IGES®
Intermountain GeoEnvironmental Services, Inc.
12429 South 300 East, Suite 100, Draper, Utah 84020
T: (801) 748-4044 ~ F: (801) 748-4045
4153 South Commerce Drive, SLC, UT 84107
T: (801) 270-9400 ~ F: (801) 270-9401

September 12, 2016

Wolf Creek Resort
3718 N. Wolf Creek Drive
Eden, Utah 84310
Attn: Mr. Eric Householder

IGES Project No. 02348-001

Subject: Geologic Hazards Assessment
The Ridge Subdivision Phases 3, 4, and 5
Eden, Utah

Mr. Householder:

At your request, IGES has performed a geologic hazards assessment for The Ridge Subdivision Phases 3, 4, and 5, located in the City of Eden in Weber County, Utah. This letter report identifies the nature and associated risk of the applicable geologic hazards associated with the property, based upon the results of the literature review, site reconnaissance, and subsurface investigation conducted as part of this assessment.

1.0 INTRODUCTION

The property is located in the City of Eden, Utah, approximately 2 miles north of Pineview Reservoir in the northeastern quarter of Section 27, Township 7 North, Range 1 East (see Appendix A, Figure A-1). The property is bound on all sides by partially completed residential neighborhoods containing intermittent developed and undeveloped lots. We understand that Phase 3 of The Ridge Subdivision will involve the development of 12 townhome units (three 4-Plex units), 29 parking stalls, and a pool and spa facility; Phase 4 will involve the development of 8 townhome units (two 4-Plex units) and 21 parking stalls; and Phase 5 of the project will involve the development of 12 townhome units (three 4-Plex units) and 31 parking stalls. The development in all three phases will cover a total of approximately 10 acres. The subject property is located within an area that is mapped as landslide deposits associated with the Norwood Tuff, and as such is required to have a geologic hazard assessment prior to development in order to adequately meet the requirements of the Weber County Code. This assessment has been produced to meet these requirements.

2.0 PURPOSE AND SCOPE

This study was initially performed as a reconnaissance-level geologic hazards assessment of the property, which was subsequently expanded to include subsurface investigation. The purpose of this assessment was to identify any surficial or subsurface geologic hazards that may be extant on the property or have the capability to adversely impact the property. Specifically, this study was conducted to:

- Analyze the existing geologic conditions present on the property and relevant adjacent areas;

- Assess the geologic hazards that pose a risk to development across the property, and determine an associated risk for each hazard; and

- Identify the most significant geologic hazard risks, and provide recommendations for appropriate additional studies and/or mitigation practices, if necessary.

In order to achieve the purpose and scope outlined above, the following services were performed as part of this investigation:

- Review of available published geologic reports and maps for the subject property and surrounding areas;

- Stereoscopic review of aerial photographs and analysis of additional available aerial imagery, including LiDAR;

- Site reconnaissance by an engineering geologist licensed in the state of Utah to map the surficial geology, determine site conditions, and assess the property for geologic hazards;

- Geologic logging of subsurface excavations, soil sampling, and slope stability analyses; and

- Preparation of this report, based upon the data reviewed and collected in this investigation.

3.0 REVIEW OF GEOLOGIC LITERATURE

A number of pertinent publications were reviewed as part of this assessment. Sorensen and Crittenden, Jr. (1979) provides the only 1:24,000 scale geologic mapping that covers the area in which the property of interest is located, in the form of the Huntsville Geologic Quadrangle. Coogan and King (2001) provide more recent geologic mapping of the area, but at a regional (1:100,000) scale. An updated Coogan and King (2016) regional geologic map (1:62,500 scale) provides the most recent published geologic mapping that covers the project area. A United States Geological Survey (USGS) topographic map for the Huntsville Quadrangle (2014) provides physiographic and hydrologic data for the project area. A Federal Emergency Management Agency (FEMA) flood map (effective in 2015) that covers the project area was reviewed. Regional-scale geologic hazard maps pertaining to landslides (Elliott and Harty, 2010; Colton, 1991), faults (Christenson and Shaw, 2008a; USGS and Utah Geological Survey (UGS), 2006), debris-flows (Christenson and Shaw, 2008b), liquefaction (Christenson and Shaw, 2008c; Anderson et al., 1994), and radon (Solomon, 1996) that cover the project area were also reviewed. More site-specific, the GeoStrata geotechnical report (2013) for the subject property was reviewed.

3.1 General Geologic Setting

The Ridge Subdivision Phase 3, 4, and 5 property is situated in the northern part of the Ogden Valley, along the foothills of the Wasatch Mountains, with the eastern margin of the property adjacent to the Heinz Canyon drainage. Ogden Valley separates the western part of the Wasatch Range from the Bear River Range to the east, a subgroup of mountains that are part of the parent Wasatch Range. The Wasatch Mountains contain a broad depositional history of thick Precambrian and Paleozoic sediments that have been subsequently modified by various tectonic episodes that have included thrusting, folding, intrusion, and volcanics, as well as scouring by glacial and fluvial processes (Stokes, 1987). The uplift of the Wasatch Mountains occurred relatively recently during the Late Tertiary Period (Miocene Epoch) between 12 and 17 million years ago (Milligan, 2000). Since uplift, the Wasatch Front has seen substantial modification due to such occurrences as movement along the Wasatch Fault and associated spurs, the development of the numerous canyons that empty into the current Salt Lake Valley and Utah Valley and their associated alluvial fans, erosion and deposition from Lake Bonneville, and localized mass movement events (Hintze, 1988). The Wasatch Mountains, as part of the Middle Rocky Mountains Province (Milligan, 2000), were uplifted as a fault block along the Wasatch Fault (Hintze, 1988). Ogden Valley itself is a fault-bounded trough that was occupied by Lake Bonneville (Sorensen and Crittenden, Jr, 1979) before being cut through by the Ogden River and subsequently dammed to form the Pineview Reservoir.

3.2 Surficial and Subsurface Geology

According to Sorensen and Crittenden, Jr. (1979), the property is located entirely on Holocene-aged (~11,700 years ago to the present) colluvium[1] and slopewash (Qcs) deposits (Figure A-2). The Qcs unit is underlain by the Norwood Tuff (Tn) across the property, and several small exposures of the Norwood Tuff are present within a 1/2-mile radius of the property. Though the southeastern part of the property abuts the Heinz Canyon drainage, no alluvial deposits were mapped in association with the drainage. Several northwest-southeast trending faults were mapped north of the property, all within 0.15 miles of the property and one as close as 150 feet north of the northern margin of the property (Sorensen and Crittenden, Jr., 1979). Coogan and King (2001) denoted the area underlying the subject property entirely as Qac (alluvium and colluvium deposits), which are described as including "stream and fan alluvium, colluvium, and, locally, mass-movement deposits." In contrast to Sorensen and Crittenden, Jr. (1979), Coogan and King (2001) do not show the faults to the north of the property.

Coogan and King (2016) displays the subject property to be entirely underlain by several lobes of old (Pleistocene-aged; between 11,700 and 2.6 million years old) landslide deposits (Qmso) (Figure A-3). This map reinserts the linear features to the north of the property identified as faults by Sorensen and Crittenden, Jr. (1979), but reinterprets them to be landslide scarps, two of which are seen to encroach the northernmost part of the property. An additional northwest-southeast trending scarp is shown near the southern margin of the property. Young alluvial fan deposits (Qafy) are found in association with the Heinz Canyon drainage approximately ¼ mile updrainage of the eastern margin of the property.

[1] Colluvium: A general term applied to any loose, heterogeneous, and incoherent mass of soil material and/or rock fragments deposited by rainwash, sheetwash, or slow continuous downslope creep, usually collecting at the base of gentle slopes or hillsides. (AGI, 2005)

As part of the geotechnical assessment for the property, GeoStrata excavated a total of 17 test pits (GeoStrata, 2013). A lean clay and sandy lean clay topsoil was found to be between 2 and 4 feet thick, and was underlain by "Holocene-aged colluvium and slopewash deposits associated with post-Bonneville cycle processes." A single occurrence of fat clay was noted in a test pit near the eastern margin of the property. Norwood Tuff bedrock was encountered in all but four of the test pits.

3.3 Hydrology

The USGS topographic map for the Huntsville Quadrangle (2014) shows that The Ridge Subdivision Phases 3, 4, and 5 project area is situated within the broad northwest-southeast trending Ogden Valley and near the northeast-southwest trending Heinz Canyon drainage, which forms the eastern margin of the property (see Figure A-1). Multiple generally north-south trending ephemeral stream drainages are found to pass through the northeastern part of the property, though none of these were subsequently found to contain flowing water during the site visit. The largest of these ephemeral stream drainages is the westernmost drainage, and passes through the property and empties into the Heinz Canyon drainage. No springs are known to occur on the property, though it is possible that springs may occur on various parts of the property during peak spring runoff.

Baseline groundwater depths for The Ridge Subdivision Phase 3, 4, and 5 property are currently unknown, but are anticipated to fluctuate both seasonally and annually. Groundwater was encountered in only 4 of the 17 test pits excavated by GeoStrata (2013) in the geotechnical investigation of the property, found between the depths of approximately 7 and 12.5 feet below existing ground level in early November.

The FEMA flood map that covers the project area shows that the property is in Zone X, located outside of the 500-year flood floodplain for the Heinz Canyon drainage (FEMA, 2015).

3.4 Geologic Hazards

Based upon the available geologic literature, regional-scale geologic hazard maps that cover The Ridge Subdivision Phases 3, 4, and 5 project area have been produced for landslide, fault, debris-flow, liquefaction, and radon hazards. The following is a summary of the data presented in these regional geologic hazard maps.

3.4.1 Landslides

Two regional-scale landslide hazard maps have been produced that cover the project area. Colton (1991) shows the property to be located within a large area that is queried as a possible landslide deposit. More recent mapping by Elliott and Harty (2010) refined the area queried by Colton (1991) and show the property to be located within an area classified as "Landslide and/or landslide undifferentiated from talus, colluvial, rockfall, glacial, or soil-creep deposits."

3.4.2 Faults

Neither Christensen and Shaw (2008a) nor the Quaternary Fault and Fold Database of the United States (USGS and UGS, 2006) show any Quaternary-aged (~2.6 million years ago to the present) faults to be present on or projecting towards the subject property. The Ogden Valley North Fork Fault and the Ogden Valley Northeastern Margin Fault are located approximately 1.5 miles to the southwest and northeast of the property, respectively, and represent the closest

Quaternary-aged faults to the property (UGS, 2016a). The Weber County Natural Hazards Overlay Districts defines an active fault to be “a fault displaying evidence of greater than four inches of displacement along one or more of its traces during Holocene time (about 11,000 years ago to the present)” (Weber County, 2015). The closest active fault to the property is the Weber Segment of the Wasatch Fault Zone, located approximately 5.7 miles west of the western margin of the property (USGS and UGS, 2006).

3.4.3 Debris-Flows

Christensen and Shaw (2008b) do not show the project area to be located within a debris-flow hazard special study area.

3.4.4 Liquefaction

Anderson, et al. (1994) and Christensen and Shaw (2008c) both show the project area to be located in an area with very low potential for liquefaction.

3.4.5 Radon

Solomon (1996) has part of the project area located in an area with moderate radon levels.

4.0 REVIEW OF AERIAL IMAGERY

A series of aerial photographs that cover project area were taken from the UGS Aerial Imagery Collection (UGS, 2016b) and analyzed stereoscopically for the presence of adverse geologic conditions across the property. This included a review of photos collected from the year 1946 which were taken prior to the development of the nearby golf course, residences and their neighborhoods. A table displaying the details of the aerial photographs reviewed can be found in the *References* section at the end of this report.

No geologic lineaments, fault scarps, landslide headscarps, or landslide deposits were observed in the aerial photography on the subject property.

Google Earth imagery of the property from between the years of 1993 and 2015 were also reviewed. No landslide or other geological hazard features were noted in the imagery. The approximately southern half of the property was observed to contain common surficial gravel, cobbles, and boulders, and the multiple north-south trending ephemeral drainages found in the eastern part of the property as discussed above were also observed. Most of the project area was observed to be covered in grasses, though some bushes were seen near the southern margin and trees were found along the eastern margin in association with the Heinz Canyon drainage.

Utah Geological Survey 1 meter LiDAR data (UGS, 2011) for the project area was reviewed. The property was shown to be quite hummocky and irregular, and the ephemeral drainages were easily delineated. The eastern half of the property appeared to contain the most irregular, hummocky topography.

5.0 SITE RECONNAISSANCE

Mr. Peter E. Doumit, P.G., C.P.G., of IGES conducted reconnaissance of the site and the immediate adjacent properties on July 25, 2016. The site reconnaissance was conducted with the intent to assess the general geologic conditions present across the property, with specific interest in those areas identified in the geologic literature and aerial imagery reviews as potential geologic hazard areas. Additionally, the site reconnaissance provided the opportunity to geologically map the surficial geology of the area. Figure A-4 is a site-specific geologic map of The Ridge Subdivision Phases 3, 4, and 5 property and adjacent areas.

Much of the property was found to have been disturbed by human activity, either actively or historically, and differentiating between the natural and human-altered modern topography was difficult to discern in places. In general, the existing terrain was largely gently sloping in the western and southern portions of the property, and highly irregular with significantly steeper slopes in the northern and eastern portions of the property.

Variously-sized boulders and cobbles were found scattered across the property, though were more heavily concentrated in the southern part of the property. These were typically subangular to subrounded, and were found to be as large as 2.5 feet in diameter. The rock clasts were found to be comprised of two distinct lithologies:

1. Very light gray to medium gray to purple, banded quartzite and pebbly conglomeratic quartzite; determined to be colluvium derived from the Wasatch Formation.
2. White to light gray sandy and silty, finely bedded tuff[2] of the Norwood Tuff.

Norwood Tuff clasts were generally found to be present across most of the property, indicating that much of the property is covered in a thin veneer of colluvium overlying near-surface Norwood Tuff bedrock. This was subsequently confirmed in the test pits excavated as part of the subsurface investigation.

A common feature encountered across the property was large shrinkage cracks in the surficial soil, which could be as much as one inch wide. These cracks are indicative of the presence of swelling (fat) clays in the soil profile, and are commonly associated with weathered volcanic ash deposits.

The existing gravel road that passes west to east along and near the northern margin of the property and currently connects Moose Hollow Drive and North Elkridge Trail exposes a south-facing road cut along its trace. This road cut was observed to display features indicative of the presence of Norwood Tuff that had been altered by way of landsliding, including highly contorted and irregular bedding, and opposing dip directions of beds found within the road cut. Additionally, the topsoil was found to be as thin as 3 inches in some locations along the road cut.

Four geologic units were differentiated on the property (see Figure A-4), as well as areas that have been modified by human activity. Each of these units are discussed in turn below.

Qal (Recent alluvium)

This unit was mapped in along the eastern margin of the property in association with the Heinz Canyon drainage, and in the east-central part of the property in association with the main north-south trending ephemeral drainage. The unit is characterized by the presence of abundant

[2] Tuff: Consolidated or cemented volcanic ash and lapilli. (AGI, 2005)

subrounded to subangular quartzite clasts up to 1.5 feet in diameter and minor angular Norwood Tuff clasts up to 3.5 inches in diameter in a lean clay matrix. Some of this unit may have been deposited by way of debris-flow or hyperconcentrated flow.

Qac (Quaternary alluvium and colluvium)

This unit was typically mapped in areas adjacent to existing drainages and their associated Qal deposits, and only a sliver of this unit is found along the eastern margin of the property. The unit is similar in character to the Qal unit, but is found on higher elevations and represents a gradation between alluvial and colluvial material.

Qlso (Pleistocene landslide deposits)

This unit was mapped along the northern margin of the property and vividly displayed in the existing road cut. It is present in the designated "wetland area" in the eastern portion of the Phase 3 area, and is seen to extend to the south along the western margin of the Heinz Canyon drainage. The unit is characterized by hummocky topography on the surface and irregular to chaotic bedding seen in the subsurface and road cut. The unit is predominantly comprised of weathered Norwood Tuff that had been mobilized in the geologic past, and has a well-developed A/B soil horizon formed upon it. However, quartzite boulders up to 2.5 feet in diameter were observed on the surface in the toes of these deposits in some places, which could be indicative of a prehistoric mobilization of some of the Qac material as well as the Norwood Tuff, or it could merely be a colluvial drape over the older landslide deposits.

Tn (Tertiary Norwood Tuff)

Norwood Tuff bedrock was found to be underlying most of the western and southern portions of the property. The tuff is highly silty and sandy, and was commonly weathered (chemically altered) to fat clay (CH). In the subsurface, the unit was found as a combination of decomposed volcanic ash, block-and-ash deposits, and friable, moderately to poorly competent tuff. Thin white lenses of material that appeared to be bentonitic[3] were commonly encountered.

5.1 Surface Water/Groundwater

At the time of the site visit, the Heinz Canyon drainage was found to be weakly flowing with water, with a constant stream that was approximately one inch deep. None of the additional ephemeral stream drainages found on the property were observed to be presently transporting surface water.

No springs were identified on the property, though a shallow water table was inferred across much of the southeastern part of the property. The presence of cattails and other hydrophilic plants in this areas suggests that shallow groundwater may be a perennial condition in this area. This would be a product of this area having the lowest ground surface elevation of the property and being located adjacent to the Heinz Canyon drainage.

[3] Bentonite: Soft clay or greasy claystone composed largely of smectite formed by the chemical alteration of glassy volcanic ash in contact with water. The rock commonly has the ability to absorb large quantities of water accompanied by a large increase in volume that can result in a thixotropic gel. (AGI, 2005)

5.2 Geologic Hazards

Based on the observation of the surficial soil cracks, thin topsoil and contorted, irregular, and variously-dipping bedding seen in the road cut, and irregular, possibly hummocky topography and potential landslide scarps observed across different parts of the property, it was determined that there is a landslide hazard present and a subsurface component of the geologic hazard assessment would be required to assess the nature and extent of the landslide deposits and associated hazard.

6.0 SUBSURFACE INVESTIGATION

A subsurface investigation of the property was performed on August 8, 2016. Three test pits and one pothole were excavated by way of a Komatsu PC200LC trackhoe to depths between 10 and 14 feet below existing grade (see Figure A-4). The pothole was simply a deep, steep hole dug with the intent to assess the presence of non-hazardous geologic conditions and identify the top of bedrock at depth, and was not logged and sampled in the same detailed manner as the test pits. The subsurface excavations were logged and photographed in detail, and the logs are displayed in Figures A-5 through A-8. Practical refusal in hard bedrock was encountered in all of the excavations. Groundwater seepage was observed in TP-3 and PH-1, entering the excavations at a depth of approximately 13 feet below existing grade and filling the base of the excavations to a depth of approximately 3 inches by the end of logging.

Norwood Tuff bedrock was encountered in all four of the excavations, with the top of the unit encountered between 1 and 8 feet below existing grade. TP-1 displayed highly weathered and irregular Norwood Tuff, and multiple slide planes exhibiting slickensides. TP-2 displayed weathered Norwood Tuff bedrock underlying a thick (3.5 feet) topsoil. TP-3 and PH-1 displayed multiple alluvial or possibly debris-flow deposits overlying Norwood Tuff bedrock. Fat clay was observed in all four excavations, as a product of Norwood Tuff weathering and alteration.

