clay with sand (CL): white, stiff to hard, moist, homogenous, low plasticity, cementation present, appears similar to talc.
6) Sandy Lean Clay (CL): tan to brown, medium stiff, moist, homogenous, fine- to medium-grained sand with oxidation throughout, thinly laminated, moderate plasticity.

DATE: 06/20/17
LOGGED BY: TQH
COORDINATES: N 41.31939, W111.80821
Total Depth: 14 feet
No Groundwater
126°SE ←

SCALE: 1"=5' H&V

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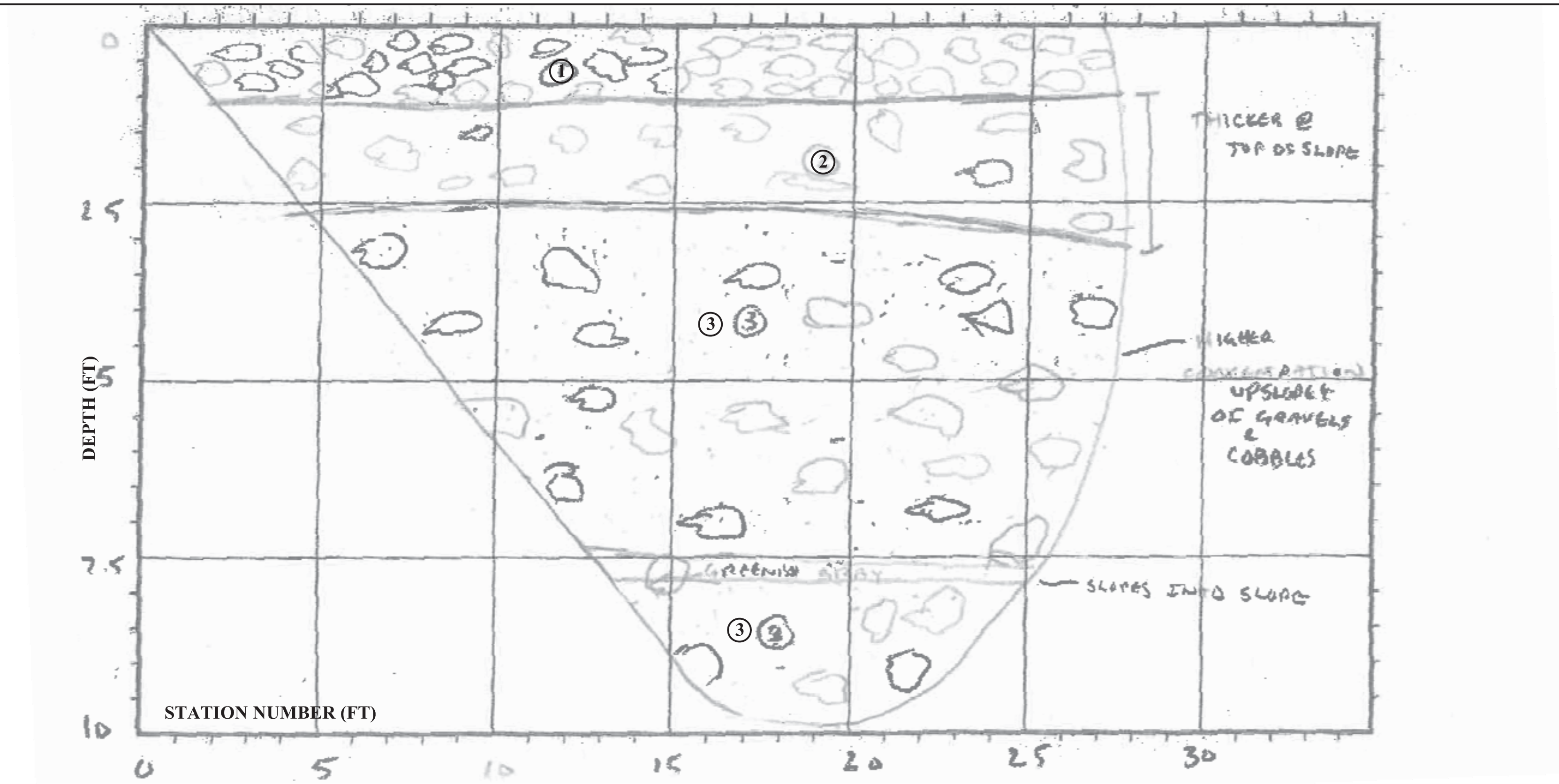
TEST PIT LOG TP-2

Figure

A-4



LITHOLOGIC UNIT DESCRIPTIONS:

1) Clayey Gravel (GC): dark brown, dense, moist, roots within upper 12", trace sand and boulders, coarse gravel, 6" to 8" nominal dia., trace 2' to 3' boulders, subangular to subrounded.
2) Fat Clay with gravel (CH): moderate gray to greenish gray, stiff to very stiff, moist, high plasticity, coarse gravel, trace cobbles, angular to subangular, becomes reddish brown near base of unit.
3) Clayey Sand with gravel (SC): reddish to orangish brown, dense to very dense, moist, well-graded sand, coarse gravel, trace 4" dia. gravel, angular to subangular, cobbles to 10".

@ 8' greenish-gray clay seam, 6" thick, with some gravel mixed in.

DATE: 06/20/17
LOGGED BY: TQH
COORDINATES: N 41.31900, W111.80865
Total Depth: 10 feet
No Groundwater
159°S ←

SCALE: 1"=5' H 1"=2.5' V

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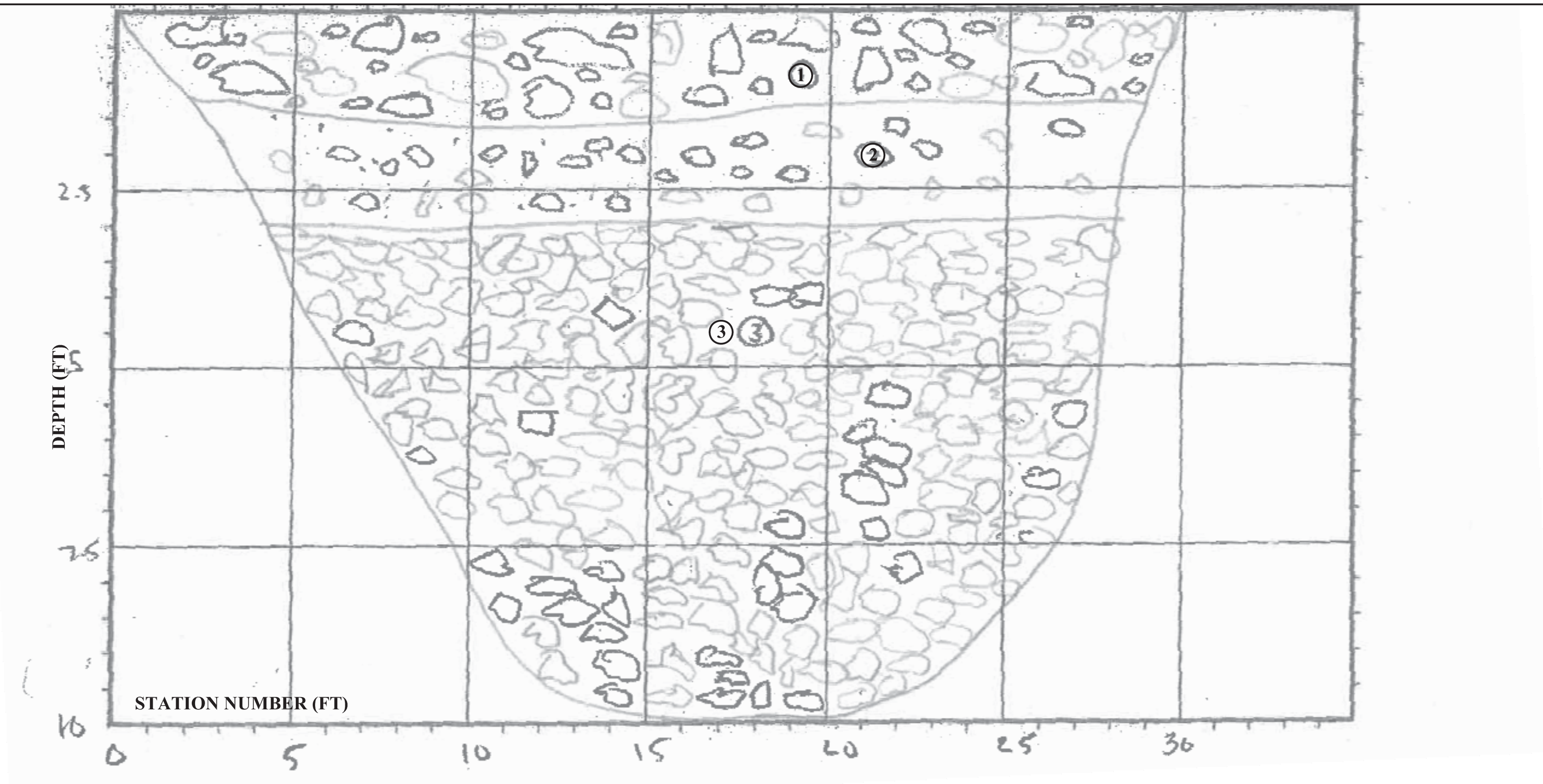
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

TEST PIT LOG TP-3

Figure

A-5



LITHOLOGIC UNIT DESCRIPTIONS:

1) Clayey Gravel (GC): dark brown, medium dense, dry to moist, coarse, angular to subangular, 5" to 7" dia. nominal, trace cobbles and boulders, boulders as large as 5' identified.
2) Fat Clay with gravel (CH): greenish gray, stiff to hard, moist, 4" to 6" dia. gravel, angular to subangular, becomes reddish brown at base of unit.
3) Clayey Sand with gravel (SC): orangish brown, dense to very dense, moist, coarse gravel, well-graded sand, trace cobbles to 10", trace boulders to 2 to 4 feet dia.

Soils in this test pit too coarse for the drive sampler

DATE: 06/20/17
LOGGED BY: TQH
COORDINATES: N 41.31933, W111.80882
Total Depth: 10 feet
No Groundwater
120°SE ←

SCALE: 1"=5' H&V

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Geotechnical Investigation
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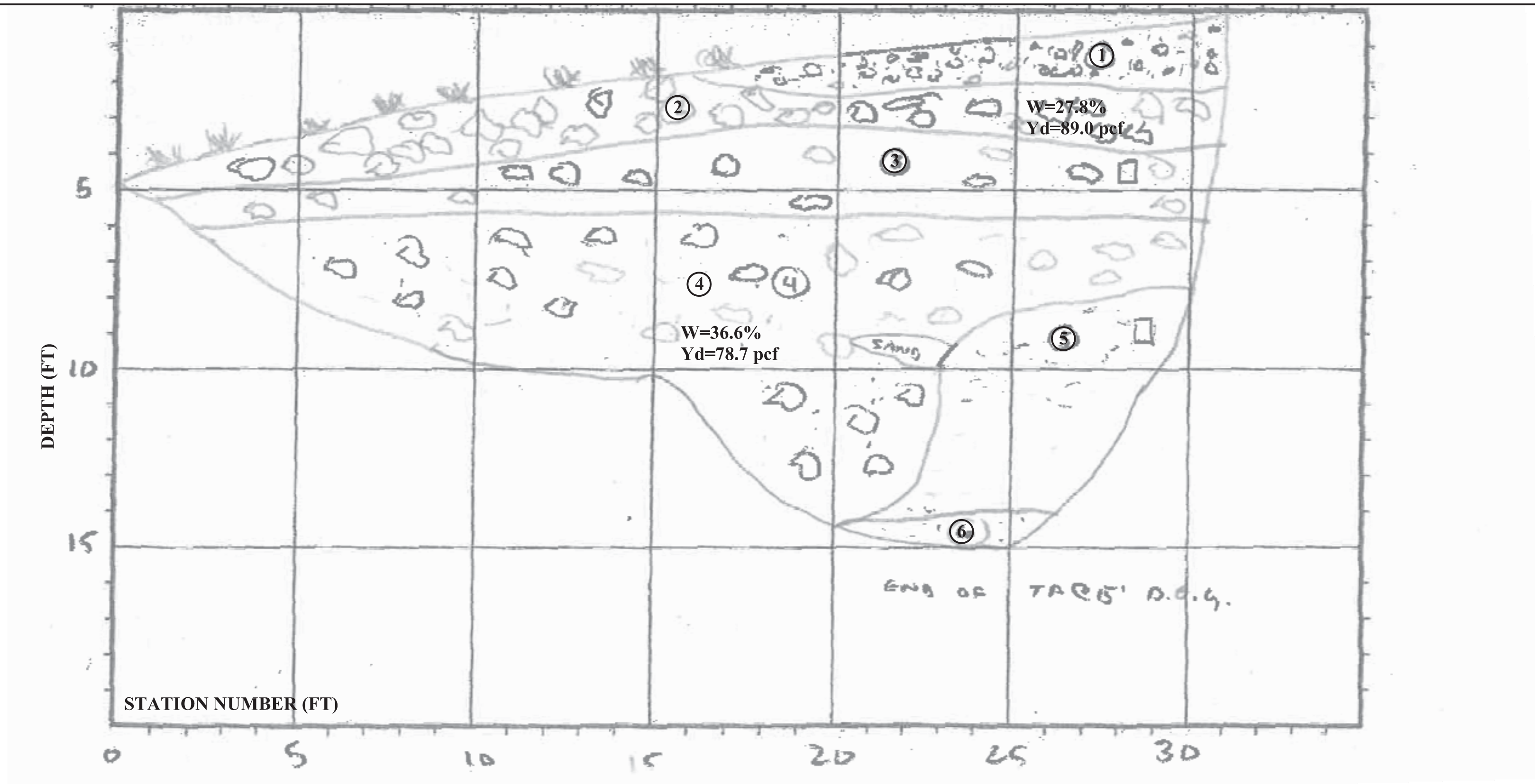
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah
TEST PIT LOG TP-4

Figure
A-6



LITHOLOGIC UNIT DESCRIPTIONS:

1) Undocumented Fill - Clayey Gravel with sand (GC): reddish brown, dense, moist, 1-2" angular gravel.
2) Alluvium - Clayey Gravel (GC): dark brown to black, medium dense, moist, coarse-grained, angular to subangular, cobbles and trace boulders.
3) Fat Clay with gravel (CH): greenish gray, stiff, moist, high plasticity, 4-6" gravels and trace 10" cobbles, angular to subangular, becomes reddish brown toward bottom of unit.
4) Lean Clay with gravel (CL): reddish brown, medium stiff to very stiff, moderate plasticity, moist, 4-6" gravel, subangular to subrounded, some thin sand lenses, oxidation throughout sand lenses.
5) Lean Clay (CL): light greenish gray, stiff to very stiff, moist, moderate plasticity, homogenous, trace gravel to 3" to 5", subrounded, oxidation present.
6) Sandy Lean Clay (CL): moderate brown, stiff, moist, homogenous.

DATE: 06/20/17
LOGGED BY: TQH
COORDINATES: N 41.31894, W111.80953
Total Depth: 15 feet
No Groundwater
138°SE ←

SCALE: 1"=5' H&V

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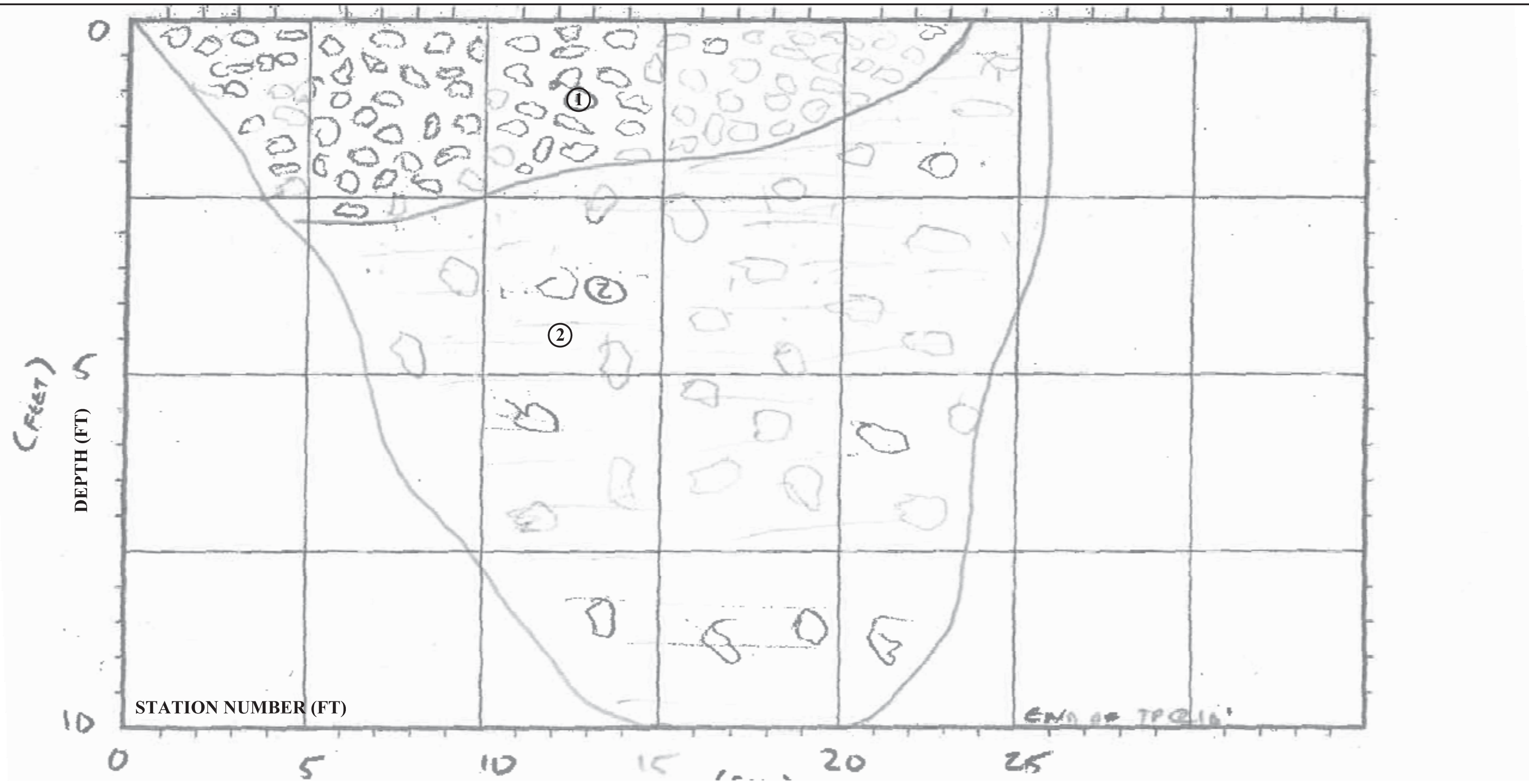
Geotechnical Investigation
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah
TEST PIT LOG TP-5

Figure
A-7



LITHOLOGIC UNIT DESCRIPTIONS:

1) Clayey Gravel (GC): light brown, medium dense, moist, trace well-graded sand, angular to subangular gravel to 3" dia., some cobbles to 10", this material could be fill but difficult to distinguish between other native soils.
2) Lean Clay with gravel (CL): reddish brown, stiff, moist, moderate plasticity, 2-4" angular gravel, some oxidized sand, some porosity (pinholes) within the upper 3 feet of unit.

