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PRELIMINARY GEOTECHNICAL INVESTIGATION
Powder Mountain Resort
Weber County, Utah

IGES Job No. 01628-001

July 26, 2012

Prepared for:

Summit, LLC

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Geotechnical Investigation
Powder Mountain Resort
Weber County, Utah

IGES Job No. 00414-006

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July 26, 2012

TABLE OF CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

This report presents the results of our preliminary geotechnical investigation conducted for potential development near Powder Mountain Ski Resort in Weber County, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the subject site and to provide preliminary geotechnical recommendations for planning purposes. Our Scope of Work included site reconnaissance, geotechnical investigation, and preparation of this report. In addition, we have assessed the geologic hazards at the site and have provided recommendations for additional study.

We understand the project consists of developing approximately 200 of 2,000 acres of lightly forested land just south of the existing ski resort. Powder Mountain may undergo a major expansion that could include golf courses, ski lifts, residential, and commercial property development. Site development would include site infrastructure including roads and bridges, retaining structures, and associated underground utilities.

Subsurface soils were sampled in eleven test pits excavated at representative locations across the site during the field investigation conducted by IGES. Site soils were predominantly loosely deposited and relatively easy to excavate. Surficial soil consists of mostly clayey/silty gravel, cobble and boulders. Bedrock was encountered 8 feet below existing grade in TP-01; however, bedrock was not encountered in any other test pit (excavation did not extend more than 10-½ feet below existing site grade).

Based on the subsurface conditions encountered at the site, it is our opinion that portions of the subject site may be suitable for the proposed development. Site suitability is subject to additional site investigation, provided that site-specific geotechnical design recommendations are incorporated into the design and construction of the project. Site development is also subject to Weber County Hillside Development Standards.

Field observations indicate structure-specific geological/geotechnical investigations should be performed at the subject site. The site should be considered a sensitive site under Weber County Development Codes due to geologic conditions. Evidence of landslide was exposed in TP-01, TP-07, and TP-09; evidence of landslide was noted above TP-03 and TP-07. Most site soils were relatively loose and required minimal effort to excavate, suggesting possible colluvium creep. Map review of the site indicates that much of the site is mapped as landslide or colluvium.

Map review also indicates that Cambrian Middle Limestone Member (Cbm) may underlie the site. The presence of limestone on-site is problematic because karst structures are formed in limestone formations. PH tests performed on site soils indicate that soils are acidic. In the previous geologic report by AMEC (2001), a depression potentially indicating a collapsed cavern was identified on-site. Drilling of site soils and coring of site rock is recommended to ascertain the acid sensitivity of underlying rock and its continuity.

For planning purposes, shallow conventional spread or continuous wall footings constructed on compacted structural fill may be proportioned utilizing a maximum net allowable bearing pressure of **2,000 pounds per square foot (psf)**. Structural fill should be a minimum of 2 ft thick and properly moisture conditioned and compacted as outlined in this report. The net allowable bearing values presented above are for dead load plus live load conditions.

Based on soil classifications and laboratory-obtained CBR values of 5.5 and 1.8 for the native soil tested, the near surface soils are expected to provide poor to fair pavement support. For the primary access road, pavements sections should consist of 5 inches of asphalt over 10 inches of roadbase on the north main access road and 5 inches of asphalt over 14 inches of road base on the southeast access road.

NOTICE: The scope of services provided within this report are limited to the assessment of the subsurface conditions at the subject site. The executive summary is provided solely for purposes of overview and is not intended to replace the report of which it is part and should not be used separately from the report.

2.0 INTRODUCTION

2.1 PURPOSE AND SCOPE OF WORK

This report presents the results of our preliminary geotechnical investigation conducted for potential development near Powder Mountain Ski Resort in Weber County, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the subject site. Our Scope of Work includes review of the 2001 AMEC report titled “Engineering Geologic Reconnaissance/Geotechnical Study”, a site reconnaissance, geotechnical site investigation, laboratory analysis of soil samples, engineering analysis, and preparation of this report. In addition, we have assessed the mapped geologic hazards at the site and provided recommendations for additional study.

Our services were performed in accordance with our proposal to Summit LLC (Client), dated June 18, 2012. The recommendations contained in this report are subject to the limitations presented in the "Limitations" section of this report (Section 7.1).

2.2 PROJECT DESCRIPTION

The site is located southeast of SR-158 Powder Mountain Road, south of previously developed portions of Powder Mountain Resort, in unincorporated Weber County, Utah. The project is accessed by Powder Ridge Road. The investigation area is shown on the *Site Vicinity Map* included in Appendix A at the end of this report (Figure A-1). The proposed developments are illustrated on Figures A-2, *Site Geologic Map*, and A-3, *Site Plan*.

Our understanding of the project is based on preliminary drawings provided by Hart Howerton, and information provided by the Client. We understand the project currently consists of developing approximately 200 of the 2,000-acre property. Based on the preliminary plans reviewed, bridges are planned, and we assume that there will be cuts and fills to accommodate the main access roads.

3.0 METHOD OF STUDY

3.1 SUBSURFACE INVESTIGATION

As a part of this investigation, subsurface soil conditions were explored by excavating eleven test pits to depths ranging to 10-½ feet below the existing surface. Figures A-2 & A-3 in Appendix A show the approximate locations of the test pits. Exploration points were placed to provide a representative cross section of the subsurface conditions in areas anticipated for development. Subsurface conditions as encountered in the explorations were logged at the time of our investigation by a member of our technical staff and are presented on the enclosed test pit logs, Figures A-4 through A-14 in Appendix A. A *Key to Soil Symbols and Terminology* is presented on Figure A-15.

The test pits were excavated with the aid of a Kubota KX080-3 rubber-tracked mini-excavator. Both bulk and relatively "undisturbed" soil samples were obtained in the test pit explorations. Relatively "undisturbed" soil samples were obtained with the use of a hand sampler attached to a 6-inch long brass tube driven into the soil with a 2 pound sledge ("undisturbed" samples were difficult to obtain due to the coarse nature of the prevailing earth materials encountered). All samples were transported to our laboratory for testing to evaluate engineering properties of the various earth materials observed. The soils observed in the explorations were logged and classified in general accordance with the *Unified Soil Classification System* (USCS). Classifications for the individual soil units are shown on the attached test pit logs (Figures A-4 through A-14).

3.2 LABORATORY INVESTIGATION

Geotechnical laboratory tests were conducted on selected relatively undisturbed and bulk soil samples obtained during our field investigation. The laboratory testing program was designed to evaluate the engineering characteristics of onsite earth materials. Laboratory tests conducted during this investigation include:

- In situ moisture content
- Atterberg Limits
- No. 200 Sieve Wash
- Grain Size Distribution
- Maximum dry density and optimum moisture content
- Direct shear
- CBR for pavement recommendations

- Water-soluble sulfate concentration for cement type recommendations
- Resistivity and pH to evaluate corrosion potential of ferrous metals in contact with site soils

Results of the in situ moisture content tests are shown on the test pit logs (Appendix A). The results of remaining laboratory tests are presented on the test pit logs (Figures A-4 through A-14). The Laboratory test results are presented in the *Summary of Laboratory Test Results Table* and in the Lab Results sheets in Appendix B.

4.0 GEOLOGIC CONDITIONS

4.1 GEOLOGIC SETTING

Ogden Valley in northern Utah is a intermontane valley that trends north-south and is part of a structural transition zone between the uplifted Middle Rocky Mountain Province on the east and the extensional Basin and Range Province on the west (Black et al., 1999). Ogden Valley is located near the center of the Intermountain seismic belt (Smith and Sbar, 1974; Smith et al., 1991), and is seismically characterized by three major active faults zones that are in or adjacent to the valley. These fault zones are the Wasatch, Ogden Valley northeastern margin, and Ogden Valley southwestern margin (Hecker, 1993). Structurally, Ogden Valley is a narrow, elongate graben formed by high-angle normal faults, bounded by the horst-block mountain ranges which were formed by the movement of the Ogden Valley margin fault zones.

The subject site is located within the uplilfted Middle Rocky Mountain Province approximately 3 miles east of the Ogden Valley northeastern margin fault zone. The geologic units mapped within or adjacent to the subject site are (from Coogan and King, 2001):

- undifferentiated mass movement deposits (Qm).
- Wasatch Formation (Tw) consisting of conglomerate, sandstone, siltstone, mudstone and minor amounts of limestone.
- St. Charles Formation (Csc) primarily consisting of Dolostone.
- Nounan Formation (Cn) primarily consisting of Dolostone.
- Calls Fort Shale Member of the Bloomington Formation (Cbc) consisting of micaceous shale and limestone.
- Middle Limestone Member of the Bloomington Formation (Cbm) consisting of limestone.

The various geologic units are shown on Figure A-2, *Site Geologic Map.*

4.2 SEISMICITY AND FAULTING

An active fault is defined as a fault that has had activity within the Holocene (<11ka). No active faults are mapped through or immediately adjacent to the site (Black et al., 2004).

Table 4.2.1 lists the closest mapped faults that would likely contribute to the seismicity at the subject site.

