IGES®
Intermountain GeoEnvironmental Services, Inc.
12429 South 300 East Suite 100, Draper, Utah 84020 ~ T: (801) 748-4044 ~ F: (801) 748-4045

July 8, 2016

Land to Sky Construction, Inc.
5582 South 700 East
South Ogden, Utah 84405
Attn: Mr. Kirt L. Bovero

IGES Project No. 02332-001

RE: Geotechnical Investigation Report
Lot 37R of Powder Mountain Resort
8343 East Summit Pass
Weber County, Utah

Ms. Bovero,

As requested, IGES has conducted a geotechnical investigation for the proposed residence to be constructed on Lot 37R of the Powder Mountain Resort located at 8343 East Summit Pass in Weber County, Utah. The approximate location of the property is illustrated on the *Site Vicinity Map* (Figure A-1 in Appendix A). The purposes of our investigation was to assess the nature and engineering properties of the subsurface soils at the proposed home site and to provide recommendations for the design and construction of foundations, grading, and drainage. The scope of work completed for this study included subsurface exploration, laboratory testing, engineering analyses and preparation of this report.

Project Understanding

Our understanding of the project is based primarily on our previous involvement with the Powder Mountain resort project, which included two geotechnical investigations for the greater 200-acre Powder Mountain Resort expansion project (IGES, 2012a and 2012b).

The Powder Mountain Resort expansion project is located southeast of SR-158 (Powder Mountain Road), south of previously developed portions of Powder Mountain Resort, in unincorporated Weber County, Utah. The project is accessed by Powder Ridge Road.

Lot 37R is a 2.01-acre single-family residential lot with a buildable envelope of approximately 0.2 acres. A single-family home will be constructed at the site, presumably a high-end vacation home. Based on available plans, the home will be a two-story wood-framed structure with a walk-out basement (three levels total), founded on conventional spread footings. The plans also show a guest house and a storage space underlying the garage. The project is expected to include improvements common for residential developments such as underground utilities, curb and gutter, flatwork, landscaping, and possibly appurtenant structures.

METHOD OF STUDY

Literature Review

IGES completed a geotechnical investigation for the Powder Mountain Resort expansion in 2012 (2012a, 2012b). Our previous work included twenty-two test pits and one soil boring excavated at various locations across the 200-acre development; as a part of this current study, the logs from relevant nearby test pits and other data from our reports were reviewed. We also reviewed the work previously done for the nearby Lot 39R located at 8365 East Summit Pass Road (2015a, 2015b, 2015c, 2016a, 2016b). In addition, Western Geologic (2012) completed a geologic hazard study for the greater 200-acre Powder Mountain expansion project – this report was reviewed to help assess the potential impact of geologic hazards on the subject lot.

Field Investigation

Subsurface soils were investigated by excavating one test pit approximately 20 feet below the existing site grade. The approximate location of the test pit is illustrated on the *Local Geology and Geotechnical Map* (Plate 1). The soil types and conditions were visually logged at the time of the excavation in general accordance with the Unified Soil Classification System (USCS). Subsurface soil classifications and descriptions are included on the test pit log included as Figures A-2 in Appendix A. A key to USCS symbols and terminology is included as Figure A-3.

Laboratory Testing

The majority of materials encountered in the test pits consisted of coarse, cemented colluvium with abundant cobbles, or relatively stiff/hard sandy clay. As such, soil samples suitable for testing in an oedometer could not be obtained. Therefore, laboratory testing and engineering analysis was based largely on previously completed geotechnical investigations (IGES, 2012a & 2012b) and laboratory testing for this project that included index testing (grain size analysis, Atterberg Limits).

Engineering Analysis

Engineering analyses were performed using soil data obtained from laboratory testing and empirical correlations based on material density, depositional characteristics and classification. Appropriate factors of safety were applied to the results consistent with industry standards and the accepted standard of care. An allowable bearing pressure value was proportioned based on estimated shear strength of bearing soils with due consideration for allowable settlement.

FINDINGS

Surface Conditions

At the time of the excavation, the lot was in a relatively natural state and was covered with a sparse vegetative cover including native grasses and shrubs. Several boulders (>12 inches) were observed throughout the site. The lot drains to the southwest; the gradient of the lot is roughly (3.5H:1V). There is about 20 feet of vertical relief across the building envelope.

Earth Materials

The site is overlain by approximately 24 inches of dark brown topsoil characterized by an abundance of organic matter (roots, etc.). The topsoil was underlain by coarse colluvium consisting of dense dark reddish-brown clayey gravel with sand. The colluvium was characterized by occasional roots and abundant rounded cobbles, and some boulders (<12 in. dia.). At approximately 5 to 7 feet below existing grade the colluvium transitions to the Wasatch Formation, which is a bedrock unit consisting of cemented conglomerate. The conglomerate is highly weathered and readily disaggregates into soil that classifies as Clayey GRAVEL (GC). Excavation of the material became more difficult with depth. The earth materials within the Wasatch Formation were observed to be orangish red, moist, clayey gravel with well-graded sands. Some clasts were observed to be greater than 12-inches in diameter, however the nominal size were smaller than that of the colluvium.

Detailed descriptions of earth materials encountered in our test pit are presented on the test pit log, Figure A-2, in Appendix A.

Groundwater

Groundwater was not encountered in the test pit excavation. However, groundwater was observed to be seeping through the northern cut of Summit Pass Road. Based on our observations, groundwater is not anticipated to adversely impact the proposed construction. However, groundwater levels could rise at any time based on several factors including recent precipitation, on- or off-site runoff, irrigation, and time of year (e.g., spring run-off). Seeps and/or springs may be present on the foundation excavation during spring run-off. Should the groundwater become a concern during the proposed construction, IGES should be contacted so that dewatering recommendations may be provided.

Expansive/Collapsible 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. 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. Based on our observations and our laboratory test results, soils classifying as fat clay were not encountered. Furthermore, soils classifying as fat clay are uncommon throughout the Powder Mountain area (IGES, 2012a, 2012b). As such, the potential for expansive soils impacting the proposed development is considered low.

Collapse (often referred to as "hydro-collapse") is a phenomena whereby undisturbed soils exhibit volumetric strain and consolidation upon wetting. Collapsible soils can cause differential settling of structures and roadways. Collapsible soils do not necessarily preclude development and can be mitigated by over-excavating porous, potentially collapsible soils and replacing with engineered fill and by controlling surface drainage and runoff. For some structures that are particularly sensitive to differential settlement, or in areas where collapsible soils are identified at great depth, a deep foundation system may be prescribed. Typical characteristics of collapsible soils include a) low dry unit weight (silts and fine sands), b) relatively dry soils, and c) porous soil structure ("pinholes"). These characteristics were not identified during our subsurface exploration; as such, wetting-induced collapse is not expected to significantly impact the proposed improvements.