6.1 Laboratory Testing

Geotechnical laboratory tests were conducted on selected soil samples obtained during our subsurface investigation. The laboratory testing program was designed to evaluate the engineering characteristics of onsite earth materials and to assist in classification. Laboratory tests conducted during this investigation included:

- In situ moisture content (ASTM D7263)
- Atterberg Limits (ASTM D4318)
- Fines Content (% passing the #200 sieve) (ASTM D1140)
- Gradation (ASTM D6913)
- Direct Shear Test (ASTM D3080)

Results of the laboratory testing are included with this report in Appendix B.

7.0 GEOLOGIC HAZARD ASSESSMENT

Geologic hazard assessments are necessary to determine the potential risk associated with particular geologic hazards that are capable of adversely affecting a proposed development area. As such, they are essential in evaluating the suitability of an area for development and provide critical data in both the planning and design stages of a proposed development. The geologic hazard assessment discussion below is based upon a qualitative assessment of the risk associated with a particular geologic hazard, based upon the data reviewed and collected as part of this investigation.

A “low” hazard rating is an indication that the hazard is either absent, is present in such a remote possibility so as to pose limited or little risk, or is not anticipated to impact the project in an adverse way. Areas with a low-risk determination for a particular geologic hazard generally do not require additional site-specific studies or associated mitigation practices with regard to the geologic hazard in question. A “moderate” hazard rating is an indication that the hazard has the capability of adversely affecting the project at least in part, and that the conditions necessary for the geologic hazard are present in a significant, though not abundant, manner. Areas with a moderate-risk determination for a particular geologic hazard may require additional site-specific studies and associated mitigation practices in the areas that have been identified as the most prone to susceptibility to the particular geologic hazard. A “high” hazard rating is an indication that the hazard is very capable of adversely affecting the project, that the geologic conditions pertaining to the particular hazard are present in abundance, and/or that there is geologic evidence of the hazard having occurred at the area in the historic or geologic past. Areas with a high-risk determination generally always require additional site-specific hazard investigations and associated mitigation practices. For areas with a high-risk geologic hazard, simple avoidance is often considered.

The following are the results of the geologic hazard assessment for The Ridge Subdivision Phases 3, 4, and 5 property.

7.1 Landslides/Mass Movement

Landslides and mass movement hazards pose the most risk to The Ridge Subdivision Phases 3, 4, and 5 property. The property is entirely within an area previously mapped as an older (Pleistocene-aged) landslide (Coogan and King, 2016), aerial and LiDAR imagery indicated hummocky topography, and the site reconnaissance observed hummocky topography, landslide scarps, and contorted bedding in the road cut. This data was the basis for a subsequent subsurface investigation to assess the nature and extend of the landslide hazard on the property.

The subsurface investigation, however, showed the landslide deposits to be limited to the northern part of the Phase 3 area and the northeastern part of the Phase 5 area (see Figure A-4). Of the four subsurface excavations, explicit landslide evidence was only observed in TP-1 in the form of irregular, chaotic bedding and multiple slide planes exhibiting slickensides. The landslide deposits were estimated to be Pleistocene-aged due to the presence of a rounded morphology and well-developed topsoil (up to 3 feet thick). However, there may be smaller areas within the mapped landslide lobe where more recent movement has taken place, evidenced by topsoil as thin as 3 inches in some places along the road cut.

Given this data, the proposed structures that are most at risk of being adversely affected by potential landslides are the pool and spa facility located in the north-central portion of the Phase 3 area, and the northernmost 4-Plex unit in the Phase 5 area. The landslide risk associated with these structures is considered to be high. The landslide risk associated with the middle 4-Plex unit is considered to be moderate, given that it is adjacent to the mapped landslide deposit. The landslide risk associated with the proposed structures on all other parts of the Phase 3, 4, and 5 property is considered to be low to moderate, as while there is no evidence of landsliding in these areas, they are still at risk of the potential downslope movement from the landslide deposit mapped along the northern margin of the property.

7.2 Slope Stability Analysis

The stability of the existing natural slope has been assessed in general accordance with methodologies set forth in Blake, et al. (2002) with respect to Section A-A', illustrated on Figure A-4. 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 rotational-type failure. Homogeneous earth materials (moderately weathered Norwood Tuff) and arcuate failure surfaces were assumed. Analysis was performed for the following cases:

a) Static analysis of existing slope
b) Pseudo-static analysis of existing slope

Strength of earth materials was estimated based on direct observation of site earth materials (Norwood Tuff) and the results of a direct shear test performed on a remolded specimen of the Norwood Tuff block and ash deposits. For our model, we have adopted a friction angle of 31 degrees and a cohesion value of 600 psf. The results of the direct shear test are presented in Appendix B.

Pseudo-static (seismic screening) analysis of the proposed slope was performed in general conformance with Blake et al. 2002. 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 in the geotechnical report (GeoStrata, 2013), the Peak Ground Acceleration (PGA) associated with a 2PE50 event is taken as 0.42g. Half of the PGA was taken as the horizontal seismic coefficient (k_h = 21g) (Hynes and Franklin, 1984), and used in the pseudo-static seismic screen analysis.

Groundwater was generally not encountered during our investigation, although some seepage at depths generally exceeding 10 feet below existing grade was noted in TP-3 and PH-1, presumed to be localized spring-like conditions associated with either spring runoff or irrigation from the golf course located above the site. Our surface reconnaissance did not reveal any obvious signs of near-surface groundwater (e.g., seeps, springs, reeds or heavily-vegetated areas, surficial slumping, etc.), with the exception of the area delineated as 'wetlands' on the northeast section of Phase 3, which we understand is protected from development. Groundwater data for the site is very limited; however, based on our understanding of the geology and hydrology of the area, groundwater (regional piezometric surface) is not expected to impact the site, although localized areas of perched groundwater or spring-like conditions could impact construction.

Our slope stability analysis indicates that areas outside of the mapped landslide areas (designated as Qlso on Figure A-4) meet the minimum acceptable factors-of-safety of 1.5 (static) and 1.0 (seismic or pseudo-static). It should be noted that our model only took into consideration the existing grade and not proposed topography (e.g., the finish grade after the townhomes are built). The results of the stability analyses are presented in Appendix C.

The analysis indicates the resulting factors-of-safety are fairly high, such that a series of relatively shallow cuts and fills to accommodate building pads for the proposed structures should not have a significant impact on the gross stability of the slope. However, *local* stability could be impacted, such as engineered slopes, rockeries, or retaining walls; assessment of local stability of specific engineered slopes or earth retaining structures was not assessed and is not a part of this scope of work, and should be addressed by the Geotechnical Engineer of record as needed.

7.3 Rockfall

No bedrock is exposed upslope of the property. As such, the rockfall hazard associated with the property is considered to be low.

7.4 Surface-Fault-Rupture and Earthquake-Related Hazards

No faults are known to be present on or projecting towards the property, and the closest active fault to the property is the Weber Segment of the Wasatch Fault Zone, located approximately 5.7 miles to the west of the property (USGS and UGS, 2006). Given this information, the risk associated with surface-fault-rupture on the property is considered low.

The entire property is subject to earthquake-related ground shaking from a large earthquake generated along the active Wasatch Fault. Given the distance from the Wasatch Fault, the hazard associated with ground shaking is considered to be moderate. Proper building design according to appropriate building code and design parameters can assist in mitigating the hazard associated with earthquake ground shaking.

7.5 Liquefaction

Given the generally clayey and relatively thin nature of the surficial materials, and consistent with the existing geologic literature for the area, the risk associated with earthquake-induced liquefaction is expected to be low. However, both shallow groundwater and some granular soils were present on the property; therefore, we cannot preclude the possibility for liquefaction to occur onsite. A liquefaction study, which would include borings and/or CPT soundings to a depth of at least 50 feet or bedrock, whichever is shallower, was not performed for this project and is not a part of our scope of work.

7.6 Debris-Flows and Flooding Hazards

No alluvial fan deposits have been mapped on the property, though these deposits have been mapped approximately ¼ mile updrainage (northeast) of the property by Coogan and King (2016) in association with the Heinz Canyon drainage. However, alluvial deposits and possible debris-flow deposits were observed in TP-3 and PH-1, evidenced by imbricated quartzite gravel beds and buried, thin paleosols. Nevertheless, the property is located near the southernmost reaches of the Heinz Canyon drainage, and well-developed topsoil between 2 and 3 feet thick are indicative that there has not been a debris-flow event in the recent geologic past. Given this situation, the debris-flow hazard associated with the property is considered to be moderate for all areas mapped as Qal or Qac, which could potentially adversely impact the two easternmost 4-Plex units in the Phase 5 area. This could be reduced to low with appropriate mitigation practices. The debris-flow hazard for all other areas of the property is considered to be low.

The FEMA flood map that covers the area (FEMA, 2015) shows the entire property to be located outside of the 500-year floodplain for the Heinz Canyon drainage. However, the flooding hazard for the property is considered to be consistent with the debris-flow hazard: moderate for all areas mapped as Qal or Qac, and low for all other areas of the property. The flooding hazard could be reduced to low by way of appropriate grading and the installation of land-drains.

7.7 Shallow Groundwater

Groundwater was encountered in only 4 of the 17 geotechnical test pits excavated on the property, located between 7 and 12.5 feet below ground level (GeoStrata, 2013). These test pits were excavated in early November, and the groundwater level observed in the test pits was likely to be dropping toward seasonal lows. Additionally, groundwater was observed in TP-3 and PH-1 in the subsurface component of this geologic hazard assessment at a depth of 13 feet below ground level in early August, likely to be dropping following a spring high. The presence of abundant hydrophilic plants in the lowland southeastern part of the property adjacent to the Heinz Creek drainage indicates a sustained shallow groundwater presence in this area, though no springs were observed on the property.

Given the existing data, it is expected that groundwater levels will fluctuate both seasonally and annually across the property, but especially in the southeastern (Phase 5) part of the property. As such, the risk associated with shallow groundwater hazards is considered to be moderate to high for the two easternmost 4-Plex units in the Phase 5 area, and low for the rest of the property, However, shallow groundwater issues can be mitigated through appropriate grading measures and/or the avoidance of the construction of structures with basements, or through the use of land-drains.

7.8 Radon

Limited data is available to address the radon hazard across the property. However, at least one study (Solomon, 1996) shows the site situated within an area designated as having a moderate radon hazard. To be conservative, the radon hazard associated with the property is considered to be moderate. A site-specific radon hazard assessment is recommended to adequately address radon concerns across the property.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the data collected and reviewed as part of this assessment, IGES makes the following reconnaissance-level conclusions regarding the geological hazards present at The Ridge Subdivision Phases 3, 4, and 5 project area:

- **The Ridge Subdivision Phases 3, 4, and 5 project area does not appear to have major geological hazards that would adversely affect significant portions of the development as currently proposed. Geological hazards in the form of landslides, debris-flows, flooding, and shallow groundwater are capable of adversely affecting the pool and spa facility in the Phase 3 area, and the two easternmost 4-Plex units in the Phase 5 area.**

- Landslide hazards are considered to be high in the northern and eastern portions of the Phase 3 area, and in the eastern portion of the Phase 5 area. This includes the pool and spa facility in the Phase 3 area, and the easternmost 4-Plex unit in the Phase 5 area. The middle 4-Plex unit in the Phase 5 area is considered to have moderate landslide hazard risk, as it is located adjacent to the mapped landslide deposit. The landslide risk associated with the proposed structures on all other parts of the Phase 3, 4, and 5 property is considered to be low to moderate, as while there is no evidence of landsliding in these areas, they are still at risk of the potential downslope movement from the landslide deposit mapped along the northern margin of the property.

- Debris-flow and flooding hazards are considered to be moderate for all areas mapped as Qal and Qac on Figure A-4. The only affected proposed structures with regard to the debris-flow and flooding hazards are the two easternmost 4-Plex units in the Phase 5 area. The debris-flow and flooding hazard is considered to be low for all other proposed structures for the property.

- Shallow groundwater is considered to be a moderate to high hazard for the two easternmost 4-Plex units in the Phase 5 area, and low for the remainder of the property.

- Earthquake ground shaking and radon are the only hazards that may potentially affect all parts of the project area, while other hazards have the potential to affect only limited portions of the project area, or pose minimal risk.

- Rockfall and surface-fault-rupture hazards are considered to be low for the property.

- Published literature, the site-specific geotechnical report (GeoStrata, 2013), and the laboratory results in this geologic hazard assessment indicate that the liquefaction potential for the site is appropriately considered low. However, due to the presence of some granular soils and shallow groundwater, the potential for liquefaction occurring at the site cannot be ruled out, but would be expected to be highly localized should liquefaction occur. The underlying Norwood Tuff is a bedrock unit and is precluded from the possibility of liquefaction.

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

- Development should not take place within the areas mapped as landslide (Qlso) until further delineation of the character and extent of the landslide mass can be determined. This will primarily impact the pool and spa facility of the Phase 3 area and the easternmost two 4-Plex units in the Phase 5 area. These areas may potentially be developed; however, recommendations for development will be contingent upon additional subsurface investigation to further define the limits of the landslide, *particularly depth to competent bedrock*. Landslide mitigation in this area would likely consist of mass-grading to break-up continuous shear structures upon which the slide took place. The extent of mass grading, assuming it is feasible, would not be known until several additional trenches can be completed within the landslide mass to better understand the landslide geometry. TP-1 suggests that over-excavation would likely be on the order of 5 to 6 feet below existing grade (note that the upper 1 to 3 feet consists of topsoil, which cannot be re-used as structural fill). The structural fill would have to be placed on horizontal benches; recommendations for benching can be provided upon request.

- It is recommended that the landscaping for this development consist of xeriscape, 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. On-site sewage or storm-drain disposal should not be allowed.

- Debris-flow and flooding hazards can be appropriately mitigated for the easternmost two 4-Plex units in the Phase 5 area by way of appropriate grading, in which these structures are elevated above the surrounding terrain, such that potential debris-flows and floodwaters stemming from the Heinz Creek drainage would be constrained to the lowland floodplain immediately adjacent to the drainage. An additional mitigation practice would be the construction of an earthen berm or a similar diversion structure along the western margin of the Heinz Creek drainage to assist in constraining debris-flows and floodwaters to the Heinz Creek drainage.

- Shallow groundwater hazards can be adequately mitigated for the easternmost two 4-Plex units in the Phase 5 area by way of appropriate grading measures and the construction of the proposed structures without basements unless land drains or other suitable mitigation measures are implemented. Land drains should act passively; continuous dewatering using sumps or pumps or dewatering wells to allow construction of basements is not recommended.

- To adequately address the radon hazard for the property, a site-specific radon assessment is recommended. This could be conducted either on a property-wide basis or a lot-by-lot basis.

- The property as a whole is largely underlain by the Norwood Tuff, which is a known landslide-prone unit. Additionally, landslide deposits have been mapped on and near the property. Therefore, it is recommended that an IGES engineering geologist observe the foundation excavations for the proposed Phase 3, 4, and 5 structures to confirm the absence of landslide evidence or other adverse geologic conditions in these areas.

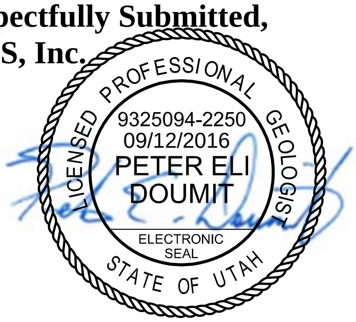
9.0 LIMITATIONS

The conclusions and recommendations presented in this report are based on limited geologic literature review, site reconnaissance, subsurface investigation, and our understanding of the proposed construction. It should be noted that these conclusions are based solely upon the geological hazards investigated for this report, and do not pertain to other potential geologic hazards that may be present on the property. Additional geologic hazards and/or geologic hazards initially concluded to pose low risk may be present that may not be identified until construction activities expose adverse geologic conditions. Therefore, the geologic hazard classifications as denoted in this report are potentially subject to change with data collected from additional site-specific excavations across the property. 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.

10.0 CLOSURE

We appreciate the opportunity to provide you with our services. If you have any questions, please contact the undersigned at your convenience at (801) 748-4044.

Respectfully Submitted,
IGES, Inc.



Peter E. Doumit, P.G., C.P.G.
Senior Geologist

Reviewed by:

David Glass

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

Attachments:

Section 11.0 References

Appendix A	Figure A-1	General Location Map
	Figure A-2	Regional Geology Map 1
	Figure A-3	Regional Geology Map 2
	Figure A-4	Local Geology Map
	Figures A-5 to A-8	Exploration Logs
Appendix B		Laboratory Results
Appendix C		Slope Stability Analysis – Summary

11.0 REFERENCES

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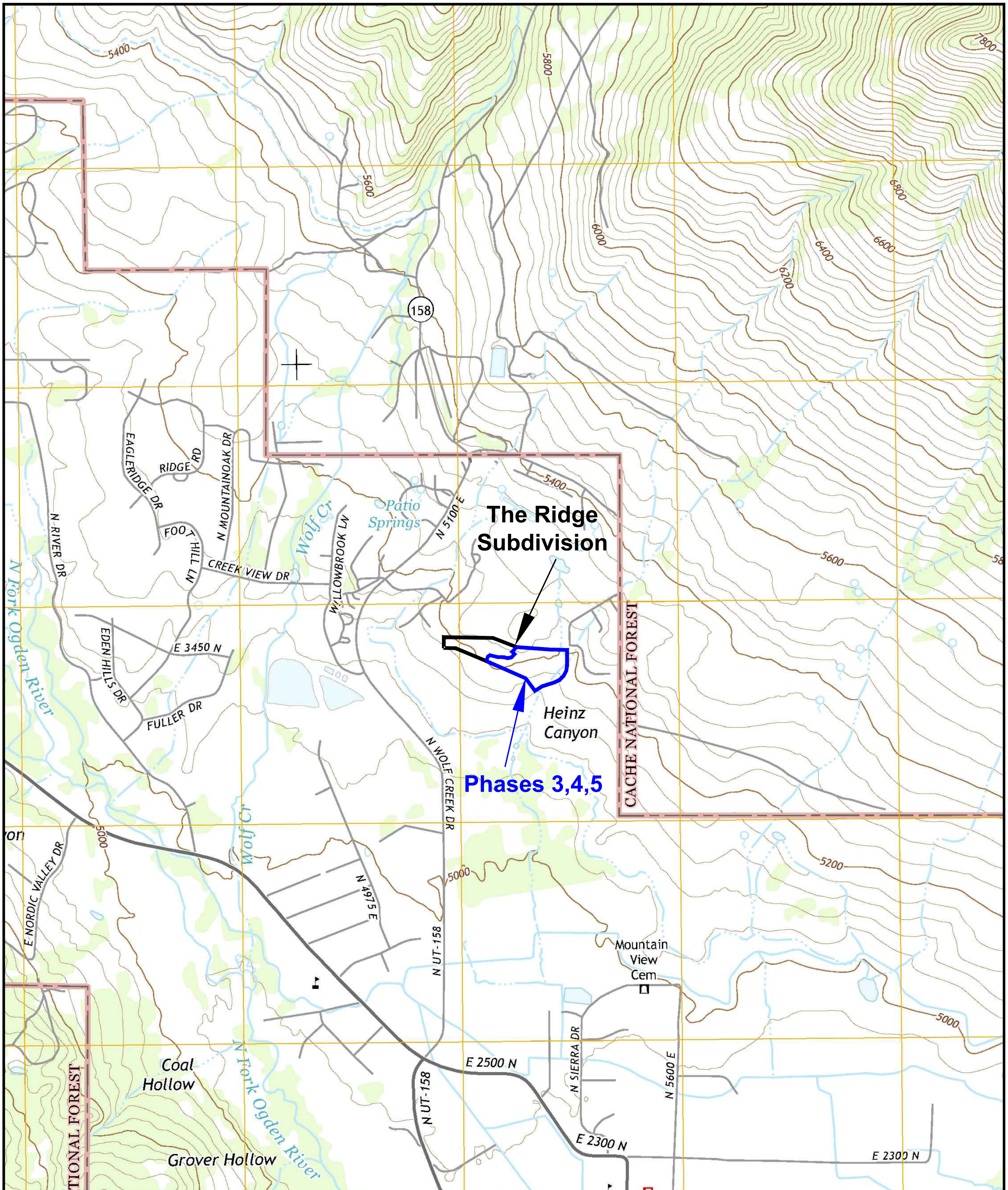
AERIAL PHOTOGRAPHS