DATE: 06/20/17
LOGGED BY: TQH
COORDINATES: N 41.31940, W111.81035
Total Depth: 10 feet
No Groundwater
162°S ←

SCALE: 1"=5' H&V

IGES®

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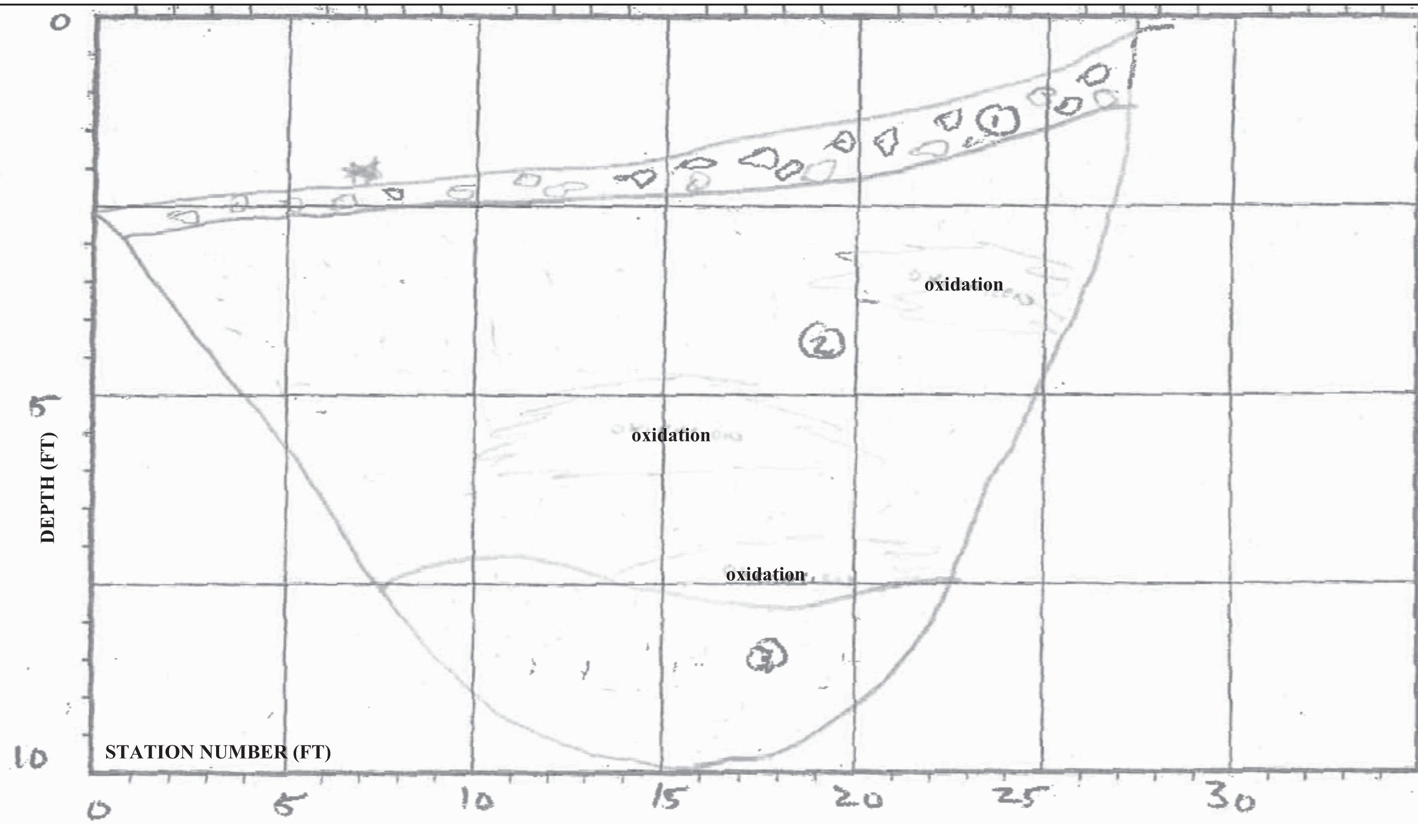
Geotechnical Investigation
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

TEST PIT LOG TP-6

Figure

A-8



LITHOLOGIC UNIT DESCRIPTIONS:

1) Topsoil - Clayey Gravel (GC): dark brown, medium dense, moist, coarse gravel, gravel is 4" to 6" dia., subangular, trace sand and cobbles.
2) Sandy Lean Clay (CL): light gray to tan, medium stiff, moist, fine-grained sand, prominent zones of reddish brown oxidation, homogenous, some porosity.
3) Sandy Lean Clay (CL): reddish to orangish brown, medium stiff, moist, fine- to medium-grained sand, homogenous, some trace porosity.

water seeping in at bottom of excavation

DATE: 06/20/17
LOGGED BY: TQH
COORDINATES: N 41.31980, W111.81153
Total Depth: 10 feet
Seepage at 10 feet
160°S ←

SCALE: 1"=5' H&V

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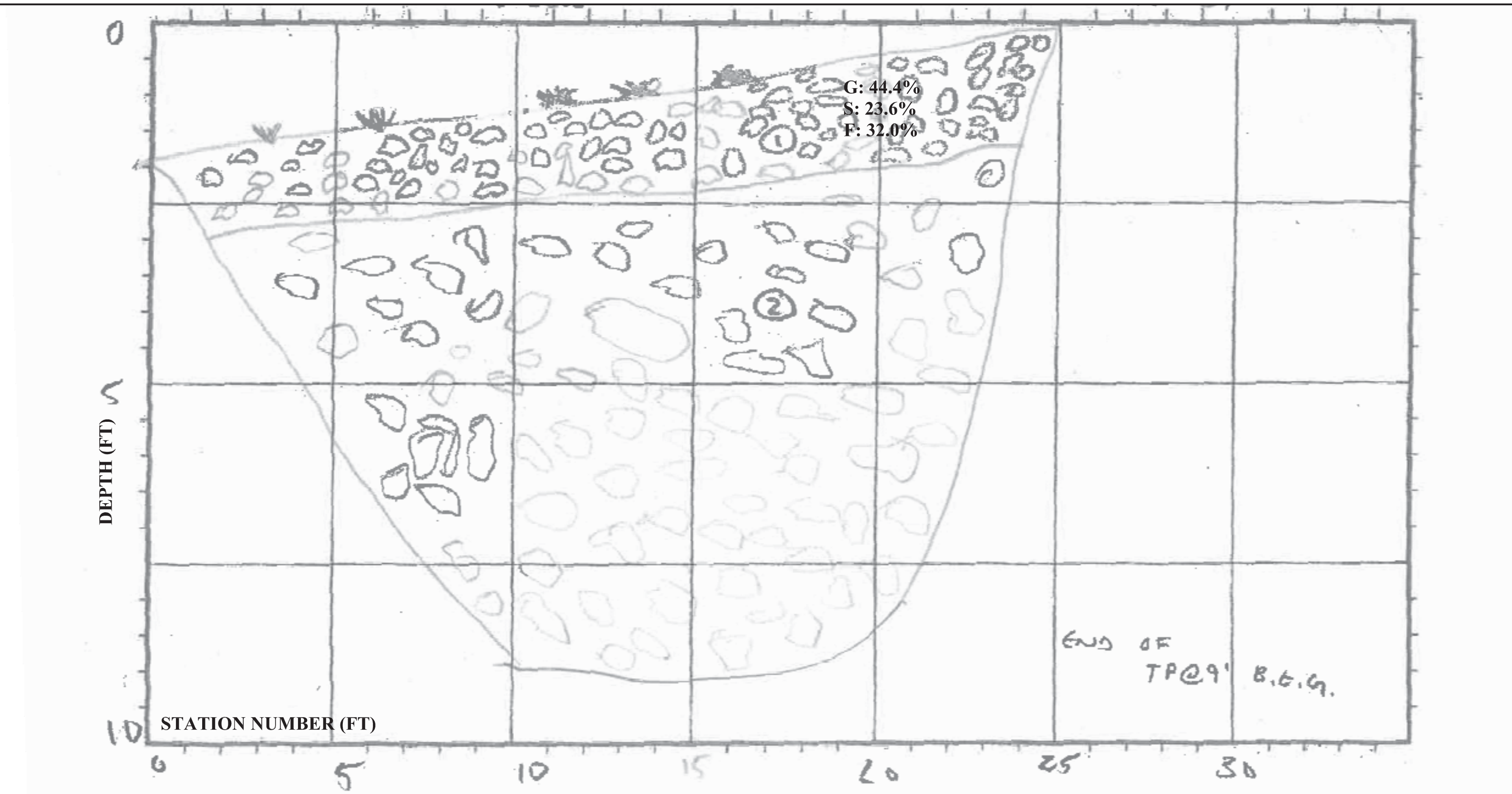
Project No. 01855-011

Geotechnical Investigation
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

TEST PIT LOG TP-7

Figure

A-9



LITHOLOGIC UNIT DESCRIPTIONS:

1) Clayey Gravel with sand (GC): moderate brown to black, dense, dry to moist, coarse-grained gravel, 2-4" dia., subrounded to subangular, organics in upper 2 feet.
2) Poorly-Graded Gravel (GP): reddish brown, dense to very dense, trace cobbles, generally subangular, 4" to 8" constituents, trace boulders to 16", oxidation staining throughout.

DATE: 06/20/17
LOGGED BY: TQH
COORDINATES: N 41.32025, W111.81200
Total Depth: 10 feet
Seepage at 10 feet
160°S ←

SCALE: 1"=5' H&V

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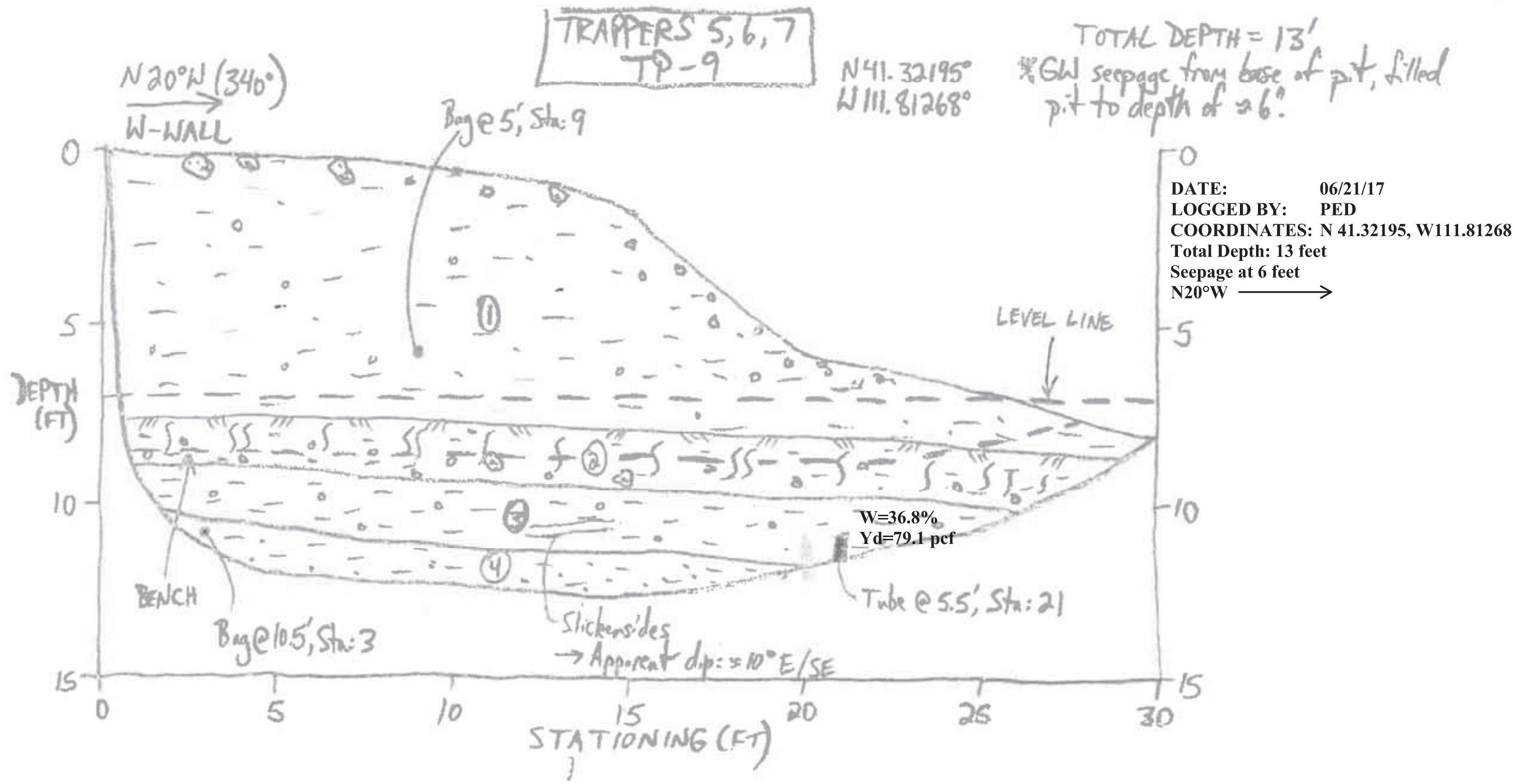
Project No. 01855-011

Geotechnical Investigation
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

TEST PIT LOG TP-8

Figure

A-10



LITHOLOGIC UNIT DESCRIPTIONS:

1) **Undocumented Fill:** ~7-8' thick; dark yellowish brown (10YR 4/2) sandy lean CLAY with gravel (CL), medium stiff to stiff, moist, low to moderate plasticity, massive; gravel and larger sized clasts comprise ~5-10% of unit; clasts entirely subangular white (N9) to very light gray (N8) quartzite up to 1' in diameter, though mode size ~1/2-1"; common grayish brown (5Y 3/2) fat clay inclusions; mottled in places with small calcium carbonate nodules; sharp, planar basal contact.

2) **A/B Soil Horizon:** ~1.5' thick; black (N1) to grayish brown (5Y 3/2) sandy fat CLAY with gravel (CH), loose to medium stiff, moist, moderate plasticity, massive; gravel and larger sized clasts comprise ~10% of unit; clasts are entirely subrounded to subangular quartzite as above, up to 1' in diameter, though mode size ~1-3"; includes distinct black A-Horizon ~6" thick, while B-Horizon is grayish brown, and contains fatter clay and more clasts; sharp, irregular basal contact.

3) **Shallow Landslide:** ~1.5-2' thick; pale olive (10Y 6/2) to medium light gray (N6) fat CLAY with gravel (CH), stiff, moist, high plasticity, massive; gravel and larger sized clasts comprise ~5-10% of unit; clasts are entirely subangular to subrounded white (N9) to pale yellowish orange (10YR 8/6) quartzite up to 5" in diameter, though mode size <1/2"; where unsaturated, exhibits glassy sheen with abundant slickensides, though not along a continuous surface; common to abundant pinholes (1 mm diameter); sharp, largely planar basal contact.

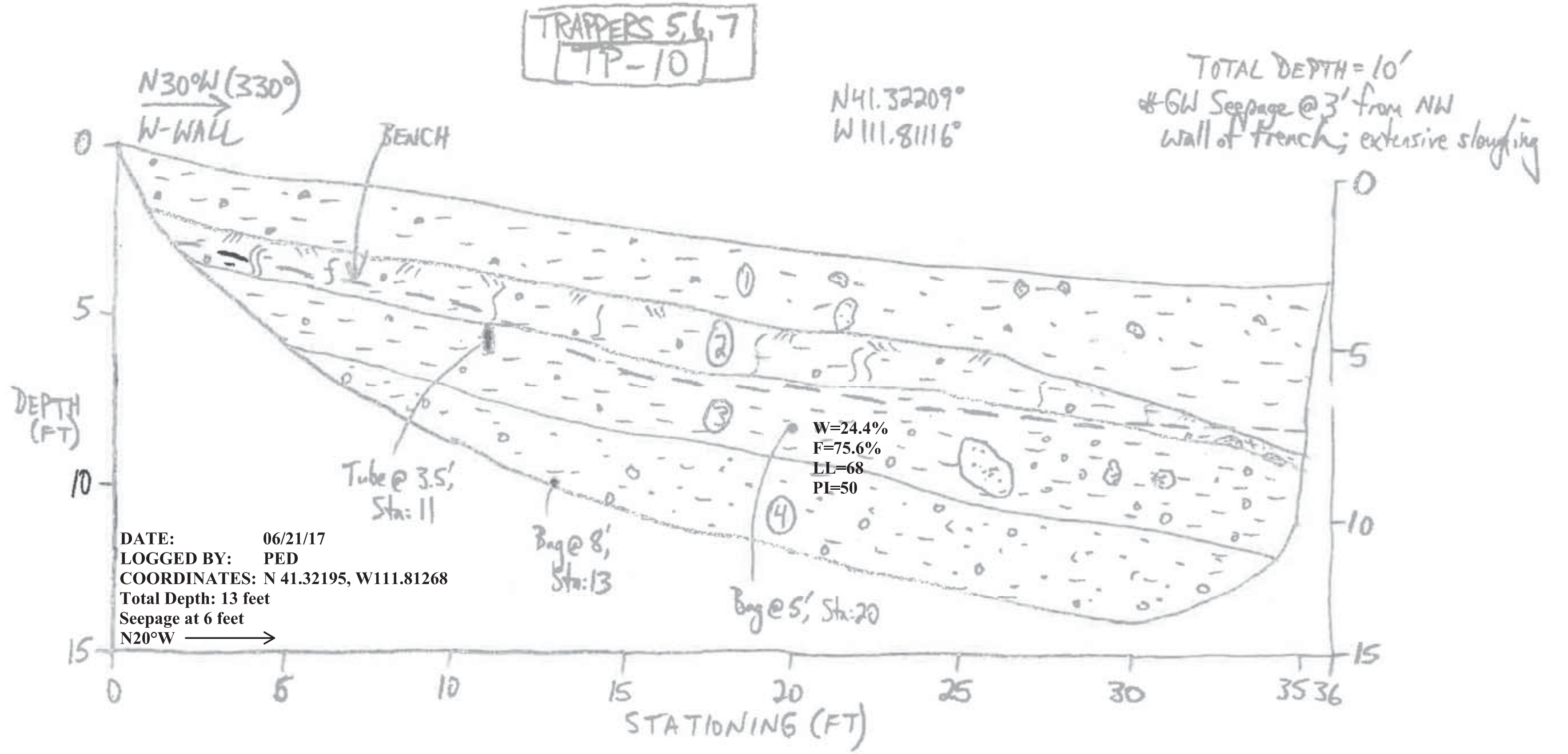
4) **Alluvium?:** At least 1.5' thick; moderate reddish brown (10R 4/6) fat CLAY (CH), stiff, moist to wet, moderate plasticity, massive; appears to be devoid of clasts; becomes sandy with depth; no observed slickensides, though appears like a transitional unit, as it has some of the Unit 3 gray clay mixed in; possibly slopewash colluvium.

SCALE: 1"=5' H&V

IGES®
Project No. 01855-011

Geotechnical Investigation
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah
TEST PIT LOG TP-9

Figure
A-11



LITHOLOGIC UNIT DESCRIPTIONS:

1) **Undocumented Fill:** ~2-3' thick; grayish brown (5Y 3/2) sandy fat CLAY with gravel (CH), medium stiff, moist, moderate to high plasticity, massive; gravel and larger sized clasts comprise ~20% of unit; clasts entirely subangular pale yellowish orange (10YR 8/6) to medium gray (N5) quartzite up to 14" in diameter, though mode size ~1-2"; contains some buried pieces of ecofabric; thickens dramatically downslope; sharp, irregular basal contact.

2) **A/B Soil Horizon:** ~6"-1.5' thick; brownish black (5YR 2/1) to black (N1) fat CLAY with gravel (CH), medium stiff, moist to wet, moderate to high plasticity, massive; gravel and larger sized clasts comprise ~5-10% of unit; clasts are entirely subangular quartzite as above, though mode size <1"; abundant plant and tree roots; partially stripped off, and pinches thinner downslope.

3) **Shallow Landslide:** ~2-3' thick; pale olive (10Y 6/2) to medium light gray (N6) fat CLAY with gravel (CH), medium stiff to stiff, wet, high plasticity, massive; gravel and larger sized clasts highly variable, comprising between ~5-40% of unit; clasts are entirely subangular to subrounded quartzite as above, in highly variable size ranges up to 2' in diameter; glassy sheen and slickensides throughout unit; common organic smear and manganese oxide staining; occasional pinholes up to 1 mm diameter; unit is constantly sloughing; sharp, irregular basal contact.

4) **Alluvium:** At least 3' thick; pale reddish brown (10R 5/4) to moderate reddish brown (10R 4/6) clayey SAND with gravel (SC) gradational to sandy fat CLAY with gravel (CH), medium dense, moist, moderate plasticity, massive; gravel and larger-sized clasts comprise ~20-25% of unit; clasts entirely subangular quartzite as above up to 1.5' in diameter, though mode clast size ~2"; contains occasional medium gray (N5) fat clay inclusions; possibly includes slopewash colluvium.