Table 4.2.1 – Nearest Mapped Faults to the Subject Site

Fault	Distance (miles)	Estimated M_w*
East Cache Fault Zone	3.0	7.1
Ogden Valley Northeastern Margin Faults	3.0	7.0
James Peak Fault	3.1	7.5
Ogden Valley North Fork Fault	6.0	7.0
Ogden Valley Southwestern Margin Faults	7.5	7.0
Weber segment of Wasatch Fault	9.0	7.1

*Hecker (1993)

Analyses suggest that the Weber Segment of the Wasatch Fault zone is the single greatest contributor to the seismic hazard at the subject site. The most recent movement along the Weber Segment of the Wasatch Fault Zone occurred during Holocene Epoch, and there is evidence that as many as 10 to 15 earthquakes have occurred along this segment in the last 15,000 years (Hecker, 1993). A location near Kaysville Utah indicated that the Weber Segment has a measurable offset of 1.4 to 3.4 meters per event (McCalpin, et al., 1994). The Weber Segment may be capable of producing earthquakes as large as magnitude 7.5 (Ms) and has a recurrence interval of approximately 1,200 years.

The site's seismologic hazard was identified following criteria outlined in the 2012 International Building Code (IBC, 2012). The short and 1-second spectral accelerations were determined based on the location of the site using the *U.S. Seismic "DesignMaps" Web Application* (USGS, 2012). Based on the field investigation, the soils at the site are representative of a "very dense soil and soft rock" profile (Site Class C) with F_a and F_v values of 1.08 and 1.53, respectively. The Design Response Spectrum corresponding to the Maximum Considered Earthquake (MCE) (the ground motion having a two percent probability of exceedance in 50 years [2PE50]) are presented in Appendix C. Based on the design spectral response accelerations and a Building Risk Category of II, the site's Seismic Design Category is D. The short- and long-period Design Spectral Response Accelerations are presented in Table 4.2.2.

The Seismic Design Category may be modified based on a different Building Risk Category and/or the provisions outlined in Section 1613.3.5.1 (IBC, 2009). If proposed structures at the site pertain to a different risk category and/or meet the provisional criteria of Section 1613.3.5.1, IGES should be contacted so that revised recommendations can be provided.

Table 4.2.2 - Short and 1-Second Period Spectral Accelerations

Parameter	**Short Period (0.2 sec)**	**Long Period (1.0 sec)**
Mapped Spectral Acceleration (g)	$S_S = 0.855$	$S_1 = 319$
MCE Spectral Response Acceleration Site Class D (g)	$S_{MS} = S_sF_a = 0.905$	$S_{M1} = S_1F_v = 0.472$
Design Spectral Response Acceleration (5 percent Damping) (g)	$S_{DS} = S_{MS*}{}^2/_3 = 0.603$	$S_{D1} = S_{M1*}{}^2/_3 = 0.314$

IBC, 2012 has not been formally adopted, but it is possible that, depending on the time development and building permits are applied for, the regulating agencies will require ground motions be determined according to the latest methods. IGES can modify these parameters as necessary at that time.

4.3 OTHER GEOLOGIC HAZARDS

Geologic hazards can be defined as naturally occurring geologic conditions or processes that could present a danger to human life and property. These hazards must be considered before development of the site. There are several hazards in addition to seismicity and faulting that may be present at the site, and which should be considered in the design of roads and critical facilities such as water tanks and structures designed for human habitation. Other geologic hazards considered significant for this site include debris flow, landslides, shallow bedrock, and karst formation. A complete list of potential geologic hazards is included in the *Summary of Geologic Hazards Table* in Appendix C of this report.

4.3.1 Debris Flow

Debris flow is a potential hazard that may exist on areas containing Holocene deposits. This type of flooding typically occurs as a debris flood consisting of a mixture of soil, organic material, and rock debris transported by fast-moving flood water. Similar to stream flooding, debris floods and debris flows can occur as a result of runoff from spring snowmelt and cloudburst rainstorms. Landslides can also mobilize a debris flow.

Debris flows are not known to have been mapped on the site (Elliott and Harty, 2010). Subsurface data collected for this site suggest that some portions of the site are covered with a relatively thin veneer of topsoil (1/2 to 4 feet), overlying colluvium consisting of slope wash and/or decomposed bedrock. Geologic evidence of past debris flow flooding is not readily apparent; as such, we anticipate any fan-style debris flow would be relatively small and consist mainly of a thin sheet-flow of mud and water. While this hazard could cause flooding of basements and damage to landscaping, sheet-flow flooding would not pose a significant hazard to structures or human life. This hazard can be minimized by proper site grading and drainage design.

4.3.2 Landslides

There are several types of landslides that should be considered when evaluating geologic hazards at a site. These include shallow debris slides, deep-seated earth or rock slumps, flows, and creep in colluvium. Several of these landslide types are reported at or adjacent to proposed development at the subject site (see Figure A-3 in Appendix A). The majority of the proposed development is located within or immediately adjacent to areas mapped as landslide material undifferentiated from talus, colluvial, rockfall, glacial, or soil-creep deposits. Furthermore, evidence of past or current landslides were observed during our field investigation. TP-01 consisted of a chaotic jumbled mass of loose boulders, cobbles, and soil overlying fractured bedrock, suggesting a possible earthflow. Mapped landslides were in evidence above TP-03. Soils in TP-07 showed evidence of landslide deposits, and sag ponds were located upslope of the test pit location. Soils were exceptionally loose in TP-12, which is in an area mapped as undifferentiated landslide. With the exception of TP-09 through 11, soils site-wide were generally loose and homogenous with little or no stratification.

It is our opinion that much of the site is composed of loose incoherent deposits of shallow (e.g. less than 10 feet) colluvium, which is subject to creep. Creep movements typically progress at a rate measured in millimeters per year. The rate of creep usually increases during spring run-off. Due to differential movement of surficial soils colluvium creep can potentially damage underground utilities, roads, and structures on shallow foundations. Structures on deep foundations founded in competent soil or bedrock must be designed and constructed to withstand passive earth pressures from saturated soil in addition to snow loads. However, based on the information available we cannot preclude the possibility of more deep-seated landslide being present at the site.

4.3.3 Shallow Bedrock

Shallow bedrock should be considered when planning improvements that may require excavations in areas where bedrock is relatively shallow or exposed on the surface. Bedrock removal is generally expensive and time consuming. Shallow bedrock may consist of relatively unweathered sandstone, dolostone, or limestone. During our subsurface exploration the excavator met with early refusal on hard rock in TP-01, probably dolomite or limestone. Based on our observations, excavations extending several feet into moderately weathered bedrock may require special handling and/or blasting.

4.3.4 Karst Formation

Map review indicates that Cambrian Middle Limestone Member (Cbm) may be on site (See Figure A-2). Limestone formations are easily eroded by water (chemical dissolution), which can form underground caverns or crevices. In addition, limestone formations dissolve more readily in the presence of acidic compounds. If caverns become large, overlying soils have the potential to collapse and cause sinkholes. Structures built on karst formations have the potential to catastrophically collapse. In the previous geologic report by AMEC (2001), a depression potentially indicating a collapsed cavern was identified on-site.

The site exploration encountered soils composed of decomposed Wasatch Formation sandstone, decomposed dolostone, and Nounan dolostone bedrock. Although dolostone is not as susceptible to erosion by water as limestone, dolostone or sandstone may be underlain by limestone susceptible to erosion by acidic fluid. pH tests performed previously by AMEC and by IGES for this report indicate on-site soils exhibit an acidic pH. Coring where Cambrian Middle Limestone (Cbm) formation is suspected below surficial soils or colluvium is especially recommended to prevent possible sinkholes and associated upslope landslides.

5.0 GENERALIZED SITE CONDITIONS

5.1 SURFACE CONDITIONS

The Powder Mountain Weber County expansion property is an irregular-shaped site of about 2,000 acres. The site topography is moderately rugged and hilly, draining west toward the south fork of Wolf Creek. Maximum topographic relief across the site is estimated to be four hundred feet. Vegetation at the site includes some mature trees (scrub oak, quaking aspens), brush, weeds and grasses. With the exception of rough dirt roads and radio towers the site is largely undeveloped and is in a relatively natural state. Access to the site is gained from Powder Mountain Road (State Highway 158) and Powder Ridge Road.

5.2 SUBSURFACE CONDITIONS

The subsurface soil conditions were explored at the subject property by excavating eleven test pits across the site. Subsurface soil conditions were logged during our field investigation and are included in the test pit logs in Appendix A at the end of this report (Figures A-4 through A-14). The soil and moisture conditions encountered during our investigation are discussed below.

5.2.1 Soils

Topsoil: Topsoil was encountered throughout the site and generally consisted of Lean CLAY (CL) or silt (ML) with cobbles. The topsoil encountered was characterized by an abundance of organic matter (roots, etc.), a dark, loamy appearance, and was generally dry and ‘crumbly’. The thickness of topsoil observed was generally 6 inches or less. Localized areas of deeper topsoil deposits may exist within the creek drainages.

Native Surficial Soils: The majority of the shallow surficial soils encountered in the explorations consisted of cobbles and boulders within a Clayey GRAVEL (GC) matrix. The majority of surficial soils most likely consist of either colluvium or *decomposed* bedrock.

Bedrock: Based on our review of geologic literature, the site is underlain by bedrock consisting of Tertiary-age Wasatch Formation (Tw), which generally consists of unconsolidated conglomerate, Cambrian-age Nounan (Cn) and St. Charles (Csc)

Formations, which consist of medium to dark grey dolostone. It is anticipated that near-surface bedrock encountered will consist primarily of highly weathered to decomposed bedrock.

Test pit logs of the subsurface soil profiles are presented in Appendix A (Figures A-4 through A-14). The stratification lines shown on the enclosed test pit logs represent the approximate boundary between soil types. The actual in-situ transition may be gradual. Due to the nature and depositional characteristics of the native soils, care should be taken in interpolating subsurface conditions between and beyond the exploration locations.