Data Set	Date	Flight	Photographs	Scale
1947 AAJ	August 10, 1946	2B	47, 48	1:20,000

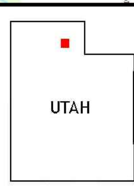
*https://geodata.geology.utah.gov/imagery/

APPENDIX A



BASE MAP:

USGS Huntsville 7.5-Minute Topographic Quadrangle Map (2014)



QUADRANGLE LOCATION

N

0 1000 2000 3000

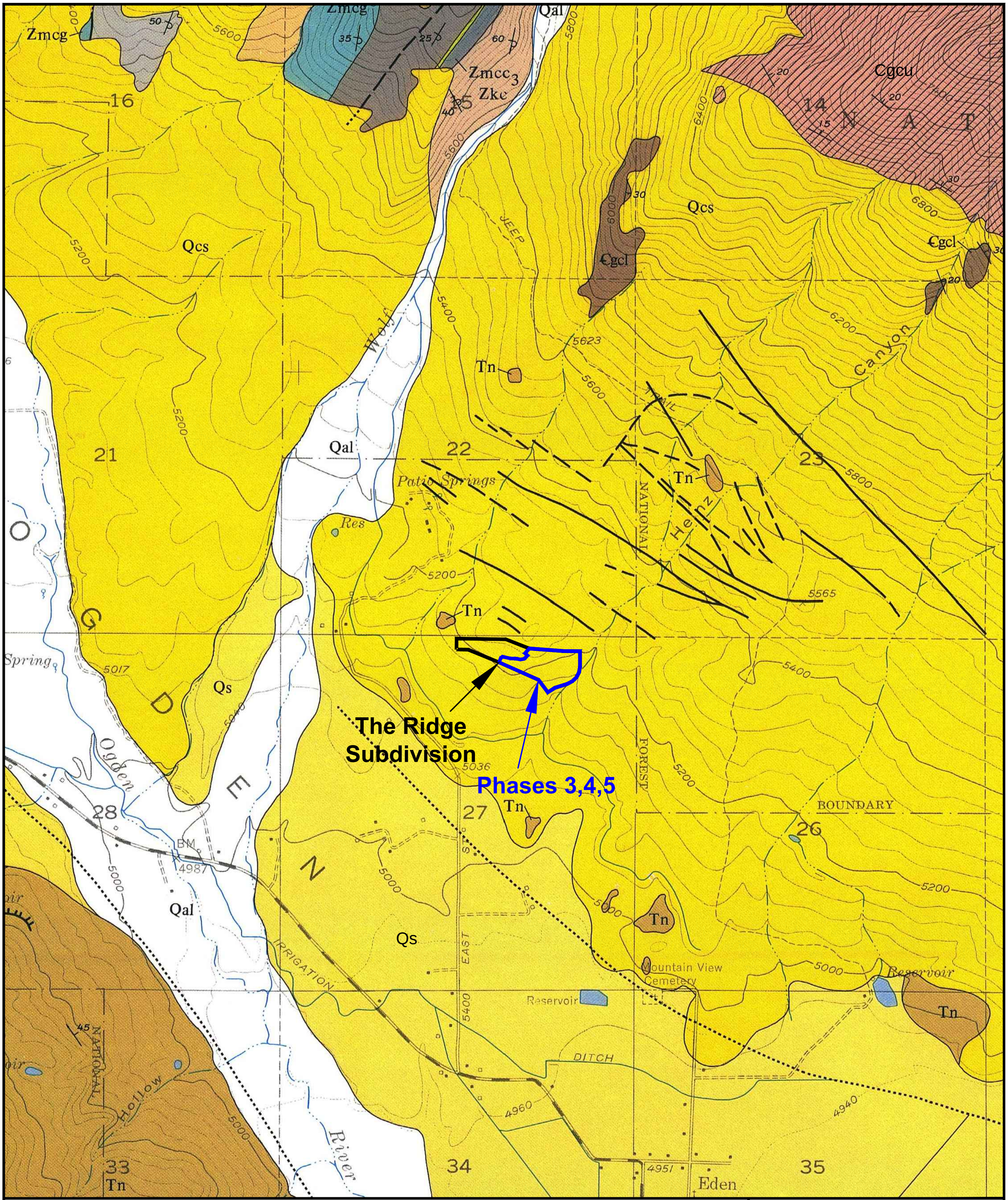
FEET

FIGURE A-1

GENERAL LOCATION MAP

THE RIDGE AT WOLF CREEK RESORT SUBDIVISION PHASE 3, 4, AND 5 GEOLOGIC HAZARDS ASSESSMENT

DATE: 08/31/2016
PROJECT:02348-001
SCALE: 1"=2,000'
IGES



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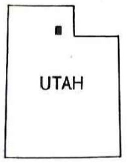


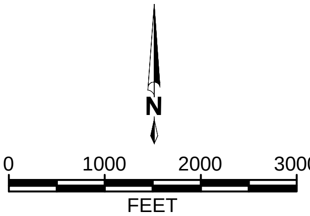


FIGURE A-2a

REGIONAL GEOLOGY MAP 1

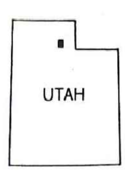
THE RIDGE AT WOLF CREEK RESORT SUBDIVISION PHASE 3, 4, AND 5 GEOLOGIC HAZARDS ASSESSMENT

DATE: 08/31/2016	SCALE: 1"=2,000'
PROJECT:02348-001	IGES

MAP LEGEND

Qal	**ALLUVIAL DEPOSITS, UNDIFFERENTIATED** (Holocene) – Unconsolidated gravel, sand, and silt deposits in presently active stream channels and floodplains; thickness 0-6 m
Qcs	**COLLUVIUM AND SLOPEWASH** (Holocene) – Bouldery colluvium and slopewash chiefly along eastern margin of Ogden Valley; in part, lag from Tertiary units; thickness 0-30 m
Qf	**ALLUVIAL FAN DEPOSITS** (Holocene) – Alluvial fan deposits; postdate, at least in part, time of highest stand of former Lake Bonneville; thickness 0-30 m
Qls	**LANDSLIDE DEPOSITS** (Holocene) – thickness 0-6 m
Qt	**TALUS DEPOSITS** (Holocene) – thickness 0-6 m
Qtd	**TERRACE AND DELTA(?) DEPOSITS** (Pleistocene) – In North Fork Ogden River, gravel, sand, and silt in stream terraces graded to high stand of former Lake Bonneville; at mouth of Middle and South Fork Ogden River, pinkish-tan sand and silt in delta(?) remnants deposited during high stands of Lake Bonneville; thickness 0-45 m
Qs	**SILT DEPOSITS** (Pleistocene) – Tan silt and sand forming extensive flats in Ogden Valley; deposited during high stands of Lake Bonneville, but may include older alluvial units; thickness 0-60 m
Qg	**GRAVEL AND COBBLE DEPOSITS** (Pleistocene) – In Ogden Canyon, gravel and cobble terrace remnants, probably deposited after time of highest stand of Lake Bonneville; thickness 0-3 m
Qog	**OLDER GRAVEL DEPOSITS** (Pleistocene) – North of Huntsville, cobble, gravel, and sand deposit that probably predates high stands of Lake Bonneville; thickness 21 m
Tn	**NORWOOD TUFF** (lower Oligocene and upper Eocene) – Fine- to medium-bedded, fine-grained, friable, white- to buff-weathering tuff and sandy tuff, probably waterlain and in part reworked; thickness 0-450+(?) m

BASE MAP:
USGS Huntsville 7.5-Minute Geologic Quadrangle Map (GQ-1503), Sorensen and Crittenden, Jr. (1979)



QUADRANGLE LOCATION

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0 1000 2000 3000
FEET

FIGURE A-2b

REGIONAL GEOLOGY MAP 1

THE RIDGE AT WOLF CREEK RESORT
SUBDIVISION PHASE 3, 4, AND 5
GEOLOGIC HAZARDS ASSESSMENT

DATE: 08/31/2016
PROJECT:02348-001
SCALE: 1"=2,000'
IGES

MAP LEGEND

€gcu

GEERTSEN CANYON QUARTZITE (Lower Cambrian) – Includes:
Upper member – Pale-buff to white or flesh-pink quartzite, locally streaked with pale red or purple. Coarse-grained; small pebbles occur throughout unit and increase in abundance downward. Base marked by zone 30-60 m thick of cobble conglomerate in beds 30 cm to 2 m thick; clasts, 5-10 cm in diameter, are mainly reddish vein quartz or quartzite, sparse gray quartzite, or red jasper; thickness 730-820 m

€gcl

Lower member – Pale-buff to white and tan quartzite with irregular streaks and lenses of cobble conglomerate decreasing in abundance downward. Lower 90-120 m strongly arkosic, streaked greenish or pinkish. Feldspar clasts increase in size to 0.6-1.3 cm in lower part of unit; thickness 490-520 m

Zkc ls

KELLEY CANYON FORMATION (Precambrian Z) – Upper part interbedded olive-drab siltstone and thin-bedded, tan- or brown-weathering quartzite, generally in wavy or contorted beds cut by small sandstone dikelets; contact with overlying unit may be marked by zone of thin-bedded quartzite (0.5-2-cm beds) with red-weathering wavy laminae of shale and siltstone. Middle part is gray to lavender argillite enclosing and intercalated with thin-bedded pinkish-gray silty limestone (at Middle Fork Ogden River, shown on map as ls). Lower part is lavender-gray, purple-gray, or olive-drab shale, with thin beds of greenish fine-grained sandstone at top. Base of unit marked by 3-m thin-bedded to laminated, tan-weathering, fine-grained dolomite; thickness 600 m

MAPLE CANYON FORMATION (Precambrian Z) – Includes:

Zmcc

Conglomerate member – Total thickness 30-150 m. Includes:

$Zmcc_3$

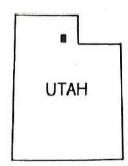
Upper conglomerate – Coarse-grained, locally conglomeratic, white quartzite

Recently active normal fault – Dashed where inferred. Ticks on downthrown side

Pre-Tertiary normal fault – Dotted where concealed Bar and ball on downthrown side

Thrust fault – Dashed where inferred Sawteeth on upper plate

BASE MAP:
USGS Huntsville 7.5-Minute Geologic Quadrangle Map (GQ-1503), Sorensen and Crittenden, Jr. (1979)



QUADRANGLE LOCATION

N

0 1000 2000 3000
FEET

FIGURE A-2c

REGIONAL GEOLOGY MAP 1

THE RIDGE AT WOLF CREEK RESORT
SUBDIVISION PHASE 3, 4, AND 5
GEOLOGIC HAZARDS ASSESSMENT

DATE: 08/31/2016
PROJECT:02348-001
SCALE: 1"=2,000'
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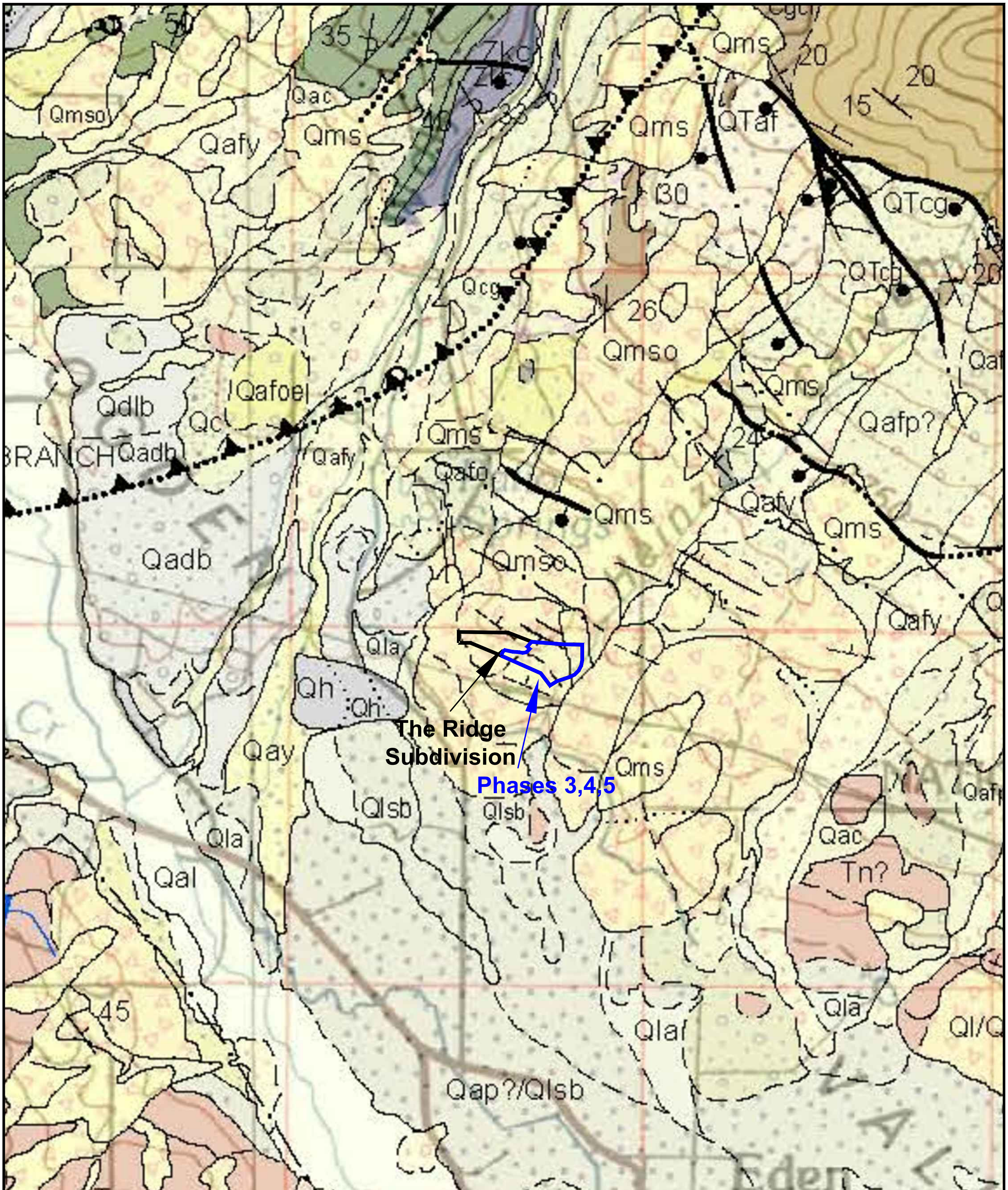

BASE MAP:

UGS Ogden 30-Minute x 60-Minute Geologic Quadrangle Map (OFR-653) Coogan and King, 2016

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FEET

FIGURE A-3a

REGIONAL GEOLOGY MAP 2

THE RIDGE AT WOLF CREEK RESORT SUBDIVISION PHASE 3, 4, AND 5 GEOLOGIC HAZARDS ASSESSMENT

DATE: 09/01/2016	SCALE: 1"=2,000'	IGES
PROJECT:02348-001		

MAP LEGEND

Qaf1, Qaf2, Qaf2?, Qafy, Qafy?

Younger alluvial-fan deposits (Holocene and uppermost Pleistocene) – Like undivided alluvial fans, but all of these fans are unconsolidated and should be considered active; height above present drainages is low and is within certain limits; generally less than 40 feet (12 m) thick; near former Lake Bonneville, fans are shown as Qafy where Qaf1 and Qaf2 cannot be separated, and all contain well-rounded recycled Lake Bonneville gravel. Younger alluvial fan deposits are queried where relative age is uncertain (see Qaf for details).

Qaf1 fans are active because they impinge on and deflect present-day drainages. Qaf2 fans appear to underlie Qaf1 fans but may be active. Qafy fans are active, impinge on present-day floodplains, divert active streams, overlie low terraces, and/or cap alluvial deposits (Qap) related to the Provo and regressive shorelines. Therefore, Qafy fans are younger than the Provo shoreline and likely mostly Holocene in age, but may be as old as latest Pleistocene and may be partly older than Qaf1 fans.

Qms, Qms?, Qmsy, Qmsy?, Qmso, Qmso?

Landslide deposits (Holocene and upper and middle? Pleistocene) – Poorly sorted clay- to boulder-sized material; includes slides, slumps, and locally flows and floods; generally characterized by hummocky topography, main and internal scarps, and chaotic bedding in displaced blocks; composition depends on local sources; morphology becomes more subdued with time and amount of water in material during emplacement; Qms may be in contact with Qms when landslides are different/distinct; thickness highly variable, up to about 20 to 30 feet (6-9 m) for small slides, and 80 to 100 feet (25-30 m) thick for larger landslides. Qmsy and Qmso queried where relative age uncertain; Qms queried where classification uncertain. Numerous landslides are too small to show at map scale and more detailed maps shown in the index to geologic mapping should be examined.

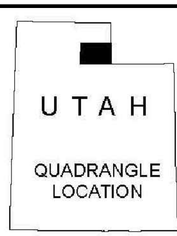
Qms without a suffix is mapped where the age is uncertain (though likely Holocene and/or late Pleistocene), where portions of slide complexes have different ages but cannot be shown separately at map scale, or where boundaries between slides of different ages are not distinct. Estimated time of emplacement is indicated by relative-age letter suffixes with: Qmsy mapped where landslides deflect streams or failures are in Lake Bonneville deposits, and scarps are variably vegetated; Qmso typically mapped where deposits are "perched" above present drainages, rumpled morphology typical of mass movements has been diminished, and/or younger surficial deposits cover or cut Qmso. Lower perched Qmso deposits are at Qao heights above drainages (95 ka and older) and the higher perched deposits may correlate with high level alluvium (QTa_) (likely older than 780 ka) (see table 1). Suffixes y and o indicate probable Holocene and Pleistocene ages, respectively, with all Qmso likely emplaced before Lake Bonneville transgression. These older deposits are as unstable as other slides, and are easily reactivated with the addition of water, be it irrigation or septic tank drain fields.