SCALE: 1"=5' H&V

IGES®

Project No. 01855-011

Geotechnical Investigation
Phase 7 and Portions of Phase 5 and 6
Trappers Ridge at Wolf Creek Subdivision
Eden, Utah

TEST PIT LOG TP-10

Figure

A-12

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

- BORING SAMPLE LOCATION
- TEST-PIT SAMPLE LOCATION
- WATER LEVEL (level after completion)
- WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

STRATIFICATION

DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"
LAYER	1/2 - 12"

DESCRIPTION	THICKNESS
OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNTRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

IGES®

Key to Soil Symbols and Terminology

Figure A-13

IGES, Inc. Project No. 01855-011

APPENDIX B

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/20/2017
By: BSS

Sample Info.	Boring No.	TP-1	TP-2	TP-2	TP-5	TP-10	TP-10		
	Sample								
	Depth	6.0'	5.0'	8.0'	9.0'	3.5'	5.0'		
	Split	No	No	No	No	No	Yes		
	Split sieve						3/8"		
	Total sample (g)						3124.80		
	Moist coarse fraction (g)						151.30		
	Moist split fraction (g)						2973.50		
Unit Weight Data	Sample height, H (in)	5.509	5.392		5.325				
	Sample diameter, D (in)	2.389	2.403		2.403				
	Mass rings + wet soil (g)	916.16	901.70		933.98				
	Mass rings/tare (g)	248.30	253.98		252.44				
	Moist unit wt., γ_m (pcf)	103.0	100.9		107.5				
Coarse Fraction	Wet soil + tare (g)						461.77		
	Dry soil + tare (g)						460.90		
	Tare (g)						310.48		
	Water content (%)						0.6		
Split Fraction	Wet soil + tare (g)	527.88	636.56	348.67	694.13	517.46	521.28		
	Dry soil + tare (g)	414.86	482.52	280.72	542.17	428.64	459.12		
	Tare (g)	152.83	127.96	152.36	127.32	127.02	219.44		
	Water content (%)	43.1	43.4	52.9	36.6	29.4	25.9		
	Water Content, w (%)	**43.1**	**43.4**	**52.9**	**36.6**	**29.4**	**24.4**		
	Dry Unit Wt., γ_d (pcf)	**72.0**	**70.3**		**78.7**				

Entered by:___________
Reviewed:___________

Amount of Material in Soil Finer than the No. 200 (75µm) Sieve

(ASTM D1140)

IGES

Project: **Trappers 5,6,7**
No: **01855-011**
Location: Eden, Utah
Date: 7/21/2017
By: BSS

Sample Info.	Boring No.	TP-2	TP-10						
	Sample								
	Depth	8.0'	5.0'						
	Split	No	Yes						
	Split Sieve*								
	Method	B	B						
	Specimen soak time (min)	430	280						
	Moist total sample wt. (g)	196.31	3124.80						
	Moist coarse fraction (g)		151.30						
	Moist split fraction + tare (g)		521.28						
	Split fraction tare (g)		219.44						
	Dry split fraction (g)		239.68						
	Dry retained No. 200 + tare (g)	259.44	266.48						
	Wash tare (g)	152.36	219.44						
	No. 200 Dry wt. retained (g)	107.08	47.04						
	Split sieve* Dry wt. retained (g)		150.43						
	Dry total sample wt. (g)	128.36	2511.58						
Coarse Fraction	Moist soil + tare (g)		461.77						
	Dry soil + tare (g)		460.90						
	Tare (g)		310.48						
	Water content (%)		0.58						
Split Fraction	Moist soil + tare (g)	348.67	521.28						
	Dry soil + tare (g)	280.72	459.12						
	Tare (g)	152.36	219.44						
	Water content (%)	52.94	25.93						
Percent passing split sieve* (%)			**94.0**						
Percent passing No. 200 sieve (%)		**16.6**	**75.6**						

Entered by:___________

Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

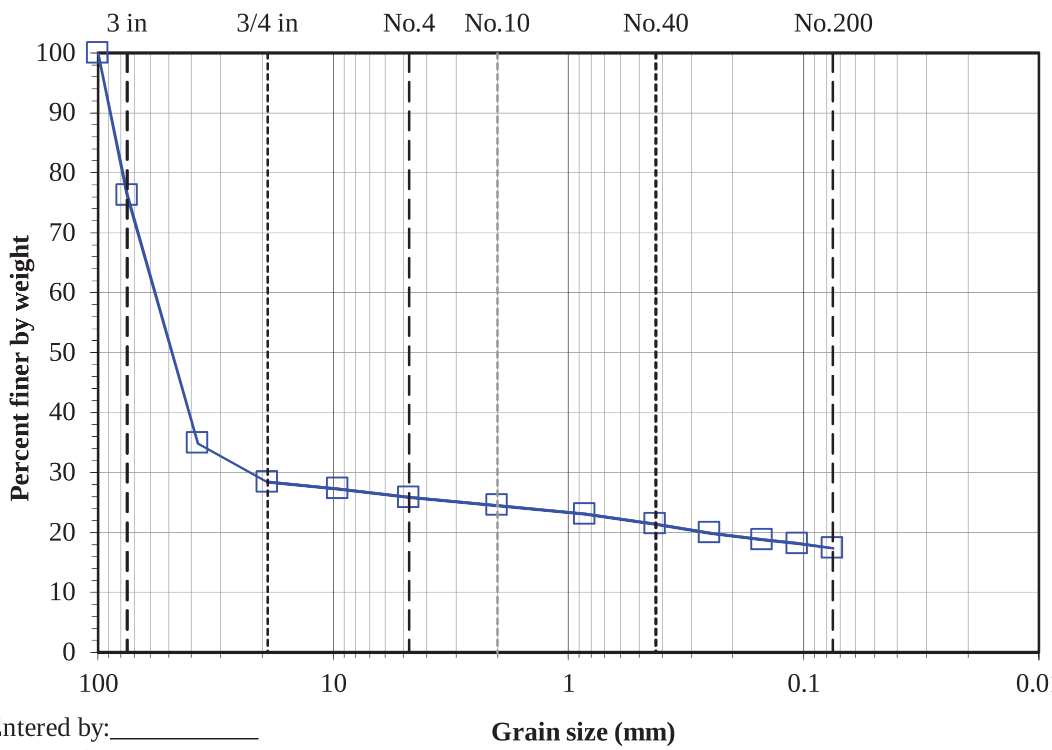
Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/21/2017
By: BSS

Boring No.: TP-2
Sample:
Depth: 2.0'
Description: Brown clayey gravel

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	4932.01	4783.01
+3/8" Coarse fraction (g):	3487.80	3479.73
-3/8" Split fraction (g):	344.21	310.62
Split fraction:	0.272	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	3819.94	808.33
Dry soil + tare (g):	3811.87	774.74
Tare (g):	332.27	464.12
Water content (%):	0.2	10.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	100.0	
3"	1135.87	75	76.3	
1.5"	3115.77	37.5	34.9	
3/4"	3424.16	19	28.4	
3/8"	3479.73	9.5	27.2	←Split
No.4	16.24	4.75	25.8	
No.10	31.20	2	24.5	
No.20	47.85	0.85	23.1	
No.40	66.60	0.425	21.4	
No.60	83.83	0.25	19.9	
No.100	96.67	0.15	18.8	
No.140	103.85	0.106	18.1	
No.200	113.22	0.075	17.3	



Gravel (%): 74.2
Sand (%): 8.5
Fines (%): 17.3

Entered by:___________
Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

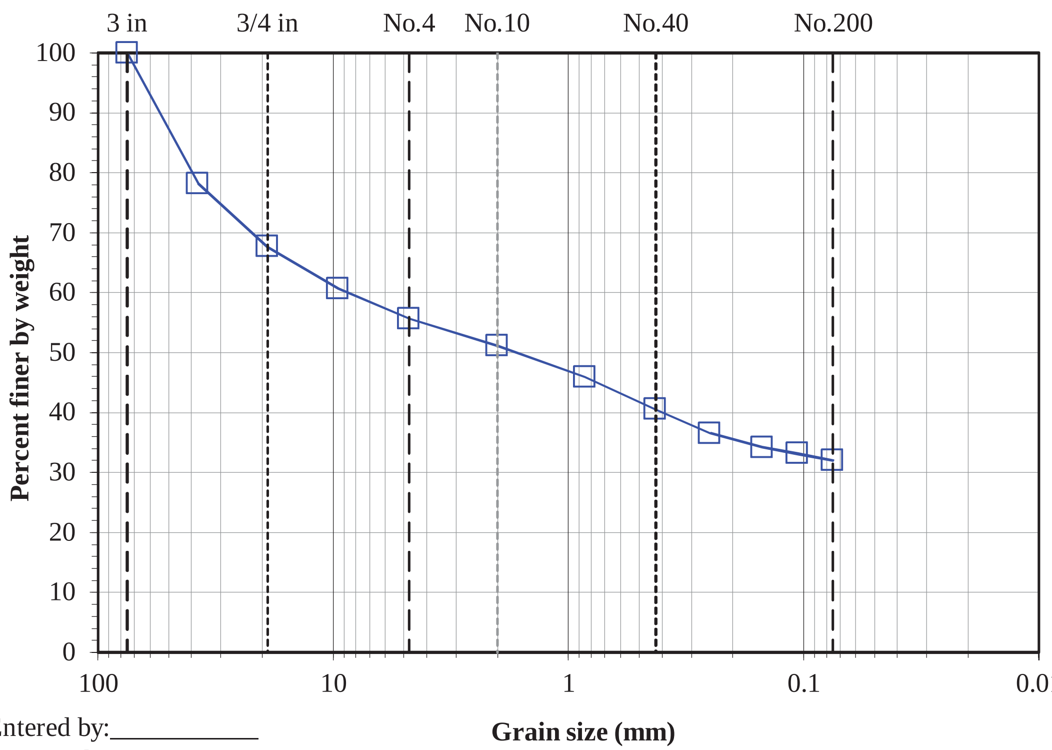
Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/21/2017
By: BSS

Boring No.: TP-8
Sample:
Depth: 2.0'
Description: Brown clayey gravel with sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	3301.40	2979.32
+3/8" Coarse fraction (g):	1179.90	1172.91
-3/8" Split fraction (g):	501.07	426.65
Split fraction:	0.606	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1490.11	810.52
Dry soil + tare (g):	1483.12	736.10
Tare (g):	310.38	309.45
Water content (%):	0.6	17.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	650.82	37.5	78.2	
3/4"	963.26	19	67.7	
3/8"	1172.91	9.5	60.6	←Split
No.4	35.28	4.75	55.6	
No.10	67.18	2	51.1	
No.20	103.74	0.85	45.9	
No.40	141.58	0.425	40.5	
No.60	169.64	0.25	36.5	
No.100	186.17	0.15	34.2	
No.140	193.45	0.106	33.1	
No.200	201.35	0.075	32.0	



Gravel (%): 44.4
Sand (%): 23.6
Fines (%): 32.0

Entered by:___________
Reviewed:___________

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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/22/2017
By: BRR
Grooving tool type: Plastic
Liquid limit device: Mechanical
Rolling method: Hand

Boring No.: TP-1
Sample:
Depth: 6.0'
Description: Brown elastic silt

Preparation method: Wet
Liquid limit test method: Multipoint
Screened over No.40: Yes
Larger particles removed: Wet sieved
Approximate maximum grain size: No.4
Estimated percent retained on No.40: Not requested
As-received water content (%): 43.1

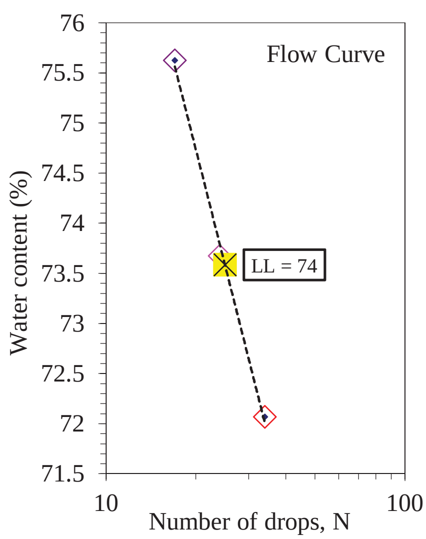
Plastic Limit

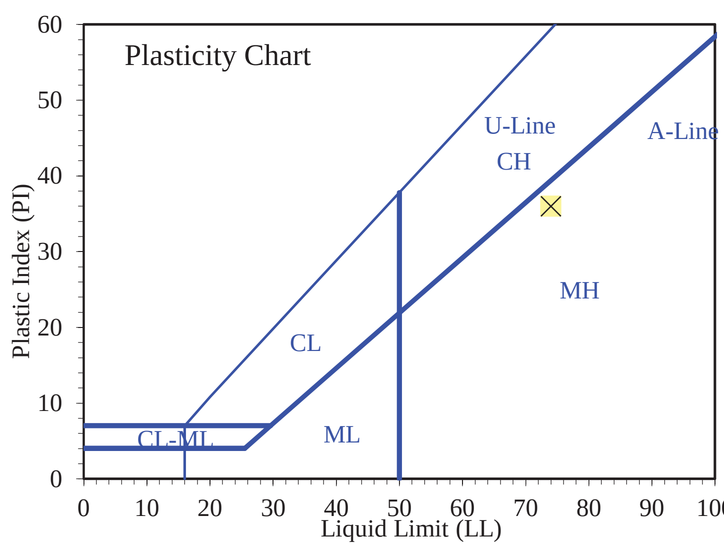
Determination No	1	2				
Wet Soil + Tare (g)	28.85	28.27				
Dry Soil + Tare (g)	26.95	26.38				
Water Loss (g)	1.90	1.89				
Tare (g)	21.89	21.39				
Dry Soil (g)	5.06	4.99				
Water Content, w (%)	37.55	37.88				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	34	24	17			
Wet Soil + Tare (g)	28.02	28.90	28.38			
Dry Soil + Tare (g)	25.44	25.71	25.65			
Water Loss (g)	2.58	3.19	2.73			
Tare (g)	21.86	21.38	22.04			
Dry Soil (g)	3.58	4.33	3.61			
Water Content, w (%)	72.07	73.67	75.62			
One-Point LL (%)		73				

Liquid Limit, LL (%)	**74**
Plastic Limit, PL (%)	**38**
Plasticity Index, PI (%)	**36**





Entered by:___________
Reviewed:___________

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/22/2017
By: BRR
Grooving tool type: Plastic
Liquid limit device: Mechanical
Rolling method: Hand

Boring No.: TP-2
Sample:
Depth: 8.0'
Description: Brown silt

Preparation method: Wet
Liquid Limit: Could not be determined (N.P.)
Screened over No.40: Yes
Larger particles removed: Wet sieved
Approximate maximum grain size: No.40
Estimated percent retained on No.40: Not requested
As-received water content (%): 52.9

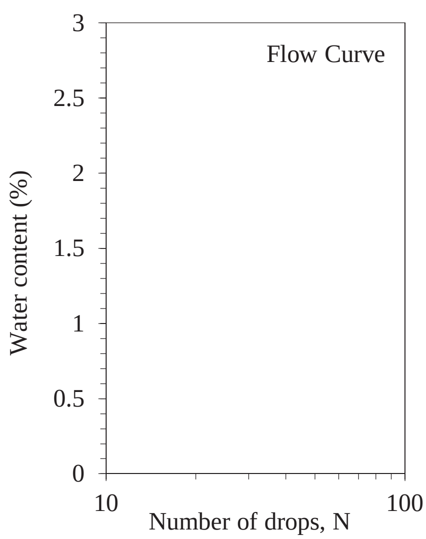
Plastic Limit

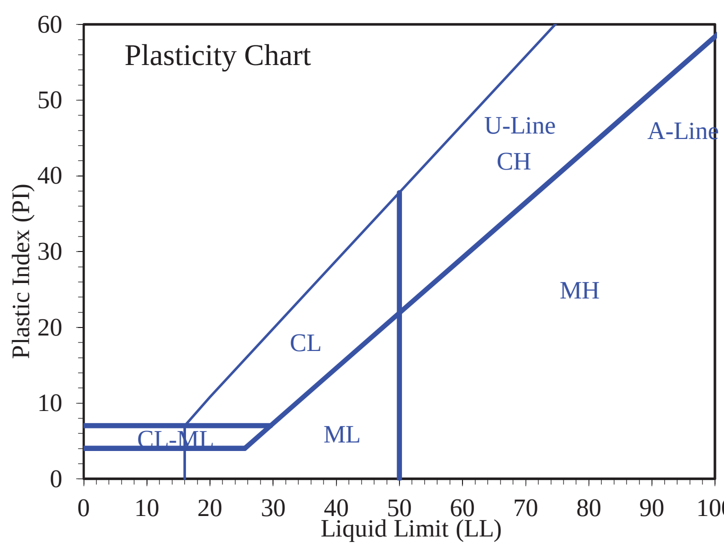
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)	Unable to obtain an adequate blow count.					
Dry Soil + Tare (g)						
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





Entered by:____________
Reviewed:____________

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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/22/2017
By: BRR
Grooving tool type: Plastic
Liquid limit device: Mechanical
Rolling method: Hand

Boring No.: TP-10
Sample:
Depth: 5.0'
Description: Brown fat clay

Preparation method: Wet
Liquid limit test method: Multipoint
Screened over No.40: Yes
Larger particles removed: Wet sieved
Approximate maximum grain size: 3/4"
Estimated percent retained on No.40: Not requested
As-received water content (%): 24.4

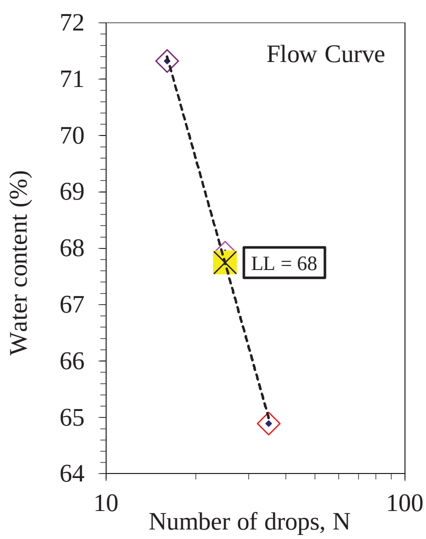
Plastic Limit

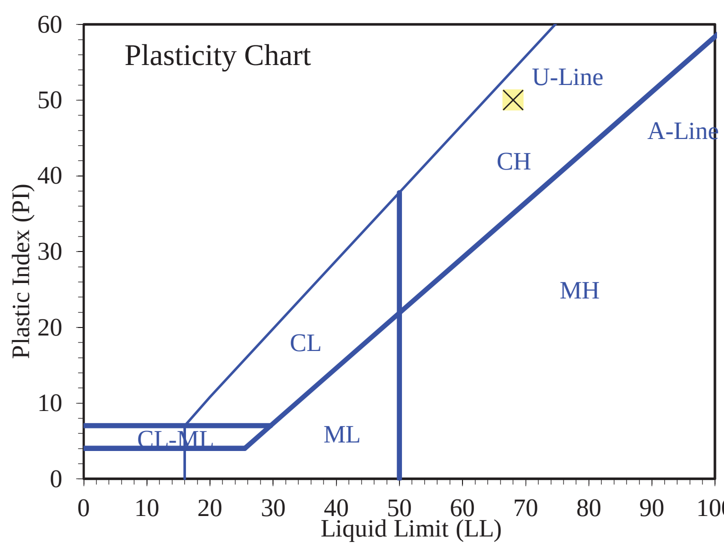
Determination No	1	2				
Wet Soil + Tare (g)	29.57	29.43				
Dry Soil + Tare (g)	28.33	28.23				
Water Loss (g)	1.24	1.20				
Tare (g)	21.57	21.73				
Dry Soil (g)	6.76	6.50				
Water Content, w (%)	18.34	18.46				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	35	25	16			
Wet Soil + Tare (g)	29.57	30.15	28.97			
Dry Soil + Tare (g)	26.41	26.72	26.06			
Water Loss (g)	3.16	3.43	2.91			
Tare (g)	21.54	21.67	21.98			
Dry Soil (g)	4.87	5.05	4.08			
Water Content, w (%)	64.89	67.92	71.32			
One-Point LL (%)		68				

Liquid Limit, LL (%)	**68**
Plastic Limit, PL (%)	**18**
Plasticity Index, PI (%)	**50**





Entered by:___________
Reviewed:___________

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Load to Prevent Swell of Cohesive Soils

IGES
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Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/17/2017
By: JDF