Geology and Geologic Hazards

Geology and geologic hazards have been previously addressed by Western Geologic in a separate submittal (Western Geologic, 2012). This work has also been referenced in our previous geotechnical reports for the project (IGES, 2012a and 2012b). The report by Western Geologic indicates that the building envelope is located outside of known geologically unstable areas. The lower quarter of the lot (beyond buildable areas) is mapped as undifferentiated "mixed slope colluvium, shallow landslides, and talus" (Western Geologic, 2012).

During our subsurface investigation, potentially adverse geologic structures (e.g., evidence of faulting or landslides) were not evident to the maximum depth of exploration (20 feet). Geomorphic expressions of shallow, surficial landslides were not observed on, or near the building envelope. An approximately 200-foot long linear feature was identified near the southern middle portion of the property, which at first glance appears to be a headscarp to a shallow surficial landslide; however, there are no associated landslide feature downslope (e.g., hummocky topography, toe bulge, internal scarps, etc.). Since there are no corresponding landslide features, this feature is thought to be associated with local, shallow soil creep, or possibly local surface erosion. Also, a shallow, surficial landslide was identified southwest of Lot 37R, downslope of Lot 38R (this feature is shown on Plate 1, *Local Geology & Geotechnical Map*). This landslide is not located directly downslope of Lot 37R and is not expected to impact the proposed improvements.

In conclusion, surface mapping did not reveal any geomorphic features indicative of potential geologic hazards (e.g., landslides, slumps, tension cracks, scarps, hummocky topography, etc.) on or near the building envelope. Based on currently available data and our observations, the potential for geologic hazards such as landslides, liquefaction, or surface fault rupture impacting the site is considered low. A map showing the local geology is presented as Plate 1, *Local Geology & Geotechnical Map.*

Slope Stability

The site is located on the side of a mountain, and therefore is on sloped terrain. The sloped terrain was modeled using SLIDE version 6.024 slope stability software. Spencer's Method was used to evaluate the stability of the slope. Calculations for stability were developed by searching for the minimum factor-of-safety for a circular-type failure. A minimum static factor-of-safety of 1.5 and seismic factor-of-safety of 1.0 was considered acceptable for this project considering the available information. The section analyzed is Section A-A', illustrated on Plate 1 of this report.

Considering the available geotechnical data, the soil types observed (coarse clayey sand and gravel), and our experience in the area, appropriate engineering parameters have been selected for our model; these parameters are summarized in Table 1.0.

Table 1.0
Engineering Parameters for Subsurface Model

Soil Type	Elevation (ft. below existing grade)	Unit Weight (pcf)	Friction Angle (Degrees)	Cohesion (psf)
Clayey Gravel (Qal)	0-6	120	36	0
Wasatch Formation (Twe)	~6-20	130	39	0

Groundwater was not identified during our geotechnical investigation; furthermore, shallow groundwater is not known to occur in this area. As such, groundwater was not considered in our model.

For the seismic (pseudo-static) assessment of slope, the seismic coefficient k_h is modeled as equal to 50% of the peak ground acceleration (PGA) resulting from a MCE seismic event (2PE50). From our referenced geotechnical report, the PGA resulting from a 2PE50 seismic event is taken as 0.326g. Therefore, we have adopted a seismic coefficient of 0.17g.

Based on our analysis, minimum factors-of-safety of 1.5 and 1.0 for static and seismic conditions, respectively, are maintained with respect to the proposed building envelope. The results of the global stability analyses are attached.

Stability of Saturated Slopes

IGES assessed the potential for surficial soils becoming mobilized under saturated parallel seepage conditions. Our assessment assumes coarse colluvium, fully saturated, and a 3.4H:1V slope, which is representative for the area below the building envelope, within the property boundary. Our model assumes an effective friction angle of 36 degrees with 50 psf cohesion, and a saturated unit weight of 136 pcf. The analysis indicates the slope will maintain a factor of safety against surficial failure under parallel seepage conditions of 1.68. Sample calculations are attached as Figures A-6.

Seismicity

Following the criteria outlined in the 2012 International Building Code (IBC, 2012), 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); 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, 2012).

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 B (*very dense soil and soft rock*). Based on IBC criteria, the short-period (F_a) coefficient is 1.0 and long-period (F_v) site coefficient is 1.0. 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 2.0; a summary of the *Design Maps* analysis is presented in Appendix B. The *peak ground acceleration* (PGA) may be taken as $0.4{*}S_{MS}$.

Table 2.0
Short- and Long-Period Spectral Accelerations for MCE

Parameter	Short Period (0.2 sec)	Long Period (1.0 sec)
MCE Spectral Response Acceleration (g)	$S_S = 0.817$	$S_1 = 0.271$
MCE Spectral Response Acceleration Site Class B (g)	$S_{MS} = S_sF_a = 0.817$	$S_{M1} = S_1F_v = 0.271$
Design Spectral Response Acceleration (g)	$S_{DS} = S_{MS}{*}^2/_3 = 0.545$	$S_{D1} = S_{M1}{*}^2/_3 = 0.181$

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of field observations, laboratory testing for this project and during a previously completed geotechnical investigation (IGES, 2012a), and other recent geotechnical work nearby, the subsurface conditions are considered suitable for the proposed construction provided that the recommendations presented in this report are incorporated into the design and construction of the project.

General Site Preparation and Grading

Prior to the placement of foundations, general site grading is recommended to provide proper support for exterior concrete flatwork, concrete slabs-on-grade, and pavement sections. Site grading is also recommended to provide proper drainage and moisture control on the subject property and to aid in preventing differential movement in foundation soils as a result of variations in moisture conditions.

Below proposed structures, fills, and man-made improvements, all vegetation, topsoil, debris and undocumented fill soils (if any) 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 that recommendations presented in this report have been complied with.

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). Scarification is not required where bedrock or hard, cemented colluvium is exposed.

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). 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 (1½H:1V) (34 degrees) in accordance with OSHA Type C soils. Trench walls may need to be laid back at a flatter grade pending evaluation of soil conditions by the geotechnical engineer. Soil conditions should be evaluated in the field on a case-by-case basis. Large rocks exposed on excavation walls should be removed (scaled) to minimize rock fall hazards.

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. 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. These lift thicknesses are *maximums*; the contractor should be aware that thinner lifts may be necessary to achieve the desired compaction. 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.