5.2.2 Groundwater

Groundwater was not encountered in the test pits, however springs were active near TP-07 during site reconnaissance and exploration. During construction the groundwater elevation may increase locally due to precipitation, surface runoff, or other sources. We do not anticipate groundwater will adversely affect construction.

5.2.3 Expansive Soil

Expansive soils contain significant amounts of clay particles that change volume as a result of varying moisture conditions. Foundations and hardscape/pavements constructed on these soils may be subject to uplifting forces caused by the swelling. Without proper measures taken, heaving and cracking of building foundations, slabs-on-grade, or pavements could result. Soils that are potentially expansive typically exhibit a high degree of plasticity, i.e. Fat CLAY (CH) and Elastic SILT (ML). Although Fat CLAY and Elastic SILT are potentially expansive, the correlation between Atterberg Limits and expansion potential is crude at best; a soil that classifies as Fat CLAY or Elastic SILT is not necessarily expansive.

Based on Atterberg limits testing, the fine-grained soils encountered generally classified as Lean CLAY (CL) or SILT (ML). Based on the results of Atterberg Limits testing and our experience in the area, and review of AMEC’s geologic report, the onsite native soils are expected to have a low to moderate expansion potential.

5.2.4 Strength of Earth Materials

A sample of SILT with sand from TP-03 was tested to evaluate the inherent strength properties of site soils on the north side of the site. A direct shear test was completed on a relatively undisturbed sample. The results indicated the sample tested had an effective friction angle of 32 degrees and an effective cohesion of 36 psf (peak strength). IGES recommends further sampling and testing of site soils to obtain engineering parameters for detailed evaluation of foundations and for slope stability modeling.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS

Weber County specifically states in the Hillside Development Review Procedures and Standards that certain criteria must be met for development of property for the purpose of human habitation. Structures in areas that are considered steep (greater than 25% grade) and having special soil and/or geologic conditions are considered *restricted lots* (36B-2). The planning division requires that parcels, lots, roads and accesses, exceeding an average of a 25% grade, shall be reviewed by the Hillside Development Review Board as part of the application request. Structures proposed in a geologically sensitive areas are required to have a site-specific study performed by an engineering geologist and qualified civil engineer or architect (Weber County: Natural Hazards Overlay Districts – 38-2G). All recommendations herein are subject to change based on future studies, observations and supporting test data.

The following foundation and pavement designs are preliminary (for planning purposes only) and should not be used for construction. The purpose is to give the developer a better indication of construction procedures and design parameters which can be expected. They have been provided on the assumption that all geologic hazards will be assessed and mitigated to the satisfaction of Weber County and/or the subject site has been proven to be free from geologic hazards by an engineering geologist with adequate data.

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

6.2 PRELIMINARY FOUNDATION RECOMMENDATION

Based on our field observations and considering the presence of loose native earth materials, we recommend that the footings for proposed structures be founded *entirely* on overexcavated recompacted competent native soils. Competent native site soils would be described as predominantly granular soils with less than 25% fines, 10-60% sand, and no constituents greater than 6 inches. Soil should be placed and compacted in 8 inch loose lifts. Results from a sample of competent granular soil taken from TP-08 at 3 feet below ground surface yielded a rock corrected Maximum Dry Density (MDD) of 133.4 pcf and an Optimum Moisture Content (OMC) of 8.0%. It is recommended that soils are compacted to 95% of MDD and +2% of OMC as determined by Modified Proctor (ASTM D1557).

We recommend building pads be over-excavated a minimum of 2 feet below the bottom of proposed footings and replaced with recompacted native site soil or imported granular fill, such that the footings bear entirely on a uniform fill blanket. The bearing material should be free from pumping behavior when rolled. If soft, loose or otherwise deleterious earth materials are exposed in the footing excavations, then the overexcavation should be deepened such that all footings bear on relatively uniform, competent native earth materials.

As mentioned previously all fill beneath foundations should consist of structural fill and should be placed and compacted in accordance with our recommendations. Shallow spread or continuous wall footings constructed on 2 ft (minimum) thick zone of structural fill may be proportioned utilizing a maximum net allowable bearing pressure of **2,000 pounds per square foot (psf)**. The net allowable bearing values presented above are for dead load plus live load conditions.

All foundations exposed to the full effects of frost should be established at a minimum depth of 42 inches below the lowest adjacent final grade. Interior footings, not subjected to the full effects of frost (i.e., a continuously heated structure), may be established at higher elevations, however, a minimum depth of embedment of 18 inches is recommended for confinement purposes. The minimum recommended footing width is 24 inches for continuous wall footings and 30 inches for isolated spread footings.

Foundation drains should be installed around below ground foundations to prevent flooding from shallow groundwater which may be present at various times during the year.

6.2 PRELIMINARY PAVEMENT SECTION DESIGN

Based on soil classifications and laboratory obtained CBR values of 1.8 and 5.5 for the native soil tested, the near-surface soils are expected to provide poor to fair pavement support. Anticipated traffic volumes were not available at the time this report was prepared. However, based on our understanding of the project development we assume traffic on roadways would be very minimal. The following pavement designs have been developed assuming a 20-year design life, with a 2 percent annual growth rate, assuming 30 passenger cars per day and 10 H20 trucks per week one way resulted in 784,000 ESALs for the main roadway accessing the community. The southeast road pavement design was designed with the same design life and performance requirements, using only half the traffic. Based on the information obtained and the above mentioned assumptions, we recommend the following pavement section be constructed on properly prepared subgrade:

Table 6.2.1 - Preliminary Pavement Sections

Roadway/Area	North Road	Southeast Road
CBR	5.5	1.8
Asphalt Concrete Pavement (inches)	5	5
Untreated Road Base (inches)	10	14

Consideration should also be given to using a geotextile as part of the pavement construction. Given the remote location of the site, using geotextiles will allow for a reduction in the required thickness of imported roadbase; decreasing construction time, related materials handling and hauling/placement costs.

During construction, a significant amount of heavy construction traffic is typical. Some distress may occur on the pavement during this initial construction time period. Maintenance may need to be performed after completion of construction of the development.

Asphalt has been assumed to be a high stability plant mix and base course material composed of crushed stone with a minimum CBR of 70. Road base should be compacted to 95% of MDD as determined by ASTM D-1557 (Modified Proctor). Asphalt should be compacted to a minimum of 96 percent of the Marshall maximum density. Asphalt and aggregate base material should conform to local requirements. Subgrade should be scarified to a depth of 8 inches and compacted to 95% of MDD as determined by ASTM D-1557. Positive drainage away from roadways must be provided to prevent potential swell or collapse of moisture sensitive soils.

Where Portland Cement Concrete (PCC) pavements are planned, such as near trash enclosures or other areas expected to support heavy truck traffic, we recommend a minimum of 6 inches PCC underlain by a minimum 6 inches of aggregate base course.

If conditions vary significantly from our stated assumptions (including stated traffic assumptions) IGES should be contacted so we can modify our pavement design parameters accordingly. The County or other governing authority may have pavement requirements over and above those listed and these should be adhered to where applicable.

6.3 MOISTURE PROTECTION AND SURFACE DRAINAGE

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

Slope Protection: To aid in maintaining surficial slope stability, we recommend that a water interceptor swale be constructed at the top of engineered slopes (cut slopes exposing surficial soil, fill slopes). This swale should be designed to intercept all uphill slope drainage and divert the drainage around the slopes. The drainage should be controlled as it travels around the slopes and should be tied into the curb and gutter or other drainage system associated with the road. This recommendation does not apply to cut slopes that are comprised solely of hard, competent bedrock.

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

We recommend that hand watering, desert landscaping or Xeriscape be considered within 5 feet of the foundations. We further recommend roof runoff devices be installed to direct all runoff a minimum of 10 feet away from structures. The home builder should be responsible for compacting the exterior backfill soils around the foundation. Additionally, the ground surface within 10 feet of the house should be constructed so as to slope a minimum of two percent away from the home. Pavement sections should be constructed to divert surface water off of the pavement into storm drains. Parking strips and roadway shoulder areas should be constructed to prevent infiltration of water into the areas surrounding pavement. Landscape plans must conform to Weber County development codes.

6.4 LANDSLIDE EVALUATION

Oftentimes the 30'x60' Quadrangles are compiled using aerial photographs without visiting the majority of the locations within the mapping area. Therefore, many landslides are lumped into *undifferentiated* classifications, which could consist of relatively shallow, surficial slumps, to deep-seated rotational slides, or anything in-between. The extents of the landslides may also be loosely identified. Additional landslide study should be performed which would determine the actual extents of potential landslide masses. IGES recommends that a detailed landslide study be performed for the proposed development at the subject site. The study should include development of a detailed geologic map of the site and development of a landslide map that will differentiate between the different mass wasting units and the specific geologic characteristics of landslides present.

6.5 PRELIMINARY SOIL CORROSION POTENTIAL

To evaluate the corrosion potential of concrete in contact with onsite native soil, representative soil samples were tested in our soils laboratory for soluble sulfate content. Laboratory test results indicate that the samples tested had sulfate contents ranging from <5.44 to 47.9 ppm. Based on this result, the onsite native soils are expected to exhibit a low potential for sulfate attack to concrete.

To evaluate the corrosion potential of ferrous metal in contact with onsite native soil, representative soil samples were tested in our soils laboratory for electrical resistivity (AASHTO T288), chloride content, and pH. The tests indicated that the onsite soil tested has minimum soil resistivity ranging from 5,600 to 14,000 OHM-cm, chloride content less than 57.5 ppm, and a minimum pH value of 4.0. Based on these results, the onsite native soil is considered moderately corrosive to ferrous metal.