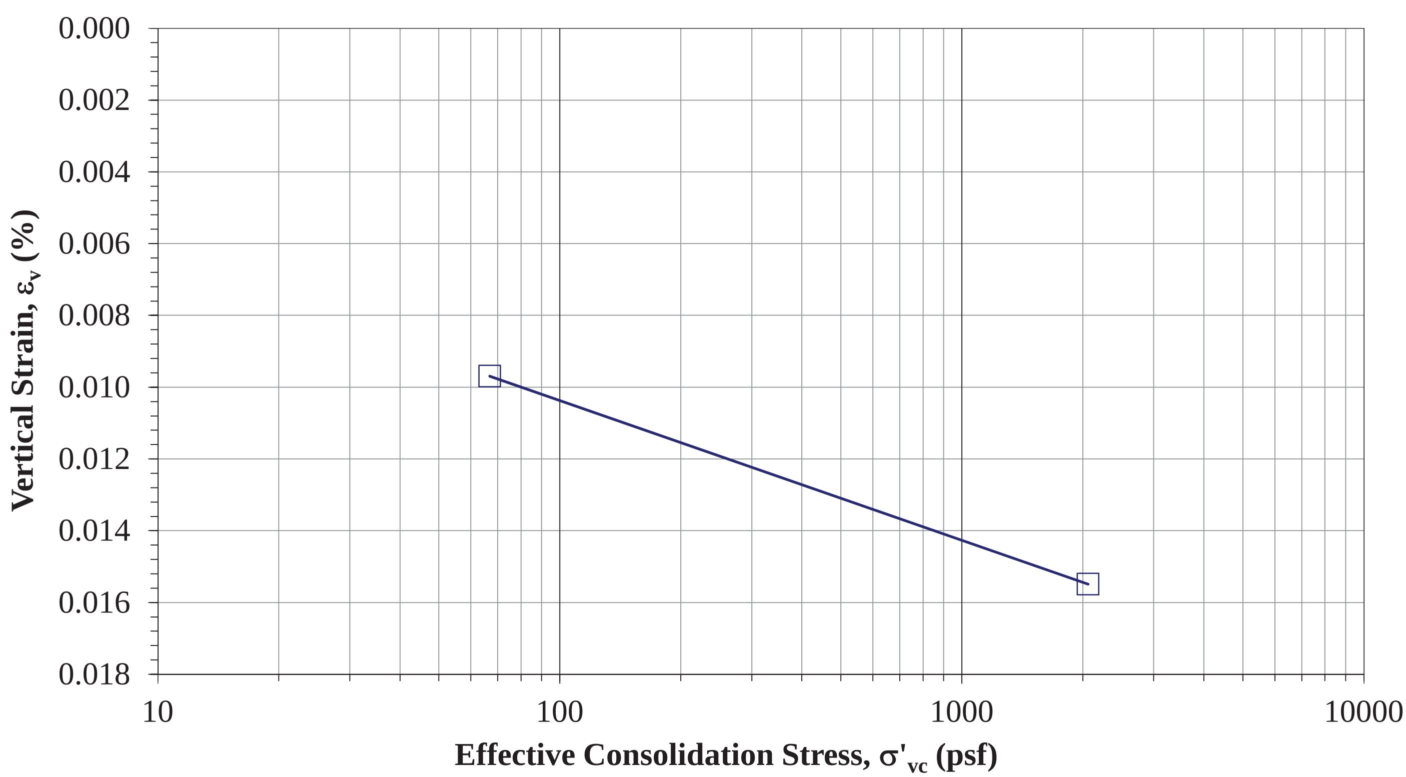
Boring No.: TP-2
Sample:
Depth: 3.0'
Sample Description: Brown clay
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

Inundation stress (psf), timing:	Seating	Beginning
Specific gravity, G_s	2.70	Assumed

Stress (psf)	Dial (in.)	1-D ε_v (%)	H_c (in.)	e
Seating	0.0000	0.00	0.9130	1.287
67	0.0001	0.01	0.9129	1.286
2060	0.0001	0.02	0.9129	1.286

	Initial (o)	Final (f)
Sample height, H (in.)	0.913	0.9129
Sample diameter, D (in.)	2.418	2.418
Mass rings + wet soil (g)	159.29	169.18
Mass rings/tare (g)	44.12	44.12
Moist unit wt., γ_m (pcf)	104.6	113.7
Wet soil + tare (g)	294.77	
Dry soil + tare (g)	245.59	
Tare (g)	128.39	
Water content, w (%)	42.0	54.2
Dry unit wt., γ_d (pcf)	73.7	73.7
Saturation	0.88	1.00

*Note: C_v, C_c, C_r, and σ_p' to be determined by Geotechnical Engineer.



Comments: Load to prevent swell is 2060 psf.

Entered: ________
Reviewed: ________

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/14/2017
By: NB/JDF

Boring No.: TP-2
Sample:
Depth: 3.0'
Sample Description: Brown clay
Sample type: Undisturbed-trimmed from thin-wall

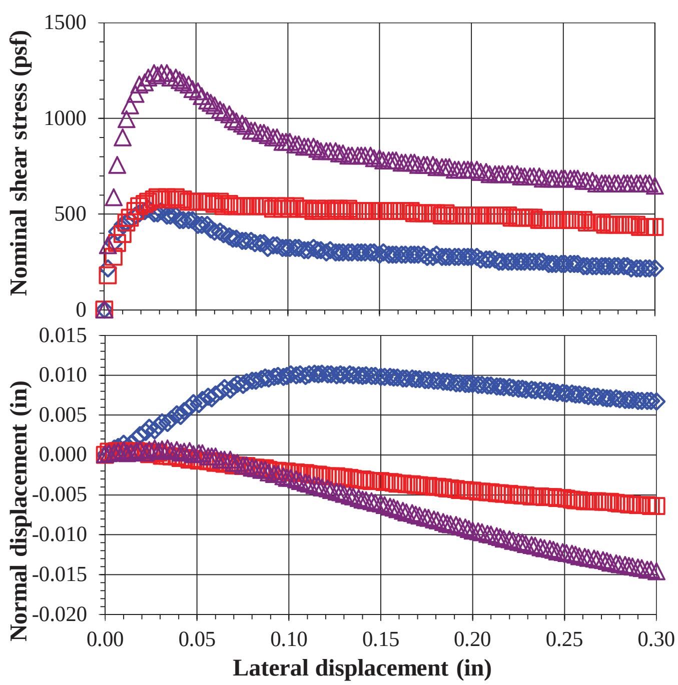
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0004
Specific gravity, Gs: 2.70 Assumed

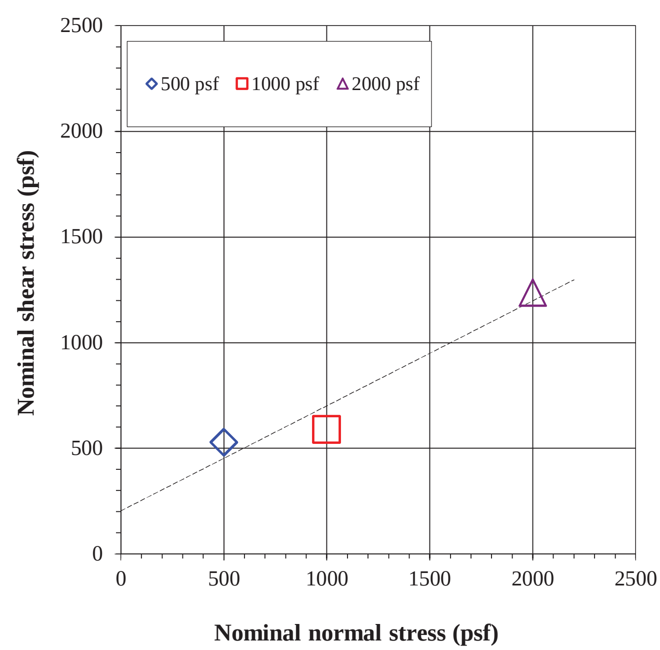
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	528		588		1236	
Lateral displacement at peak (in)	0.024		0.029		0.027	
Load Duration (min)	1120		2471		3915	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0040	1.0210	0.9930	0.9933	1.0000	0.9959
Sample diameter (in)	2.416	2.416	2.417	2.417	2.416	2.416
Wt. rings + wet soil (g)	171.00	177.91	162.68	171.20	167.65	172.73
Wt. rings (g)	45.59	45.59	43.78	43.78	42.34	42.34
Wet soil + tare (g)	294.77		294.77		294.77	
Dry soil + tare (g)	245.59		245.59		245.59	
Tare (g)	128.39		128.39		128.39	
Water content (%)	42.0	49.8	42.0	52.1	42.0	47.7
Dry unit weight (pcf)	73.1	71.9	70.0	70.0	73.3	73.6
Void ratio, e, for assumed Gs	1.31	1.34	1.41	1.41	1.30	1.29
Saturation (%)*	86.8	100.0	80.5	100.0	87.3	100.0

φ' (deg)	26
c' (psf)	204

Average of 3 samples	Initial	Pre-shear
Water content (%)	42.0	49.9
Dry unit weight (pcf)	72.2	71.8

*Pre-shear saturation set to 100% for phase calculations





Comments:
Test specimens swelled upon inundation.

Entered by:___________
Reviewed:___________

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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-2
Sample:
Depth: 3.0'

Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	0	0.000	0.000	0	0.000	0.000	0	0.000
0.002	216	0.001	0.002	180	0.000	0.002	336	0.000
0.005	348	0.001	0.005	276	0.000	0.005	588	0.000
0.007	408	0.001	0.007	348	0.001	0.007	756	0.000
0.010	444	0.001	0.010	396	0.000	0.010	900	0.001
0.012	456	0.001	0.012	456	0.001	0.012	996	0.000
0.014	468	0.001	0.014	480	0.000	0.014	1068	0.000
0.017	492	0.002	0.017	516	0.001	0.017	1128	0.001
0.019	504	0.003	0.019	540	0.000	0.019	1176	0.001
0.022	516	0.003	0.022	552	0.000	0.022	1188	0.000
0.024	528	0.003	0.024	564	0.000	0.024	1212	0.001
0.027	504	0.003	0.027	576	0.000	0.027	1236	0.001
0.029	504	0.004	0.029	588	0.000	0.029	1224	0.001
0.031	516	0.004	0.031	576	0.000	0.031	1236	0.001
0.034	492	0.004	0.034	588	0.000	0.034	1236	0.001
0.036	492	0.005	0.036	576	0.000	0.036	1212	0.001
0.039	492	0.005	0.039	588	0.000	0.039	1212	0.001
0.041	468	0.005	0.041	576	0.000	0.041	1200	0.000
0.043	468	0.006	0.043	576	0.000	0.043	1188	0.000
0.046	468	0.006	0.046	564	-0.001	0.046	1176	0.001
0.048	468	0.007	0.048	564	-0.001	0.048	1152	0.000
0.051	444	0.006	0.051	564	-0.001	0.051	1140	0.000
0.053	444	0.007	0.053	564	-0.001	0.053	1116	0.000
0.056	444	0.007	0.056	564	-0.001	0.056	1092	0.000
0.058	420	0.007	0.058	564	-0.001	0.058	1080	0.000
0.060	408	0.008	0.060	552	-0.001	0.060	1068	0.000
0.063	408	0.008	0.063	564	-0.001	0.063	1044	-0.001
0.065	396	0.008	0.065	540	-0.001	0.065	1032	-0.001
0.068	384	0.008	0.068	552	-0.001	0.068	1020	-0.001
0.070	372	0.009	0.070	540	-0.001	0.070	996	-0.001
0.072	372	0.009	0.072	540	-0.001	0.072	984	-0.001
0.075	360	0.009	0.075	540	-0.001	0.075	972	-0.001
0.077	360	0.009	0.077	540	-0.001	0.077	960	-0.001
0.080	360	0.009	0.080	540	-0.002	0.080	936	-0.002
0.082	348	0.009	0.082	540	-0.002	0.082	936	-0.002
0.085	348	0.010	0.085	540	-0.002	0.085	924	-0.002
0.087	348	0.010	0.087	540	-0.002	0.087	924	-0.002
0.089	324	0.010	0.089	540	-0.002	0.089	912	-0.002
0.092	336	0.010	0.092	528	-0.002	0.092	900	-0.002
0.094	336	0.010	0.094	540	-0.002	0.094	900	-0.002
0.097	324	0.010	0.097	528	-0.002	0.097	876	-0.003
0.099	324	0.010	0.099	540	-0.002	0.099	876	-0.003
0.101	324	0.010	0.101	528	-0.002	0.101	876	-0.003
0.104	324	0.010	0.104	540	-0.002	0.104	864	-0.003
0.106	324	0.010	0.106	528	-0.002	0.106	864	-0.003
0.109	312	0.010	0.109	528	-0.002	0.109	852	-0.004
0.111	312	0.010	0.111	528	-0.002	0.111	852	-0.004
0.114	324	0.010	0.114	516	-0.003	0.114	852	-0.004
0.116	312	0.010	0.116	528	-0.003	0.116	840	-0.004
0.118	312	0.010	0.118	516	-0.003	0.118	828	-0.004
0.121	300	0.010	0.121	528	-0.003	0.121	828	-0.004
0.123	312	0.010	0.123	516	-0.003	0.123	828	-0.004
0.126	300	0.010	0.126	528	-0.003	0.126	828	-0.005
0.128	300	0.010	0.128	528	-0.003	0.128	816	-0.005
0.130	300	0.010	0.130	516	-0.003	0.130	816	-0.005
0.133	300	0.010	0.133	528	-0.003	0.133	804	-0.005
0.135	300	0.010	0.135	516	-0.003	0.135	804	-0.005
0.138	300	0.010	0.138	516	-0.003	0.138	804	-0.005
0.140	300	0.010	0.140	516	-0.003	0.140	804	-0.006
0.142	300	0.010	0.142	516	-0.003	0.142	804	-0.006
0.145	300	0.010	0.145	516	-0.003	0.145	804	-0.006
0.147	300	0.010	0.147	516	-0.003	0.147	792	-0.006
0.150	288	0.010	0.150	516	-0.003	0.150	792	-0.006
0.152	300	0.010	0.152	516	-0.003	0.152	780	-0.006
0.155	288	0.010	0.155	516	-0.003	0.155	780	-0.007

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-2
Sample:
Depth: 3.0'

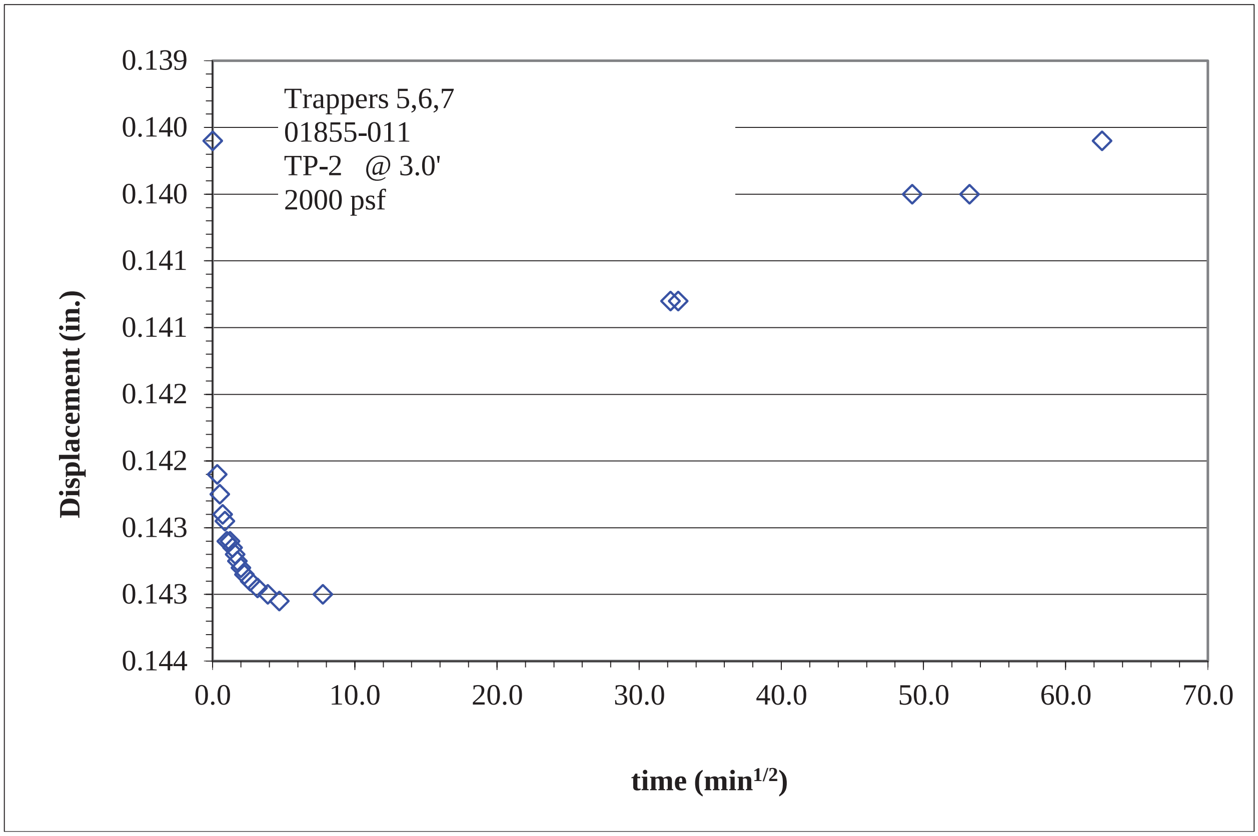
Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.157	288	0.010	0.157	516	-0.004	0.157	780	-0.007
0.159	288	0.010	0.159	516	-0.004	0.159	780	-0.007
0.162	288	0.010	0.162	516	-0.004	0.162	768	-0.007
0.164	288	0.010	0.164	516	-0.004	0.164	768	-0.007
0.167	288	0.010	0.167	516	-0.004	0.167	768	-0.007
0.169	288	0.010	0.169	504	-0.004	0.169	768	-0.008
0.171	288	0.010	0.171	504	-0.004	0.171	756	-0.008
0.174	288	0.009	0.174	504	-0.004	0.174	756	-0.008
0.176	276	0.009	0.176	504	-0.004	0.176	756	-0.008
0.179	276	0.009	0.179	504	-0.004	0.179	756	-0.008
0.181	288	0.009	0.181	504	-0.004	0.181	744	-0.008
0.184	276	0.009	0.184	492	-0.004	0.184	744	-0.008
0.186	276	0.009	0.186	504	-0.004	0.186	744	-0.009
0.188	276	0.009	0.188	492	-0.004	0.188	744	-0.009
0.191	276	0.009	0.191	492	-0.004	0.191	732	-0.009
0.193	276	0.009	0.193	492	-0.004	0.193	732	-0.009
0.196	276	0.009	0.196	492	-0.004	0.196	732	-0.009
0.198	276	0.009	0.198	492	-0.005	0.198	732	-0.009
0.200	276	0.009	0.200	492	-0.005	0.200	732	-0.010
0.203	276	0.009	0.203	492	-0.005	0.203	732	-0.010
0.205	264	0.009	0.205	492	-0.005	0.205	720	-0.010
0.208	264	0.009	0.208	492	-0.005	0.208	720	-0.010
0.210	264	0.009	0.210	492	-0.005	0.210	708	-0.010
0.213	264	0.009	0.213	492	-0.005	0.213	708	-0.010
0.215	252	0.009	0.215	492	-0.005	0.215	708	-0.010
0.217	252	0.009	0.217	492	-0.005	0.217	708	-0.011
0.220	252	0.009	0.220	492	-0.005	0.220	708	-0.011
0.222	252	0.008	0.222	480	-0.005	0.222	708	-0.011
0.225	252	0.008	0.225	480	-0.005	0.225	708	-0.011
0.227	252	0.008	0.227	480	-0.005	0.227	696	-0.011
0.229	252	0.008	0.229	480	-0.005	0.229	696	-0.011
0.232	252	0.008	0.232	480	-0.005	0.232	696	-0.011
0.234	252	0.008	0.234	480	-0.005	0.234	696	-0.011
0.237	252	0.008	0.237	468	-0.005	0.237	696	-0.012
0.239	252	0.008	0.239	468	-0.005	0.239	684	-0.012
0.242	240	0.008	0.242	468	-0.005	0.242	684	-0.012
0.244	240	0.008	0.244	468	-0.005	0.244	684	-0.012
0.246	240	0.008	0.246	468	-0.005	0.246	684	-0.012
0.249	240	0.008	0.249	468	-0.005	0.249	684	-0.012
0.251	240	0.008	0.251	468	-0.006	0.251	684	-0.012
0.254	240	0.008	0.254	468	-0.006	0.254	684	-0.012
0.256	240	0.008	0.256	468	-0.006	0.256	684	-0.013
0.258	240	0.008	0.258	468	-0.006	0.258	684	-0.013
0.261	228	0.008	0.261	468	-0.006	0.261	672	-0.013
0.263	228	0.007	0.263	456	-0.006	0.263	672	-0.013
0.266	228	0.007	0.266	456	-0.006	0.266	672	-0.013
0.268	228	0.007	0.268	456	-0.006	0.268	660	-0.013
0.271	228	0.007	0.271	456	-0.006	0.271	660	-0.013
0.273	228	0.007	0.273	444	-0.006	0.273	660	-0.013
0.275	228	0.007	0.275	444	-0.006	0.275	660	-0.014
0.278	228	0.007	0.278	444	-0.006	0.278	660	-0.014
0.280	228	0.007	0.280	444	-0.006	0.280	660	-0.014
0.283	228	0.007	0.283	444	-0.006	0.283	660	-0.014
0.285	228	0.007	0.285	444	-0.006	0.285	660	-0.014
0.287	216	0.007	0.287	444	-0.006	0.287	660	-0.014
0.290	216	0.007	0.290	444	-0.006	0.290	660	-0.014
0.292	216	0.007	0.292	432	-0.006	0.292	660	-0.014
0.295	216	0.007	0.295	432	-0.006	0.295	660	-0.014
0.297	216	0.007	0.297	432	-0.006	0.297	660	-0.014
0.300	216	0.007	0.300	432	-0.006	0.300	648	-0.015