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.

Utility Trench Backfill

Utility trenches should be backfilled with structural fill in accordance with the previous section. 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, which generally does not require densification. Native earth materials can be used as backfill over the pipe bedding zone. All utility trenches backfilled below pavement sections, curb and gutter, 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.

Foundations

Based on our field observations and considering the presence of relatively competent native earth materials, we recommend that the footings for the proposed home be founded either *entirely* on competent native earth materials or *entirely* on structural fill. Native/fill transition zones are not allowed. Furthermore, if part of the foundation excavation exposes hard/cemented colluvium and/or conglomerate bedrock, all foundations should be deepened such that the entire foundation system is placed on similarly firm earth materials.

If soft, loose, or otherwise deleterious earth materials are exposed in the footing excavations, then the footings should be deepened such that all footings bear on relatively uniform, competent native earth materials. Alternatively, the foundation excavation may be over-excavated a minimum of 2 feet below the bottom of proposed footings and replaced with structural fill, such that the footings bear entirely on a uniform fill blanket. We recommend that IGES inspect the bottom of the foundation excavation prior to the placement of steel or concrete to identify the competent native earth materials as well as any unsuitable soils or transition zones. Additional over-excavation may be required based on the actual subsurface conditions observed.

Shallow spread or continuous wall footings constructed entirely on competent, uniform native earth materials or on a minimum of 2 feet of *structural fill* may be proportioned utilizing a maximum net allowable bearing pressure of **2,800 pounds per square foot (psf)** for dead load plus live load conditions. 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 42 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 must 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.

Settlement

Static settlement of properly designed and constructed conventional foundations, founded as described above, 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.

Competent native earth materials and/or properly compacted structural fill is expected to exhibit negligible seismically-induced settlement during a MCE seismic event.

Earth Pressure 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 0.40 for clayey native soils or structural fill should 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 3.0:

Table 3.0
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)	0.33	40	0.53	64
At-rest (Ko)	0.50	60	0.80	96
Passive (Kp)	3.0	360	—	—

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. Backfill should consist of native granular soil with an Expansion Index (EI) less than 20.

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 or buried tank 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.

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'' W4.0×W4.0 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 **280 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.

Moisture Protection

Moisture should not be allowed to infiltrate into the soils in the vicinity of the foundations. As such, design strategies to minimize ponding and infiltration near the home should be implemented. The new home may be subject to sheet flow during periods of heavy rain or snow melt; therefore, the Civil Engineer may also wish to consider construction of additional surface drainage to intercept surface runoff, or a curtain drain to intercept seasonal groundwater flow, if any.

We recommend that hand watering, desert landscaping or Xeriscape be considered within 5 feet of the foundations. We further recommend roof runoff devices be installed to direct all runoff a minimum of 10 feet away from structures. The home builder should be responsible for compacting the exterior backfill soils around the foundation. Additionally, 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. 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 areas surrounding pavement. Landscape plans must conform to Weber County development codes.

IGES recommends a perimeter foundation drain be constructed for the proposed residential structure in accordance with the International Residential Code (IRC).

Soil Corrosion Potential

Laboratory testing of a representative soil sample obtained from the test pit indicated that the soil sample tested had a sulfate content of 135 ppm. Accordingly, the soils are classified as having a 'moderate' potential for deterioration of concrete due to the presence of soluble sulfate. As such, conventional Type II/V 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 13,534 OHM-cm, soluble chloride content of 17.1 ppm and a pH of 5.2. Based on this result, the onsite native soil is considered to be *mildly corrosive* to ferrous metal. We recommend a lower water/cement ratio, ~0.4, to address the acidic soil conditions. The lower water/cement ratio will reduce permeability of the concrete and prevent acidic attacks on the steel.

Construction Considerations

- Excavation Difficulty: The rocky, cemented colluvium identified approximately 6 feet below existing grade was difficult to excavate. Hard, cemented gravels, or conglomerate bedrock (Wasatch Formation) may be difficult to excavate and may require heavy-duty rippers or other specialized excavation procedures.

- Over-Size Material: Rounded boulders to 24 inches were identified in the test pits and on the ground surface; larger rocks may be present locally. The site is overlain with bouldery colluvium, largely derived from the underlying Wasatch Formation, which consists of cobbly/bouldery conglomerate. Large rocks may require special handling, such as segregation from structural fill, and disposal.

CLOSURE

The recommendations presented in this report are based on limited field exploration, literature review, and a general understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the exploration(s) made for this investigation. It is possible that variations in the soil and groundwater conditions could exist beyond the point explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, IGES should be immediately notified so that any necessary revisions to recommendations contained in this report may be made. In addition, if the scope of the proposed construction changes from that described in this report, IGES should also be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

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.

Additional Services

The recommendations presented in this report are based on the assumption that an adequate program of tests and observations will be made during the construction. IGES staff should be on site to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation, earthwork and structural fill placement.
- Consultation as may be required during construction.
- Quality control testing of cast-in-place concrete.
- Review of plans and specifications to assess compliance with our recommendations.

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 contact the undersigned at (801) 748-4044.

Respectfully submitted,
IGES, Inc.

Reviewed by:

PROFESSIONAL ENGINEER
No. 6370734
DAVID A. GLASS
07-08-16
ELECTRONIC SEAL
STATE OF UTAH

Taylor Q. Hall, P.E. (CA)
Staff Engineer

David A. Glass, P.E.
Senior Geotechnical Engineer

PROFESSIONAL
LICENSED GEOLOGIST
9325094-2250
PETER ELI DOUMIT
07-08-16
ELECTRONIC SEAL
STATE OF UTAH

Peter E. Doumit, P.G.
Senior Geologist

Attachments:

References

Appendix A
- Figure A-1 – Site Vicinity Map
- Figure A-2– Test Pit Log
- Figure A-3 – Key to Soil Symbols and Terminology
- Figure A-4 – Static Slope Stability Analysis
- Figure A-5 – Seismic Slope Stability Analysis
- Figure A-6 – Saturated Slopes Stability Analysis

Appendix B – Laboratory Test Results

Appendix C – 2012 IBC MCE and Design Response Acceleration

Plate 1 – Local Geology and Geotechnical Map

References

AMEC, 2001, Report Engineering Geologic Reconnaissance/Geotechnical Study Powder Mountain Resort.

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.

IGES, Inc., 2012a, Design Geotechnical Investigation, Powder Mountain Resort, Weber County, Utah, Project No. 01628-003, dated November 9, 2012.