Contact, approximately located
Contact, approximately located, queried
Contact, concealed
Contact, concealed, queried
Contact, scratch, used where map units combined
Contact, well located

Fault, uncertain sense of movement, approximately located
Fault, uncertain sense of movement, approximately located, queried
Fault, uncertain sense of movement, concealed
Fault, uncertain sense of movement, concealed, queried
Fault, uncertain sense of movement, well located
Scarp, landslide
Scarp, terrace
Scarp, undefined

BASE MAP:

UGS Ogden 30-Minute x 60-Minute Geologic Quadrangle Map (OFR-653)
Coogan and King, 2016



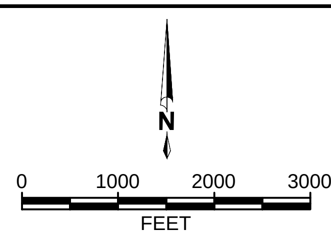
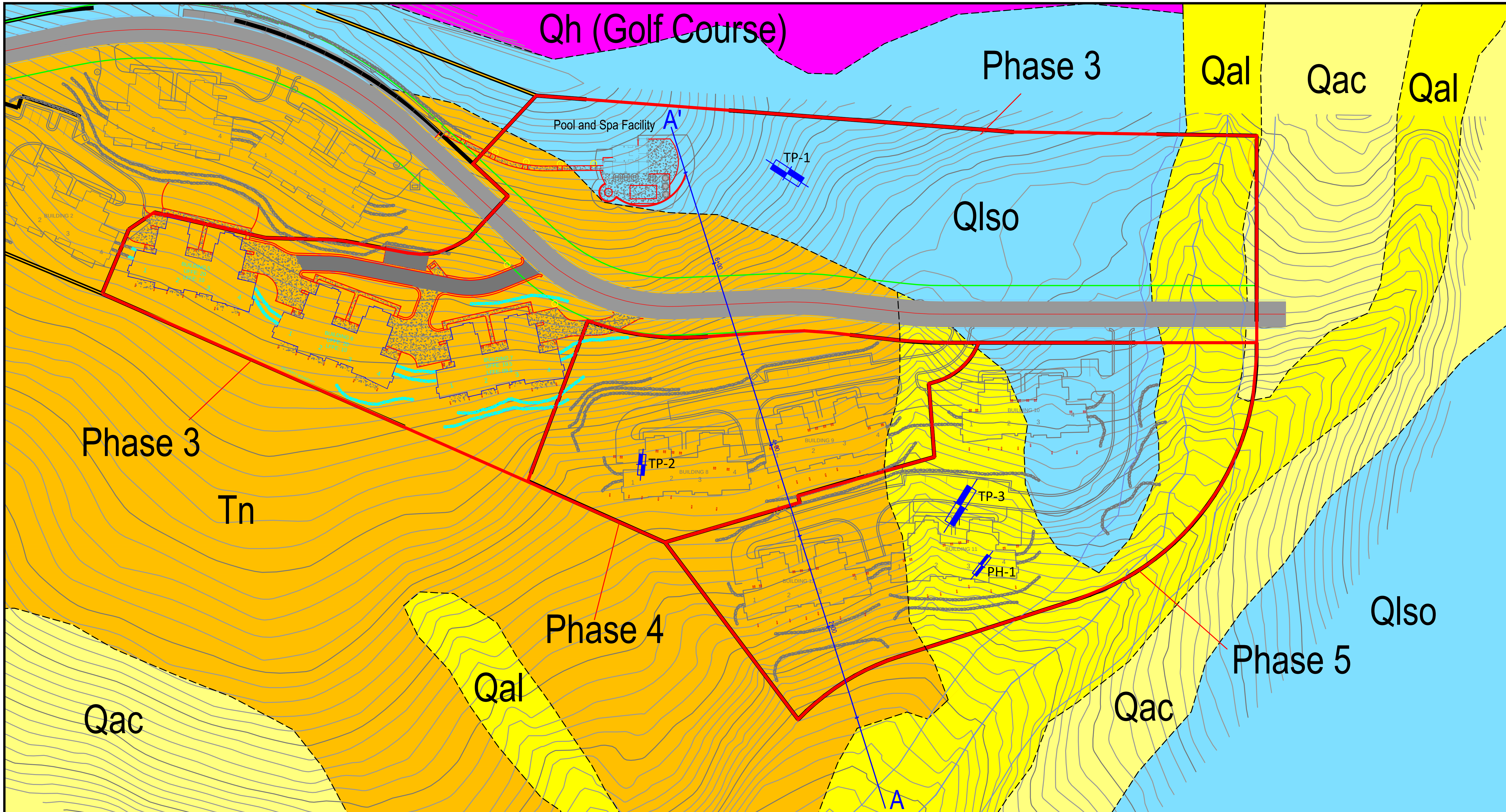


FIGURE A-3b

REGIONAL GEOLOGY MAP 2

THE RIDGE AT WOLF CREEK RESORT SUBDIVISION PHASE 3, 4, AND 5 GEOLOGIC HAZARDS ASSESSMENT

DATE: 09/01/2016
PROJECT:02348-001
SCALE: 1"=2,000'
IGES



LEGEND

Qh HUMAN DISTURBED

Qal RECENT ALLUVIUM

Qac ALLUVIUM AND COLLUVIUM

Qlso LANDSLIDE DEPOSITS (PLEISTOCENE)

Tn NORWOOD TUFF

THE RIDGE PHASES 3, 4, AND 5 PROPERTY BOUNDARY

TP-3 TEST PIT/POTHOLE LOCATION

ALL CONTACTS APPROXIMATE

A' A CROSS-SECTION A-A'

N

0 200 FEET

Basemap provided by Gardner Engineering

FIGURE A-4

LOCAL GEOLOGY MAP

THE RIDGE TOWNHOMES

GEOTECHNICAL AND GEOLOGIC HAZARD ASSESSMENT

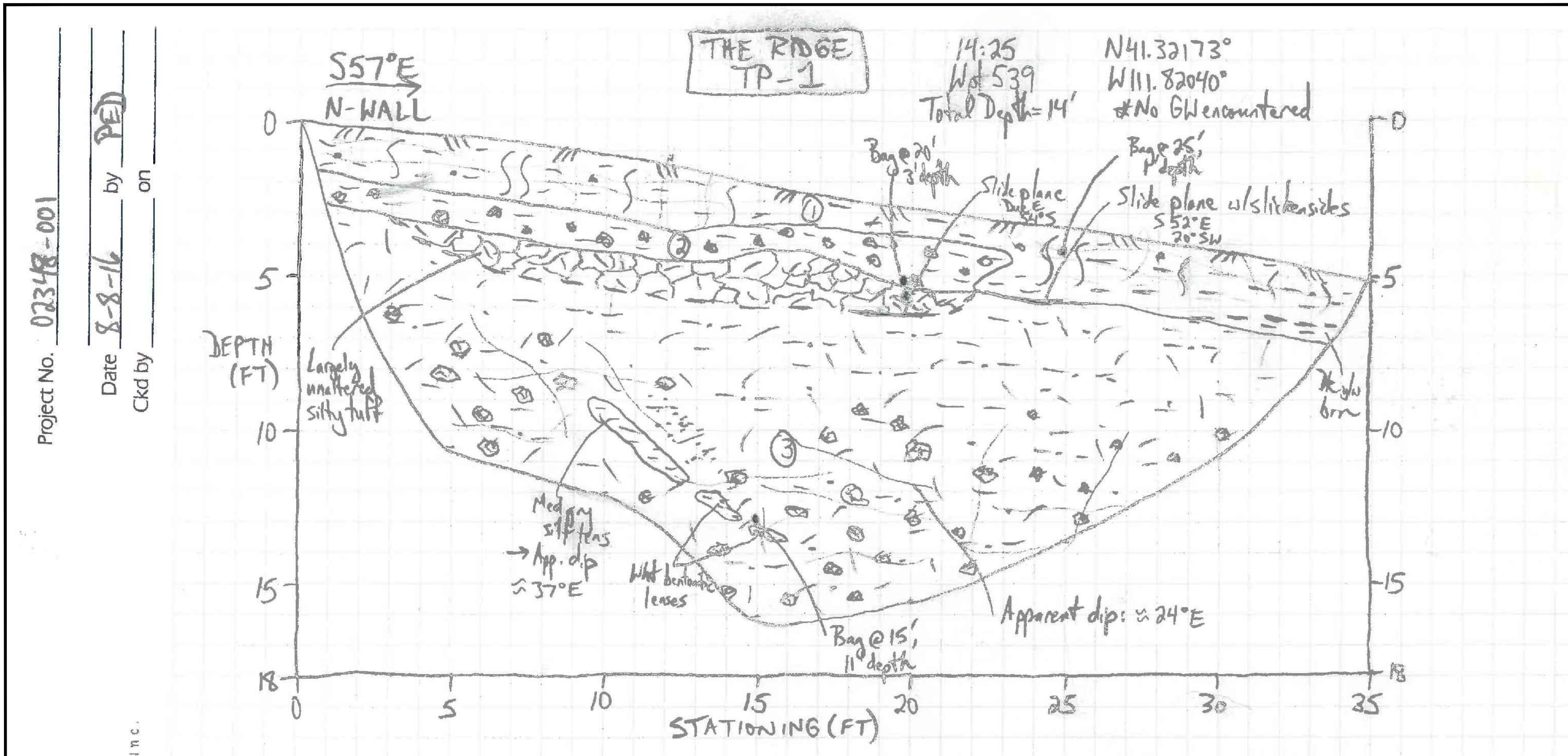
WOLF CREEK RESORT
EDEN, UTAH

DATE: 09/06/2016

FILE: 02348-001

SCALE: 1"=100'

IGES



LITHOLOGIC UNIT DESCRIPTIONS:

1. A/B Soil Horizon: ~1-3' thick; brownish black (5YR 2/1) fat CLAY, very stiff, slightly moist, moderate to high plasticity, massive, though blocky appearance due to abundant desiccation cracks; very similar to A/B horizon seen in TP-3, except slightly moist and therefore does not exhibit as large, wide, and prevalent desiccation cracks as seen in other test pits; subrounded quartzite clasts up to 2" diameter; abundant plant and tree roots, especially uppermost ~6"; irregular, sharp basal contact exhibits slickensides in places.

2. Highly Weathered Norwood Tuff Bedrock: ~1-2' thick; mottled grayish brown (5Y 3/2) and white (N9) mix of topsoil (Unit 1) and abundant small, angular Norwood Tuff clasts; gradational between gravelly fat CLAY and clayey GRAVEL, dense to very stiff, slightly moist, moderate plasticity, massive; common plant roots; irregular, gradational basal contact; basal contact largely characterized by thin brown shear plane, though slickensides not well defined; likely represents a shallow landslide deposit.

3. Norwood Tuff: >10' thick; light gray (N7) to medium light gray (N6) tuff partially to largely weathered to various masses of silt, sand, and clay; uppermost ~1.5' is lens of largely competent silty tuff, the top of which is a slide plane upon which the overlying material passes; contains common calcite-filled fractures, both along bedding planes and subvertical; basal ~6' exposed in pit exhibits highly irregular, possibly chaotic structure with hard and soft areas scattered throughout; calcium carbonate and manganese oxide dendrites and nodules commonly found scattered through basal ~6"; occasional white (N9) lenses largely decomposed to bentonite; uppermost ~4' of unit is predominantly silty tuff largely decomposed to silt; no quartzite observed.

FIGURE A-5

TP-1 LOG

THE RIDGE TOWNHOMES

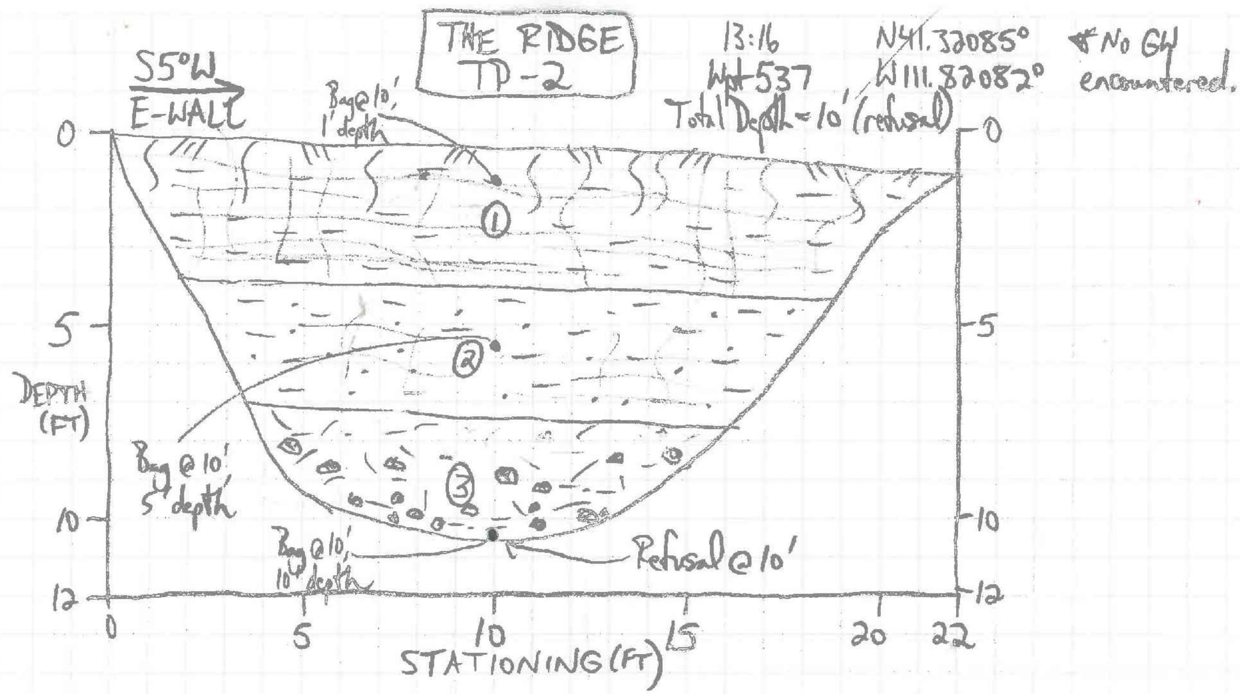
GEOTECHNICAL AND GEOLOGIC HAZARD ASSESSMENT

WOLF CREEK RESORT

EDEN, UTAH

DATE: 08/17/2016	SCALE:	IGES
PROJECT: 02348-001	1"=5'	

Project No. 02348-001
Date 8-8-16 by PED
Ckd by ______ on ______



LITHOLOGIC UNIT DESCRIPTIONS:

1. A/B Soil Horizon: ~3.5' thick; brownish black (5YR 2/1) to grayish brown (5Y 3/2) fat CLAY, very stiff, dry, moderate to high plasticity, massive, though blocky appearance due to abundant desiccation cracks; very similar to as seen in TP-3, except unit is thicker, contains fewer clasts (~1%), and displays wider desiccation cracks (seen to extend to the base of unit at up to 1" wide); common small plant roots throughout, though abundant in uppermost ~6" of unit; sharp, planar basal contact.

2. Weathered Norwood Tuff Ash: ~3' thick; dark yellowish brown (10YR 4/2), mottled with white (N9) specks; fat CLAY, stiff to very stiff, slightly moist, moderate to high plasticity, massive; abundant small white CaCO3 nodules scattered throughout unit, up to 1 cm in diameter; ash almost entirely decomposed to fat clay, though possibly a B-horizon; exhibits mechanically-induced slickensides, though no natural slickensides observed; minor desiccation cracking; sharp, planar basal contact.

3. Norwood Tuff Block-and-Ash: >3.5' thick; moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2) silty lean CLAY with gravel, very stiff to stiff, slightly moist, low to moderate plasticity, massive; gravel and larger sized clasts comprise ~30-40% of unit; clasts are ~60% very light gray (N8), subangular to subrounded, silty, soft tuff, and ~40% dark yellowish orange (10YR 6/6), very hard, subrounded to subangular quartzite clasts up to 4" in diameter, though mode size ~1"; uppermost ~1' is largely deviod of clasts and exhibits a blocky structure due to possible desiccation cracks; clast concentration increases with depth.

FIGURE A-6
TP-2 LOG

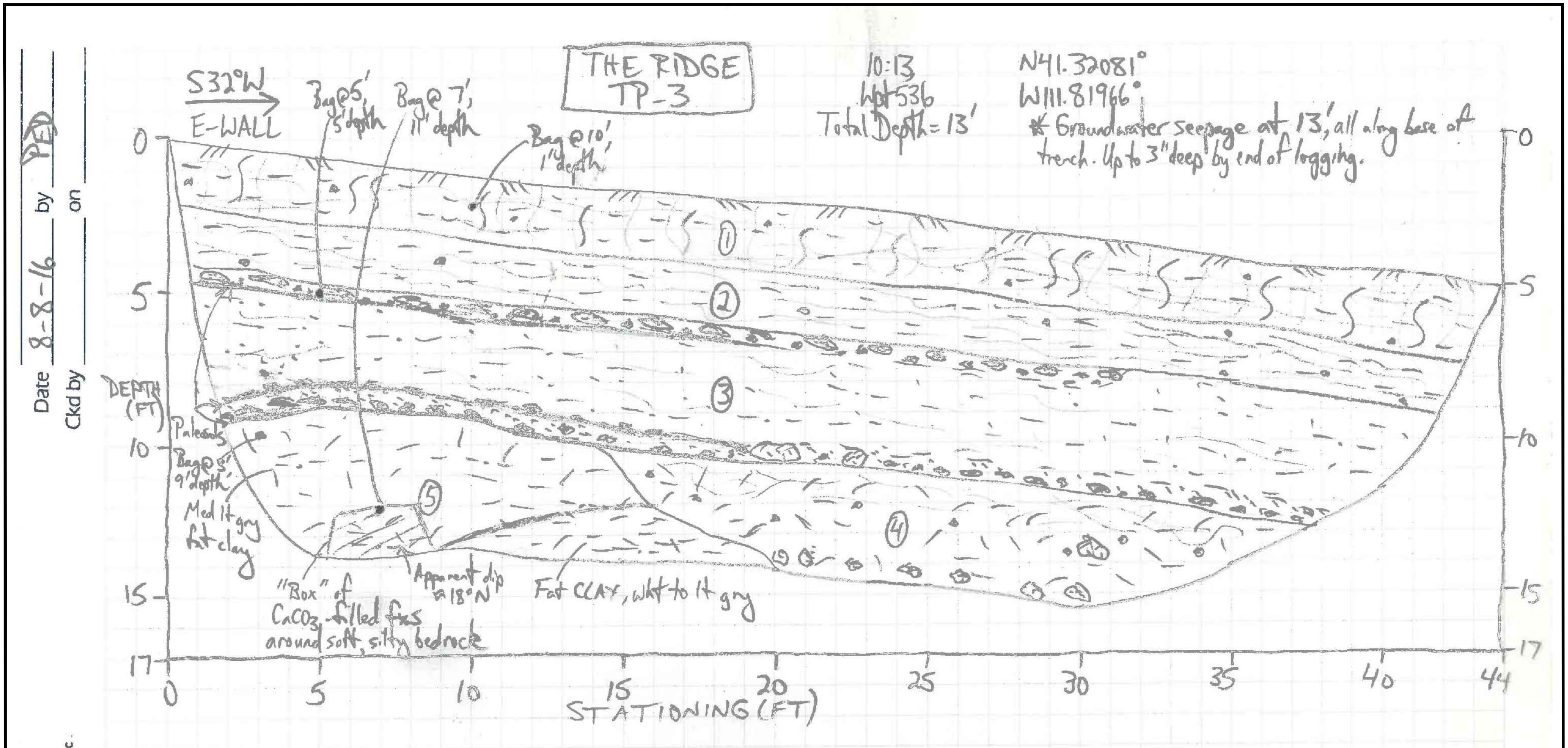
THE RIDGE TOWNHOMES

GEOTECHNICAL AND GEOLOGIC HAZARD ASSESSMENT

WOLF CREEK RESORT

EDEN, UTAH

DATE: 08/17/2016 | SCALE: 1"=5'
PROJECT: 02348-001 | IGES



LITHOLOGIC UNIT DESCRIPTIONS:

1. A/B Soil Horizon: ~2-2.5' thick; brownish black (5YR 2/1) to grayish brown (5Y 3/2) fat CLAY, very stiff, dry, moderate to high plasticity, massive, though blocky appearance due to abundant desiccation cracks; very well developed soil horizon; desiccation cracks are spaced between 1-2", and extend to base of unit; aperture of cracks seen to be 1" or greater on the surface in places, and generally 1-5 mm in subsurface; minor (<5%) gravel and larger sized clasts; clasts are entirely pink to dark yellowish orange (10YR 6/6) subrounded to subangular quartzite up to 1" in diameter; common plant and tree roots in uppermost 1', but decrease with depth; sharp, planar basal contact.