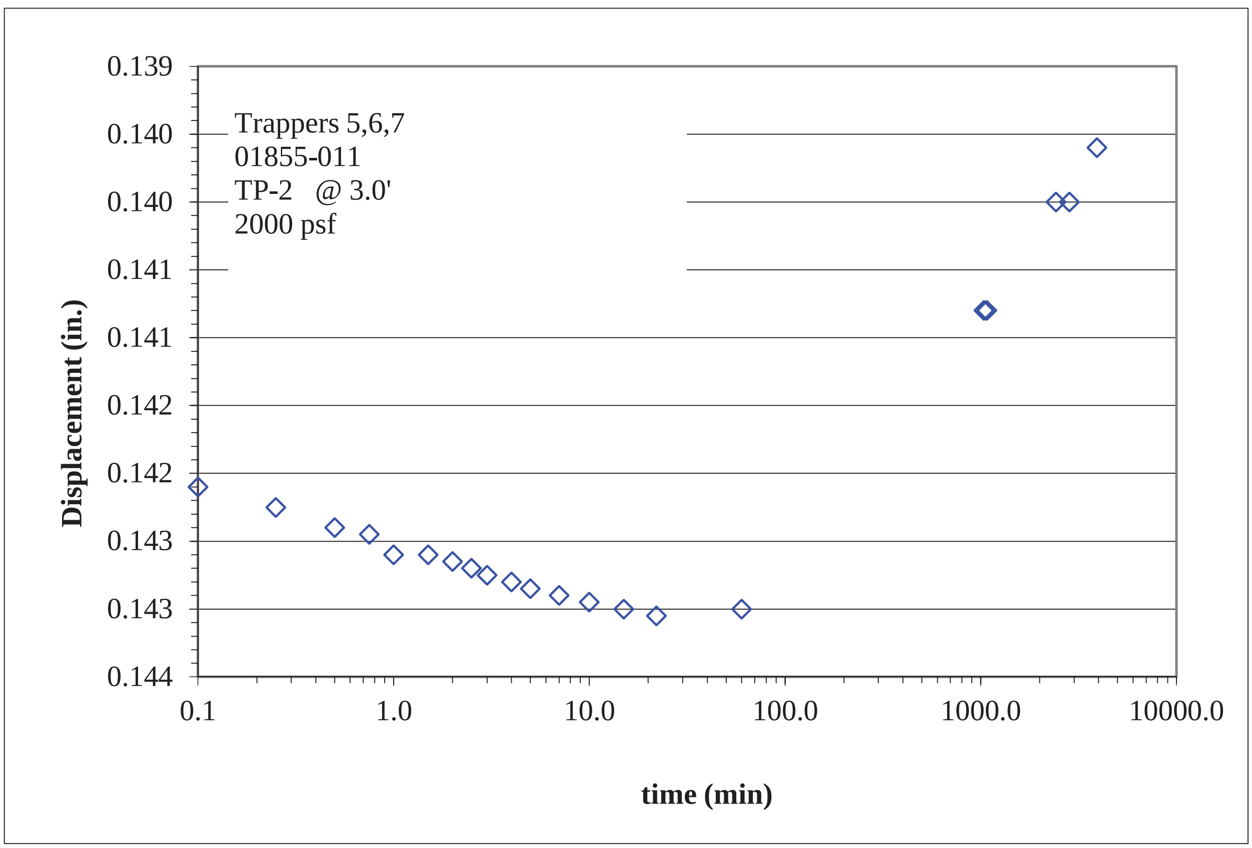
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-2
Sample:
Depth: 3.0'





Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/27/2017
By: JDF

Boring No.: TP-2
Sample:
Depth: 9.0'
Sample Description: Brown clay
Sample type: Undisturbed-trimmed from thin-wall

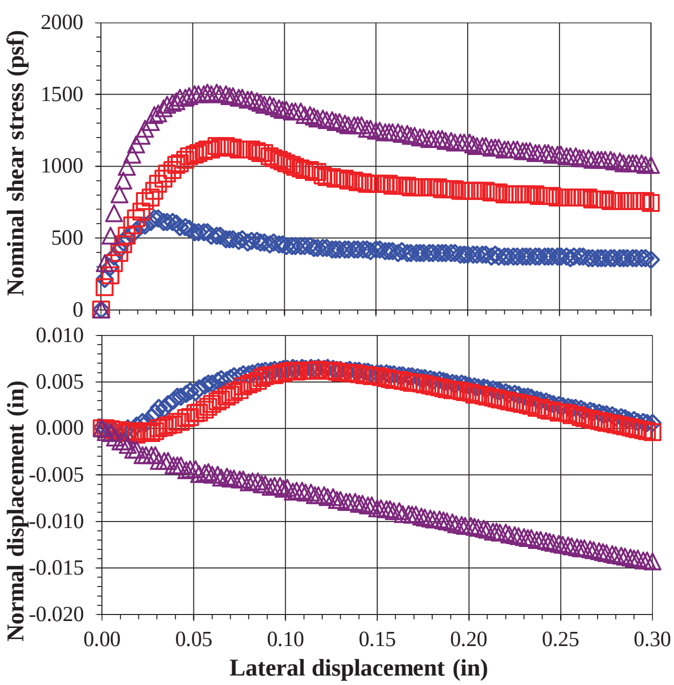
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0009
Specific gravity, Gs: 2.70 Assumed

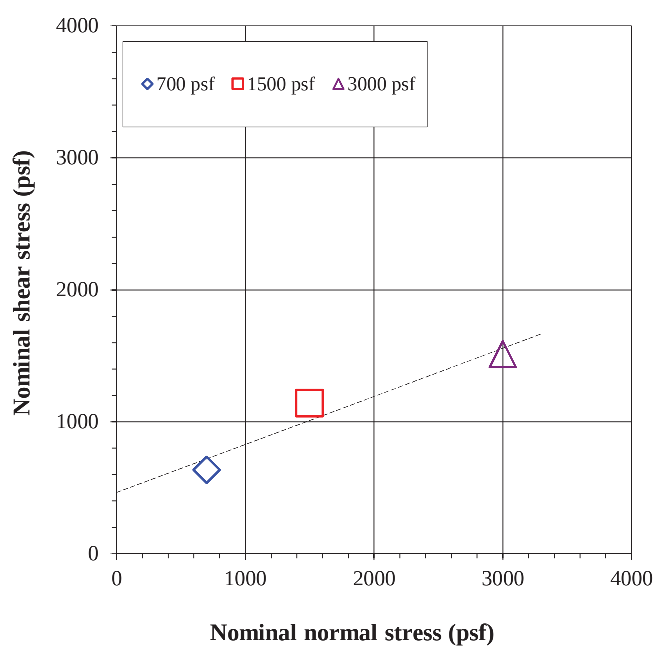
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	700		1500		3000	
Peak shear stress (psf)	636		1140		1512	
Lateral displacement at peak (in)	0.029		0.063		0.058	
Load Duration (min)	1102		2448		1765	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	0.9930	0.9907	993.0000	0.9930	1.0060	0.9855
Sample diameter (in)	2.423	2.423	2.417	2.417	2.417	2.417
Wt. rings + wet soil (g)	168.29	174.18	168.97	175.29	171.88	176.87
Wt. rings (g)	41.94	41.94	43.78	43.78	45.28	45.28
Wet soil + tare (g)	472.88		472.88		472.88	
Dry soil + tare (g)	376.80		376.80		376.80	
Tare (g)	128.21		128.21		128.21	
Water content (%)	38.6	45.1	38.6	45.7	38.6	44.1
Dry unit weight (pcf)	75.8	76.0	0.1	75.5	75.4	76.9
Void ratio, e, for assumed Gs	1.22	1.22	2231.58	1.23	1.24	1.19
Saturation (%)*	85.3	100.0	0.0	100.0	84.4	100.0

φ' (deg)	20
c' (psf)	465

Average of 3 samples	Initial	Pre-shear
Water content (%)	38.6	45.0
Dry unit weight (pcf)	50.4	76.1

*Pre-shear saturation set to 100% for phase calculations





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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-2
Sample:
Depth: 9.0'

Nominal normal stress = 700 psf			Nominal normal stress = 1500 psf			Nominal normal stress = 3000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	0	0.000	0.000	0	0.000	0.000	0	0.000
0.002	216	0.000	0.002	156	0.000	0.002	324	0.000
0.005	300	0.000	0.005	240	0.000	0.005	516	-0.001
0.007	372	0.000	0.007	324	0.000	0.007	672	-0.001
0.010	420	-0.001	0.010	396	0.000	0.010	804	-0.001
0.012	468	0.000	0.012	456	-0.001	0.012	900	-0.001
0.014	504	0.000	0.014	516	0.000	0.014	996	-0.002
0.017	528	0.000	0.017	588	0.000	0.017	1080	-0.002
0.019	552	0.000	0.019	636	-0.001	0.019	1152	-0.002
0.022	588	0.001	0.022	684	-0.001	0.022	1212	-0.003
0.024	588	0.001	0.024	756	0.000	0.024	1260	-0.003
0.027	612	0.001	0.027	780	-0.001	0.027	1308	-0.003
0.029	636	0.002	0.029	828	0.000	0.029	1356	-0.003
0.031	636	0.002	0.031	876	0.000	0.031	1368	-0.004
0.034	612	0.002	0.034	912	0.000	0.034	1404	-0.004
0.036	612	0.003	0.036	948	0.000	0.036	1428	-0.004
0.039	612	0.003	0.039	972	0.000	0.039	1440	-0.004
0.041	600	0.003	0.041	1008	0.001	0.041	1452	-0.004
0.043	576	0.003	0.043	1020	0.001	0.043	1476	-0.004
0.046	576	0.004	0.046	1044	0.001	0.046	1476	-0.005
0.048	564	0.004	0.048	1068	0.001	0.048	1488	-0.004
0.051	540	0.004	0.051	1080	0.002	0.051	1500	-0.004
0.053	540	0.004	0.053	1092	0.002	0.053	1500	-0.005
0.056	540	0.005	0.056	1104	0.002	0.056	1500	-0.005
0.058	540	0.005	0.058	1116	0.002	0.058	1512	-0.005
0.060	516	0.005	0.060	1116	0.003	0.060	1500	-0.005
0.063	516	0.005	0.063	1140	0.003	0.063	1512	-0.005
0.065	516	0.005	0.065	1128	0.003	0.065	1500	-0.005
0.068	492	0.005	0.068	1140	0.003	0.068	1500	-0.005
0.070	492	0.005	0.070	1128	0.004	0.070	1488	-0.005
0.072	492	0.006	0.072	1128	0.004	0.072	1488	-0.005
0.075	480	0.006	0.075	1116	0.004	0.075	1476	-0.006
0.077	492	0.006	0.077	1116	0.005	0.077	1476	-0.006
0.080	468	0.006	0.080	1116	0.005	0.080	1464	-0.006
0.082	480	0.006	0.082	1116	0.005	0.082	1464	-0.006
0.085	480	0.006	0.085	1104	0.005	0.085	1452	-0.006
0.087	468	0.006	0.087	1092	0.005	0.087	1440	-0.006
0.089	468	0.006	0.089	1092	0.006	0.089	1428	-0.006
0.092	456	0.006	0.092	1068	0.006	0.092	1428	-0.006
0.094	468	0.006	0.094	1056	0.006	0.094	1416	-0.006
0.097	456	0.006	0.097	1044	0.006	0.097	1404	-0.006
0.099	456	0.006	0.099	1032	0.006	0.099	1392	-0.007
0.101	444	0.006	0.101	1020	0.006	0.101	1392	-0.006
0.104	444	0.007	0.104	1008	0.006	0.104	1380	-0.007
0.106	444	0.006	0.106	996	0.006	0.106	1380	-0.007
0.109	444	0.007	0.109	984	0.006	0.109	1380	-0.007
0.111	444	0.006	0.111	972	0.006	0.111	1356	-0.007
0.114	444	0.007	0.114	972	0.006	0.114	1356	-0.007
0.116	432	0.006	0.116	960	0.006	0.116	1344	-0.007
0.118	432	0.007	0.118	960	0.006	0.118	1332	-0.007
0.121	432	0.006	0.121	936	0.006	0.121	1332	-0.007
0.123	432	0.007	0.123	924	0.006	0.123	1320	-0.007
0.126	420	0.006	0.126	924	0.006	0.126	1320	-0.007
0.128	420	0.006	0.128	912	0.006	0.128	1308	-0.008
0.130	420	0.006	0.130	912	0.006	0.130	1308	-0.008
0.133	420	0.006	0.133	912	0.006	0.133	1296	-0.008
0.135	420	0.006	0.135	900	0.006	0.135	1284	-0.008
0.138	420	0.006	0.138	900	0.006	0.138	1284	-0.008
0.140	420	0.006	0.140	888	0.006	0.140	1284	-0.008
0.143	420	0.006	0.143	888	0.006	0.142	1284	-0.008
0.145	420	0.006	0.145	876	0.006	0.145	1260	-0.008
0.147	408	0.006	0.147	876	0.006	0.147	1260	-0.008
0.150	420	0.006	0.150	876	0.006	0.150	1248	-0.009
0.152	420	0.006	0.152	876	0.006	0.152	1248	-0.009
0.155	408	0.006	0.155	876	0.005	0.155	1236	-0.009

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7 **Boring No.:** TP-2

No: 01855-011 **Sample:**

Location: Eden, Utah **Depth:** 9.0'

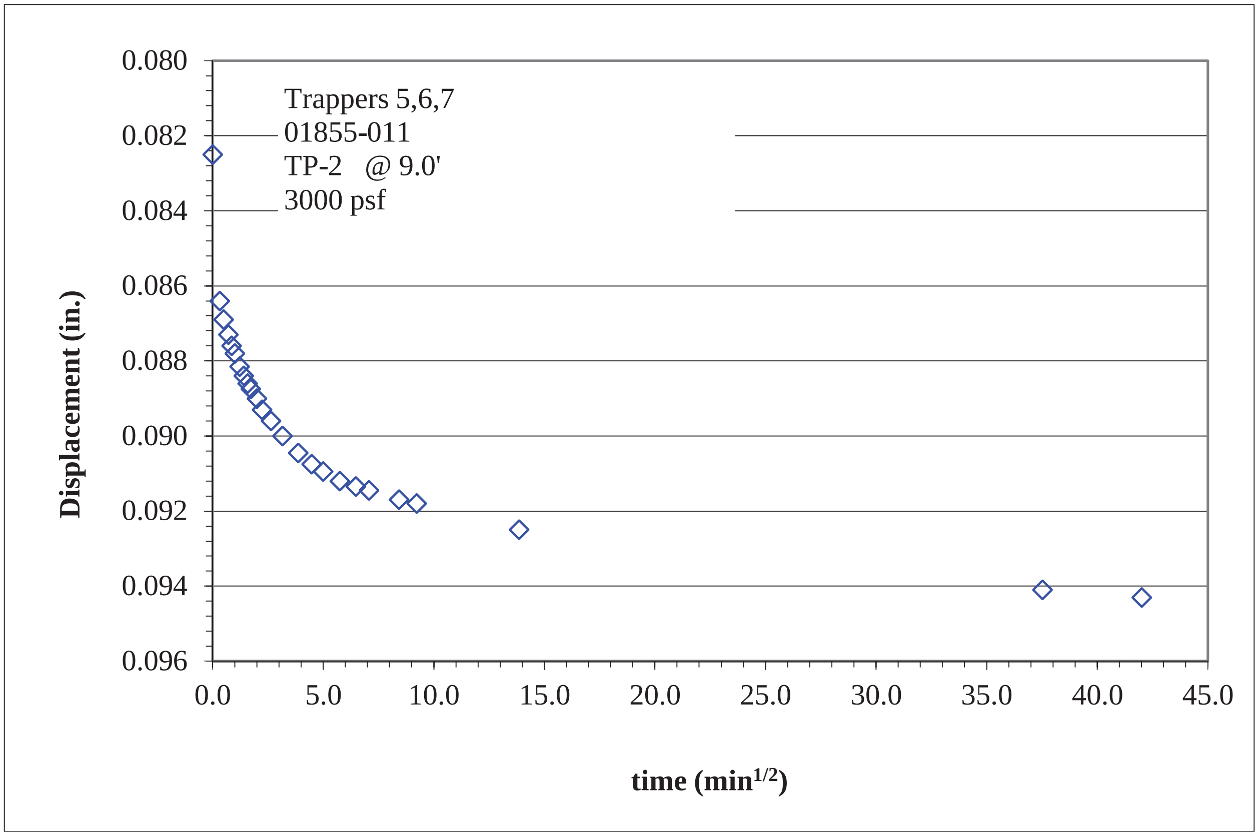
Nominal normal stress = 700 psf			Nominal normal stress = 1500 psf			Nominal normal stress = 3000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.157	408	0.006	0.157	876	0.005	0.157	1236	-0.009
0.159	408	0.006	0.159	864	0.005	0.159	1236	-0.009
0.162	396	0.006	0.162	864	0.005	0.162	1236	-0.009
0.164	408	0.006	0.164	864	0.005	0.164	1224	-0.009
0.167	396	0.006	0.167	864	0.005	0.167	1224	-0.009
0.169	396	0.006	0.169	852	0.005	0.169	1212	-0.009
0.172	396	0.006	0.171	852	0.005	0.171	1212	-0.009
0.174	396	0.005	0.174	852	0.005	0.174	1200	-0.010
0.176	396	0.005	0.176	852	0.005	0.176	1200	-0.010
0.179	396	0.005	0.179	852	0.005	0.179	1188	-0.010
0.181	396	0.005	0.181	852	0.005	0.181	1188	-0.010
0.184	396	0.005	0.184	852	0.004	0.184	1188	-0.010
0.186	396	0.005	0.186	840	0.004	0.186	1188	-0.010
0.188	396	0.005	0.188	840	0.004	0.188	1176	-0.010
0.191	396	0.005	0.191	840	0.004	0.191	1176	-0.010
0.193	396	0.005	0.193	840	0.004	0.193	1164	-0.010
0.196	384	0.005	0.196	828	0.004	0.196	1164	-0.010
0.198	384	0.005	0.198	828	0.004	0.198	1164	-0.011
0.200	384	0.005	0.201	828	0.004	0.201	1164	-0.011
0.203	384	0.005	0.203	828	0.004	0.203	1152	-0.011
0.205	384	0.004	0.205	828	0.004	0.205	1140	-0.011
0.208	384	0.004	0.208	828	0.004	0.208	1140	-0.011
0.210	384	0.004	0.210	828	0.003	0.210	1140	-0.011
0.213	372	0.004	0.213	816	0.003	0.213	1128	-0.011
0.215	384	0.004	0.215	816	0.003	0.215	1128	-0.011
0.217	372	0.004	0.217	816	0.003	0.217	1128	-0.011
0.220	372	0.004	0.220	804	0.003	0.220	1116	-0.011
0.222	372	0.004	0.222	804	0.003	0.222	1116	-0.011
0.225	372	0.004	0.225	804	0.003	0.225	1116	-0.012
0.227	372	0.004	0.227	804	0.003	0.227	1116	-0.012
0.230	372	0.003	0.229	804	0.003	0.230	1104	-0.012
0.232	372	0.003	0.232	804	0.003	0.232	1104	-0.012
0.234	372	0.003	0.234	804	0.002	0.234	1104	-0.012
0.237	372	0.003	0.237	804	0.002	0.237	1092	-0.012
0.239	372	0.003	0.239	792	0.002	0.239	1092	-0.012
0.242	372	0.003	0.242	792	0.002	0.242	1092	-0.012
0.244	372	0.003	0.244	792	0.002	0.244	1092	-0.012
0.246	372	0.003	0.246	792	0.002	0.246	1080	-0.012
0.249	372	0.003	0.249	780	0.002	0.249	1080	-0.012
0.251	372	0.002	0.251	780	0.002	0.251	1080	-0.013
0.254	372	0.002	0.254	780	0.002	0.254	1068	-0.013
0.256	360	0.002	0.256	780	0.001	0.256	1068	-0.013
0.258	372	0.002	0.259	780	0.001	0.259	1068	-0.013
0.261	372	0.002	0.261	780	0.001	0.261	1056	-0.013
0.263	372	0.002	0.263	780	0.001	0.263	1056	-0.013
0.266	360	0.002	0.266	780	0.001	0.266	1056	-0.013
0.268	360	0.002	0.268	768	0.001	0.268	1044	-0.013
0.271	360	0.002	0.271	768	0.001	0.271	1044	-0.013
0.273	360	0.002	0.273	768	0.001	0.273	1044	-0.013
0.275	360	0.002	0.275	768	0.001	0.275	1044	-0.013
0.278	360	0.001	0.278	756	0.001	0.278	1044	-0.014
0.280	360	0.001	0.280	756	0.000	0.280	1032	-0.014
0.283	360	0.001	0.283	756	0.000	0.283	1032	-0.014
0.285	360	0.001	0.285	756	0.000	0.285	1020	-0.014
0.287	360	0.001	0.288	756	0.000	0.288	1020	-0.014
0.290	360	0.001	0.290	756	0.000	0.290	1020	-0.014
0.292	360	0.001	0.292	756	0.000	0.292	1020	-0.014
0.295	360	0.001	0.295	756	0.000	0.295	1020	-0.014
0.297	360	0.001	0.297	756	0.000	0.297	1008	-0.014
0.300	348	0.001	0.300	744	0.000	0.300	1008	-0.014