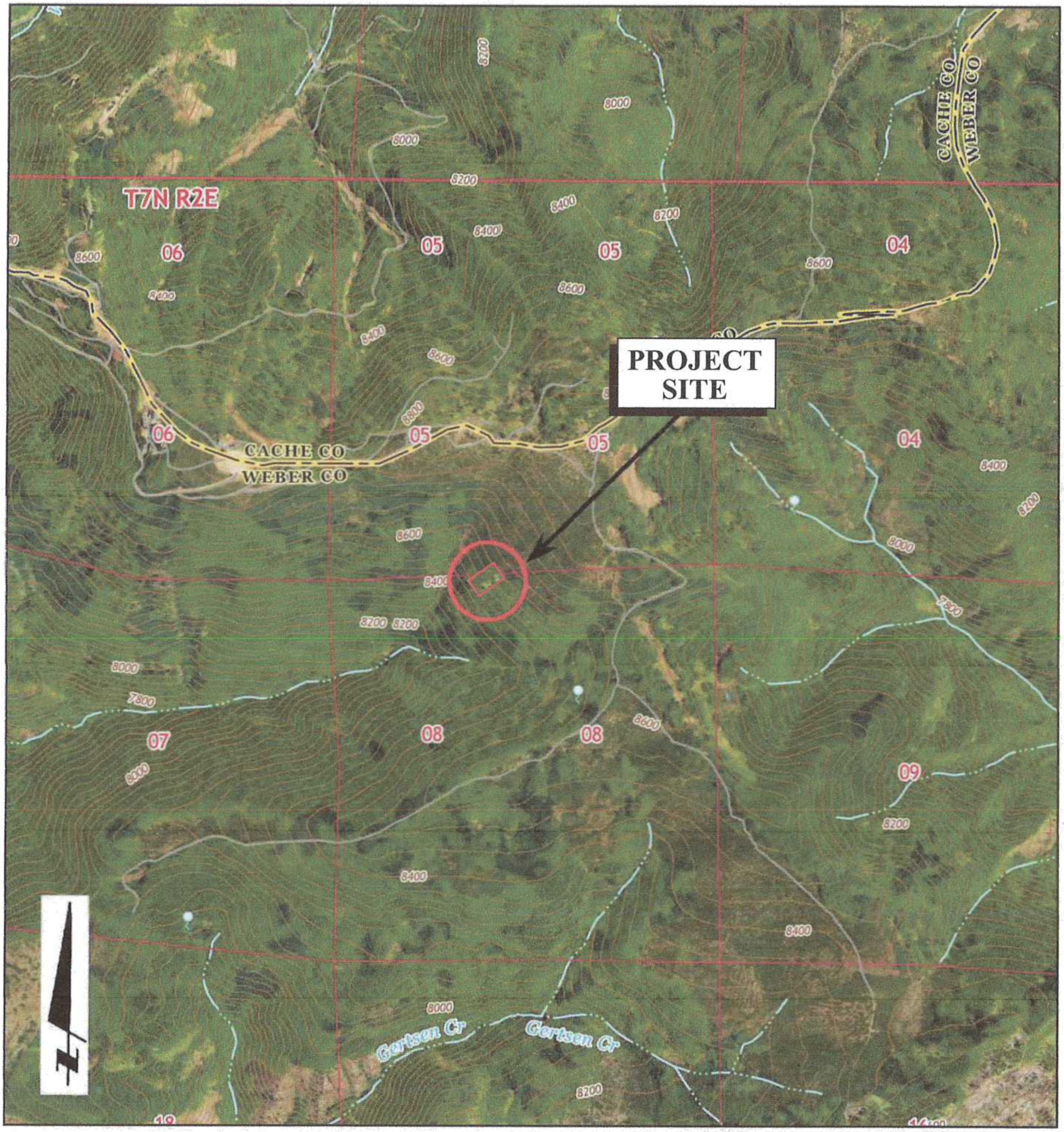
IGES, Inc., 2012b, Preliminary Geotechnical Investigation, Powder Mountain Resort, Weber County, Utah, Project No. 01628-001, dated July 26, 2012.

IGES, Inc., 2015a, Geotechnical Investigation Report, Lot 39R of Powder Mountain Resort, 8365 East Summit Pass, Weber County, Utah, Project No. 02052-001, June 3, 2015

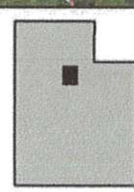
International Building Code [IBC], 2012, International Code Council, Inc.

U.S. Geological Survey, 2012, U.S. *Seismic "Design Maps" Web Application*, site: https://geohazards.usgs.gov/secure/designmaps/us/application.php.

Western Geologic, 2012, Report: Geologic Hazards Reconnaissance, Proposed Area 1 Mixed-Use Development, Powder Mountain Resort, Weber County, Utah, dated August 28, 2012.



BASE MAP:
USGS Huntsville, Browns Hole, James Peak and Sharp Mountain
7.5-Minute Quadrangle Topographic Maps (2014)



MAP LOCATION

IGES®

Project No. 02052-001

Geotechnical Investigation
Lot 37R of Summit Eden Phase 1C
8343 East Summit Pass
Weber County, Utah

SITE VICINITY MAP

Figure
A-1

DATE	
STARTED:	6/23/16
COMPLETED:	6/23/16
BACKFILLED:	6/23/16

Geotechnical Investigation
Lot 37R of Summit Eden Phase 1C
8343 East Summit Pass
Weber County, Utah

Project Number 02332-001

IGES Rep: TQH
Rig Type: CAT 315C

TEST PIT NO: **TP-1**

Sheet 1 of 1

LOCATION

LATITUDE 41.36540 LONGITUDE -111.75053 ELEVATION 8,620

ELEVATION	DEPTH (FEET)	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit – Moisture Content – Liquid Limit; 10 20 30 40 50 60 70 80 90)
	0					**TOPSOIL** Clayey SAND with gravel - medium dense to loose, slightly moist to moist, dark brown - trace roots throughout						
					GC	@ 2' **COLLUVIUM (Qc)** Poorly Graded Clayey GRAVEL with sand - orangish brown, dry to moist, low plasticity clay, well-graded sand, large subangular to subrounded quartzite clasts (3- to 4-foot diameter maximum and 1- to 2-foot diameter typical), trace roots						
8615	5											
		Grab sample				@ 6' **WASATCH FORMATION (Twe)** Conglomerate, highly weathered, moderatley cemented, readily dissagregates to soil classifying as Poorly Graded Clayey GRAVEL with sand (GC) - orangish red, moist, low plasticity clay, well-graded sand, large subangular to subrounded quartzite clasts (3- to 4-foot diameter maximum and 8- to 14-inch diameter typical), similar to overllying colluvium except Twe is more cemented and increasingly difficult to excavate			25.0	26	8	
8610	10											
8605	15											
8600	20					Total depth 20 feet No groundwater						

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

IGES®

Figure A-2

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

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

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.