2. Alluvial?: ~2' thick; mottled very light gray (N8) and dark yellowish brown (10YR 4/2) lean CLAY with gravel; stiff, slightly moist, low plasticity, weakly thinly bedded (<1/2"); mottled due to abundant CaCO3 stringers, flour, and bedding plane infilling throughout; uppermost ~1' is highly calcareous and CaCO3 decreases with depth; gravel and larger sized clasts comprise ~5% of unit, ~80% of which is subrounded quartzite and ~20% is subrounded white (N9) Norwood Tuff; clasts up to 2.5" diameter; gradational, planar basal contact; possibly hyperconcentrated flow deposit.

3. Debris-Flow?: ~4' thick; dark yellowish brown (10YR 4/2) and mottled with white (N9) CaCO3 stringers and flour in places; silty lean CLAY with gravel gradational to clayey GRAVEL in places; stiff to dense, moist, low to medium plasticity, thinly to moderately bedded (up to 3.5"), blocky in places; top and bottom of unit has ~6"-1' thick clayey, sandy gravel lenses with imbricated quartzite clasts and associated thin (~3 mm) paleosols; clasts predominantly ~80% subrounded quartzite, ~20% Norwood Tuff weathered to clay; common 1 mm pinholes; sharp, irregular basal contact.

4. Norwood Tuff Block-and-Ash: >4' thick; mottled dark yellowish brown (10YR 4/2) and white (N9); top 1-2' has abundant CaCO3 stringers; silty fat CLAY with gravel; stiff, moist, moderate to high plasticity, massive; fat clay content and clast frequency increases with depth; gravel and larger sized clasts comprise ~5-10% of unit; clasts predominantly quartzite up to 5" in diameter.

5. Weathered Bedrock: >4' thick; medium light gray (N6) to light gray (N7); Norwood Tuff bedrock largely disaggregated to silty fat CLAY and clayey SILT; stiff to very stiff, moist, moderate to high plasticity, possibly thickly bedded; common organic or MnO2 smear in fat clay, as seen in silty tuff; some CaCO3 filled fractures; no natural slickensides observed.

FIGURE A-7
TP-3 LOG

THE RIDGE TOWNHOMES

GEOTECHNICAL AND GEOLOGIC HAZARD ASSESSMENT

WOLF CREEK RESORT

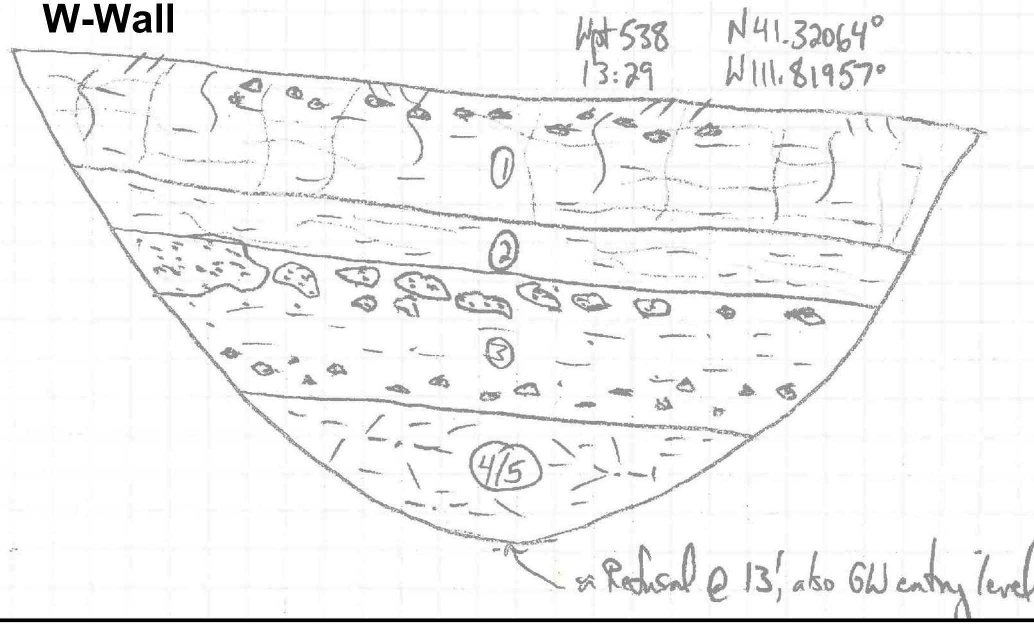
EDEN, UTAH

DATE: 08/17/2016	SCALE:
PROJECT: 02348-001	1"=5'

8/8/16 02348-001 Pothole 1
→ Located ≈ 60' E of TP-1, in an attempt to hit bedrock
→ GW present @ 13', water ≈ 3" deep
→ Pothole TD = 13', ≈ 25' long, oriented @ S38°W

PH-1

W-Wall



LITHOLOGIC UNIT DESCRIPTIONS:

All units same as seen in TP-3, except:

- Unit 1 is ~3' thick, and has an upper colluvial / alluvial bed ~6" thick.
- Unit 3 has huge boulders up to 4' in diameter along uppermost gravel bed
- Unit 4 and 5 unable to be distinguished due to smear, though refusal @ 13' likely from silty Norwood Tuff bedrock.

FIGURE A-8

PH-1 LOG

THE RIDGE TOWNHOMES

GEOTECHNICAL AND GEOLOGIC HAZARD ASSESSMENT

WOLF CREEK RESORT

EDEN, UTAH

DATE: 08/17/2016	SCALE: 1"=5'
PROJECT: 02348-001	

IGES

APPENDIX B

Water Content and Unit Weight of Soil

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

IGES

Project: **Wolf Creek- The Ridge**
No: **02348-001**
Location: Eden, UT
Date: 8/17/2016
By: IM

Sample Info.	Boring No.	TP-1	TP-1	TP-2	TP-2	TP-3			
	Sample								
	Depth	1.0'	11.0'	5.0'	10.0'	1.0'			
	Split	No	Yes	No	Yes	No			
	Split sieve		3/8"		3/8"				
Total sample (g)			4057.57		3088.07				
Moist coarse fraction (g)			798.04		97.26				
Moist split fraction (g)			3259.53		2990.81				
	Sample height, H (in)								
	Sample diameter, D (in)								
	Mass rings + wet soil (g)								
	Mass rings/tare (g)								
	Moist unit wt., γ_m (pcf)								
Coarse Fraction	Wet soil + tare (g)		1265.97		224.04				
	Dry soil + tare (g)		1204.60		220.85				
	Tare (g)		467.93		126.78				
	Water content (%)		8.3		3.4				
Split Fraction	Wet soil + tare (g)	624.84	618.51	435.82	384.34	472.07			
	Dry soil + tare (g)	553.43	535.23	381.39	334.44	428.04			
	Tare (g)	215.37	222.27	126.63	129.47	140.00			
	Water content (%)	21.1	26.6	21.4	24.3	15.3			
Water Content, w (%)		**21.1**	**22.5**	**21.4**	**23.6**	**15.3**			
Dry Unit Wt., γ_d (pcf)									

Entered by:___________

Reviewed:___________

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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Wolf Creek - The Ridge
No: 02348-001
Location: Eden, UT
Date: 8/19/2016
By: BRR

Boring No.: TP-1
Sample:
Depth: 1.0'
Description: Dark brown fat clay

Preparation method: Wet
Liquid limit test method: Multipoint

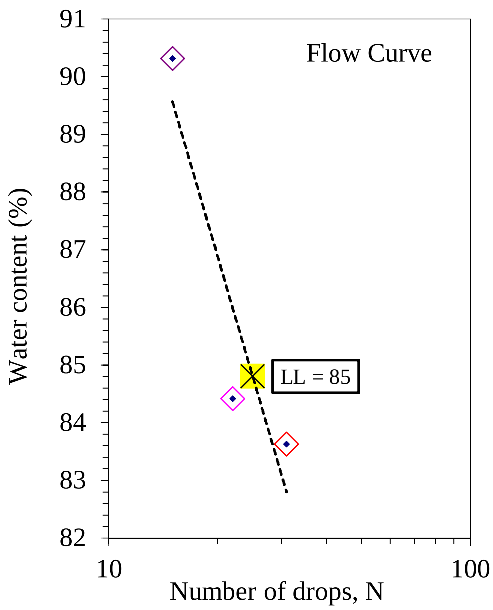
Plastic Limit

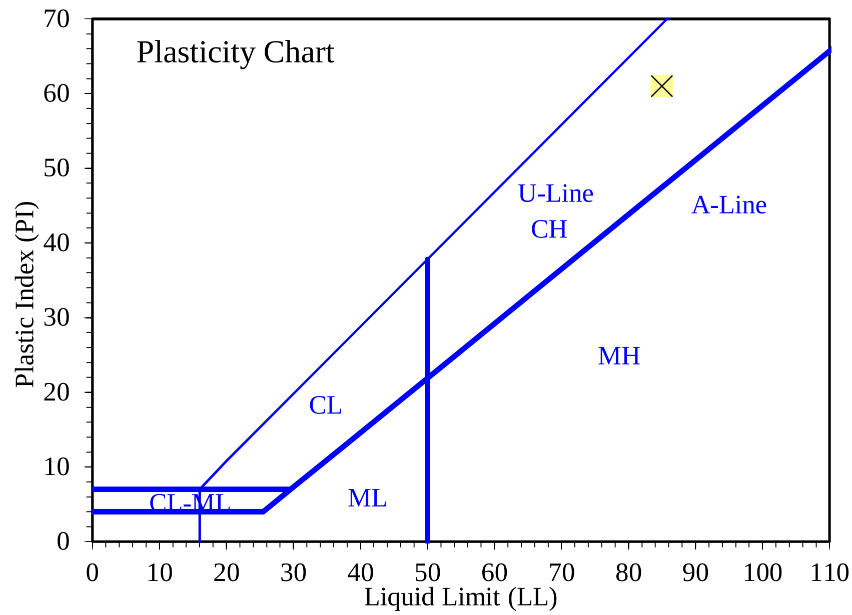
Determination No	1	2				
Wet Soil + Tare (g)	27.67	28.04				
Dry Soil + Tare (g)	26.53	26.84				
Water Loss (g)	1.14	1.20				
Tare (g)	21.63	21.98				
Dry Soil (g)	4.90	4.86				
Water Content, w (%)	23.27	24.69				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	31	22	15			
Wet Soil + Tare (g)	30.52	30.48	29.97			
Dry Soil + Tare (g)	26.79	26.58	26.24			
Water Loss (g)	3.73	3.90	3.73			
Tare (g)	22.33	21.96	22.11			
Dry Soil (g)	4.46	4.62	4.13			
Water Content, w (%)	83.63	84.42	90.31			
One-Point LL (%)		83				

Liquid Limit, LL (%)	**85**
Plastic Limit, PL (%)	**24**
Plasticity Index, PI (%)	**61**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Wolf Creek - The Ridge
No: 02348-001
Location: Eden, UT
Date: 8/19/2016
By: BRR

Boring No.: TP-2
Sample:
Depth: 5.0'
Description: Light brown fat clay

Preparation method: Wet
Liquid limit test method: Multipoint

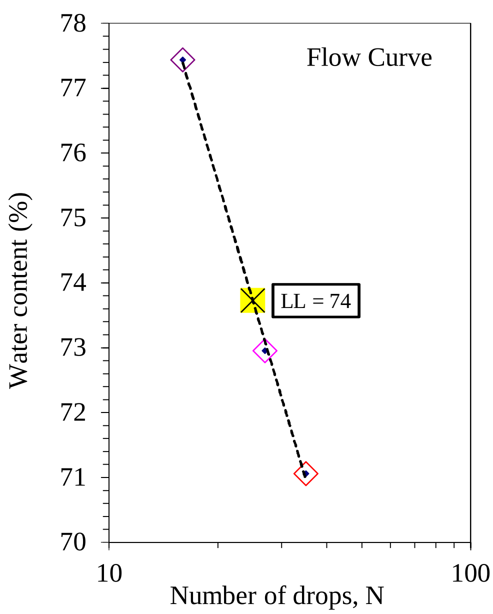
Plastic Limit

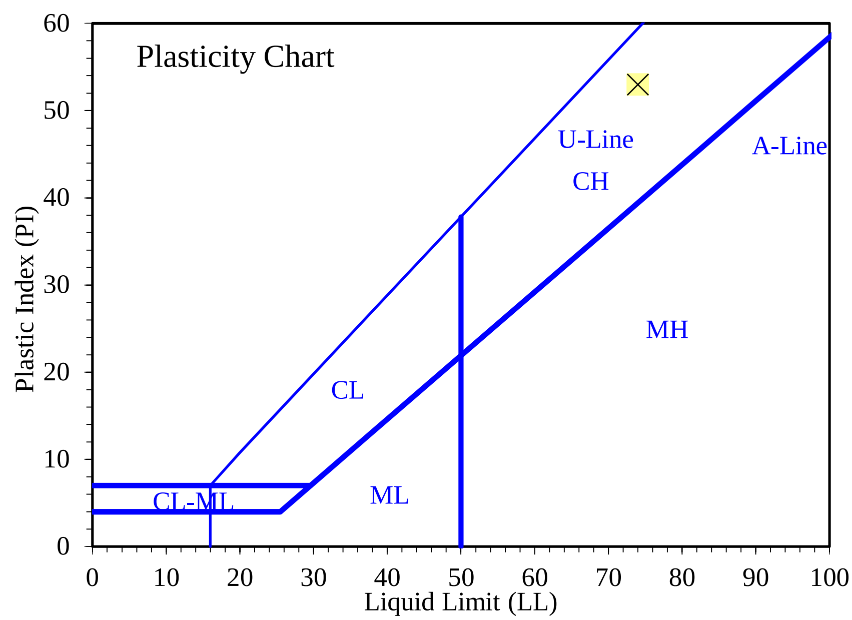
Determination No	1	2				
Wet Soil + Tare (g)	28.03	28.67				
Dry Soil + Tare (g)	26.95	27.55				
Water Loss (g)	1.08	1.12				
Tare (g)	21.75	22.10				
Dry Soil (g)	5.20	5.45				
Water Content, w (%)	20.77	20.55				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	35	27	16			
Wet Soil + Tare (g)	29.06	28.47	29.29			
Dry Soil + Tare (g)	26.04	25.53	26.03			
Water Loss (g)	3.02	2.94	3.26			
Tare (g)	21.79	21.50	21.82			
Dry Soil (g)	4.25	4.03	4.21			
Water Content, w (%)	71.06	72.95	77.43			
One-Point LL (%)		74				

Liquid Limit, LL (%)	**74**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**53**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Wolf Creek - The Ridge
No: 02348-001
Location: Eden, UT
Date: 8/18/2016
By: BRR

Boring No.: TP-3
Sample:
Depth: 1.0'
Description: Brown fat clay

Preparation method: Wet
Liquid limit test method: Multipoint

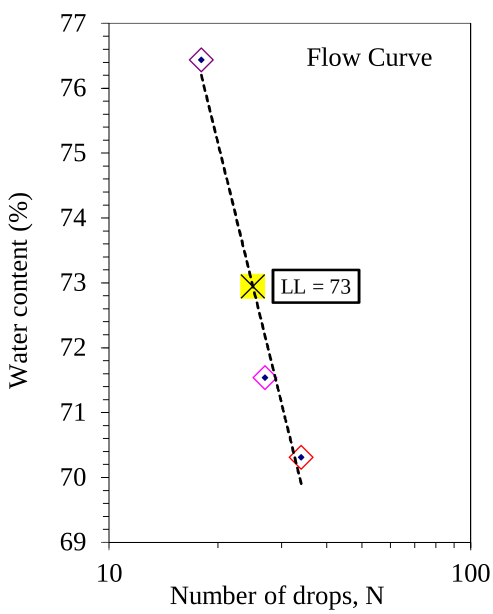
Plastic Limit

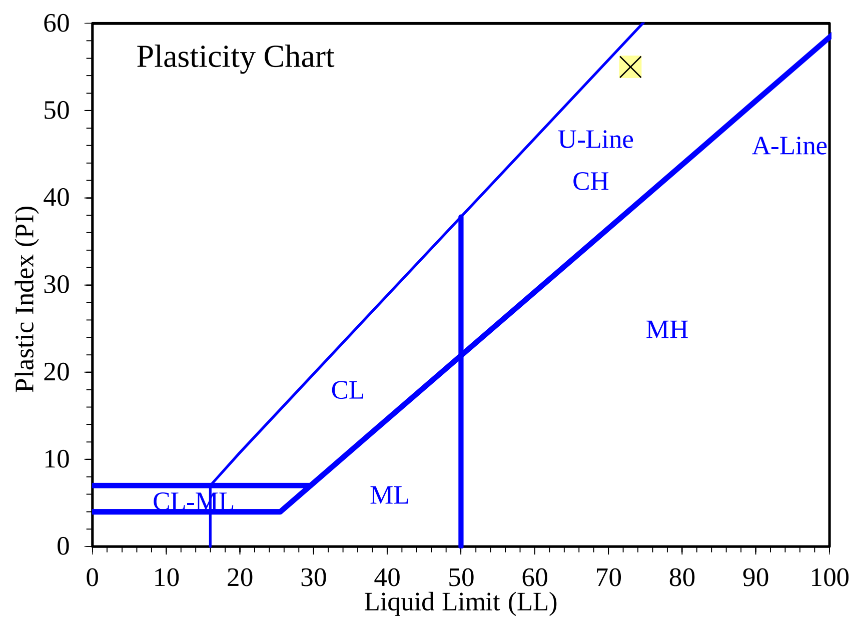
Determination No	1	2				
Wet Soil + Tare (g)	29.13	28.52				
Dry Soil + Tare (g)	28.03	27.43				
Water Loss (g)	1.10	1.09				
Tare (g)	21.92	21.55				
Dry Soil (g)	6.11	5.88				
Water Content, w (%)	18.00	18.54				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	34	27	18			
Wet Soil + Tare (g)	30.38	28.75	27.73			
Dry Soil + Tare (g)	26.97	26.01	25.20			
Water Loss (g)	3.41	2.74	2.53			
Tare (g)	22.12	22.18	21.89			
Dry Soil (g)	4.85	3.83	3.31			
Water Content, w (%)	70.31	71.54	76.44			
One-Point LL (%)		72				

Liquid Limit, LL (%)	**73**
Plastic Limit, PL (%)	**18**
Plasticity Index, PI (%)	**55**





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

(ASTM D6913)