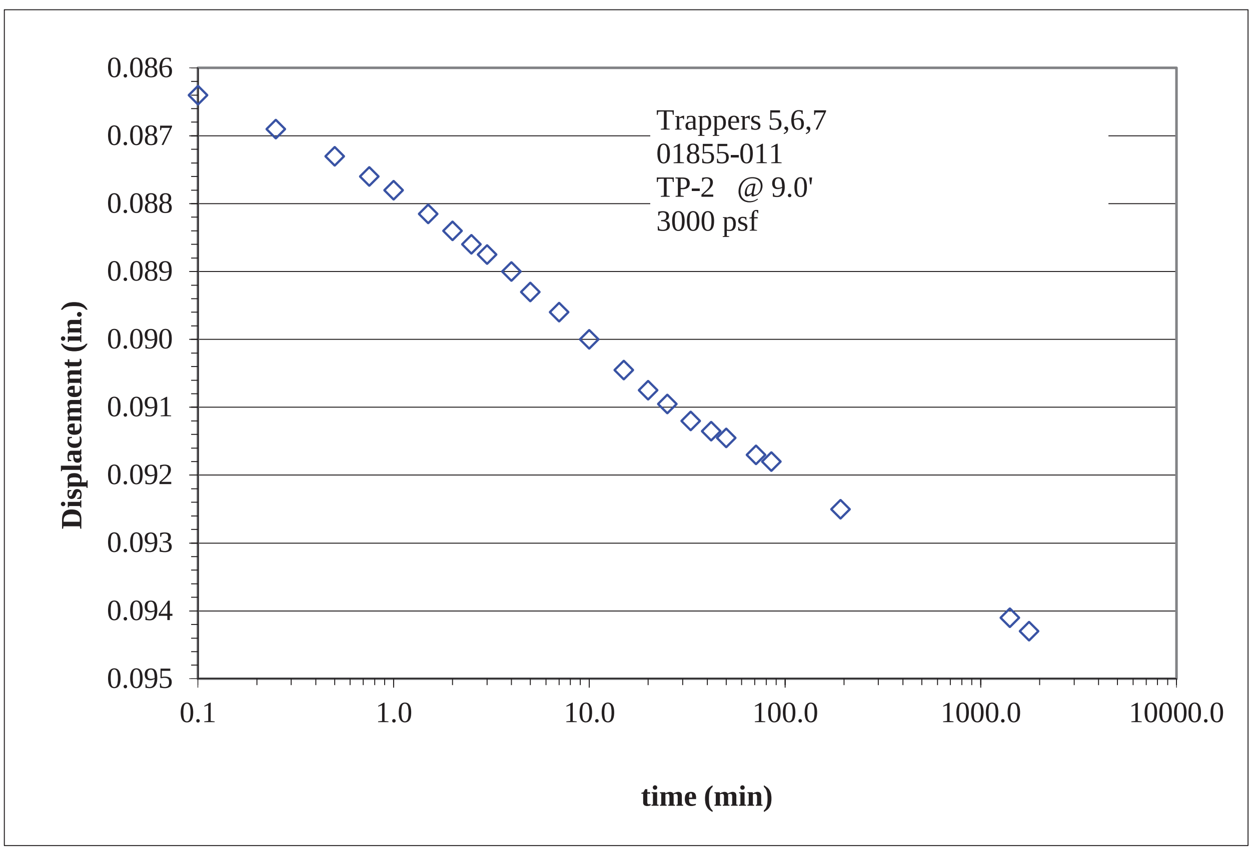
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-2
Sample:
Depth: 9.0'





Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/27/2017
By: JDF

Boring No.: TP-5
Sample:
Depth: 3.0'
Sample Description: Brown clay
Sample type: Undisturbed-trimmed from thin-wall

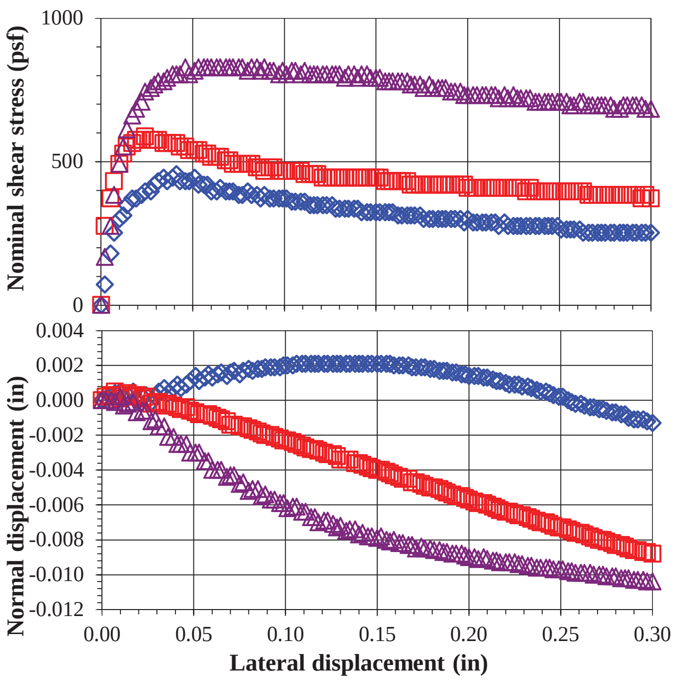
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0003
Specific gravity, Gs: 2.70 Assumed

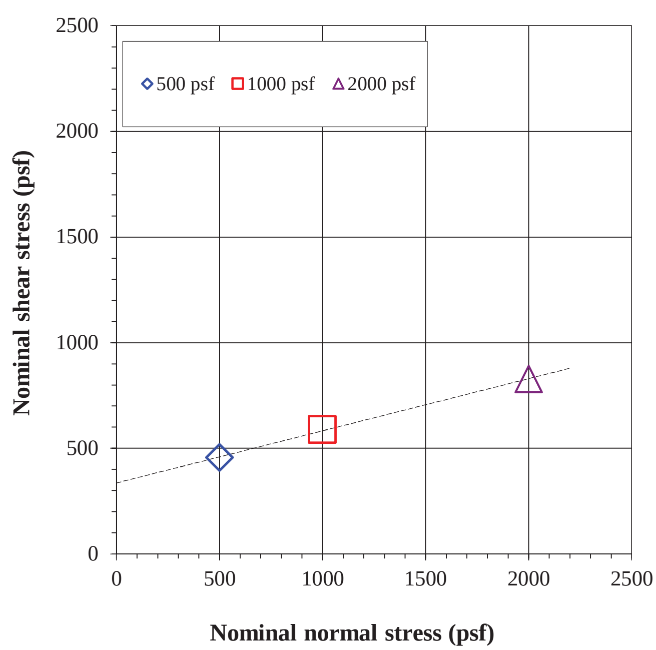
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	456		588		828	
Lateral displacement at peak (in)	0.041		0.024		0.046	
Load Duration (min)	1467		7020		7165	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0020	1.0025	1.0020	0.9993	0.9990	0.9887
Sample diameter (in)	2.420	2.420	2.415	2.415	2.414	2.414
Wt. rings + wet soil (g)	180.38	186.16	184.79	187.89	184.71	188.07
Wt. rings (g)	42.80	42.80	43.01	43.01	45.12	45.12
Wet soil + tare (g)	389.60		389.60		389.60	
Dry soil + tare (g)	332.04		332.04		332.04	
Tare (g)	124.68		124.68		124.68	
Water content (%)	27.8	33.1	27.8	30.6	27.8	30.8
Dry unit weight (pcf)	89.0	88.9	92.1	92.3	91.0	91.9
Void ratio, e, for assumed Gs	0.89	0.89	0.83	0.82	0.85	0.83
Saturation (%)*	83.9	100.0	90.3	100.0	88.0	100.0

ϕ' (deg)	14
c' (psf)	336

Average of 3 samples	Initial	Pre-shear
Water content (%)	27.8	31.5
Dry unit weight (pcf)	90.7	91.1

*Pre-shear saturation set to 100% for phase calculations





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Reviewed:___________

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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-5
Sample:
Depth: 3.0'

Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	0	0.000	0.000	0	0.000	0.000	0	0.000
0.002	72	0.000	0.002	276	0.000	0.002	168	0.000
0.005	180	0.000	0.005	372	0.000	0.005	276	0.000
0.007	252	0.000	0.007	432	0.001	0.007	384	0.000
0.010	300	0.001	0.010	492	0.000	0.010	492	0.000
0.012	312	0.000	0.012	528	0.000	0.012	552	0.000
0.014	348	0.000	0.014	552	0.000	0.014	612	0.000
0.017	372	0.001	0.017	564	0.000	0.017	660	0.000
0.019	372	0.000	0.019	576	0.000	0.019	684	-0.001
0.022	384	0.000	0.022	576	0.000	0.022	708	-0.001
0.024	396	0.000	0.024	588	0.000	0.024	744	-0.001
0.027	396	0.000	0.027	576	0.000	0.027	756	-0.001
0.029	420	0.000	0.029	576	0.000	0.029	768	-0.001
0.031	432	0.001	0.031	576	0.000	0.031	780	-0.002
0.034	444	0.001	0.034	564	0.000	0.034	780	-0.002
0.036	432	0.000	0.036	564	0.000	0.036	792	-0.002
0.039	444	0.001	0.039	564	0.000	0.039	804	-0.002
0.041	456	0.001	0.041	564	0.000	0.041	804	-0.003
0.043	432	0.001	0.043	552	-0.001	0.043	804	-0.003
0.046	432	0.001	0.046	552	0.000	0.046	828	-0.003
0.048	432	0.001	0.048	540	-0.001	0.048	804	-0.003
0.051	444	0.001	0.051	540	-0.001	0.051	816	-0.003
0.053	420	0.001	0.053	540	-0.001	0.053	828	-0.003
0.056	420	0.001	0.056	528	-0.001	0.056	828	-0.004
0.058	420	0.002	0.058	528	-0.001	0.058	828	-0.004
0.060	396	0.001	0.060	516	-0.001	0.060	828	-0.004
0.063	396	0.002	0.063	516	-0.001	0.063	828	-0.004
0.065	408	0.002	0.065	516	-0.001	0.065	828	-0.004
0.068	396	0.001	0.068	504	-0.001	0.068	828	-0.004
0.070	396	0.002	0.070	504	-0.001	0.070	828	-0.004
0.072	396	0.002	0.072	492	-0.001	0.072	828	-0.004
0.075	384	0.002	0.075	492	-0.002	0.075	828	-0.005
0.077	384	0.002	0.077	492	-0.002	0.077	828	-0.005
0.080	396	0.002	0.080	492	-0.002	0.080	816	-0.005
0.082	384	0.002	0.082	492	-0.002	0.082	828	-0.005
0.085	384	0.002	0.085	480	-0.002	0.085	828	-0.005
0.087	372	0.002	0.087	480	-0.002	0.087	816	-0.006
0.089	384	0.002	0.089	468	-0.002	0.089	828	-0.005
0.092	372	0.002	0.092	480	-0.002	0.092	816	-0.006
0.094	372	0.002	0.094	480	-0.002	0.094	816	-0.006
0.097	372	0.002	0.097	468	-0.002	0.097	804	-0.006
0.099	372	0.002	0.099	468	-0.002	0.099	816	-0.006
0.101	372	0.002	0.101	468	-0.002	0.101	804	-0.006
0.104	360	0.002	0.104	468	-0.002	0.104	816	-0.006
0.106	360	0.002	0.106	468	-0.003	0.106	816	-0.006
0.109	360	0.002	0.109	468	-0.003	0.109	804	-0.006
0.111	360	0.002	0.111	456	-0.003	0.111	816	-0.006
0.114	348	0.002	0.114	456	-0.003	0.114	804	-0.007
0.116	348	0.002	0.116	456	-0.003	0.116	804	-0.007
0.118	348	0.002	0.118	456	-0.003	0.118	804	-0.007
0.121	348	0.002	0.121	444	-0.003	0.121	804	-0.007
0.123	348	0.002	0.123	444	-0.003	0.123	804	-0.007
0.126	348	0.002	0.126	444	-0.003	0.126	804	-0.007
0.128	336	0.002	0.128	444	-0.003	0.128	804	-0.007
0.130	336	0.002	0.130	444	-0.003	0.130	804	-0.007
0.133	336	0.002	0.133	444	-0.003	0.133	792	-0.008
0.135	336	0.002	0.135	444	-0.003	0.135	804	-0.007
0.138	336	0.002	0.138	444	-0.004	0.138	804	-0.007
0.140	336	0.002	0.140	444	-0.004	0.140	792	-0.008
0.142	324	0.002	0.142	444	-0.004	0.142	804	-0.008
0.145	324	0.002	0.145	444	-0.004	0.145	804	-0.008
0.147	324	0.002	0.147	444	-0.004	0.147	792	-0.008
0.150	324	0.002	0.150	444	-0.004	0.150	792	-0.008
0.152	324	0.002	0.152	444	-0.004	0.152	792	-0.008
0.155	324	0.002	0.155	432	-0.004	0.155	780	-0.008

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7 **Boring No.:** TP-5
No: 01855-011 **Sample:**
Location: Eden, Utah **Depth:** 3.0'

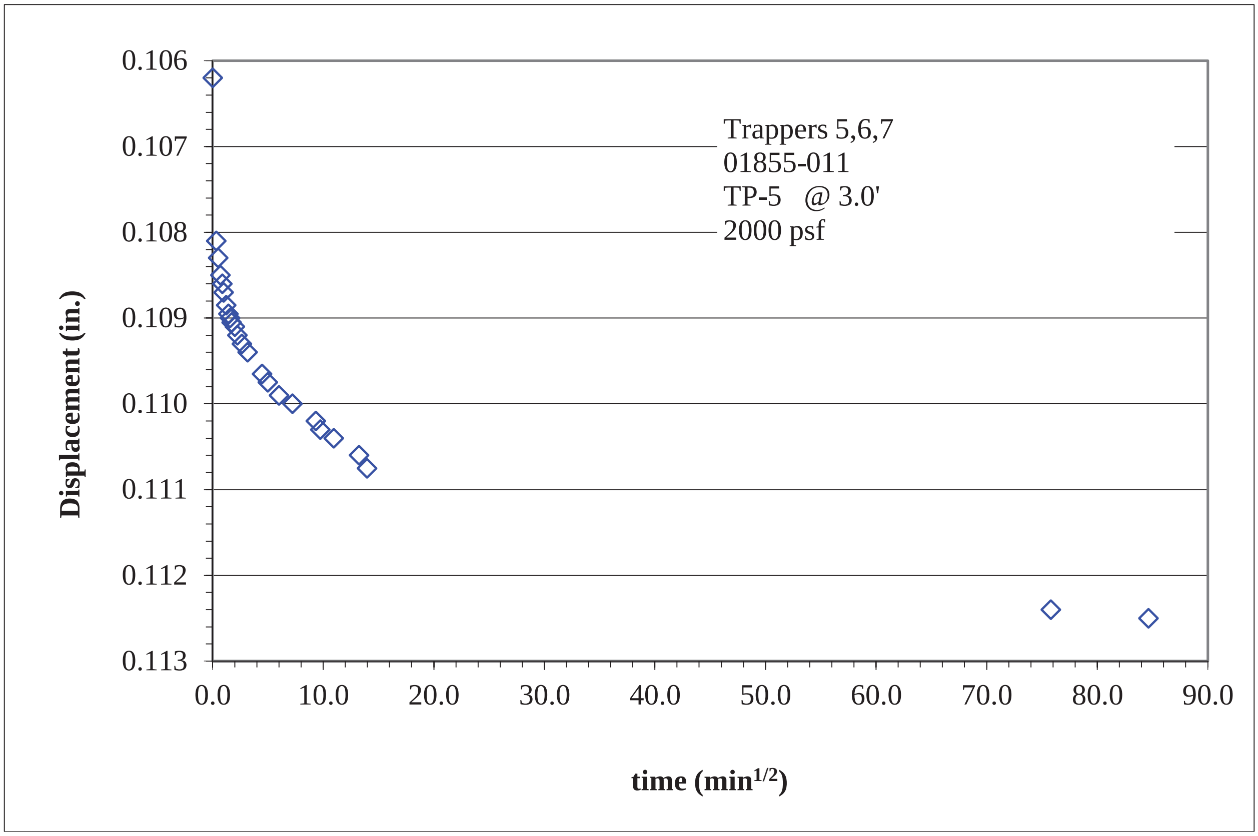
Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.157	324	0.002	0.157	432	-0.004	0.157	780	-0.008
0.159	324	0.002	0.159	432	-0.004	0.159	780	-0.008
0.162	312	0.002	0.162	432	-0.004	0.162	780	-0.008
0.164	312	0.002	0.164	432	-0.005	0.164	780	-0.008
0.167	312	0.002	0.167	432	-0.005	0.167	780	-0.008
0.169	312	0.002	0.169	420	-0.005	0.169	768	-0.008
0.171	312	0.002	0.171	420	-0.005	0.171	768	-0.009
0.174	312	0.002	0.174	420	-0.005	0.174	768	-0.008
0.176	300	0.002	0.176	420	-0.005	0.176	756	-0.009
0.179	300	0.002	0.179	420	-0.005	0.179	768	-0.009
0.181	300	0.002	0.181	420	-0.005	0.181	756	-0.009
0.184	300	0.002	0.184	420	-0.005	0.184	756	-0.009
0.186	300	0.002	0.186	420	-0.005	0.186	756	-0.009
0.188	300	0.002	0.188	420	-0.005	0.188	756	-0.009
0.191	300	0.002	0.191	420	-0.005	0.191	744	-0.009
0.193	300	0.002	0.193	420	-0.006	0.193	744	-0.009
0.196	300	0.002	0.196	420	-0.006	0.196	744	-0.009
0.198	288	0.002	0.198	420	-0.006	0.198	732	-0.009
0.200	300	0.001	0.200	408	-0.006	0.200	732	-0.009
0.203	288	0.001	0.203	408	-0.006	0.203	732	-0.009
0.205	288	0.001	0.205	408	-0.006	0.205	732	-0.009
0.208	288	0.001	0.208	408	-0.006	0.208	732	-0.009
0.210	288	0.001	0.210	408	-0.006	0.210	732	-0.009
0.213	288	0.001	0.213	408	-0.006	0.213	732	-0.009
0.215	288	0.001	0.215	408	-0.006	0.215	732	-0.009
0.217	276	0.001	0.217	408	-0.006	0.217	720	-0.009
0.220	288	0.001	0.220	408	-0.006	0.220	732	-0.009
0.222	276	0.001	0.222	408	-0.006	0.222	720	-0.009
0.225	276	0.001	0.225	408	-0.007	0.225	732	-0.009
0.227	276	0.001	0.227	408	-0.007	0.227	720	-0.009
0.229	276	0.001	0.229	408	-0.007	0.229	720	-0.009
0.232	276	0.001	0.232	396	-0.007	0.232	720	-0.010
0.234	276	0.001	0.234	408	-0.007	0.234	720	-0.010
0.237	276	0.001	0.237	396	-0.007	0.237	708	-0.010
0.239	276	0.001	0.239	396	-0.007	0.239	708	-0.010
0.242	276	0.001	0.242	396	-0.007	0.242	708	-0.010
0.244	276	0.000	0.244	396	-0.007	0.244	708	-0.010
0.246	276	0.000	0.246	396	-0.007	0.246	708	-0.010
0.249	276	0.000	0.249	396	-0.007	0.249	708	-0.010
0.251	264	0.000	0.251	396	-0.007	0.251	708	-0.010
0.254	264	0.000	0.254	396	-0.007	0.254	708	-0.010
0.256	264	0.000	0.256	396	-0.008	0.256	696	-0.010
0.258	264	0.000	0.258	396	-0.008	0.258	696	-0.010
0.261	264	0.000	0.261	396	-0.008	0.261	708	-0.010
0.263	252	0.000	0.263	396	-0.008	0.263	708	-0.010
0.266	252	0.000	0.266	384	-0.008	0.266	696	-0.010
0.268	252	0.000	0.268	384	-0.008	0.268	696	-0.010
0.271	252	-0.001	0.271	384	-0.008	0.271	696	-0.010
0.273	252	-0.001	0.273	384	-0.008	0.273	696	-0.010
0.275	252	-0.001	0.275	384	-0.008	0.275	696	-0.010
0.278	252	-0.001	0.278	384	-0.008	0.278	696	-0.010
0.280	252	-0.001	0.280	384	-0.008	0.280	684	-0.010
0.283	252	-0.001	0.283	384	-0.008	0.283	684	-0.010
0.285	252	-0.001	0.285	384	-0.008	0.285	696	-0.010
0.287	252	-0.001	0.287	384	-0.009	0.287	696	-0.010
0.290	252	-0.001	0.290	384	-0.009	0.290	696	-0.010
0.292	252	-0.001	0.292	384	-0.009	0.292	696	-0.010
0.295	252	-0.001	0.295	372	-0.009	0.295	696	-0.010
0.297	252	-0.001	0.297	384	-0.009	0.297	684	-0.010
0.300	252	-0.001	0.300	372	-0.009	0.300	684	-0.010