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

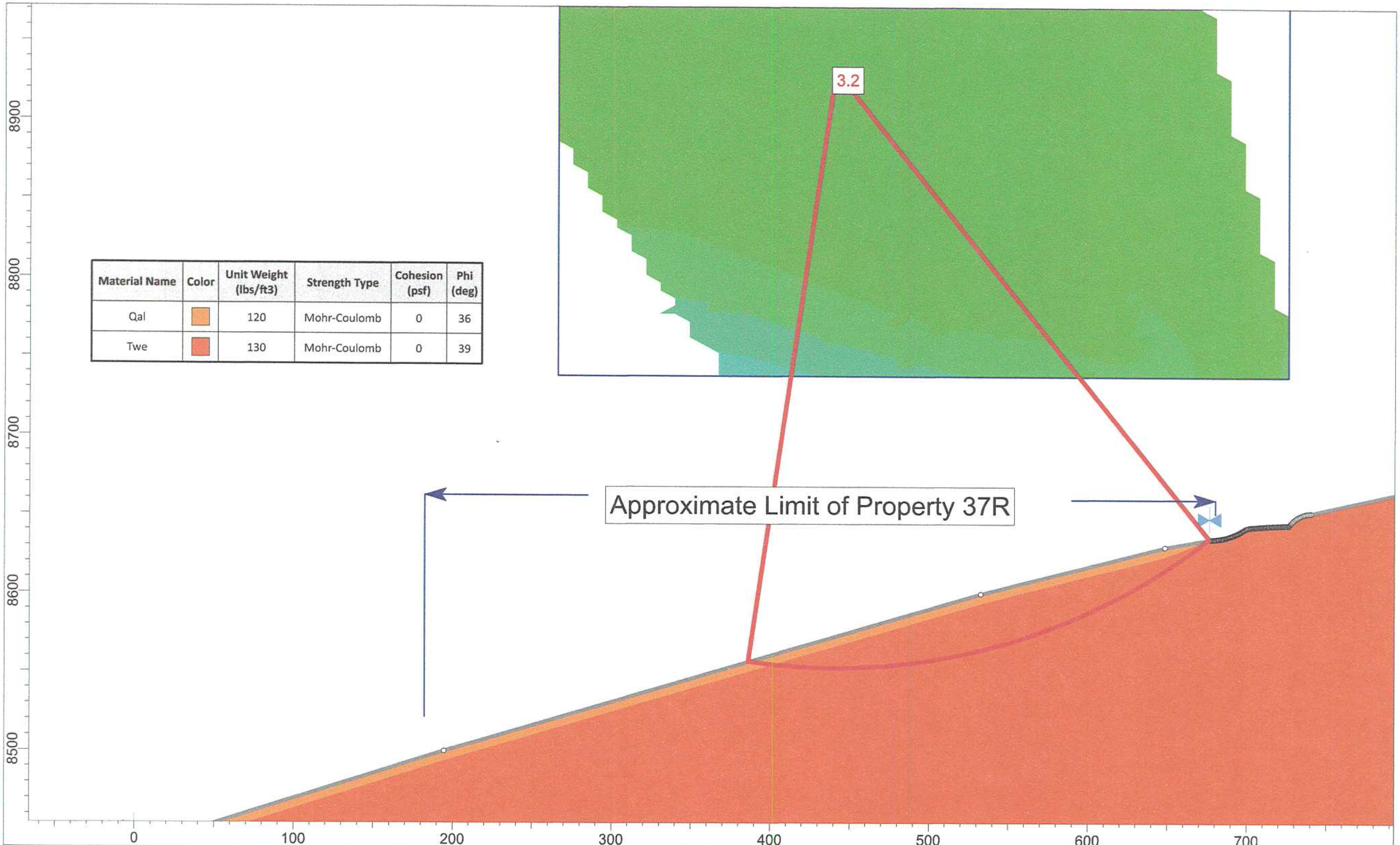
CONSISTENCY - FINE-GRAINED SOIL

		TORVANE	POCKET PENETROMETER	FIELD TEST
CONSISTENCY	SPT (blows/ft)	UNTRAINED SHEAR STRENGTH (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	
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-3