Consideration should be given to retaining the services of a qualified corrosion engineer to provide an assessment of any metal and concrete that may be associated with planned construction. Including buried utilities, reinforcing steel, valves, and similar improvements in contact with native soils. Due to low soil pH (acidic soil chemistry), the corrosion engineer should also provide an assessment of any concrete that may in contact with native soils. Drilling of site soils and coring of site rock is recommended to ascertain the acid sensitivity of underlying rock and its continuity.

7.0 CLOSURE

7.1 LIMITATIONS

The recommendations contained in this report are preliminary and based on limited field exploration, laboratory testing, review of existing hazard studies and other geotechnical data, and our understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and groundwater conditions could exist between and beyond the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, we should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, IGES should also be notified.

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

It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

7.2 ADDITIONAL SERVICES

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

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

- Quality control and testing during placement and compaction of asphalt.

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

We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience (801) 270-9400.

8.0 REFERENCES

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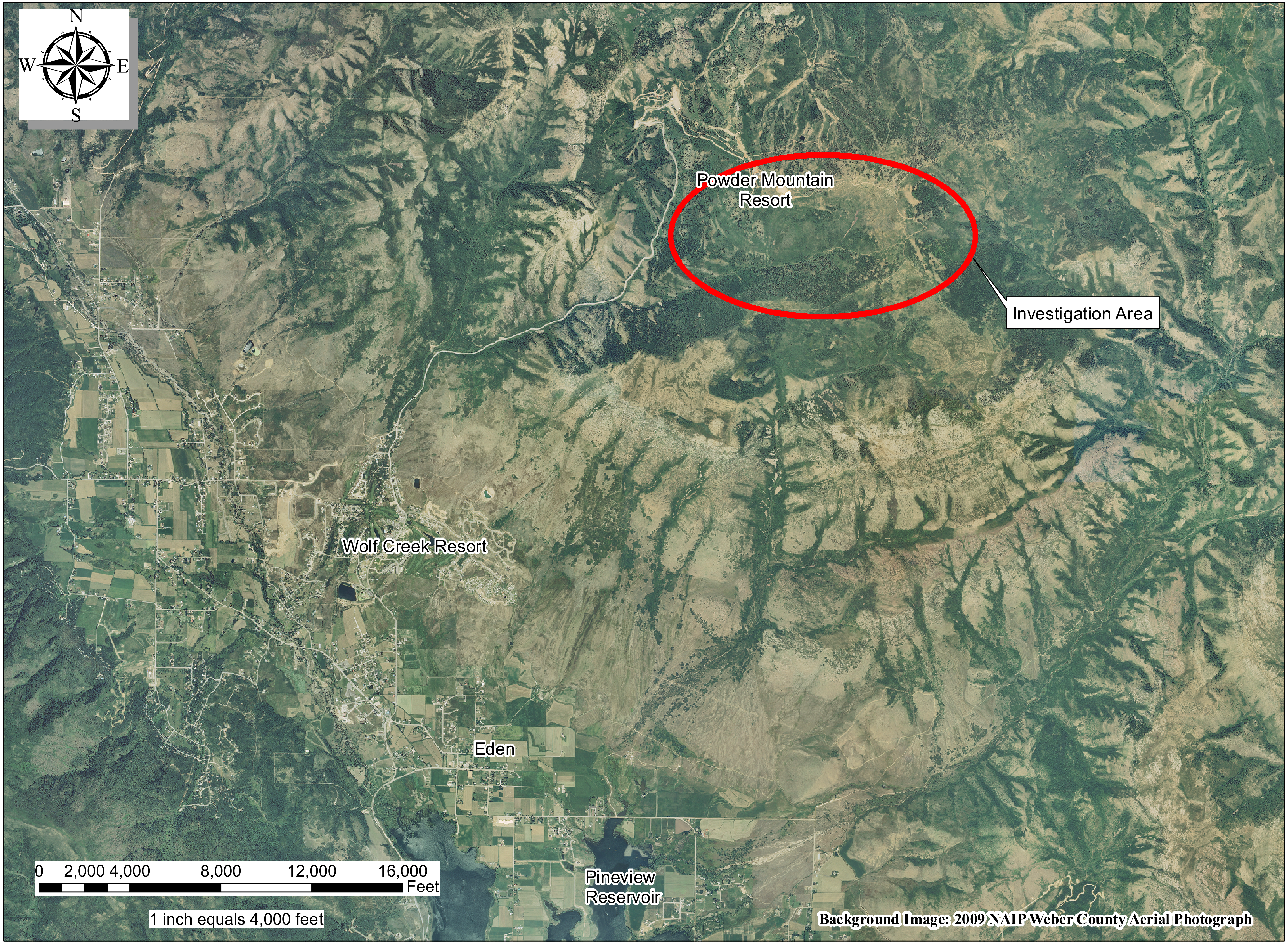
APPENDIX A



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(801) 270-9400 (T)
(801) 270-9401 (F)

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ISSUE: DRAFT

PROJECT#:	01628-001
FILE LOCATION:	01628\001\Maps\GIS\Site_map.mxd
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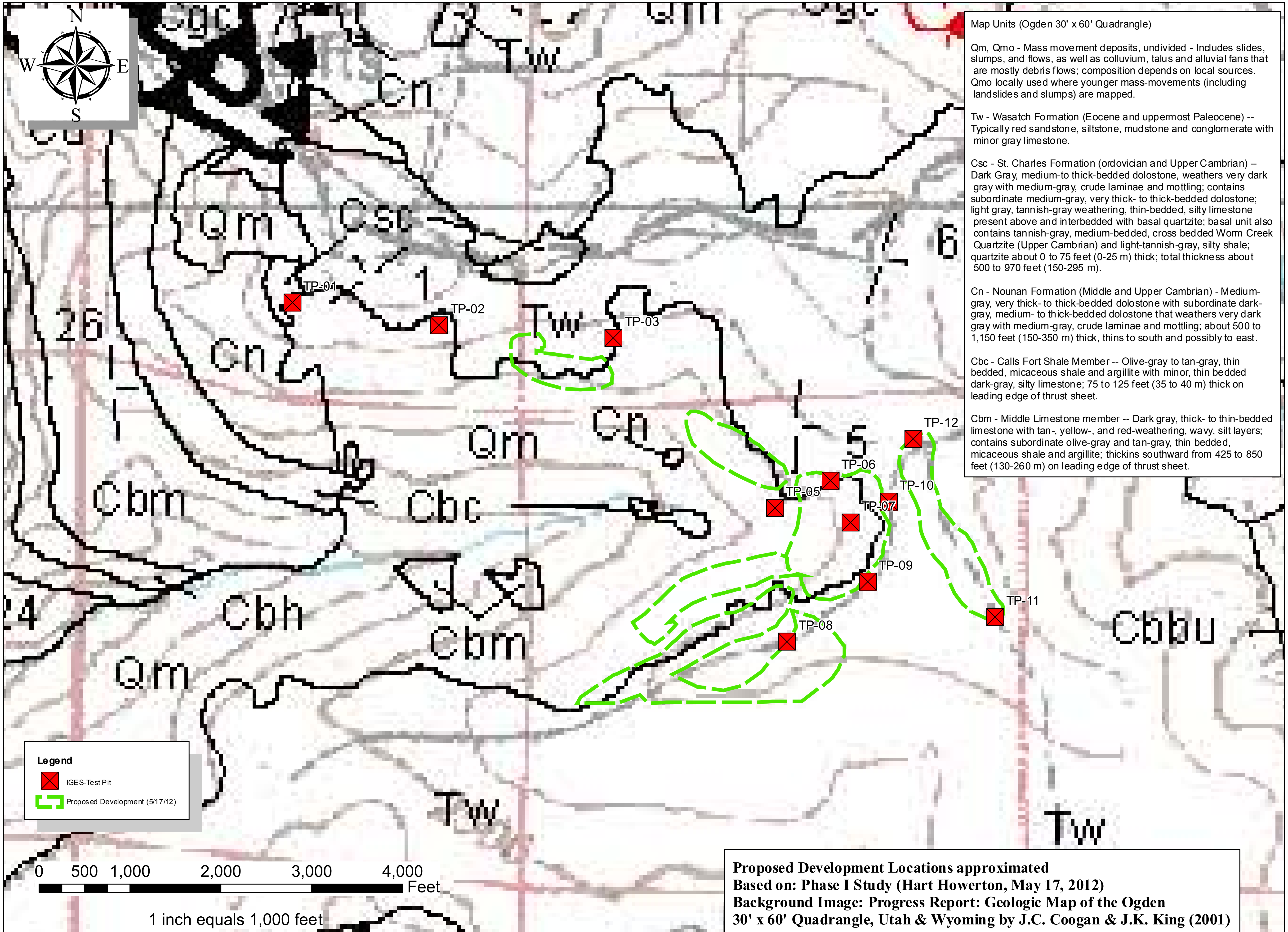
SHEET TITLE

Powder Mountain

SITE VICINITY MAP

FIGURE

A-1



Map Units (Ogden 30' x 60' Quadrangle)

Qm, Qmo - Mass movement deposits, undivided - Includes slides, slumps, and flows, as well as colluvium, talus and alluvial fans that are mostly debris flows; composition depends on local sources. Qmo locally used where younger mass-movements (including landslides and slumps) are mapped.