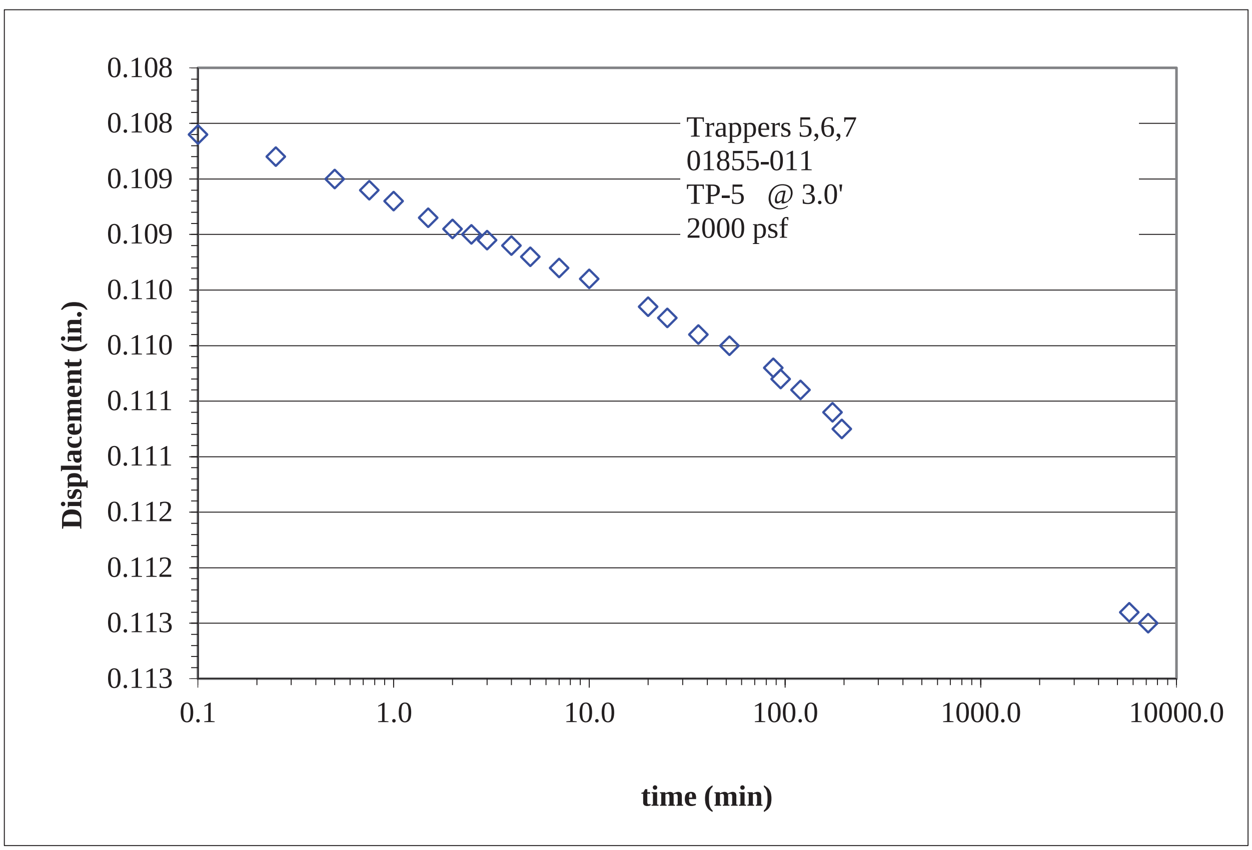
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-5
Sample:
Depth: 3.0'





Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 8/1/2017
By: JDF

Boring No.: TP-9
Sample:
Depth: 5.5'
Sample Description: Grey clay
Sample type: Undisturbed-trimmed from thin-wall

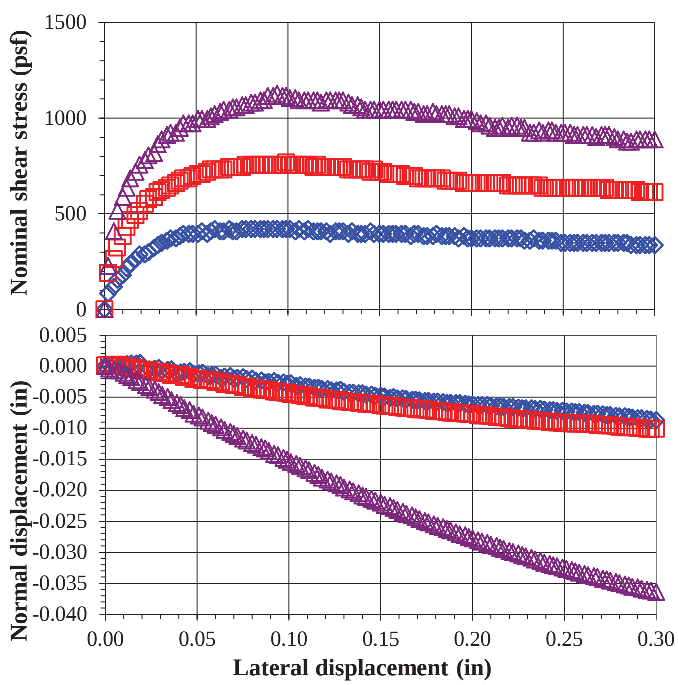
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0003
Specific gravity, Gs: 2.70 Assumed

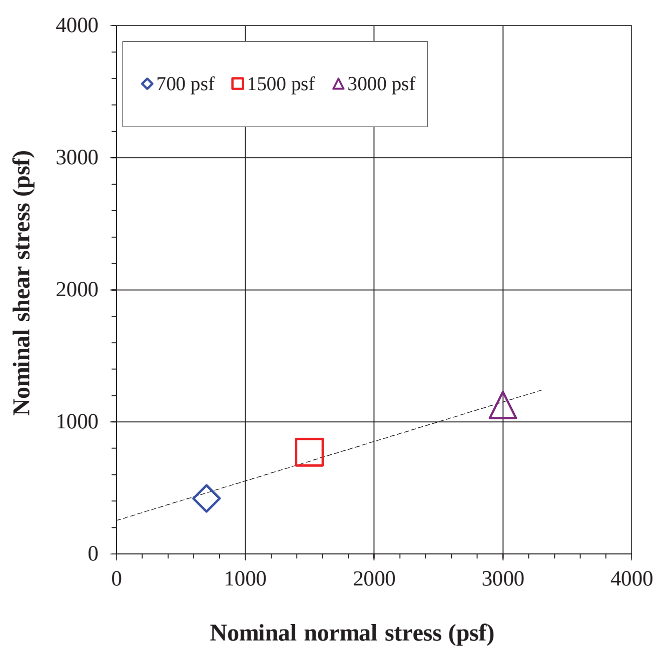
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	700		1500		3000	
Peak shear stress (psf)	420		768		1128	
Lateral displacement at peak (in)	0.060		0.099		0.094	
Load Duration (min)	1222		2418		4387	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0010	0.9974	0.9990	1.0034	0.9990	0.9547
Sample diameter (in)	2.413	2.413	2.420	2.420	2.414	2.414
Wt. rings + wet soil (g)	175.71	180.30	173.32	178.47	175.52	176.75
Wt. rings (g)	45.71	45.71	42.72	42.72	45.11	45.11
Wet soil + tare (g)	417.84		417.84		417.84	
Dry soil + tare (g)	338.60		338.60		338.60	
Tare (g)	123.04		123.04		123.04	
Water content (%)	36.8	41.6	36.8	42.2	36.8	38.1
Dry unit weight (pcf)	79.1	79.4	79.2	78.8	79.4	83.1
Void ratio, e, for assumed Gs	1.13	1.12	1.13	1.14	1.12	1.03
Saturation (%)*	87.8	100.0	87.9	100.0	88.5	100.0

ϕ' (deg)	17
c' (psf)	254

Average of 3 samples	Initial	Pre-shear
Water content (%)	36.8	40.6
Dry unit weight (pcf)	79.2	80.4

*Pre-shear saturation set to 100% for phase calculations





Entered by:___________
Reviewed:___________

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-9
Sample:
Depth: 5.5'

Nominal normal stress = 700 psf			Nominal normal stress = 1500 psf			Nominal normal stress = 3000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	0	0.000	0.000	0	0.000	0.000	0	0.000
0.002	84	0.000	0.002	192	0.000	0.002	228	0.000
0.005	120	0.000	0.005	264	0.000	0.005	408	-0.001
0.007	156	0.000	0.007	324	0.000	0.007	516	-0.001
0.010	180	0.000	0.010	384	0.000	0.010	588	-0.001
0.012	216	0.000	0.012	432	0.000	0.012	636	-0.002
0.014	240	0.000	0.014	468	0.000	0.014	684	-0.002
0.017	264	0.000	0.017	492	0.000	0.017	720	-0.002
0.019	288	0.001	0.019	516	-0.001	0.019	756	-0.003
0.022	288	-0.001	0.022	552	-0.001	0.022	780	-0.003
0.024	300	-0.001	0.024	576	-0.001	0.024	804	-0.003
0.027	324	0.000	0.027	588	-0.001	0.027	816	-0.004
0.029	336	0.000	0.029	612	-0.001	0.029	864	-0.004
0.031	348	-0.001	0.031	624	-0.001	0.031	888	-0.005
0.034	360	-0.001	0.034	636	-0.001	0.034	912	-0.005
0.036	372	-0.001	0.036	648	-0.002	0.036	924	-0.006
0.039	372	-0.001	0.039	660	-0.002	0.039	924	-0.006
0.041	384	-0.001	0.041	672	-0.002	0.041	948	-0.006
0.043	396	-0.001	0.043	684	-0.002	0.043	972	-0.007
0.046	396	-0.001	0.046	684	-0.002	0.046	972	-0.007
0.048	396	-0.001	0.048	696	-0.002	0.048	972	-0.008
0.051	396	-0.001	0.051	708	-0.002	0.051	996	-0.008
0.053	408	-0.001	0.053	708	-0.002	0.053	996	-0.008
0.056	396	-0.002	0.056	720	-0.002	0.056	996	-0.009
0.058	408	-0.002	0.058	732	-0.002	0.058	1008	-0.009
0.060	420	-0.001	0.060	732	-0.003	0.060	1020	-0.010
0.063	408	-0.002	0.063	732	-0.003	0.063	1032	-0.010
0.065	408	-0.002	0.065	732	-0.003	0.065	1044	-0.010
0.068	420	-0.002	0.068	744	-0.003	0.068	1044	-0.011
0.070	408	-0.002	0.070	744	-0.003	0.070	1056	-0.011
0.072	408	-0.002	0.072	744	-0.003	0.072	1056	-0.011
0.075	420	-0.002	0.075	744	-0.003	0.075	1068	-0.012
0.077	420	-0.002	0.077	756	-0.003	0.077	1068	-0.012
0.080	420	-0.002	0.080	756	-0.004	0.080	1080	-0.012
0.082	420	-0.002	0.082	756	-0.004	0.082	1080	-0.013
0.085	420	-0.002	0.085	756	-0.004	0.085	1092	-0.013
0.087	420	-0.003	0.087	756	-0.004	0.087	1092	-0.013
0.089	420	-0.003	0.089	756	-0.004	0.089	1116	-0.014
0.092	420	-0.002	0.092	756	-0.004	0.092	1116	-0.014
0.094	420	-0.003	0.094	756	-0.004	0.094	1128	-0.014
0.097	420	-0.003	0.097	756	-0.004	0.097	1116	-0.015
0.099	420	-0.003	0.099	768	-0.004	0.099	1116	-0.015
0.101	420	-0.003	0.101	756	-0.005	0.101	1104	-0.016
0.104	408	-0.003	0.104	756	-0.005	0.104	1104	-0.016
0.106	420	-0.003	0.106	756	-0.005	0.106	1092	-0.016
0.109	408	-0.003	0.109	756	-0.005	0.109	1092	-0.017
0.111	420	-0.003	0.111	756	-0.005	0.111	1092	-0.017
0.114	408	-0.004	0.114	744	-0.005	0.114	1092	-0.017
0.116	408	-0.004	0.116	756	-0.005	0.116	1092	-0.018
0.118	408	-0.004	0.118	744	-0.005	0.118	1080	-0.018
0.121	408	-0.004	0.121	744	-0.005	0.121	1092	-0.018
0.123	396	-0.004	0.123	744	-0.005	0.123	1092	-0.019
0.126	408	-0.004	0.126	744	-0.006	0.126	1092	-0.019
0.128	408	-0.004	0.128	744	-0.006	0.128	1092	-0.019
0.130	408	-0.004	0.130	744	-0.006	0.130	1092	-0.020
0.133	396	-0.004	0.133	732	-0.006	0.133	1080	-0.020
0.135	408	-0.004	0.135	732	-0.006	0.135	1068	-0.020
0.138	396	-0.004	0.138	732	-0.006	0.138	1068	-0.021
0.140	396	-0.004	0.140	732	-0.006	0.140	1056	-0.021
0.142	396	-0.005	0.142	732	-0.006	0.142	1044	-0.021
0.145	408	-0.005	0.145	720	-0.006	0.145	1044	-0.021
0.147	396	-0.005	0.147	732	-0.006	0.147	1044	-0.022
0.150	396	-0.005	0.150	720	-0.006	0.150	1044	-0.022
0.152	396	-0.005	0.152	720	-0.006	0.152	1044	-0.022
0.155	396	-0.005	0.155	708	-0.007	0.155	1044	-0.023

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7 **Boring No.:** TP-9
No: 01855-011 **Sample:**
Location: Eden, Utah **Depth:** 5.5'

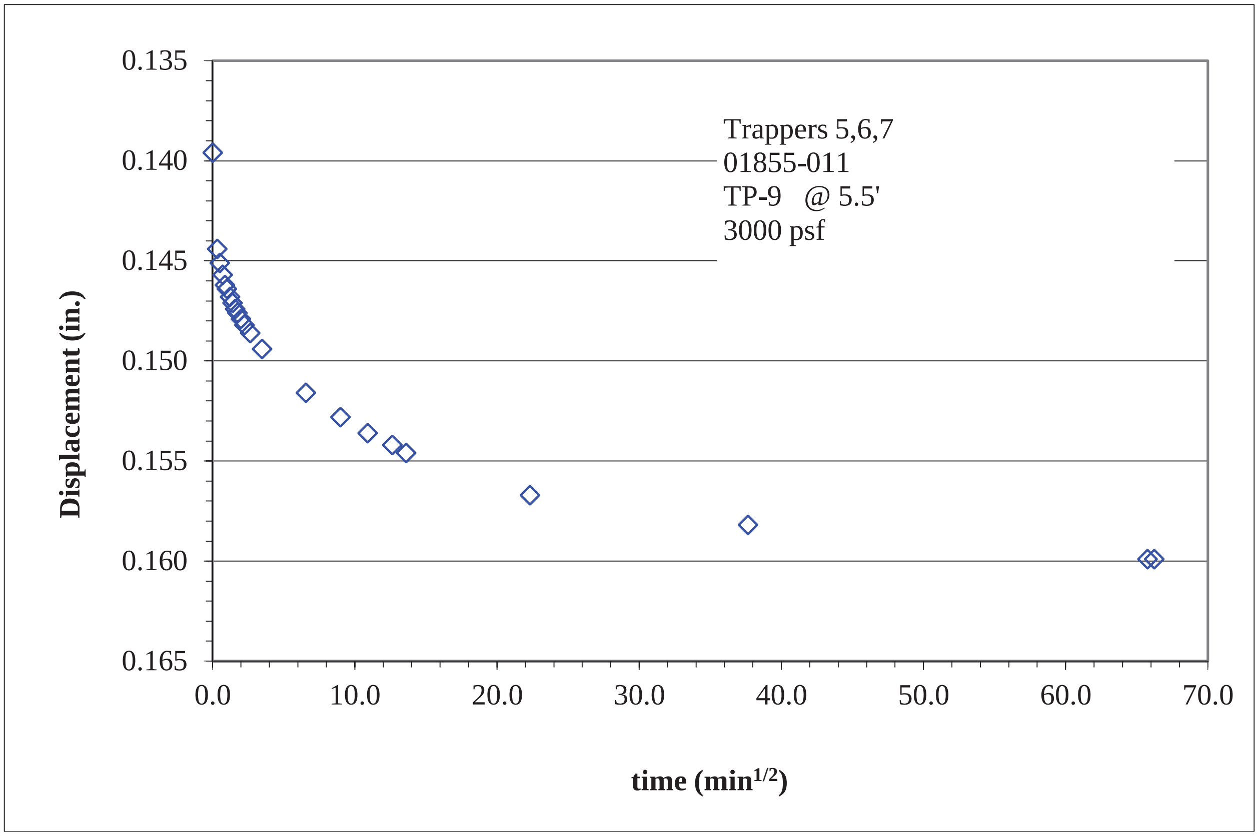
Nominal normal stress = 700 psf			Nominal normal stress = 1500 psf			Nominal normal stress = 3000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.157	396	-0.005	0.157	708	-0.007	0.157	1044	-0.023
0.159	396	-0.005	0.159	708	-0.007	0.159	1044	-0.023
0.162	396	-0.005	0.162	708	-0.007	0.162	1044	-0.024
0.164	396	-0.005	0.164	696	-0.007	0.164	1044	-0.024
0.167	384	-0.005	0.167	696	-0.007	0.167	1044	-0.024
0.169	396	-0.005	0.169	696	-0.007	0.169	1032	-0.024
0.171	396	-0.006	0.171	684	-0.007	0.171	1032	-0.025
0.174	384	-0.006	0.174	684	-0.007	0.174	1020	-0.025
0.176	384	-0.006	0.176	684	-0.007	0.176	1020	-0.025
0.179	384	-0.006	0.179	684	-0.007	0.179	1032	-0.026
0.181	396	-0.006	0.181	684	-0.007	0.181	1020	-0.026
0.184	384	-0.006	0.184	684	-0.007	0.184	1020	-0.026
0.186	384	-0.006	0.186	672	-0.007	0.186	1020	-0.026
0.188	384	-0.006	0.188	672	-0.008	0.188	1020	-0.027
0.191	384	-0.006	0.191	672	-0.008	0.191	1008	-0.027
0.193	372	-0.006	0.193	672	-0.008	0.193	1008	-0.027
0.196	384	-0.006	0.196	660	-0.008	0.196	996	-0.027
0.198	372	-0.006	0.198	660	-0.008	0.198	996	-0.028
0.200	372	-0.006	0.200	660	-0.008	0.200	996	-0.028
0.203	372	-0.006	0.203	660	-0.008	0.203	984	-0.028
0.205	372	-0.006	0.205	660	-0.008	0.205	972	-0.028
0.208	372	-0.006	0.208	660	-0.008	0.208	972	-0.029
0.210	372	-0.006	0.210	660	-0.008	0.210	960	-0.029
0.213	372	-0.007	0.213	660	-0.008	0.213	948	-0.029
0.215	372	-0.007	0.215	660	-0.008	0.215	948	-0.029
0.217	372	-0.007	0.217	660	-0.008	0.217	960	-0.030
0.220	372	-0.007	0.220	648	-0.008	0.220	948	-0.030
0.222	372	-0.007	0.222	648	-0.009	0.222	960	-0.030
0.225	372	-0.007	0.225	648	-0.009	0.225	960	-0.030
0.227	372	-0.007	0.227	648	-0.009	0.227	948	-0.031
0.229	360	-0.007	0.229	648	-0.009	0.229	948	-0.031
0.232	360	-0.007	0.232	648	-0.009	0.232	924	-0.031
0.234	372	-0.007	0.234	648	-0.009	0.234	924	-0.031
0.237	360	-0.007	0.237	648	-0.009	0.237	936	-0.031
0.239	360	-0.007	0.239	636	-0.009	0.239	924	-0.032
0.242	360	-0.007	0.242	636	-0.009	0.242	936	-0.032
0.244	360	-0.007	0.244	636	-0.009	0.244	936	-0.032
0.246	360	-0.007	0.246	636	-0.009	0.246	924	-0.032
0.249	348	-0.007	0.249	636	-0.009	0.249	924	-0.033
0.251	348	-0.007	0.251	636	-0.009	0.251	924	-0.033
0.254	348	-0.007	0.254	636	-0.009	0.254	924	-0.033
0.256	348	-0.007	0.256	636	-0.009	0.256	912	-0.033
0.258	348	-0.007	0.258	636	-0.009	0.258	912	-0.033
0.261	348	-0.008	0.261	636	-0.009	0.261	912	-0.034
0.263	348	-0.008	0.263	636	-0.009	0.263	912	-0.034
0.266	348	-0.008	0.266	636	-0.009	0.266	912	-0.034
0.268	348	-0.008	0.268	636	-0.010	0.268	900	-0.034
0.271	348	-0.008	0.271	636	-0.010	0.271	912	-0.034
0.273	348	-0.008	0.273	636	-0.010	0.273	912	-0.034
0.275	348	-0.008	0.275	624	-0.010	0.275	912	-0.035
0.278	348	-0.008	0.278	624	-0.010	0.278	900	-0.035
0.280	348	-0.008	0.280	624	-0.010	0.280	888	-0.035
0.283	348	-0.008	0.283	624	-0.010	0.283	888	-0.035
0.285	348	-0.008	0.285	624	-0.010	0.285	876	-0.035
0.287	336	-0.008	0.287	624	-0.010	0.287	876	-0.036
0.290	336	-0.008	0.290	624	-0.010	0.290	888	-0.036
0.292	336	-0.008	0.292	612	-0.010	0.292	888	-0.036
0.295	336	-0.009	0.295	612	-0.010	0.295	888	-0.036
0.297	336	-0.009	0.297	612	-0.010	0.297	888	-0.036
0.300	336	-0.009	0.300	612	-0.010	0.300	888	-0.036