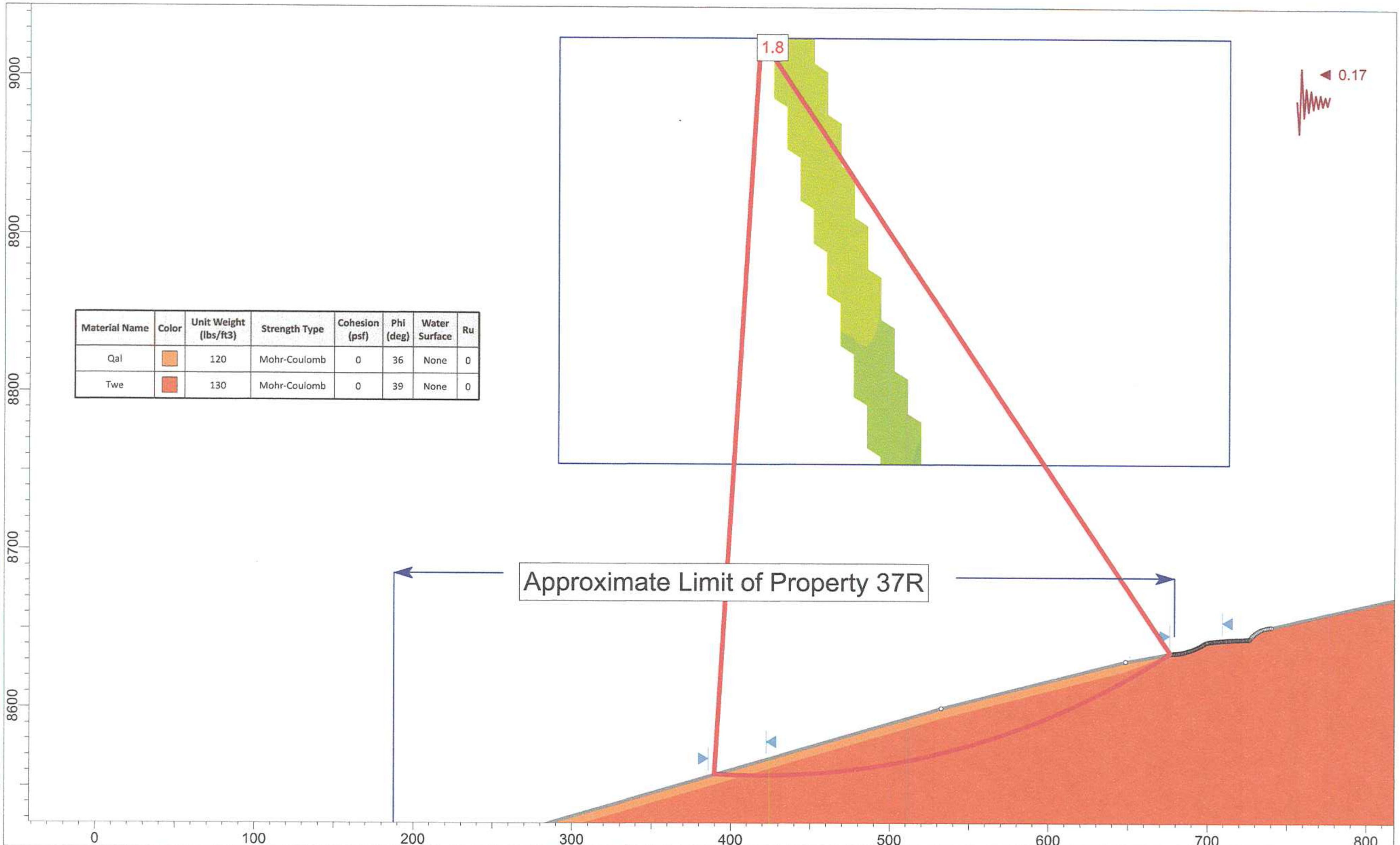


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Qal		120	Mohr-Coulomb	0	36
Twe		130	Mohr-Coulomb	0	39

IGES®

SLIDEINTERPRET 6.024

Project	Powder Mountain Lot 37R		
Analysis Description	Static		
Drawn By	TQH	*Company*	IGES Inc.
Date	7/1/2016	*File Name*	Lot 37R.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Qal		120	Mohr-Coulomb	0	36	None	0
Twe		130	Mohr-Coulomb	0	39	None	0

IGES®

SLIDEINTERPRET 6.024

Project	Powder Mountain Lot 37R
Analysis Description	Psuedo-Static
Drawn By	TQH
Company	IGES Inc.
Date	7/1/2016
File Name	Lot 37R Seismic.slim

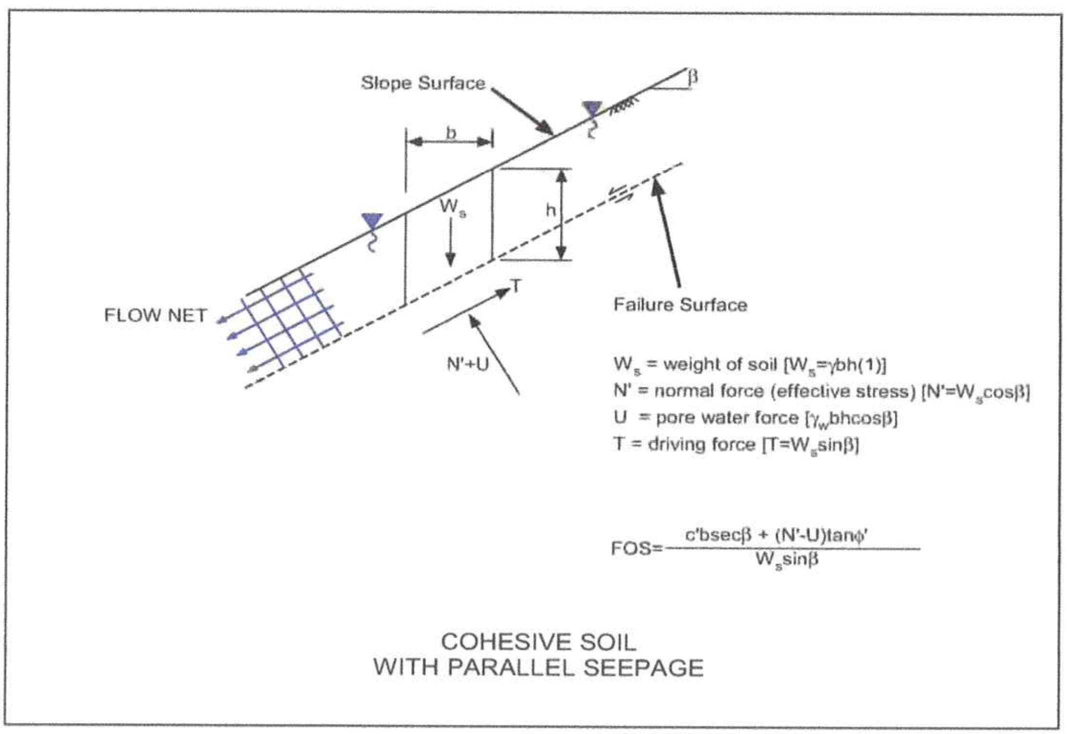
Lot 37R
02332-001
7/1/2016

c'	50	psf	Effective Cohesion (including apparent cohesion for coarse, angular soils)
ϕ'	36	deg	Effective Friction Angle
γ_{sat}	136	pcf	Saturated Unit Weight of Soil
γ_w	62.4	pcf	Unit weight of water
h	4	ft	Depth to shear surface
β	16.4	deg	Slope Gradient (3.4H:1V)

FS 1.68

Input Variable
Calculated Value

This model assumes c>0 and the face of the slope is saturated to depth h



Liquid Limit, Plastic Limit, and Plasticity Index of Soils
(ASTM D4318)

IGES

Project: Lot 37R - Powder Mountain
No: 02332-001
Location: Eden, UT
Date: 6/28/2016
By: BRR