Tw - Wasatch Formation (Eocene and uppermost Paleocene) -- Typically red sandstone, siltstone, mudstone and conglomerate with minor gray limestone.

Csc - St. Charles Formation (ordovician and Upper Cambrian) – Dark Gray, medium-to thick-bedded dolostone, weathers very dark gray with medium-gray, crude laminae and mottling; contains subordinate medium-gray, very thick- to thick-bedded dolostone; light gray, tannish-gray weathering, thin-bedded, silty limestone present above and interbedded with basal quartzite; basal unit also contains tannish-gray, medium-bedded, cross bedded Worm Creek Quartzite (Upper Cambrian) and light-tannish-gray, silty shale; quartzite about 0 to 75 feet (0-25 m) thick; total thickness about 500 to 970 feet (150-295 m).

Cn - Nounan Formation (Middle and Upper Cambrian) - Medium-gray, very thick- to thick-bedded dolostone with subordinate dark-gray, medium- to thick-bedded dolostone that weathers very dark gray with medium-gray, crude laminae and mottling; about 500 to 1,150 feet (150-350 m) thick, thins to south and possibly to east.

Cbc - Calls Fort Shale Member -- Olive-gray to tan-gray, thin bedded, micaceous shale and argillite with minor, thin bedded dark-gray, silty limestone; 75 to 125 feet (35 to 40 m) thick on leading edge of thrust sheet.

Cbm - Middle Limestone member -- Dark gray, thick- to thin-bedded limestone with tan-, yellow-, and red-weathering, wavy, silt layers; contains subordinate olive-gray and tan-gray, thin bedded, micaceous shale and argillite; thickins southward from 425 to 850 feet (130-260 m) on leading edge of thrust sheet.

Proposed Development Locations approximated
Based on: Phase I Study (Hart Howerton, May 17, 2012)
Background Image: Progress Report: Geologic Map of the Ogden 30' x 60' Quadrangle, Utah & Wyoming by J.C. Coogan & J.K. King (2001)

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ISSUE: DRAFT
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FILE LOCATION: 01628\001\Maps\GIS\Site_map.mxd
DRAWN BY: JH
DESIGNED BY: BM
CHECKED BY: BM
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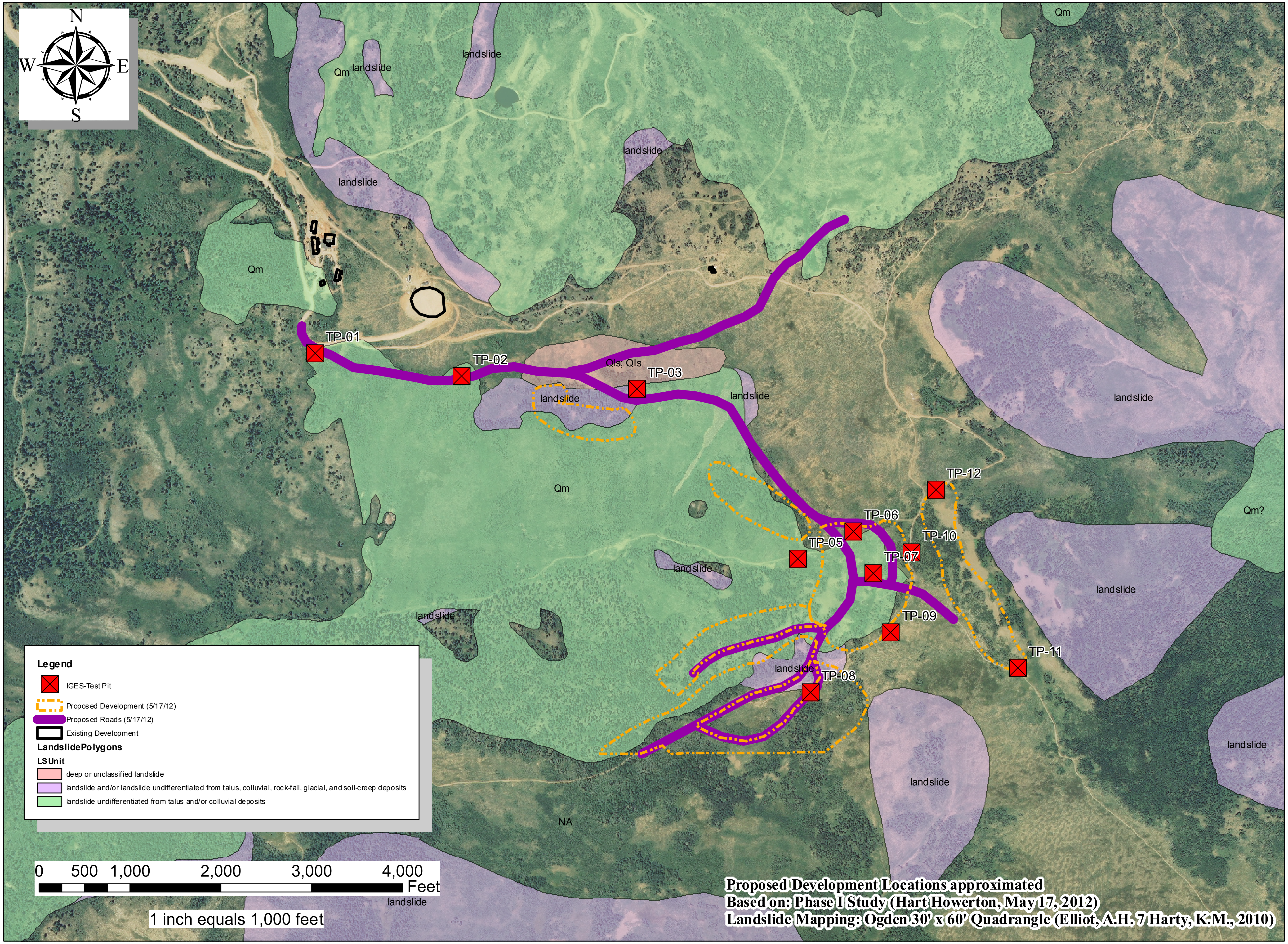
SHEET TITLE
Powder Mountain
SITE GEOLOGIC MAP

FIGURE
A-2



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SHEET TITLE

Powder Mountain

SITE PLAN

FIGURE

A-3

DATE		
STARTED:	7/2/12	
COMPLETED:	7/2/12	
BACKFILLED:	7/2/12	

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah

Project Number 01628-001

IGES Rep: JMG
Rig Type: Kubota KX080-3

TEST PIT NO: **TP-01**
Sheet 1 of 1

LOCATION: NORTHING 41.37 EASTING 111.77 ELEVATION 8,722.56

MATERIAL DESCRIPTION

Depth (Meters)	Depth (Feet)	Samples	Unified Soil Classification	Material Description	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0			Clayey GRAVEL - 30 to 40% cobbles and boulders - medium dense, slightly moist, brown, some organics, boulders bedded various directions (stratigraphy not evident) loose gravel in 3-ft by 2-ft pockets, boulders encountered primarily limestone up to 3-ft at smallest dimension, some rounded rock in upper 12-in					
		Grab	GC						
		Grab	GC						
1				- excavation raveling					
		Grab	GC			4.4	21.6	34	13
	5								
				- excavation raveling					
2									
		Grab		Nounan Formation - dark grey dolostone with thin veins of quartzite stringers, no reaction to HCl					
				Bottom of Test Pit @ 8.5 Feet					
3	10								

Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit (scale 10 20 30 40 50 60 70 80 90)

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-4

DATE	
STARTED:	7/2/12
COMPLETED:	7/2/12
BACKFILLED:	7/2/12

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah

Project Number 01628-001

IGES Rep: JMG
Rig Type: Kubota KX080-3

TEST PIT NO: **TP-02**
Sheet 1 of 1

LOCATION
NORTHING 41.37 EASTING 111.76 ELEVATION 8,672.72

MATERIAL DESCRIPTION

DEPTH (METERS)	DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0	GM	Silty GRAVEL - 30% cobbles and boulders - dense, slightly moist, brown, cobbles and boulders rounded, up to 2.5' - excavation standing vertical					
1		SM	Silty SAND with gravel - 30% cobbles and boulders - dense, slightly moist, reddish-brown, boulders up to 1.5'					
	5	SM						
2		SC	Clayey SAND with gravel - 20% cobbles - dense, moist, reddish-brown					
3	10	SC	- excavation held vertical walls to 10 feet					
			Bottom of Test Pit @ 10.5 Feet					

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-5

DATE	
STARTED:	7/2/12
COMPLETED:	7/2/12
BACKFILLED:	7/2/12

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah
Project Number 01628-001

IGES Rep: JMG
Rig Type: Kubota KX080-3

TEST PIT NO: **TP-03**
Sheet 1 of 1

LOCATION
NORTHING 41.37 EASTING 111.76 ELEVATION 8,603.30

Depth (Feet)	Samples	USCS	MATERIAL DESCRIPTION	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			SILT with sand - medium stiff, slightly moist, brown					
	Grab	ML			10.5	73.5	41	14
	3" O.D. thin-walled hand sampler	ML	- top 4' of excavation raveling					
	3" O.D. thin-walled hand sampler	GC	Clayey GRAVEL - dense, moist, reddish-brown	102.1	21.2			
5								
	Grab	CL	Lean CLAY with gravel - medium stiff, moist, red mottled with yellow		32.4	80.3	48	27
	Grab	CL	Sandy Lean CLAY with gravel - medium stiff, moist, grey mottled with reddish-brown, angular gravel up to 3/4"		32.5	58.9	43	22
			Bottom of Test Pit @ 8.5 Feet					
10								