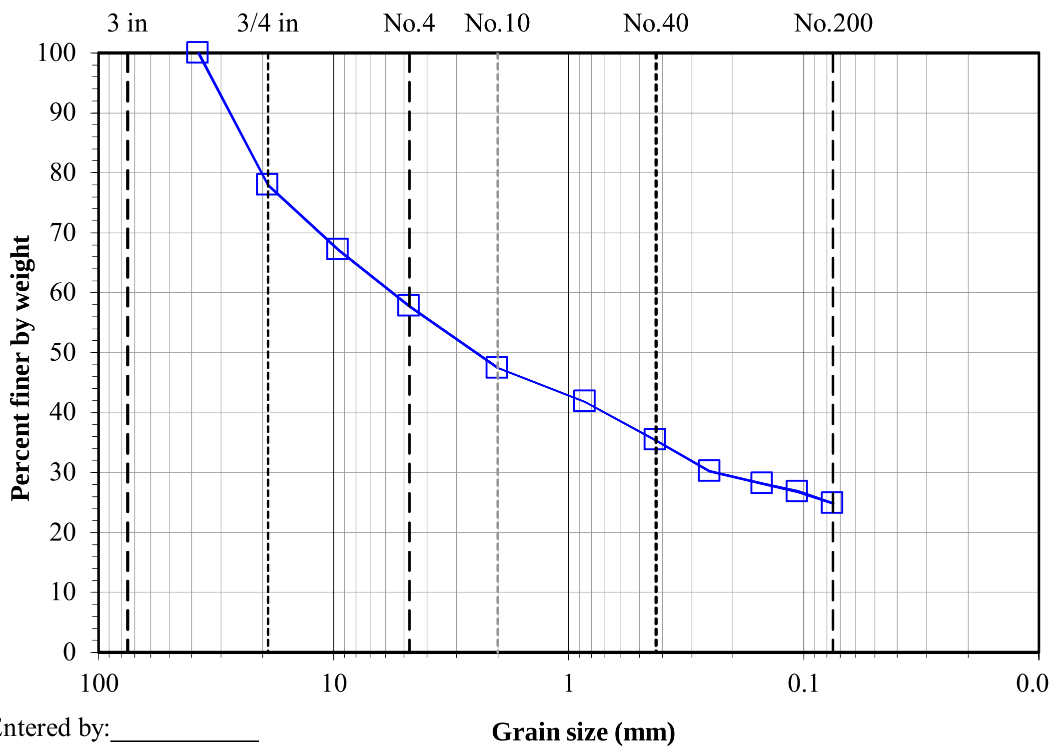
Project: Wolf Creek- The Ridge
No: 02348-001
Location: Eden, UT
Date: 8/18/2016
By: BSS

Boring No.: TP-3
Sample:
Depth: 9.0'
Description: Light brown clayey gravel with sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	1470.05	1259.03
+3/8" Coarse fraction (g):	424.45	413.73
-3/8" Split fraction (g):	483.09	390.55
Split fraction:	0.671	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	542.70	876.13
Dry soil + tare (g):	531.98	783.59
Tare (g):	118.33	393.04
Water content (%):	2.6	23.7

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	277.17	19	78.0	
3/8"	413.73	9.5	67.1	←Split
No.4	54.93	4.75	57.7	
No.10	114.72	2	47.4	
No.20	147.28	0.85	41.8	
No.40	184.61	0.425	35.4	
No.60	215.10	0.25	30.2	
No.100	227.02	0.15	28.1	
No.140	234.81	0.106	26.8	
No.200	246.11	0.075	24.8	



Gravel (%): 42.3
Sand (%): 32.9
Fines (%): 24.8

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

(ASTM D1140)

IGES

Project: **Wolf Creek - The Ridge**
No: **02348-001**
Location: Eden, UT
Date: 8/18/2016
By: BSS

Sample Info.	Boring No.	TP-1	TP-2	TP-3					
	Sample								
	Depth	11.0'	10.0'	5.0'					
	Split	Yes	Yes	No					
	Split Sieve*	3/8"	3/8"						
	Method	B	B	B					
	Specimen soak time (min)	270	250	310					
	Moist total sample wt. (g)	4057.57	3088.07	256.45					
	Moist coarse fraction (g)	798.04	97.37						
	Moist split fraction + tare (g)	618.51	384.34						
	Split fraction tare (g)	222.27	129.47						
	Dry split fraction (g)	312.96	204.97						
	Dry retained No. 200 + tare (g)	353.04	194.76	144.15					
	Wash tare (g)	222.27	129.47	127.39					
	No. 200 Dry wt. retained (g)	130.77	65.29	16.76					
	Split sieve* Dry wt. retained (g)	736.67	94.18						
	Dry total sample wt. (g)	3311.13	2499.34	203.26					
Coarse Fraction	Moist soil + tare (g)	1265.97	224.04						
	Dry soil + tare (g)	1204.60	220.85						
	Tare (g)	467.93	126.78						
	Water content (%)	8.33	3.39						
Split Fraction	Moist soil + tare (g)	618.51	384.34	383.84					
	Dry soil + tare (g)	535.23	334.44	330.65					
	Tare (g)	222.27	129.47	127.39					
	Water content (%)	26.61	24.35	26.17					
	Percent passing split sieve* (%)	**77.8**	**96.2**						
	Percent passing No. 200 sieve (%)	**45.3**	**65.6**	**91.8**					

Entered by:___________
Reviewed:___________

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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Wolf Creek - The Ridge
No: 02348-001
Location: Eden, UT
Date: 8/19/2016
By: JDF

Boring No.: TP-3
Sample:
Depth: 11.0'
Sample Description: Greenish brown clay
Sample type: Arbitrary remold

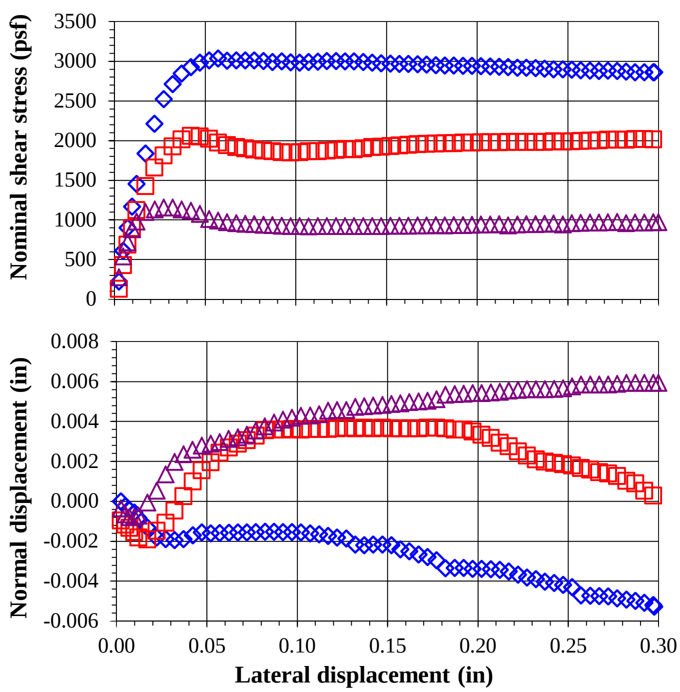
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0012
Specific gravity, Gs: 2.70 Assumed

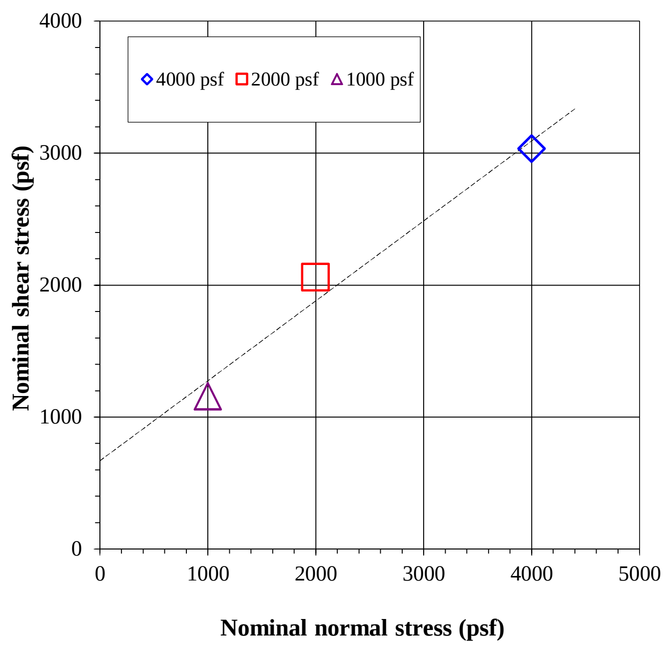
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	4000		2000		1000	
Peak shear stress (psf)	3034		2058		1157	
Lateral displacement at peak (in)	0.057		0.042		0.027	
Load Duration (min)	1247		138		1276	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9552	1.0000	0.9802	1.0000	0.9867
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	188.95	185.86	186.95	185.74	186.46	185.74
Wt. rings (g)	44.74	44.74	42.74	42.74	42.25	42.25
Wet soil + tare (g)	575.27		575.27		575.27	
Dry soil + tare (g)	472.62		472.62		472.62	
Tare (g)	140.51		140.51		140.51	
Water content (%)	30.9	28.1	30.9	29.8	30.9	30.3
Dry unit weight (pcf)	91.5	95.8	91.5	93.4	91.5	92.7
Void ratio, e, for assumed Gs	0.84	0.76	0.84	0.80	0.84	0.82
Saturation (%)*	99.2	100.0	99.2	100.0	99.2	100.0

ϕ' (deg)	31
c' (psf)	669

Average of 3 samples	Initial	Pre-shear
Water content (%)	30.9	29.4
Dry unit weight (pcf)	91.5	94.0

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





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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Wolf Creek - The Ridge
No: 02348-001
Location: Eden, UT

Boring No.: TP-3
Sample:
Depth: 11.0'

Nominal normal stress = 4000 psf			Nominal normal stress = 2000 psf			Nominal normal stress = 1000 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.)
0.002	222	0.000	0.002	131	-0.001	0.002	277	0.000
0.005	609	0.000	0.005	429	-0.001	0.005	539	-0.001
0.007	900	0.000	0.007	688	-0.001	0.007	715	-0.001
0.010	1169	-0.001	0.010	895	-0.002	0.010	882	-0.001
0.012	1455	-0.001	0.012	1123	-0.002	0.012	980	-0.001
0.017	1837	-0.001	0.017	1424	-0.002	0.017	1100	0.000
0.022	2213	-0.002	0.022	1660	-0.001	0.022	1132	0.001
0.027	2523	-0.002	0.027	1813	-0.001	0.027	1157	0.001
0.032	2711	-0.002	0.032	1925	0.000	0.032	1154	0.002
0.037	2848	-0.002	0.037	2015	0.000	0.037	1131	0.002
0.042	2928	-0.002	0.042	2058	0.001	0.042	1115	0.003
0.047	2985	-0.002	0.047	2051	0.002	0.047	1073	0.003
0.052	3013	-0.002	0.052	2021	0.002	0.052	1009	0.003
0.057	3034	-0.002	0.057	1975	0.002	0.057	988	0.003
0.062	3008	-0.002	0.062	1942	0.003	0.062	970	0.003
0.067	3011	-0.002	0.067	1916	0.003	0.067	959	0.003
0.072	3013	-0.002	0.072	1902	0.003	0.072	951	0.003
0.077	3013	-0.002	0.077	1887	0.003	0.077	945	0.004
0.082	3003	-0.002	0.082	1875	0.004	0.082	939	0.004
0.087	2993	-0.002	0.087	1865	0.004	0.087	934	0.004
0.092	2998	-0.002	0.092	1854	0.004	0.092	923	0.004
0.097	2987	-0.002	0.097	1851	0.004	0.097	922	0.004
0.102	2985	-0.002	0.102	1855	0.004	0.102	920	0.004
0.107	2993	-0.002	0.107	1865	0.004	0.107	918	0.004
0.112	2995	-0.002	0.112	1867	0.004	0.112	920	0.004
0.117	3003	-0.002	0.117	1874	0.004	0.117	922	0.005
0.122	3003	-0.002	0.122	1883	0.004	0.122	920	0.005
0.127	3000	-0.002	0.127	1892	0.004	0.127	919	0.005
0.132	3000	-0.002	0.132	1891	0.004	0.132	919	0.005
0.137	2993	-0.002	0.137	1902	0.004	0.137	920	0.005
0.142	2982	-0.002	0.142	1916	0.004	0.142	923	0.005
0.147	2977	-0.002	0.147	1922	0.004	0.147	923	0.005
0.152	2972	-0.002	0.152	1930	0.004	0.152	925	0.005
0.157	2969	-0.002	0.157	1940	0.004	0.157	925	0.005
0.162	2967	-0.003	0.162	1948	0.004	0.162	926	0.005
0.167	2964	-0.003	0.167	1953	0.004	0.167	929	0.005
0.172	2959	-0.003	0.172	1958	0.004	0.172	931	0.005
0.177	2951	-0.003	0.177	1963	0.004	0.177	933	0.005
0.182	2949	-0.003	0.182	1966	0.004	0.182	931	0.005
0.187	2946	-0.003	0.187	1968	0.004	0.187	934	0.005
0.192	2944	-0.003	0.192	1973	0.004	0.192	935	0.005
0.197	2941	-0.003	0.197	1973	0.003	0.197	937	0.005
0.202	2938	-0.003	0.202	1977	0.003	0.202	940	0.005
0.207	2936	-0.003	0.207	1978	0.003	0.207	943	0.005
0.212	2931	-0.003	0.212	1977	0.003	0.212	944	0.005
0.217	2928	-0.004	0.217	1982	0.003	0.217	929	0.006
0.222	2918	-0.004	0.222	1982	0.003	0.222	941	0.006
0.227	2918	-0.004	0.227	1981	0.002	0.227	944	0.006
0.232	2913	-0.004	0.232	1983	0.002	0.232	947	0.006
0.237	2907	-0.004	0.237	1984	0.002	0.237	951	0.006
0.242	2900	-0.004	0.242	1989	0.002	0.242	952	0.006
0.247	2900	-0.004	0.247	1988	0.002	0.247	943	0.006
0.252	2894	-0.004	0.252	1991	0.002	0.252	957	0.006
0.257	2887	-0.005	0.257	1994	0.002	0.257	960	0.006
0.262	2882	-0.005	0.262	1997	0.002	0.262	965	0.006
0.267	2879	-0.005	0.267	2004	0.001	0.267	967	0.006
0.272	2882	-0.005	0.272	2010	0.001	0.272	970	0.006
0.277	2879	-0.005	0.277	2009	0.001	0.277	975	0.006
0.282	2871	-0.005	0.282	2012	0.001	0.282	960	0.006
0.287	2864	-0.005	0.287	2017	0.001	0.287	964	0.006
0.292	2861	-0.005	0.292	2017	0.001	0.292	966	0.006
0.297	2861	-0.005	0.297	2015	0.000	0.297	968	0.006
0.298	2861	-0.005	0.302	2015	0.000	0.300	970	0.006

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Wolf Creek - The Ridge

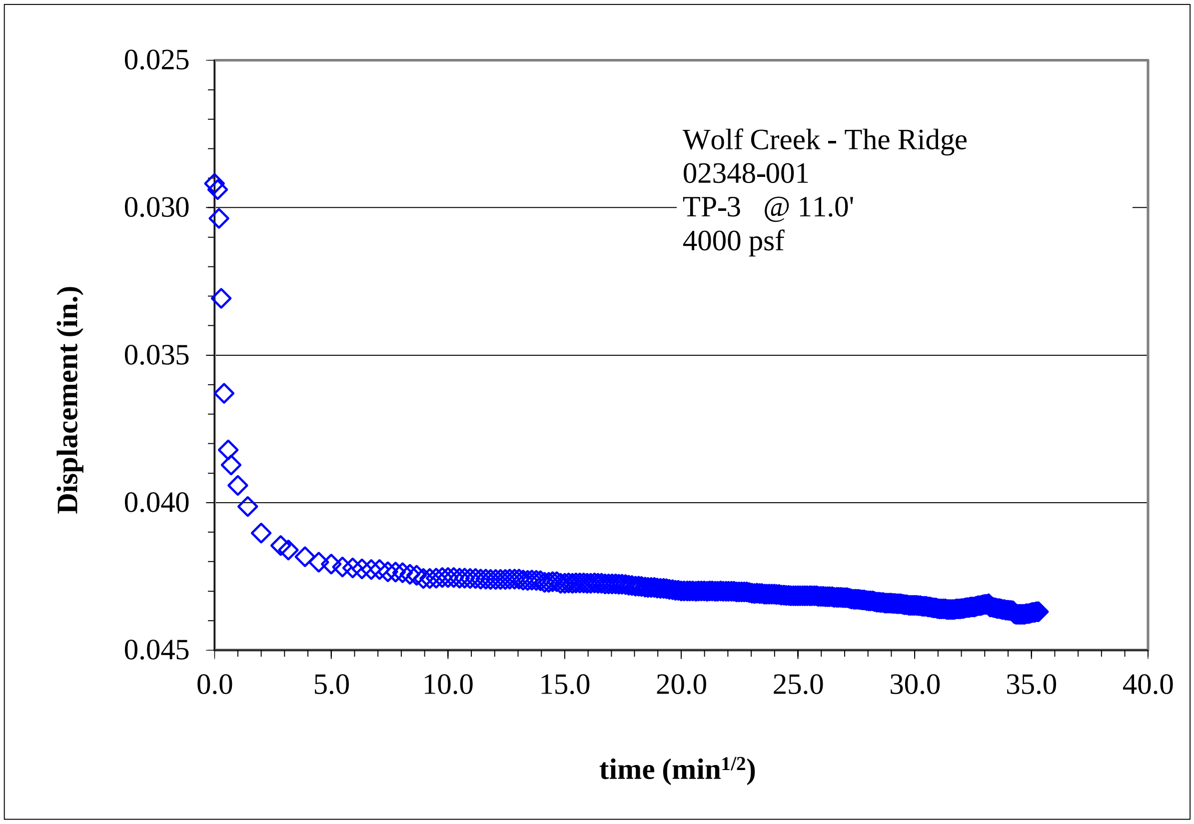
No: 02348-001

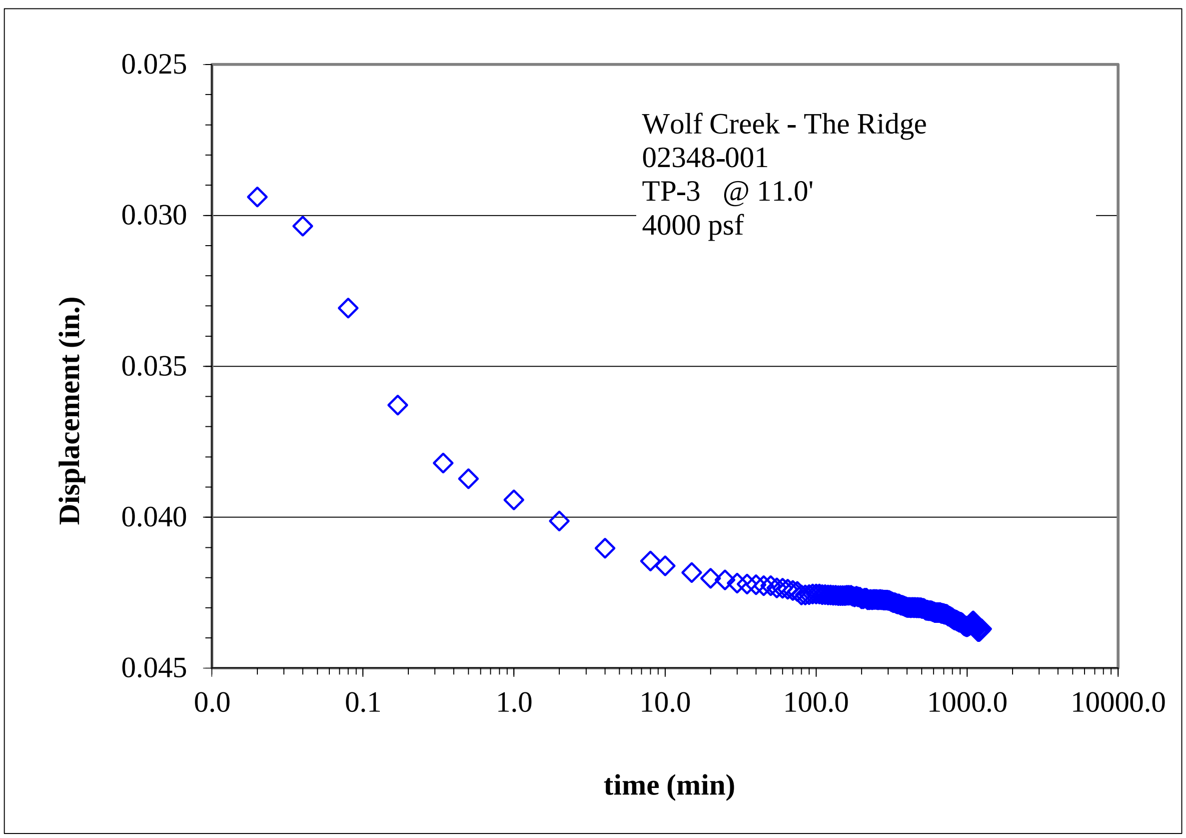
Location: Eden, UT

Boring No.: TP-3

Sample:

Depth: 11.0'





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: Wolf Creek- The Ridge
No: 02348-001
Location: Eden, UT
Date: 8/17/2016
By: BSS

Sample info.	Boring No.	TP-3							
	Sample								
	Depth	5.0'							
Water content data	Wet soil + tare (g)	67.66							
	Dry soil + tare (g)	63.44							
	Tare (g)	37.33							
	Water content (%)	16.2							
Chem. data	pH	7.24							
	Soluble chloride* (ppm)	29.6							
	Soluble sulfate** (ppm)	38.5							
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	10550	0.67	7069				
		+3	4926	0.67	3300				
		+6	3580	0.67	2399				
		+9	2323	0.67	1556				
		+12	1841	0.67	1233				
		+15	1374	0.67	921				
		+18	1251	0.67	838				
		+21	1201	0.67	805				
		+24	1343	0.67	900				
	Minimum resistivity (Ω-cm)	**805**							

* Performed by AWAL using EPA 300.0

** Performed by AWAL using ASTM C1580

Entered by:___________

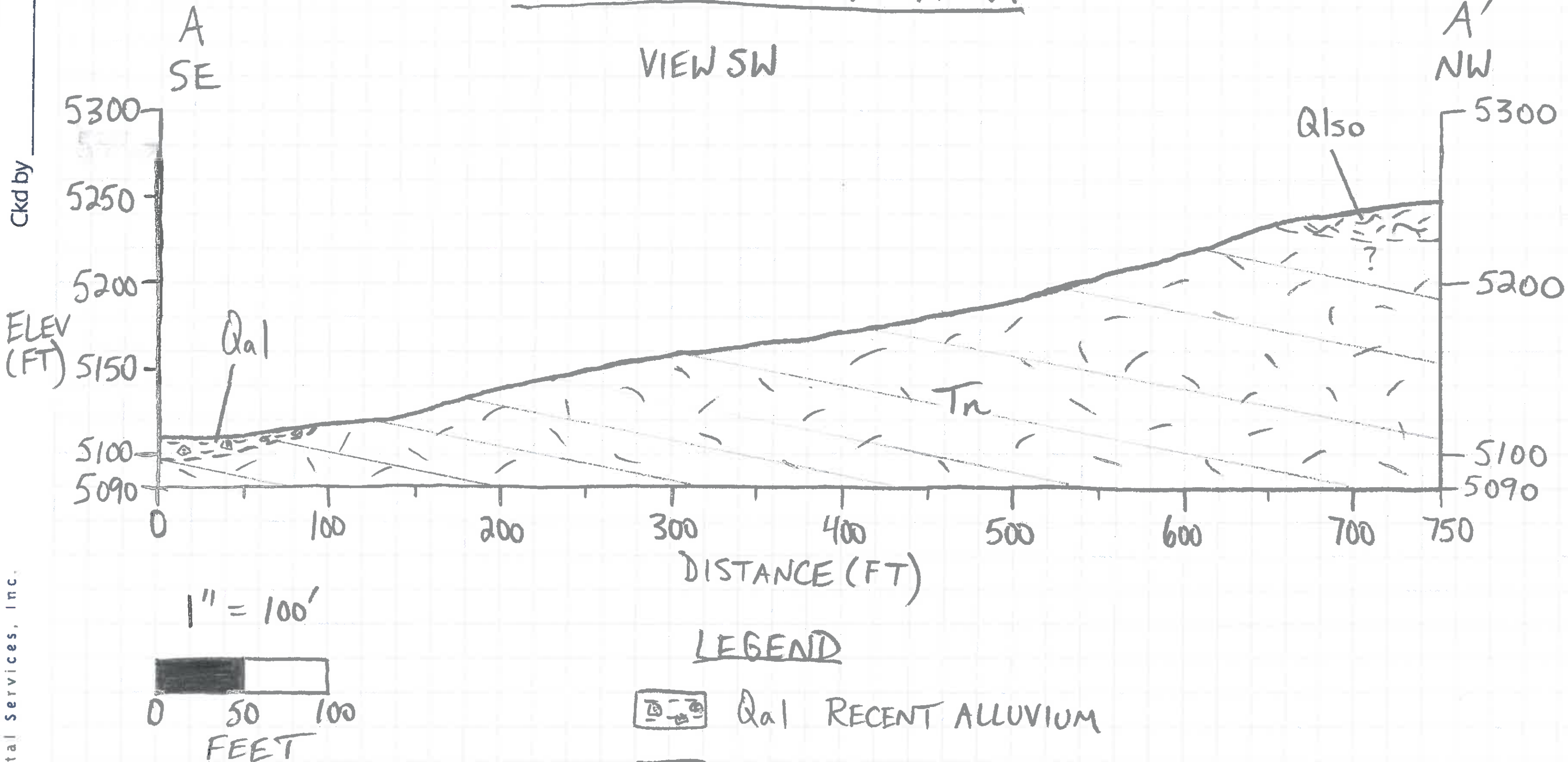
Reviewed:___________

APPENDIX C

Project No. 02348-001
Date 9-9-16 by PED
Ckd by ______ on ______

WOLF CREEK RESORT
THE RIDGE PHASES 3,4,5

CROSS-SECTION A-A'



LEGEND

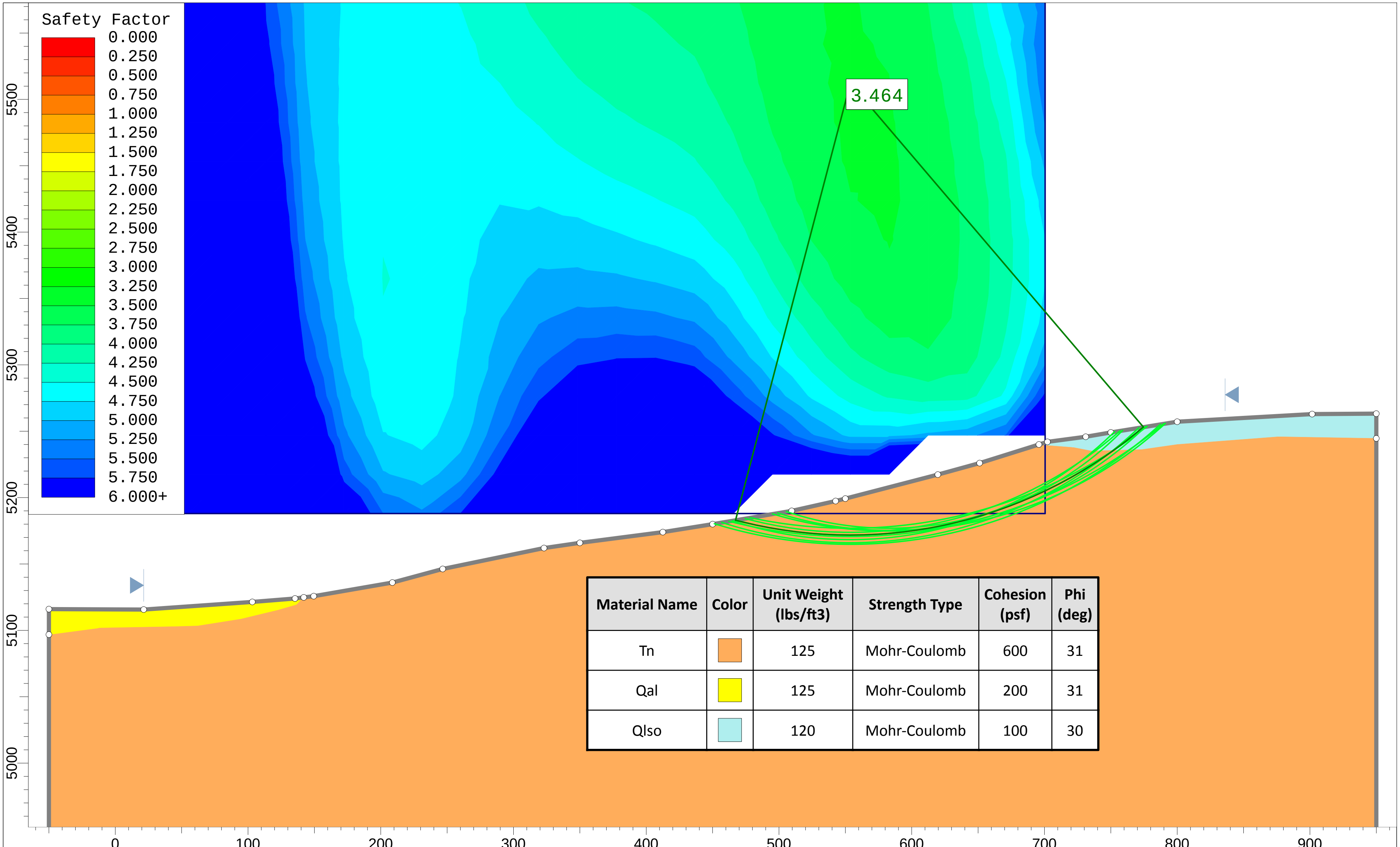
Qal RECENT ALLUVIUM

Qlso PLEISTOCENE LANDSLIDE

Tn NORWOOD TUFF

*SEE FIGURE A-4 FOR CROSS-SECTION LINE.

IGES
Intermountain GeoEnvironmental Services, Inc.



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Tn		125	Mohr-Coulomb	600	31
Qal		125	Mohr-Coulomb	200	31
Qlso		120	Mohr-Coulomb	100	30

IGES®

SLIDEINTERPRET 7.018

Project	The Ridge Townhomes, Wolf Creek Resort, Eden, Utah
Analysis Description	Section A : A' Global Stability
Drawn By	JKW
Scale	1:1200
Company	IGES, Inc.
Date	9/9/2016, 3:46:52 PM
File Name	Section A_A.slim

Slide Analysis Information

The Ridge Townhomes, Wolf Creek Resort, Eden, Utah

Project Summary

File Name:	Section A_A (Static)
Slide Modeler Version:	7.018
Project Title:	The Ridge Townhomes, Wolf Creek Resort, Eden, Utah
Analysis:	Section A : A' Global Stability
Author:	JKW
Company:	IGES, Inc.
Date Created:	9/9/2016, 3:46:52 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled

Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Tn	Qal	Qlso
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	125	120
Cohesion [psf]	600	200	100
Friction Angle [deg]	31	31	30
Water Surface	None	None	None
Ru Value	0	0	0

Global Minimums

Method: spencer

FS	3.463580
Center:	553.775, 5512.186
Radius:	340.433
Left Slip Surface Endpoint:	467.328, 5182.912
Right Slip Surface Endpoint:	774.612, 5253.100
Resisting Moment:	2.73957e+008 lb-ft
Driving Moment:	7.90965e+007 lb-ft
Resisting Horizontal Force:	766809 lb
Driving Horizontal Force:	221392 lb
Total Slice Area:	8315.15 ft2
Surface Horizontal Width:	307.284 ft
Surface Average Height:	27.0602 ft

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	4388
Number of Invalid Surfaces:	364

Error Codes:

- Error Code -106 reported for 3 surfaces
- Error Code -108 reported for 18 surfaces
- Error Code -111 reported for 8 surfaces
- Error Code -112 reported for 32 surfaces
- Error Code -114 reported for 303 surfaces

Error Codes

The following errors were encountered during the computation:

- -106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
- -108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
- -111 = safety factor equation did not converge
- -112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
- -114 = Surface with Reverse Curvature.

Slice Data

- **Global Minimum Query (spencer) - Safety Factor: 3.46358**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	6.19479	1008.7	-14.1726	Tn	600	31	221.858	768.424	280.305	0	280.305
2	6.19479	2978.53	-13.0996	Tn	600	31	283.851	983.139	637.649	0	637.649
3	6.19479	4853.87	-12.0314	Tn	600	31	341.808	1183.88	971.737	0	971.737
4	6.19479	6635.87	-10.9674	Tn	600	31	395.883	1371.17	1283.45	0	1283.45
5	6.19479	8325.61	-9.90717	Tn	600	31	446.216	1545.51	1573.58	0	1573.58
6	6.19479	9924	-8.85038	Tn	600	31	492.935	1707.32	1842.89	0	1842.89
7	6.19479	11436.2	-7.79662	Tn	600	31	536.289	1857.48	2092.8	0	2092.8
8	6.19479	13033.4	-6.74551	Tn	600	31	581.583	2014.36	2353.87	0	2353.87
9	6.19479	14632.6	-5.69667	Tn	600	31	626.265	2169.12	2611.45	0	2611.45
10	6.19479	16143.3	-4.64975	Tn	600	31	667.627	2312.38	2849.88	0	2849.88
11	6.19479	17565.8	-3.60438	Tn	600	31	705.755	2444.44	3069.66	0	3069.66
12	6.19479	18900.4	-2.56021	Tn	600	31	740.734	2565.59	3271.29	0	3271.29
13	6.19479	20194.9	-1.51689	Tn	600	31	774.023	2680.89	3463.18	0	3463.18
14	6.19479	21495.4	-0.474074	Tn	600	31	807.012	2795.15	3653.33	0	3653.33
15	6.19479	22730.9	0.568584	Tn	600	31	837.639	2901.23	3829.9	0	3829.9
16	6.19479	23880.8	1.61143	Tn	600	31	865.362	2997.25	3989.7	0	3989.7
17	6.19479	24943.3	2.65481	Tn	600	31	890.183	3083.22	4132.78	0	4132.78
18	6.19479	25918.1	3.69907	Tn	600	31	912.154	3159.32	4259.42	0	4259.42
19	6.19479	26805.2	4.74457	Tn	600	31	931.32	3225.7	4369.89	0	4369.89
20	6.19479	27604	5.79165	Tn	600	31	947.722	3282.51	4464.45	0	4464.45
21	6.19479	28314.1	6.84068	Tn	600	31	961.398	3329.88	4543.27	0	4543.27
22	6.19479	28935.1	7.89202	Tn	600	31	972.384	3367.93	4606.6	0	4606.6
23	6.19479	29466.2	8.94604	Tn	600	31	980.711	3396.77	4654.59	0	4654.59

24	6.19479	29906.7	10.0031	Tn	600	31	986.404	3416.49	4687.42	0	4687.42
25	6.19479	30262.2	11.0637	Tn	600	31	989.661	3427.77	4706.2	0	4706.2
26	6.19479	30584.5	12.128	Tn	600	31	991.916	3435.58	4719.21	0	4719.21
27	6.19479	30828.1	13.1967	Tn	600	31	991.971	3435.77	4719.51	0	4719.51
28	6.19479	30977	14.2701	Tn	600	31	989.442	3427.01	4704.95	0	4704.95
29	6.19479	31030	15.3485	Tn	600	31	984.346	3409.36	4675.57	0	4675.57
30	6.19479	30994.8	16.4326	Tn	600	31	976.931	3383.68	4632.83	0	4632.83
31	6.19479	30990.4	17.5228	Tn	600	31	970.314	3360.76	4594.68	0	4594.68
32	6.19479	30927.6	18.6196	Tn	600	31	962.181	3332.59	4547.8	0	4547.8
33	6.19479	30762.1	19.7235	Tn	600	31	951.438	3295.38	4485.86	0	4485.86
34	6.19479	30491.9	20.8351	Tn	600	31	938.081	3249.12	4408.88	0	4408.88
35	6.19479	30114.8	21.9549	Tn	600	31	922.112	3193.81	4316.82	0	4316.82
36	6.19479	29628.3	23.0837	Tn	600	31	903.522	3129.42	4209.67	0	4209.67
37	6.19479	29029.2	24.222	Tn	600	31	882.295	3055.9	4087.29	0	4087.29
38	6.19479	28268.7	25.3706	Tn	600	31	857.295	2969.31	3943.19	0	3943.19
39	6.19479	26893.1	26.5302	Tn	600	31	817.622	2831.9	3714.51	0	3714.51
40	6.19479	25040.5	27.7017	Tn	600	31	766.967	2656.45	3422.5	0	3422.5
41	6.19479	23062.2	28.8859	Tn	600	31	713.995	2472.98	3117.17	0	3117.17
42	6.19479	20944.2	30.0837	Tn	600	31	658.475	2280.68	2797.11	0	2797.11
43	6.19479	18692.8	31.2962	Tn	600	31	600.642	2080.37	2463.75	0	2463.75
44	6.19479	16432.9	32.5246	Tn	600	31	543.501	1882.46	2134.36	0	2134.36
45	6.19479	14087.5	33.77	Tn	600	31	485.31	1680.91	1798.93	0	1798.93
46	6.19479	11591.9	35.0338	Tn	600	31	424.674	1470.89	1449.41	0	1449.41
47	5.58084	8207.93	36.2529	Qlso	100	30	224.438	777.36	1173.22	0	1173.22
48	5.58084	6014.81	37.4266	Qlso	100	30	170.163	589.374	847.622	0	847.622
49	5.58084	3699.23	38.6191	Qlso	100	30	113.97	394.744	510.511	0	510.511
50	5.58084	1255.05	39.8318	Qlso	100	30	56.0364	194.086	162.962	0	162.962

Interslice Data

- **Global Minimum Query (spencer) - Safety Factor: 3.46358**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	467.328	5182.91	0	0	0
2	473.523	5181.35	1812.09	382.676	11.9245
3	479.718	5179.91	4488.69	947.917	11.9245
4	485.913	5178.59	7887.91	1665.76	11.9245
5	492.107	5177.38	11879.7	2508.74	11.9244
6	498.302	5176.3	16344.9	3451.71	11.9245
7	504.497	5175.34	21174.5	4471.6	11.9244
8	510.692	5174.49	26269.9	5547.65	11.9245
9	516.887	5173.76	31595.4	6672.28	11.9245
10	523.081	5173.14	37086.6	7831.9	11.9244
11	529.276	5172.64	42655.9	9008.03	11.9245
12	535.471	5172.25	48223.3	10183.7	11.9244
13	541.666	5171.97	53715.5	11343.6	11.9245
14	547.86	5171.8	59075.9	12475.6	11.9245
15	554.055	5171.75	64259.6	13570.3	11.9245
16	560.25	5171.81	69210.2	14615.7	11.9244