Boring No.:
Sample: 37R
Depth:
Description: Brown lean clay

Preparation method: Wet
Liquid limit test method: Multipoint

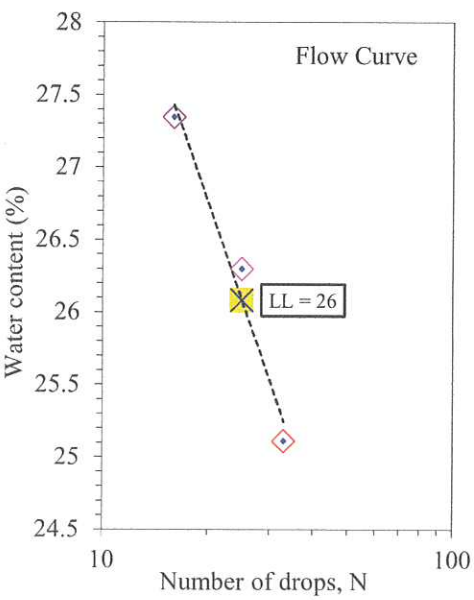
Plastic Limit

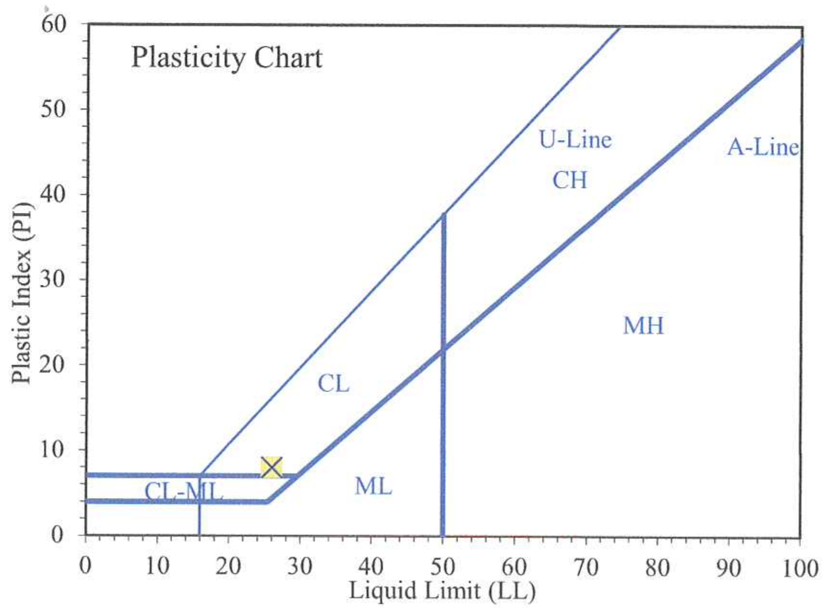
Determination No	1	2				
Wet Soil + Tare (g)	28.32	28.91				
Dry Soil + Tare (g)	27.38	27.85				
Water Loss (g)	0.94	1.06				
Tare (g)	22.19	22.02				
Dry Soil (g)	5.19	5.83				
Water Content, w (%)	18.11	18.18				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	33	25	16			
Wet Soil + Tare (g)	30.66	32.47	31.68			
Dry Soil + Tare (g)	28.94	30.29	29.64			
Water Loss (g)	1.72	2.18	2.04			
Tare (g)	22.09	22.00	22.18			
Dry Soil (g)	6.85	8.29	7.46			
Water Content, w (%)	25.11	26.30	27.35			
One-Point LL (%)		26				

Liquid Limit, LL (%)	**26**
Plastic Limit, PL (%)	**18**
Plasticity Index, PI (%)	**8**





Entered by:____________
Reviewed:____________

Z:\PROJECTS\02332_Land_to_Sky_Con\001_Lot_37\[ALv1.xlsm]1

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

(ASTM D6913)

IGES

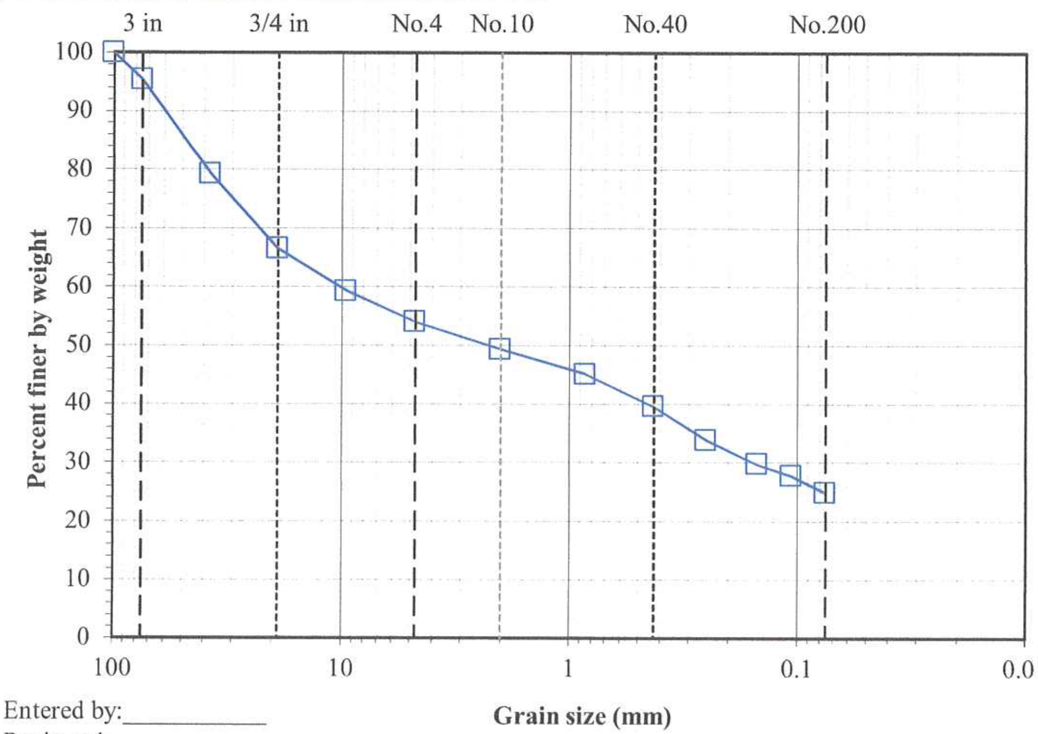
Project: Lot 37R - Powder Mountain
No: 02332-001
Location: Eden, UT
Date: 6/28/2016
By: BRR/BSS

Boring No.:
Sample: 37R
Depth:
Description: Brown clayey gravel with sand

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	61170.80	57991.79
+3/4" Coarse fraction (g):	19704.70	19412.42
-3/4" Split fraction (g):	1619.73	1506.97
Split fraction:	0.665	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	2061.65	2083.86
Dry soil + tare (g):	2037.98	1971.10
Tare (g):	465.88	464.13
Water content (%):	1.5	7.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	100.0	
3"	2691.48	75	95.4	
1.5"	12047.51	37.5	79.2	
3/4"	19412.42	19	66.5	←Split
3/8"	164.20	9.5	59.3	
No.4	284.20	4.75	54.0	
No.10	390.90	2	49.3	
No.20	486.40	0.85	45.1	
No.40	610.40	0.425	39.6	
No.60	740.90	0.25	33.8	
No.100	833.00	0.15	29.8	
No.140	879.50	0.106	27.7	
No.200	944.20	0.075	24.8	