Moisture Content and Atterberg Limits (Plastic Limit — Moisture Content — Liquid Limit; scale 10 20 30 40 50 60 70 80 90)

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-6

DATE	
STARTED:	7/2/12
COMPLETED:	7/2/12
BACKFILLED:	7/2/12

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah

Project Number 01628-001

IGES Rep: JMG

Rig Type: Kubota KX080-3

TEST PIT NO:

TP-05

Sheet 1 of 1

LOCATION

NORTHING 41.36 EASTING 111.75 ELEVATION 8,488.35

MATERIAL DESCRIPTION

DEPTH (METERS)	DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0	ML	Gravelly SILT - stiff, dry, light brown, some cobbles					
		SM	Silty SAND with gravel - 20% cobbles - dense, slightly moist, light reddish brown, some boulders up to 2.5' throughout					
1	5	GC	Clayey GRAVEL with sand - 20% cobbles - dense, moist, reddish brown		10.6		27	10
2		GC-GM	Silty Clayey GRAVEL with sand - 20% cobbles - dense, moist, reddish brown					
			Bottom of Test Pit @ 9 Feet					
3	10							

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

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

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:
No ground water encountered

Figure A-7

DATE		
STARTED:	7/3/12	
COMPLETED:	7/3/12	
BACKFILLED:	7/3/12	

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah

Project Number 01628-001

IGES Rep: DAG

Rig Type: Kubota KX080-3

TEST PIT NO:

TP-06

Sheet 1 of 1

LOCATION

NORTHING 41.36 EASTING 111.75 ELEVATION 8,506.30

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				GM	Silty GRAVEL with sand - 50% gravel, cobbles, and boulders - medium dense, moist, reddish brown, subrounded gravel, cobbles and boulders up to 3 feet in silty sand matrix, easy to excavate, homogenous appearance - uniform from top to bottom					
	5	Grab sample						9.7	35.7		
	8					Bottom of Test Pit @ 8 Feet					
3	10										

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure

A-8

DATE		
STARTED:	7/3/12	
COMPLETED:	7/3/12	
BACKFILLED:	7/3/12	

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah

Project Number 01628-001

IGES Rep: DAG

Rig Type: Kubota KX080-3

TEST PIT NO: **TP-07**

Sheet 1 of 1

LOCATION

NORTHING 41.36 EASTING 111.75 ELEVATION 8,481.63

DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	CL	Gravelly Lean CLAY - medium stiff, slightly moist, yellowish brown, subrounded gravel and cobble in a lean clay matrix, low plasticity clay, roots; homogenous appearance, possible debris flow or landslide deposits)					
(grab sample)				15.5	55.9	36	18
	GC	Clayey GRAVEL with sand - moist, reddish brown, with coarse, clayey sand matrix, subrounded gravel and cobble					
(grab sample)				9.2	15.8		
10		- possible landslide deposits					
11		Bottom of Test Pit @ 11 Feet					

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-9

DATE		
STARTED:	7/2/12	
COMPLETED:	7/3/12	
BACKFILLED:	7/3/12	

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah
Project Number 01628-001

IGES Rep: DAG
Rig Type: Kubota KX080-3

TEST PIT NO: **TP-08**
Sheet 1 of 1

LOCATION
NORTHING 41.36 EASTING 111.75 ELEVATION 8,504.52

DEPTH (METERS)	DEPTH (FEET)	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				CL	Lean CLAY with sand and gravel - medium stiff, dry, medium brown, low plasticity, abundant sand and rounded gravel and cobbles, thin topsoil ~4 to 6"						
					SC	Clayey SAND with gravel - dense, moist, reddish brown, well-rounded gravel and cobble in very stiff to hard clayey matrix						
1	5	Grab sample							21.6	32	12	
2					SC	Clayey SAND with gravel - medium dense to loose, moist, reddish brown, medium grained, well-rounded gravel and some cobbles, moderately difficult to excavate						
		Grab sample						12.0		34	13	
						Bottom of Test Pit @ 9 Feet						
3	10											

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-10

DATE		
STARTED:	7/3/12	
COMPLETED:	7/3/12	
BACKFILLED:	7/3/12	

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah
Project Number 01628-001

IGES Rep: DAG
Rig Type: Kubota KX080-3

TEST PIT NO: **TP-09**
Sheet 1 of 1

LOCATION
NORTHING 41.36 EASTING 111.75 ELEVATION 8,533.41

MATERIAL DESCRIPTION

DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	CL	Lean CLAY with sand and gravel - soft, slightly moist, medium brown, low plasticity clay, easy to excavate,abundant roots, well-rounded gravel and cobble					
	SC	Clayey SAND with gravel - medium dense, moist, reddish brown, medium grained, subangular to subrounded gravel to 3", well-bedded, stratified, some roots					
	GC	Clayey GRAVEL with sand - dense, moist, reddish brown, well-rounded gravel and cobble to 8", some boulders to 3', very stiff clayey sand matrix, difficult excavation, homogenous - possible landslide		13.9	39.2		
8		Bottom of Test Pit @ 8 Feet					

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-11

DATE	
STARTED:	7/3/12
COMPLETED:	7/3/12
BACKFILLED:	7/3/12

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah

Project Number 01628-001

IGES Rep: DAG
Rig Type: Kubota KX080-3

TEST PIT NO:
TP-10
Sheet 1 of 1

LOCATION
NORTHING 41.36 EASTING 111.74 ELEVATION 8,572.90

MATERIAL DESCRIPTION

DEPTH (FEET)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		CL	Lean CLAY with sand and gravel - loose, dry, yellowish brown, ~15% subrounded gravel to 3", topsoil to 2", well-rooted, krotovina					
		SC	Clayey SAND with gravel - dense, moist reddish brown, subrounded gravel and cobble, occasional boulders to 3.5', moderately cemented, homogenous, mottled appearence					
	Grab					21.8	36	15
	Grab	SM	Silty SAND with gravel to cobbles, some boulders					
			Bottom of Test Pit @ 8.5 Feet					

Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit; scale 10 20 30 40 50 60 70 80 90

Depth scale: METERS 0, 1, 2, 3; FEET 0, 5, 10

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-12

DATE	
STARTED:	7/3/12
COMPLETED:	7/3/12
BACKFILLED:	7/3/12

Geotechnical Investigation
Summit, LLC
Powder Mountain Development
Weber County, Utah — Project Number 01628-001

IGES Rep: DAG
Rig Type: Kubota KX080-3

TEST PIT NO: **TP-11**
Sheet 1 of 1

LOCATION
NORTHING 41.36 EASTING 111.74 ELEVATION 8,533.64

MATERIAL DESCRIPTION

Depth (feet)	USCS	Material Description	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	CL	Topsoil - Lean CLAY with sand and gravel - medium yellowish brown, roots					
	CL	Lean CLAY with sand - stiff, very moist, reddish brown, low plasticity, ~ 25% fine sand, roots through abundant fissures, homogenous, porous		13.7	75.3		
	SM	- 12" lens of Silty SAND - medium grained, low to non-plastic fines					
	CL	Lean CLAY - stiff, moist, reddish brown, low plasticity, ~15% sand					
	GC	Clayey GRAVEL with sand - dense, moist, grayish brown, coarse gravel and subrounded cobble in a clayey sand matrix		15.8	41.1	25	9
9.5		Bottom of Test Pit @ 9.5 Feet					

Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit; scale 10 20 30 40 50 60 70 80 90

Depth scale: METERS 0, 1, 2, 3; FEET 0, 5, 10

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-13

DATE		Geotechnical Investigation	IGES Rep: JMG	TEST PIT NO:
STARTED: 7/2/12	COMPLETED: 7/2/12	Summit, LLC Powder Mountain Development Weber County, Utah — Project Number 01628-001	Rig Type: Kubota KX080-3	TP-12 Sheet 1 of 1
BACKFILLED: 7/2/12				

LOCATION

NORTHING 41.36 EASTING 111.74 ELEVATION 8,565.58

Depth (Feet)	USCS	MATERIAL DESCRIPTION
0 – 4	SM	Silty SAND with gravel - 50% cobble and boulders - medium dense, slightly moist, medium dense, brown, cobble and gravel rounded to subrounded, boulders up to 2.5' - test pit easy to excavate, excavation fairly homogenous and loose to to 7.5', excavation raveling throughout
4 – 5	ML	Sandy SILT - 60-80% cobbles - soft, slightly moist, cobbles 2 to 4", predominant voids
5 – 7.5	SM	Silty SAND with gravel - 40 to 50% cobbles - medium dense, moist, brown, boulders up to 1.5'
7.5 – 8.5	GC	Clayey GRAVEL with sand - 30% cobbles - dense, moist, brown, gravel up to 1.5"
8.5		Bottom of Test Pit @ 8.5 Feet

Columns: DEPTH (METERS, FEET), SAMPLES, WATER LEVEL, GRAPHICAL LOG, UNIFIED SOIL CLASSIFICATION, MATERIAL DESCRIPTION, Dry Density(pcf), Moisture Content %, Percent minus 200, Liquid Limit, Plasticity Index, Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)

Depth scale: Meters 0, 1, 2, 3; Feet 0, 5, 10

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

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
No ground water encountered