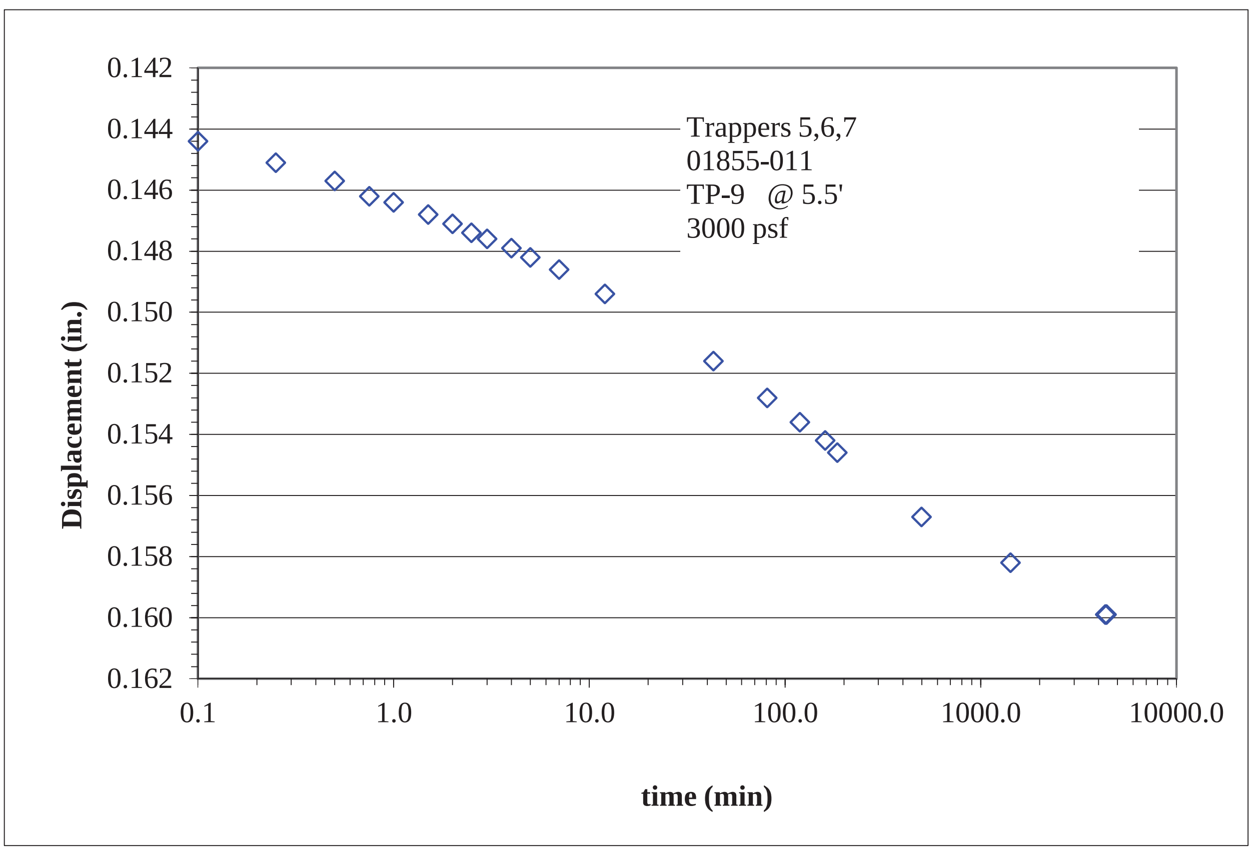
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah

Boring No.: TP-9
Sample:
Depth: 5.5'





Minimum Laboratory Soil Resistivity, pH of Soil for Use in Corrosion Testing, and Ions in Water by Chemically Suppressed Ion Chromatography *(AASHTO T 288, T 289, ASTM D4327, and C1580)*

Project: Trappers 5,6,7
No: 01855-011
Location: Eden, Utah
Date: 7/27/2017
By: DKS

Section	Field	Approximate Soil condition (%)	Resistance Reading (Ω)	Soil Box Multiplier (cm)	Resistivity (Ω-cm)	Approximate Soil condition (%)	Resistance Reading (Ω)	Soil Box Multiplier (cm)	Resistivity (Ω-cm)
Sample info.	Boring No.	TP-4							
	Sample								
	Depth	2.5'							
Water content data	Wet soil + tare (g)	56.06							
	Dry soil + tare (g)	52.42							
	Tare (g)	37.57							
	Water content (%)	24.5							
Chem. data	pH	5.45							
	Soluble chloride* (ppm)	<6.23							
	Soluble sulfate** (ppm)	21.7							
Resistivity data	Pin method	2							
	Soil box	Miller Small							
		As Is	4255	0.67	2851				
		+3	1513	0.67	1014				
		+6	1266	0.67	848				
		+9	943	0.67	632				
		+12	901	0.67	604				
		+15	857	0.67	574				
		+18	922	0.67	618				
	Minimum resistivity (Ω-cm)	**574**							

* Performed by AWAL using EPA 300.0

** Performed by AWAL using ASTM C1580

Entered by:___________
Reviewed:___________

APPENDIX C

USGS Design Maps Detailed Report

2012/2015 International Building Code (41.31977°N, 111.80906°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 1613.3.1 — Mapped acceleration parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2012/2015 International Building Code are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 1613.3.3.

From Figure 1613.3.1(1) [1]	S_S = 0.892 g
From Figure 1613.3.1(2) [2]	S_1 = 0.301 g

Section 1613.3.2 — Site class definitions

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Section 1613.

2010 ASCE-7 Standard – Table 20.3-1
SITE CLASS DEFINITIONS

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 1613.3.3 — Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters

TABLE 1613.3.3(1)
VALUES OF SITE COEFFICIENT F_a

Site Class	Mapped Spectral Response Acceleration at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 0.892 g, F_a = 1.143

TABLE 1613.3.3(2)
VALUES OF SITE COEFFICIENT F_v

Site Class	Mapped Spectral Response Acceleration at 1–s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.301 g, F_v = 1.798

Equation (16-37):	$S_{MS} = F_aS_S = 1.143 \times 0.892 = 1.020$ g
Equation (16-38):	$S_{M1} = F_vS_1 = 1.798 \times 0.301 = 0.541$ g

Section 1613.3.4 — Design spectral response acceleration parameters

Equation (16-39):	$S_{DS} = ⅔\ S_{MS} = ⅔ \times 1.020 = 0.680$ g
Equation (16-40):	$S_{D1} = ⅔\ S_{M1} = ⅔ \times 0.541 = 0.361$ g

Section 1613.3.5 — Determination of seismic design category

TABLE 1613.3.5(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD (0.2 second) RESPONSE ACCELERATION

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	**III**	**IV**
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.680 g, Seismic Design Category = D

TABLE 1613.3.5(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	**III**	**IV**
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.361 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 1613.3.5(1) or 1613.3.5(2)" = D

Note: See Section 1613.3.5.1 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 1613.3.1(1)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(1).pdf
2. *Figure 1613.3.1(2)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(2).pdf

USGS Design Maps Summary Report

User–Specified Input

Report Title Wolf Creek
Tue October 17, 2017 15:57:46 UTC

Building Code Reference Document 2012/2015 International Building Code
(which utilizes USGS hazard data available in 2008)

Site Coordinates 41.31977°N, 111.80906°W

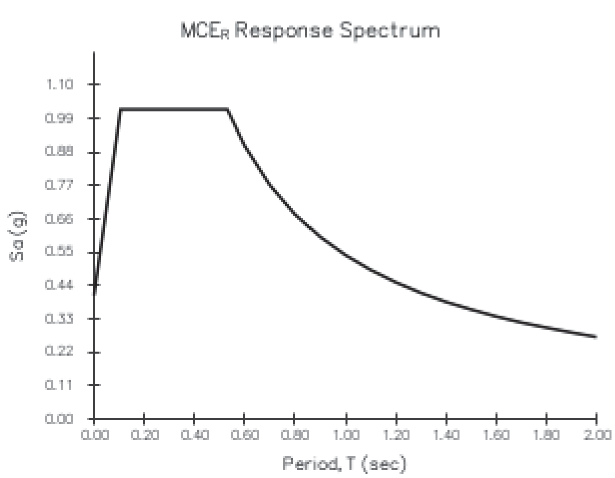
Site Soil Classification Site Class D – "Stiff Soil"

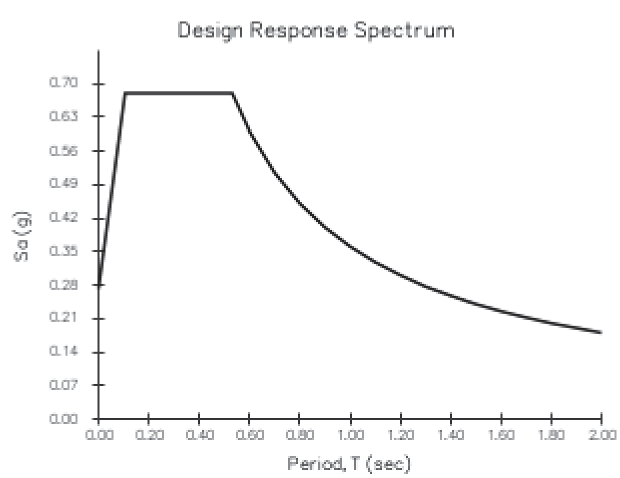
Risk Category I/II/III

USGS–Provided Output

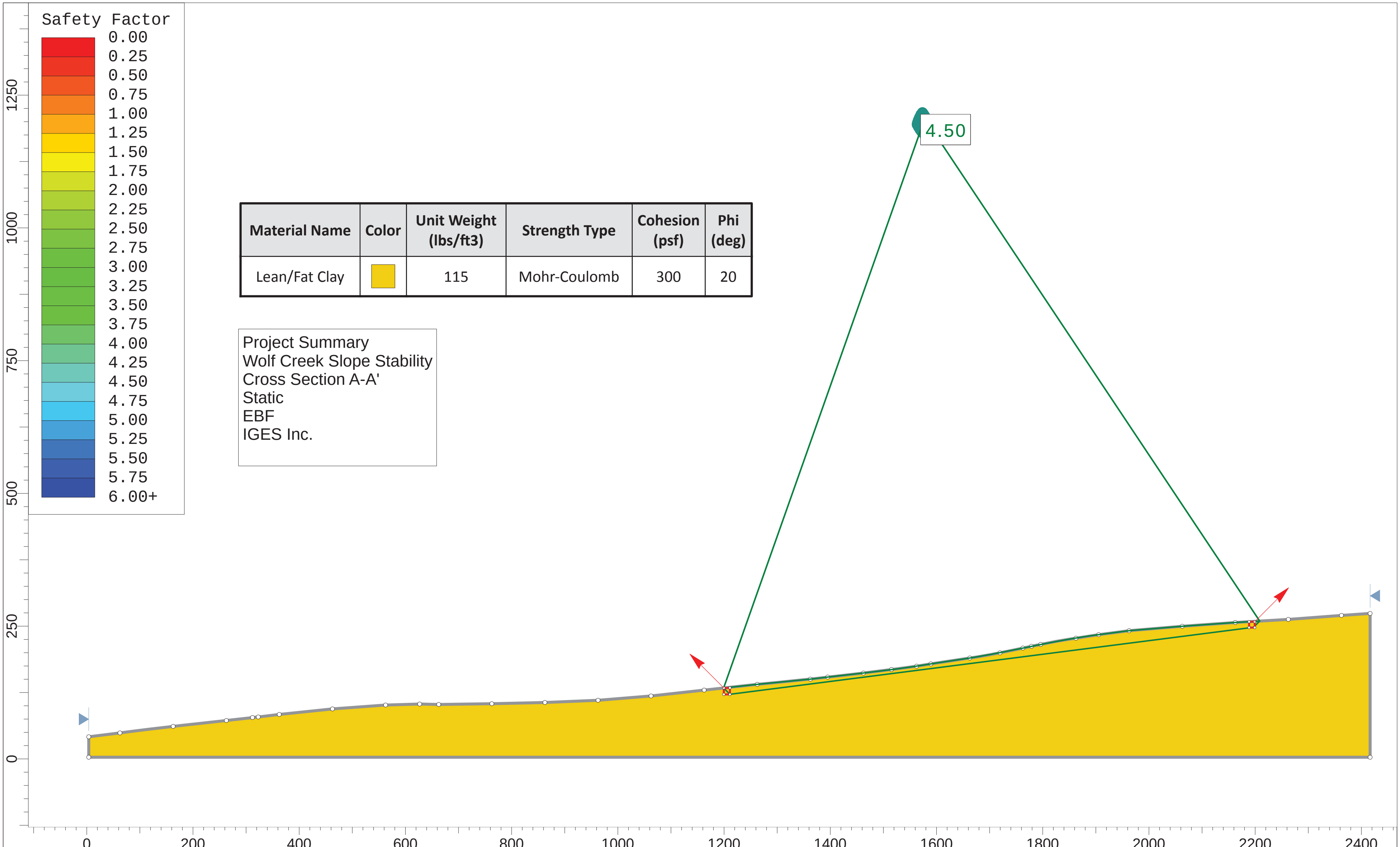
S_S =	0.892 g	S_{MS} =	1.020 g	S_{DS} =	0.680 g
S_1 =	0.301 g	S_{M1} =	0.541 g	S_{D1} =	0.361 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





APPENDIX D

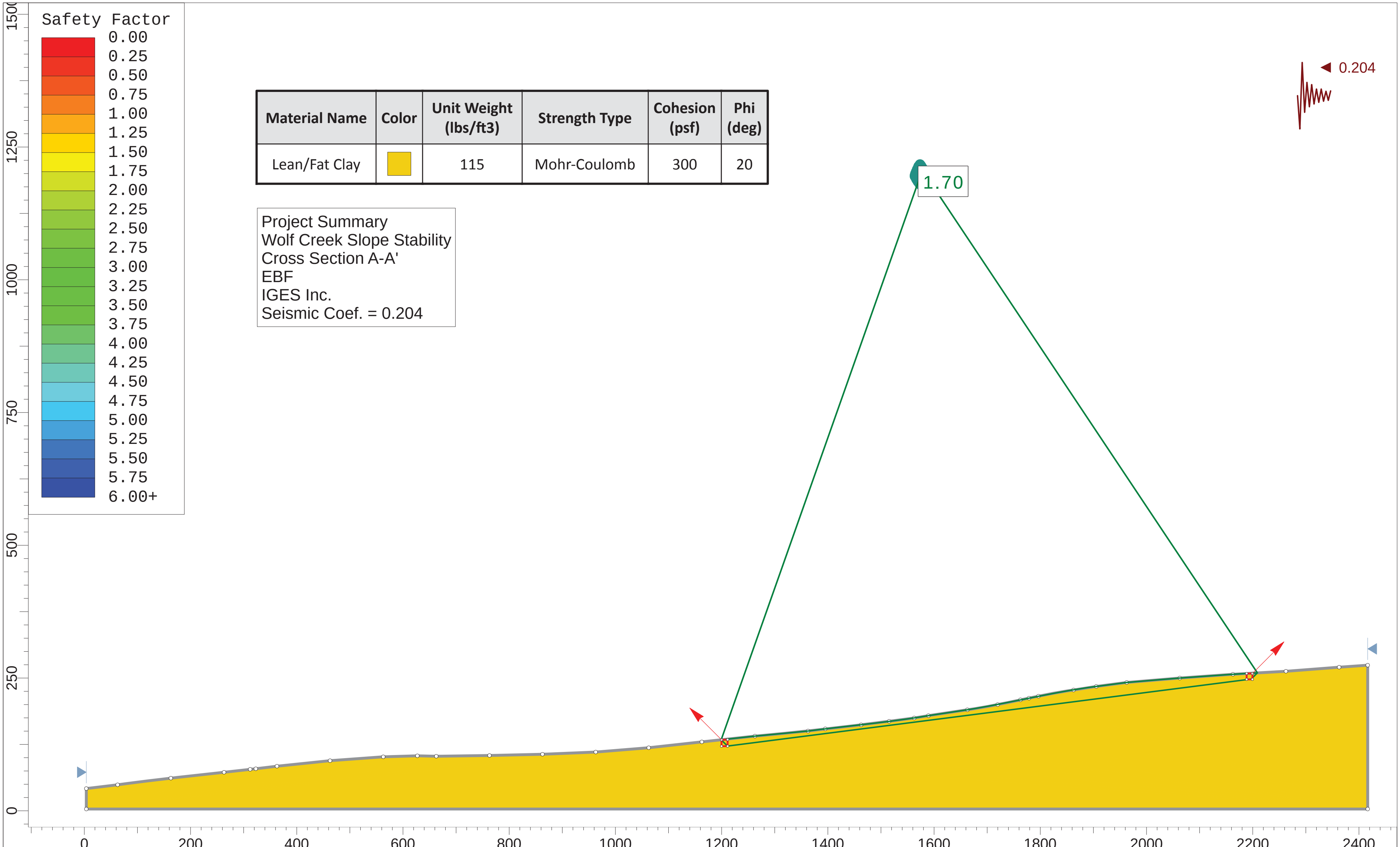


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Lean/Fat Clay		115	Mohr-Coulomb	300	20

Project Summary
Wolf Creek Slope Stability
Cross Section A-A'
Static
EBF
IGES Inc.

SLIDEINTERPRET 7.029

Project	Wolf Creek Slope Stability
Analysis Description	Cross Section A-A' Static Block
Drawn By	EBF
Scale	1:3000
Company	IGES Inc.
Date	10/27/2017, 9:47:33 AM
File Name	Trapper PHase 7.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Lean/Fat Clay		115	Mohr-Coulomb	300	20

Project Summary
Wolf Creek Slope Stability
Cross Section A-A'
EBF
IGES Inc.
Seismic Coef. = 0.204

Project	Wolf Creek Slope Stability		
Analysis Description	Cross Section A-A' Pseudostatic		
Drawn By EBF	*Scale* 1:3000	*Company*	IGES Inc.
Date 10/27/2017, 9:47:33 AM		*File Name*	Trapper PHase 7.slmd

SLIDEINTERPRET 7.029