Gravel (%): 46.0
Sand (%): 29.1
Fines (%): 24.8

Entered by:___________
Reviewed:___________

Z:\PROJECTS\02332_Land_to_Sky_Con\001_Lot_37\[GSDv2.xlsx]1

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)*

IGES

Project: Lot 37R - Powder Mountain
No: 02332-001
Location: Eden, UT
Date: 6/28/2016
By: BRR

Sample info.	Boring No.								
	Sample	37R							
	Depth								
Water content data	Wet soil + tare (g)	145.79							
	Dry soil + tare (g)	135.26							
	Tare (g)	37.31							
	Water content (%)	10.8							
Chem. data	pH	5.16							
	Soluble chloride* (ppm)	17.1							
	Soluble sulfate** (ppm)	135							
Resistivity data	Pin method	2							
	Soil box	Miller Small							
		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)
		As Is	36600	0.67	24522				
		+3	21800	0.67	14606				
		+6	21000	0.67	14070				
		+9	20200	0.67	13534				
		+12	20900	0.67	14003				
	Minimum resistivity (Ω-cm)	13534							

* Performed by AWAL using EPA 300.0

** Performed by AWAL using ASTM C1580

Entered by:___________

Reviewed:___________

USGS Design Maps Detailed Report

2012 International Building Code (41.36672°N, 111.75108°W)

Site Class B – "Rock", 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 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 = 0.817 g

From Figure 1613.3.1(2) [2] S_1 = 0.271 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 B, 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 $w \geq 40\%$, 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				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
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 = B and S_s = 0.817 g, F_a = 1.000

TABLE 1613.3.3(2)
VALUES OF SITE COEFFICIENT F_v

Site Class	Mapped Spectral Response Acceleration at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
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 = B and S_1 = 0.271 g, F_v = 1.000

Equation (16-37): $S_{MS} = F_aS_S = 1.000 \times 0.817 = 0.817$ g

Equation (16-38): $S_{M1} = F_vS_1 = 1.000 \times 0.271 = 0.271$ g

Section 1613.3.4 — Design spectral response acceleration parameters

Equation (16-39): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 0.817 = 0.545$ g

Equation (16-40): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 0.271 = 0.181$ 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} = 0.545 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} = 0.181 g, Seismic Design Category = C

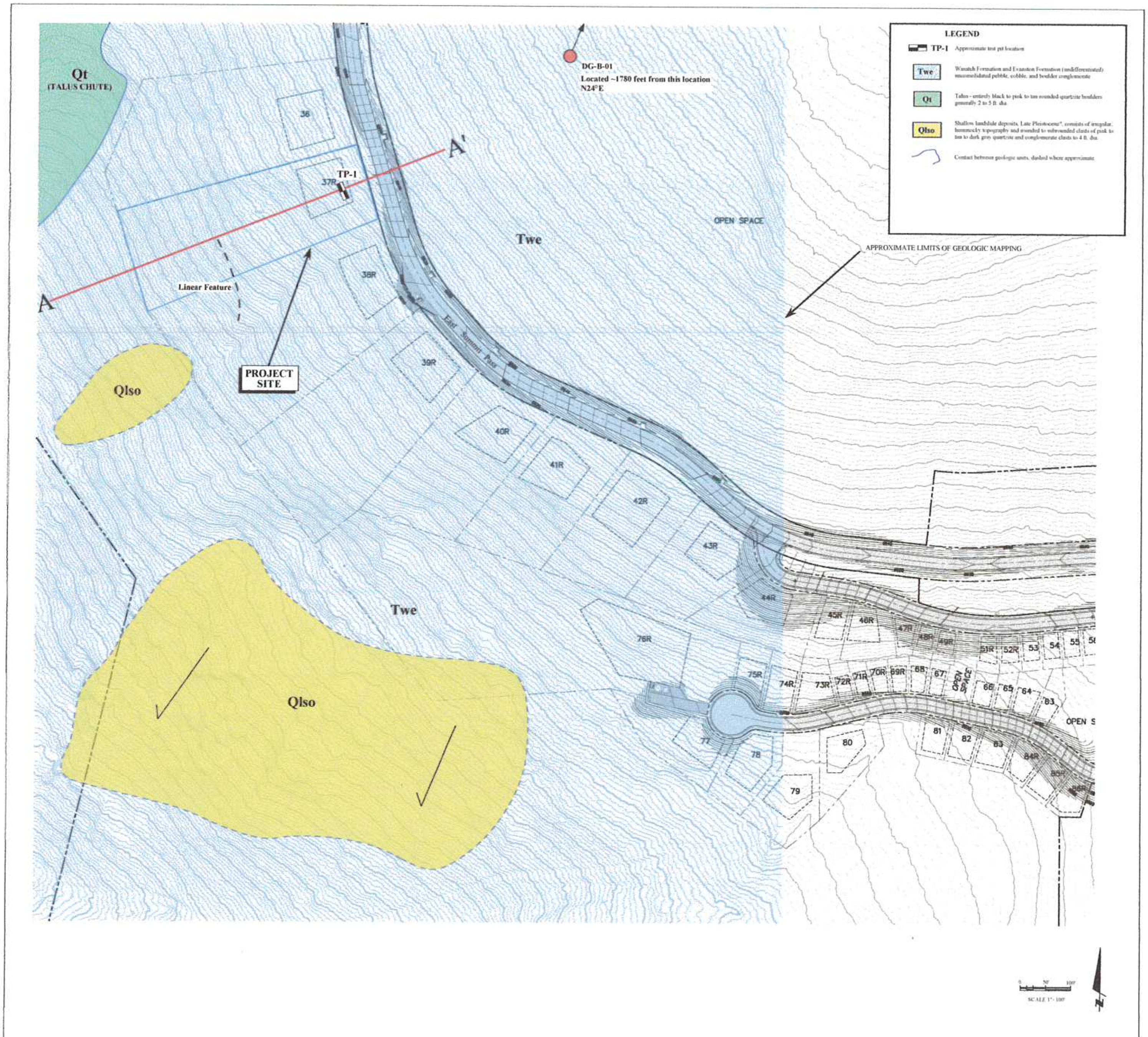
Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

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



LOCAL GEOLOGY AND GEOTECHNICAL MAP

Base Map:
Topographic map prepared by NV5, undated

IGES®

Geotechnical Investigation
Lot 37R of Summit Eden Phase 1C
8343 East Summit Pass
Weber County, Utah

Plate 1