Figure A-14

UNIFIED SOIL CLASSIFICATION SYSTEM

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

LOG KEY SYMBOLS

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

CEMENTATION

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

OTHER TESTS KEY

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

MODIFIERS

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

MOISTURE CONTENT

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

STRATIFICATION

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

GENERAL NOTES

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

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

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

CONSISTENCY - FINE-GRAINED SOIL

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

KEY TO SOIL SYMBOLS AND TERMINOLOGY

IGES

Project Number 01628-001

Plate A-15

APPENDIX B

SUMMARY OF LABORATORY TEST RESULTS TABLE

Preliminary Geotechnical Investigation **Summit LLC/Powder Mountain Weber County Development** **Project No: 01628-001**

SAMPLE LOCATION		Natural Dry Density (pcf)	Natural Moisture Content (%)	GRADATION			ATTERBERG LIMITS							CHEMICAL TESTS				
Point No.	Depth (ft)			Gravel >#4 (%)	Sand (%)	Silt and Clay <#200 (%)	Liquid Limit	Plasticity Index	Direct Shear c' (psf)	Direct Shear phi' (degrees)	Proctor (Standard) MDD (pcf)	Proctor (Standard) OMC (%)	CBR (%)	Soluable Sulfate (ppm)	Chloride Content (ppm)	Resistivity (Minimum ohm-cm)	pH	pH $CaCl_2$
TP-01	4		4.4	70.7	7.7	21.6	34	13										
TP-02	1													<5.44	<54.4	5600	5.2	4.8
TP-03	0.5		10.5			73.5	41	14			98.2	19.9	5.5					
TP-03	2								36	32								
TP-03	4	102.1	21.2															
TP-03	6		32.4			80.3	48	27										
TP-03	8		32.5	17.0	24.1	58.9	43	22										
TP-05	6		10.6				27	10						32.1	<55.4	14000	4.0	3.3
TP-06	5		9.7			35.7												
TP-07	4		15.5			55.9	36	18										
TP-07	7		9.2			15.8												
TP-08	3			29.9	44.3	21.6	32	12			133.4	8.0						
TP-08	7.5		12.0				34	13										
TP-09	3													24.6	<53.0	13000	4.1	3.8
TP-09	5		13.9			39.2												
TP-10	4			29.4	44.0	21.8	36	15										
TP-11	2		13.7			75.3					107.3	16.7	1.8					
TP-11	7		15.8			41.1	25	9						47.9	<57.7	5800	4.7	3.9

Moisture Content and Unit Weight of Soil

(In General Accordance with ASTM D2937 and D2216)

Project: **Powder Mountain**
No: **01628-001**
Location: Weber County
Date: 7/12/2012
By: JDF

Sample Info.	Boring No.	TP-01	TP-03	TP-03	TP-03	TP-05	TP-07	TP-08	TP-11
	Sample								
	Depth	4'	0.5'	4'	6'	6'	4'	7.5'	7'
	Split	Yes	Yes	No	No	No	No	No	No
	Split sieve	3/4"	3/8"						
	Total sample (g)	4344.48	14739.90						
	Moist coarse fraction (g)	1965.20	790.00						
	Moist split fraction (g)	2379.28	13949.90						
Unit Weight Data	Sample height, H (in)			3.421					
	Sample diameter, D (in)			2.416					
	Wt. rings + wet soil (g)			509.53					
	Wt. rings/tare (g)			0.00					
	Moist unit wt., γ_m (pcf)			123.8					
Coarse Fraction	Wet soil + tare (g)	2373.22	909.88						
	Dry soil + tare (g)	2346.14	905.39						
	Tare (g)	408.43	119.97						
	Moisture content (%)	1.4	0.6						
Split Fraction	Wet soil + tare (g)	2056.10	781.78	637.79	717.51	1093.35	617.96	685.04	739.74
	Dry soil + tare (g)	1941.07	732.48	548.77	571.84	1009.73	564.35	625.40	669.30
	Tare (g)	310.46	288.34	128.26	122.18	222.28	219.21	126.63	223.55
	Moisture content (%)	7.1	11.1	21.2	32.4	10.6	15.5	12.0	15.8
	Moisture Content, w (%)	**4.4**	**10.5**	**21.2**	**32.4**	**10.6**	**15.5**	**12.0**	**15.8**
	Dry Unit Wt., γ_d (pcf)			**102.1**					

Entered by:___________

Reviewed:___________

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: BRR

Boring No.: TP-01
Sample:
Depth: 4'
Description: Brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

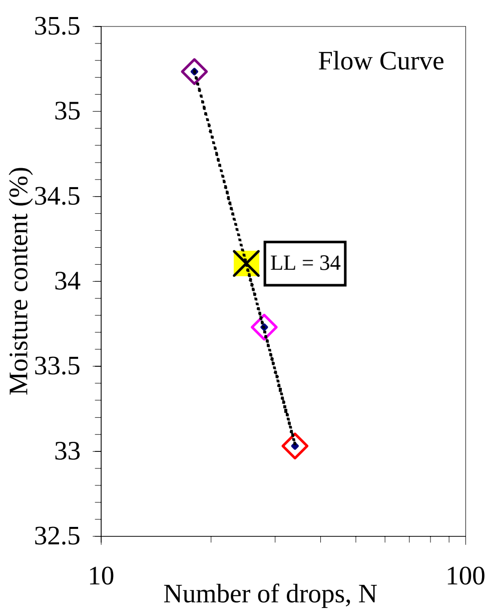
Plastic Limit

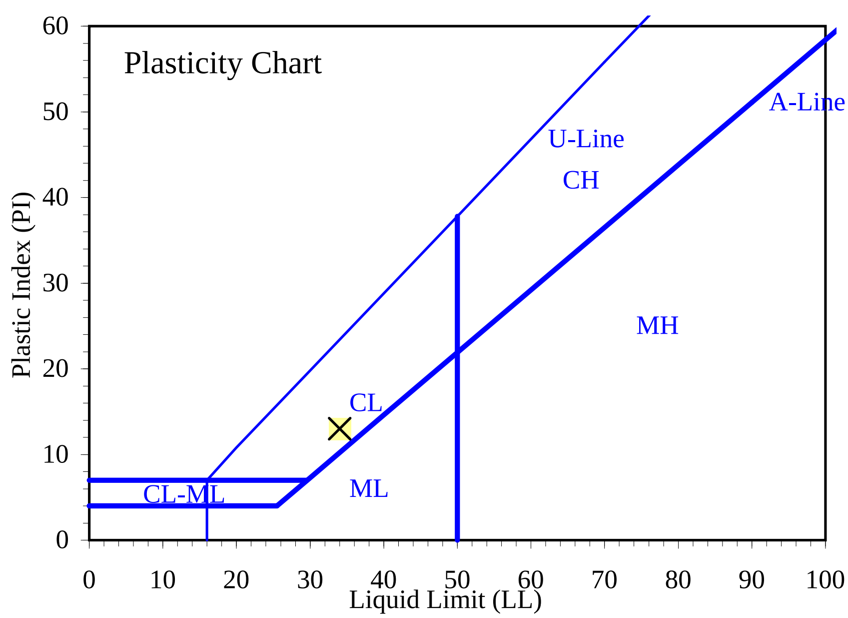
Determination No	1	2				
Wet Soil + Tare (g)	30.17	32.22				
Dry Soil + Tare (g)	28.62	30.38				
Moisture Loss (g)	1.55	1.84				
Tare (g)	21.32	21.80				
Dry Soil (g)	7.30	8.58				
Moisture Content, w (%)	21.23	21.45				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	34	28	18			
Wet Soil + Tare (g)	31.59	32.64	33.18			
Dry Soil + Tare (g)	29.04	29.81	30.09			
Moisture Loss (g)	2.55	2.83	3.09			
Tare (g)	21.32	21.42	21.32			
Dry Soil (g)	7.72	8.39	8.77			
Moisture Content, w (%)	33.03	33.73	35.23			
One-Point LL (%)		34				

Liquid Limit, LL (%)	**34**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**13**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: BRR