17	566.445	5171.99	73872.7	15600.3	11.9244
18	572.64	5172.28	78197	16513.5	11.9244
19	578.834	5172.68	82138.5	17345.9	11.9244
20	585.029	5173.19	85657.8	18089.1	11.9244
21	591.224	5173.82	88720.3	18735.9	11.9245
22	597.419	5174.56	91296.3	19279.8	11.9244
23	603.614	5175.42	93360.9	19715.8	11.9244
24	609.808	5176.4	94893.7	20039.5	11.9244
25	616.003	5177.49	95879.1	20247.6	11.9244
26	622.198	5178.7	96305.8	20337.8	11.9245
27	628.393	5180.03	96164.8	20308	11.9245
28	634.588	5181.48	95450.8	20157.2	11.9245
29	640.782	5183.06	94163.8	19885.4	11.9245
30	646.977	5184.76	92308.1	19493.5	11.9244
31	653.172	5186.59	89892.1	18983.3	11.9244
32	659.367	5188.54	86912.8	18354.2	11.9245
33	665.561	5190.63	83378.1	17607.7	11.9245
34	671.756	5192.85	79306	16747.8	11.9245
35	677.951	5195.21	74719.9	15779.3	11.9245
36	684.146	5197.71	69649.1	14708.4	11.9244
37	690.341	5200.35	64128.7	13542.6	11.9244
38	696.535	5203.13	58200.3	12290.7	11.9245
39	702.73	5206.07	51924.5	10965.4	11.9245
40	708.925	5209.16	45498.9	9608.4	11.9244
41	715.12	5212.42	39115.5	8260.36	11.9244
42	721.315	5215.83	32882.5	6944.09	11.9245
43	727.509	5219.42	26921.5	5685.25	11.9245
44	733.704	5223.19	21361.9	4511.19	11.9245
45	739.899	5227.14	16295.6	3441.29	11.9245
46	746.094	5231.28	11848.5	2502.15	11.9244
47	752.289	5235.62	8182.88	1728.05	11.9244
48	757.869	5239.72	4633.36	978.468	11.9245
49	763.45	5243.99	1962.31	414.397	11.9244
50	769.031	5248.45	322.049	68.0099	11.9244
51	774.612	5253.1	0	0	0

List Of Coordinates

External Boundary

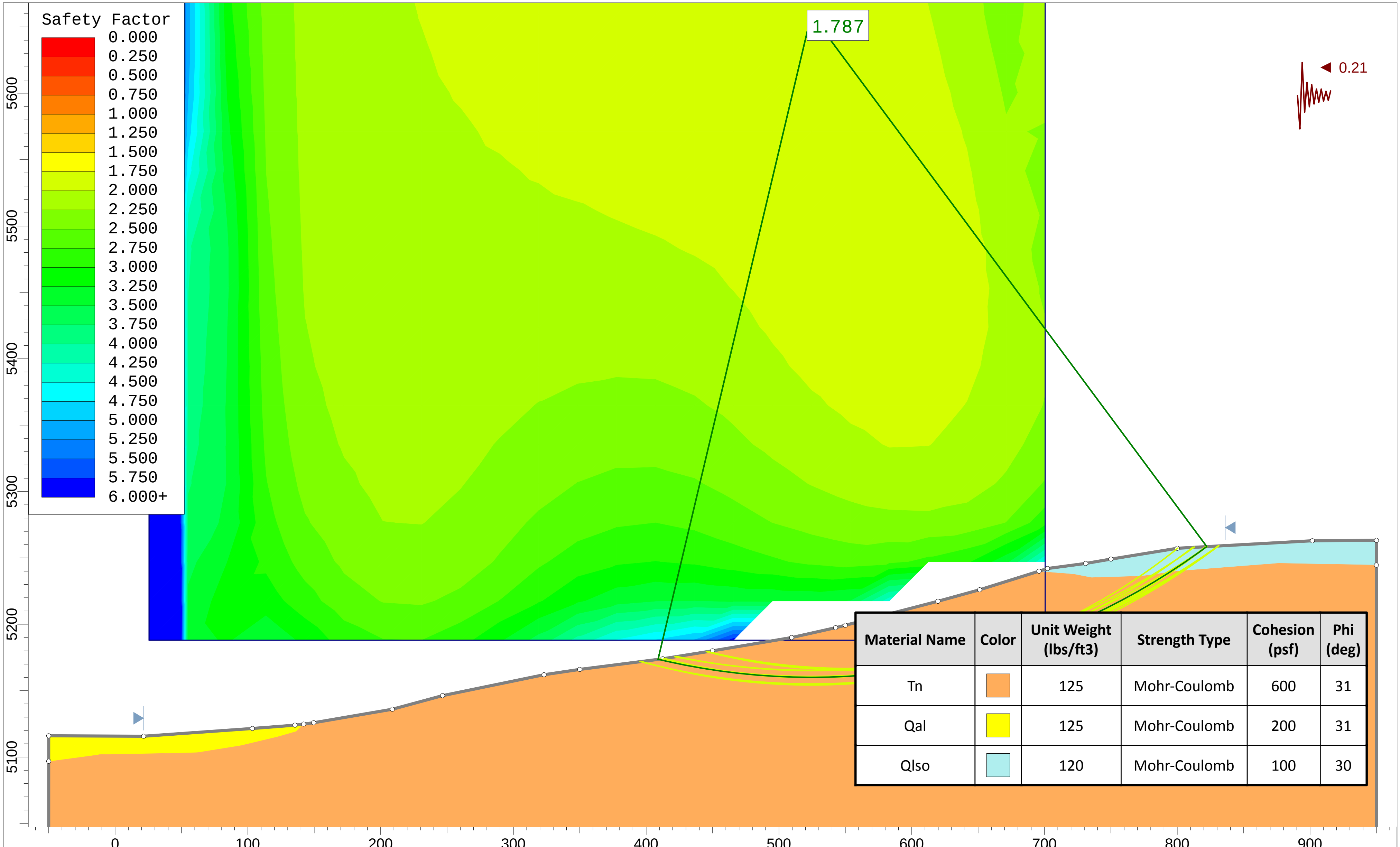
X	Y
-50	5116.04
-50	5096.87
-50	4780
950	4780
950	5244.59
950	5263.27
901.71	5262.95
800	5257.23
750	5249.1
731.088	5245.87
702.287	5242
695.902	5240
651.205	5226
619.745	5217.33
550	5199.29
542.703	5197.44
509.587	5190.01
450	5180
412.533	5174
350	5165.99
323.072	5162
246.679	5146.3
208.823	5136
149.56	5125.82
142.027	5124.85
135.468	5124
103.303	5121.49
21.4775	5115.72

Material Boundary

X	Y
-50	5096.87
-12.9169	5101.81
44.6944	5102.87
62.2038	5103.38
94.7793	5108.57
122.342	5115.2
136.593	5119.27
142.027	5124.85

Material Boundary

X	Y
695.902	5240
721.925	5238.04
736.512	5235.18
773.291	5236.22
800	5240
876.253	5245.89
950	5244.59



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Tn		125	Mohr-Coulomb	600	31
Qal		125	Mohr-Coulomb	200	31
Qlso		120	Mohr-Coulomb	100	30

IGES®

Project	The Ridge Townhomes, Wolf Creek Resort, Eden, Utah		
Analysis Description	Section A : A' Global Stability		
Drawn By JKW	*Scale* 1:1200	*Company*	IGES, Inc.
Date	9/9/2016, 3:46:52 PM	*File Name*	Section A_A.slim

SLIDEINTERPRET 7.018

Slide Analysis Information

The Ridge Townhomes, Wolf Creek Resort, Eden, Utah

Project Summary

File Name:	Section A_A (Seismic)
Slide Modeler Version:	7.018
Project Title:	The Ridge Townhomes, Wolf Creek Resort, Eden, Utah
Analysis:	Section A : A' Global Stability
Author:	JKW
Company:	IGES, Inc.
Date Created:	9/9/2016, 3:46:52 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled

Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal): 0.21

Material Properties

Property	Tn	Qal	Qlso
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	125	120
Cohesion [psf]	600	200	100
Friction Angle [deg]	31	31	30
Water Surface	None	None	None
Ru Value	0	0	0

Global Minimums

Method: spencer

FS	1.786850
Center:	524.429, 5659.523
Radius:	499.521
Left Slip Surface Endpoint:	408.931, 5173.539
Right Slip Surface Endpoint:	822.225, 5258.477
Resisting Moment:	6.12962e+008 lb-ft
Driving Moment:	3.43042e+008 lb-ft
Resisting Horizontal Force:	1.18227e+006 lb
Driving Horizontal Force:	661650 lb
Total Slice Area:	13688.8 ft2
Surface Horizontal Width:	413.294 ft
Surface Average Height:	33.1213 ft

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	4398
Number of Invalid Surfaces:	354

Error Codes:

- Error Code -106 reported for 3 surfaces
- Error Code -108 reported for 13 surfaces
- Error Code -111 reported for 14 surfaces
- Error Code -112 reported for 21 surfaces
- Error Code -114 reported for 303 surfaces

Error Codes

The following errors were encountered during the computation:

- -106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
- -108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
- -111 = safety factor equation did not converge
- -112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
- -114 = Surface with Reverse Curvature.

Slice Data

- **Global Minimum Query (spencer) - Safety Factor: 1.78685**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	8.19999	1542.16	-12.8863	Tn	600	31	505.485	903.226	504.654	0	504.654
2	8.19999	4711	-11.9232	Tn	600	31	663.218	1185.07	973.721	0	973.721
3	8.19999	7758.46	-10.9635	Tn	600	31	809.977	1447.31	1410.15	0	1410.15
4	8.19999	10660.1	-10.0069	Tn	600	31	945.077	1688.71	1811.92	0	1811.92
5	8.19999	13417.2	-9.05319	Tn	600	31	1069.13	1910.38	2180.84	0	2180.84
6	8.19999	16063.6	-8.10195	Tn	600	31	1184.29	2116.14	2523.28	0	2523.28
7	8.19999	18601.6	-7.15296	Tn	600	31	1291.03	2306.87	2840.71	0	2840.71
8	8.19999	20998.2	-6.20593	Tn	600	31	1388.18	2480.47	3129.63	0	3129.63
9	8.19999	23254.4	-5.26061	Tn	600	31	1476.18	2637.71	3391.32	0	3391.32
10	8.19999	25370.9	-4.31672	Tn	600	31	1555.42	2779.3	3626.96	0	3626.96
11	8.19999	27348.2	-3.374	Tn	600	31	1626.28	2905.92	3837.7	0	3837.7
12	8.19999	29186.7	-2.4322	Tn	600	31	1689.11	3018.18	4024.52	0	4024.52
13	8.19999	31011.3	-1.49106	Tn	600	31	1749.68	3126.41	4204.65	0	4204.65
14	8.19999	33029.1	-0.550313	Tn	600	31	1817.06	3246.82	4405.04	0	4405.04
15	8.19999	34926.7	0.390282	Tn	600	31	1877.56	3354.92	4584.96	0	4584.96
16	8.19999	36686.3	1.33098	Tn	600	31	1930.65	3449.78	4742.82	0	4742.82
17	8.19999	38364.3	2.27204	Tn	600	31	1978.93	3536.06	4886.43	0	4886.43
18	8.19999	40090.9	3.21371	Tn	600	31	2027.97	3623.68	5032.24	0	5032.24
19	8.19999	41723.2	4.15626	Tn	600	31	2071.86	3702.1	5162.77	0	5162.77
20	8.19999	43217.5	5.09993	Tn	600	31	2109.01	3768.49	5273.25	0	5273.25

21	8.19999	44572.1	6.04499	Tn	600	31	2139.58	3823.1	5364.14	0	5364.14
22	8.19999	45786.4	6.99171	Tn	600	31	2163.74	3866.28	5436.01	0	5436.01
23	8.19999	46859.5	7.94034	Tn	600	31	2181.68	3898.33	5489.35	0	5489.35
24	8.19999	47790.6	8.89118	Tn	600	31	2193.55	3919.55	5524.65	0	5524.65
25	8.19999	48578.6	9.84449	Tn	600	31	2199.51	3930.19	5542.37	0	5542.37
26	8.19999	49228.3	10.8006	Tn	600	31	2199.92	3930.92	5543.58	0	5543.58
27	8.19999	49831.7	11.7597	Tn	600	31	2198.35	3928.13	5538.93	0	5538.93
28	8.19999	50323.3	12.7222	Tn	600	31	2192.47	3917.62	5521.45	0	5521.45
29	8.19999	50666.2	13.6883	Tn	600	31	2181.08	3897.26	5487.56	0	5487.56
30	8.19999	50891.4	14.6584	Tn	600	31	2165.44	3869.32	5441.06	0	5441.06
31	8.19999	51201.6	15.6329	Tn	600	31	2152.86	3846.84	5403.64	0	5403.64
32	8.19999	51404.5	16.612	Tn	600	31	2136.49	3817.59	5354.97	0	5354.97
33	8.19999	51450.6	17.5961	Tn	600	31	2114.74	3778.73	5290.3	0	5290.3
34	8.19999	51337.3	18.5857	Tn	600	31	2087.71	3730.42	5209.9	0	5209.9
35	8.19999	51062	19.581	Tn	600	31	2055.47	3672.81	5114.02	0	5114.02
36	8.19999	50519.3	20.5825	Tn	600	31	2014.69	3599.95	4992.75	0	4992.75
37	8.19999	48770.2	21.5906	Tn	600	31	1934.82	3457.23	4755.22	0	4755.22
38	8.19999	46415.9	22.6058	Tn	600	31	1836.79	3282.07	4463.72	0	4463.72
39	8.19999	43872.2	23.6285	Tn	600	31	1734.66	3099.57	4159.98	0	4159.98
40	8.19999	41197.8	24.6593	Tn	600	31	1630.46	2913.39	3850.13	0	3850.13
41	8.19999	38588.2	25.6987	Tn	600	31	1530.45	2734.69	3552.72	0	3552.72
42	8.19999	35830.5	26.7472	Tn	600	31	1427.97	2551.56	3247.94	0	3247.94
43	8.19999	32829	27.8055	Tn	600	31	1320.24	2359.07	2927.58	0	2927.58
44	8.19999	29616.2	28.8742	Tn	600	31	1208.52	2159.45	2595.36	0	2595.36
45	8.19999	26203.8	29.9541	Tn	600	31	1093.42	1953.78	2253.07	0	2253.07
46	8.19999	22607.5	31.0458	Tn	600	31	975.622	1743.29	1902.76	0	1902.76
47	8.19999	18795.3	32.1501	Tn	600	31	854.429	1526.74	1542.35	0	1542.35
48	9.29811	16433.6	33.3439	Qlso	100	30	448.943	802.193	1216.24	0	1216.24
49	9.29811	10226.8	34.6304	Qlso	100	30	294.592	526.392	738.532	0	738.532
50	9.29811	3468.11	35.9371	Qlso	100	30	136.717	244.292	249.921	0	249.921

Interslice Data

- **Global Minimum Query (spencer) - Safety Factor: 1.78685**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	408.931	5173.54	0	0	0
2	417.131	5171.66	4777.9	1700.1	19.5869
3	425.331	5169.93	10926.1	3887.81	19.587
4	433.531	5168.34	18194.8	6474.2	19.5869
5	441.731	5166.9	26346.3	9374.72	19.5869
6	449.931	5165.59	35166.3	12513.1	19.5869
7	458.131	5164.42	44473.1	15824.7	19.5869
8	466.331	5163.39	54102.1	19251	19.5869
9	474.531	5162.5	63893.8	22735.1	19.5869
10	482.731	5161.75	73704.8	26226.1	19.5869

11	490.931	5161.13	83407.3	29678.5	19.5869
12	499.131	5160.64	92887.3	33051.8	19.5869
13	507.331	5160.3	102044	36310	19.5869
14	515.531	5160.08	110811	39429.6	19.587
15	523.731	5160	119158	42399.7	19.587
16	531.931	5160.06	127001	45190.3	19.5869
17	540.131	5160.25	134263	47774.3	19.5869
18	548.331	5160.57	140883	50130	19.5869
19	556.531	5161.04	146817	52241.3	19.5869
20	564.731	5161.63	152009	54088.9	19.5869
21	572.931	5162.36	156410	55654.9	19.5869
22	581.131	5163.23	159979	56924.8	19.5869
23	589.331	5164.24	162683	57887	19.5869
24	597.531	5165.38	164498	58532.6	19.5869
25	605.731	5166.66	165405	58855.6	19.5869
26	613.931	5168.09	165397	58852.6	19.5869
27	622.131	5169.65	164470	58522.9	19.5869
28	630.331	5171.36	162621	57864.7	19.5869
29	638.531	5173.21	159853	56879.9	19.5869
30	646.731	5175.21	156182	55573.5	19.5868
31	654.931	5177.35	151624	53951.7	19.5869
32	663.131	5179.65	146169	52010.7	19.5869
33	671.331	5182.09	139835	49757	19.5869
34	679.531	5184.69	132656	47202.4	19.5869
35	687.731	5187.45	124670	44360.9	19.5869
36	695.931	5190.37	115926	41249.6	19.5869
37	704.131	5193.45	106504	37896.8	19.5868
38	712.331	5196.69	96734.9	34420.8	19.5869
39	720.531	5200.11	86845.3	30901.8	19.5869
40	728.731	5203.69	76967.5	27387.1	19.5869
41	736.931	5207.46	67224.3	23920.2	19.5869
42	745.131	5211.4	57681.4	20524.5	19.5868
43	753.331	5215.54	48472.1	17247.7	19.587
44	761.531	5219.86	39770.3	14151.3	19.5869
45	769.731	5224.38	31749	11297.1	19.5868
46	777.931	5229.11	24587.1	8748.75	19.5869
47	786.131	5234.04	18467.1	6571.09	19.5869
48	794.331	5239.2	13594.4	4837.24	19.5869
49	803.629	5245.32	6886.94	2450.56	19.5869
50	812.927	5251.74	2742.55	975.872	19.5869
51	822.225	5258.48	0	0	0

List Of Coordinates

External Boundary

X	Y
-50	5116.04
-50	5096.87
-50	4780
950	4780
950	5244.59
950	5263.27
901.71	5262.95
800	5257.23
750	5249.1
731.088	5245.87
702.287	5242
695.902	5240
651.205	5226
619.745	5217.33
550	5199.29
542.703	5197.44
509.587	5190.01
450	5180
412.533	5174
350	5165.99
323.072	5162
246.679	5146.3

208.823	5136
149.56	5125.82
142.027	5124.85
135.468	5124
103.303	5121.49
21.4775	5115.72

Material Boundary

X	Y
-50	5096.87
-12.9169	5101.81
44.6944	5102.87
62.2038	5103.38
94.7793	5108.57
122.342	5115.2
136.593	5119.27
142.027	5124.85

Material Boundary

X	Y
695.902	5240
721.925	5238.04
736.512	5235.18
773.291	5236.22
800	5240
876.253	5245.89
950	5244.59