Boring No.: TP-03
Sample:
Depth: 0.5'
Description: Dark brown silt

Preparation method: Air Dry
Liquid limit test method: Multipoint

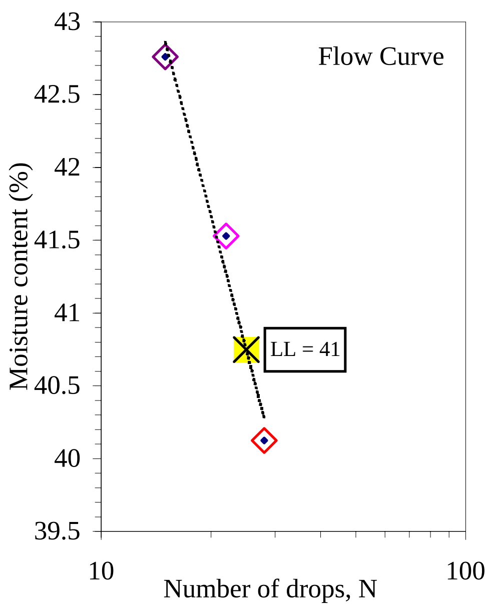
Plastic Limit

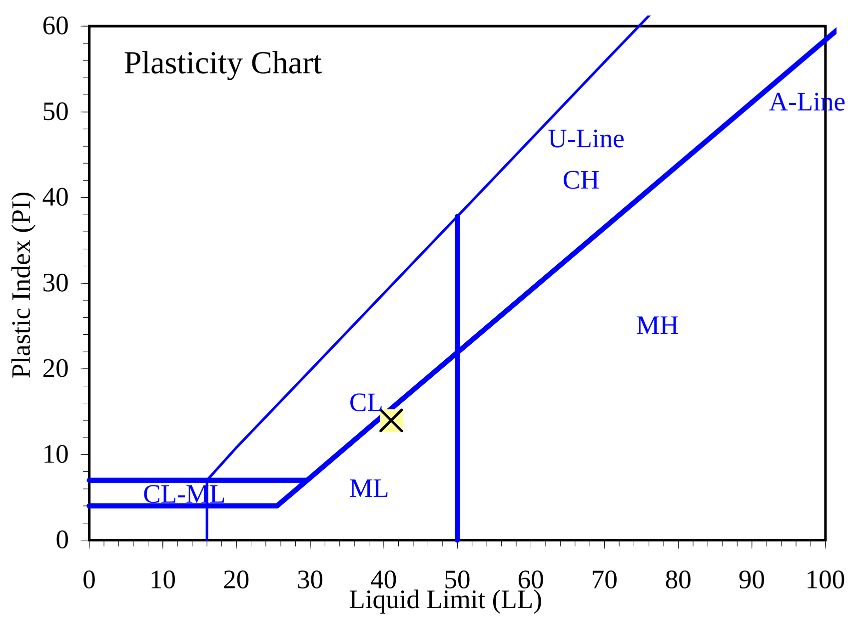
Determination No	1	2			
Wet Soil + Tare (g)	32.50	31.29			
Dry Soil + Tare (g)	30.19	29.13			
Moisture Loss (g)	2.31	2.16			
Tare (g)	21.52	21.05			
Dry Soil (g)	8.67	8.08			
Moisture Content, w (%)	26.64	26.73			

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	28	22	15			
Wet Soil + Tare (g)	32.84	31.90	31.83			
Dry Soil + Tare (g)	29.59	28.86	28.67			
Moisture Loss (g)	3.25	3.04	3.16			
Tare (g)	21.49	21.54	21.28			
Dry Soil (g)	8.10	7.32	7.39			
Moisture Content, w (%)	40.12	41.53	42.76			
One-Point LL (%)	41	41				

Liquid Limit, LL (%)	**41**
Plastic Limit, PL (%)	**27**
Plasticity Index, PI (%)	**14**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: BRR

Boring No.: TP-03
Sample:
Depth: 6'
Description: Red/brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

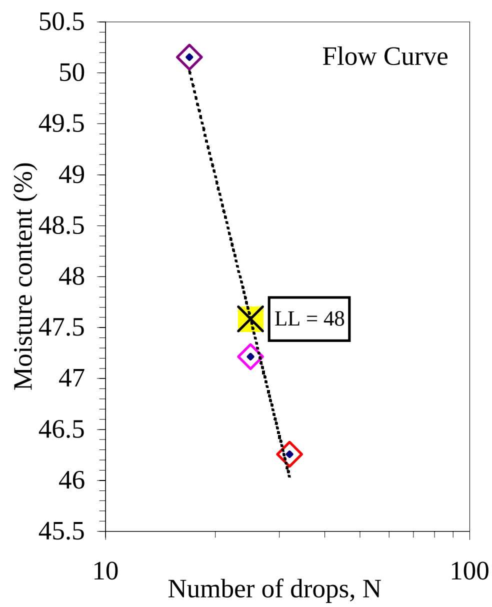
Plastic Limit

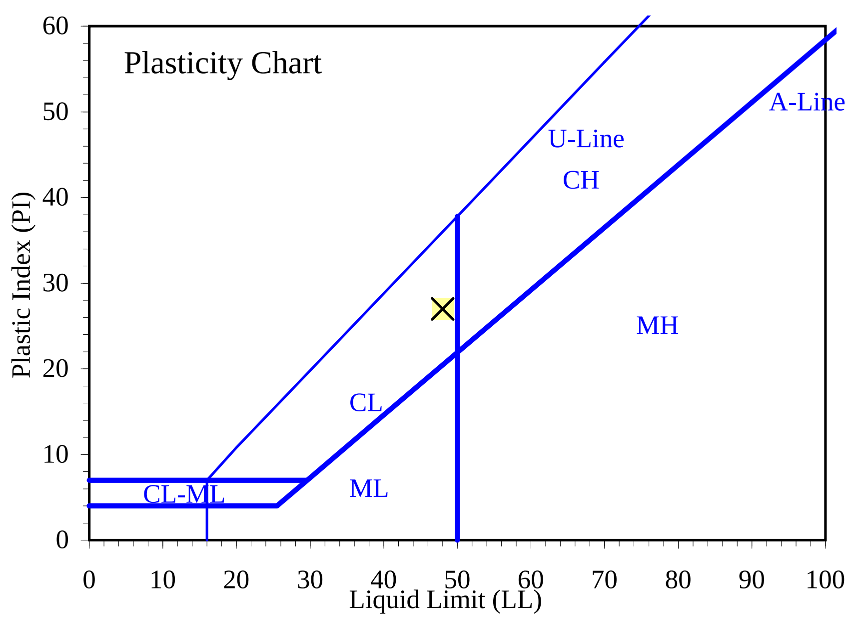
Determination No	1	2			
Wet Soil + Tare (g)	29.90	32.78			
Dry Soil + Tare (g)	28.43	30.80			
Moisture Loss (g)	1.47	1.98			
Tare (g)	21.56	21.49			
Dry Soil (g)	6.87	9.31			
Moisture Content, w (%)	21.40	21.27			

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	32	25	17			
Wet Soil + Tare (g)	30.99	31.46	31.08			
Dry Soil + Tare (g)	27.90	28.24	27.86			
Moisture Loss (g)	3.09	3.22	3.22			
Tare (g)	21.22	21.42	21.44			
Dry Soil (g)	6.68	6.82	6.42			
Moisture Content, w (%)	46.26	47.21	50.16			
One-Point LL (%)		47				

Liquid Limit, LL (%)	**48**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**27**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: BRR

Boring No.: TP-03
Sample:
Depth: 8'
Description: Brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

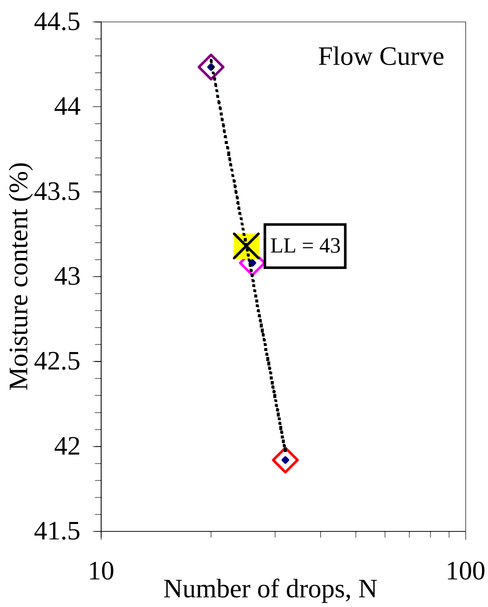
Plastic Limit

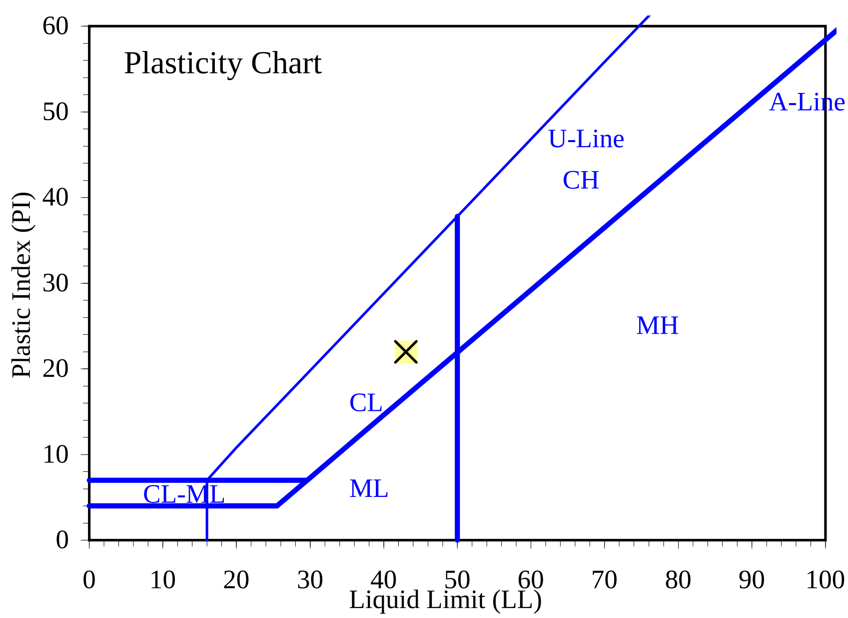
Determination No	1	2				
Wet Soil + Tare (g)	30.16	32.27				
Dry Soil + Tare (g)	28.68	30.37				
Moisture Loss (g)	1.48	1.90				
Tare (g)	21.59	21.21				
Dry Soil (g)	7.09	9.16				
Moisture Content, w (%)	20.87	20.74				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	32	26	20			
Wet Soil + Tare (g)	33.12	31.76	32.32			
Dry Soil + Tare (g)	29.67	28.74	29.06			
Moisture Loss (g)	3.45	3.02	3.26			
Tare (g)	21.44	21.73	21.69			
Dry Soil (g)	8.23	7.01	7.37			
Moisture Content, w (%)	41.92	43.08	44.23			
One-Point LL (%)		43	43			

Liquid Limit, LL (%)	**43**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**22**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: BRR

Boring No.: TP-05
Sample:
Depth: 6'
Description: Reddish brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

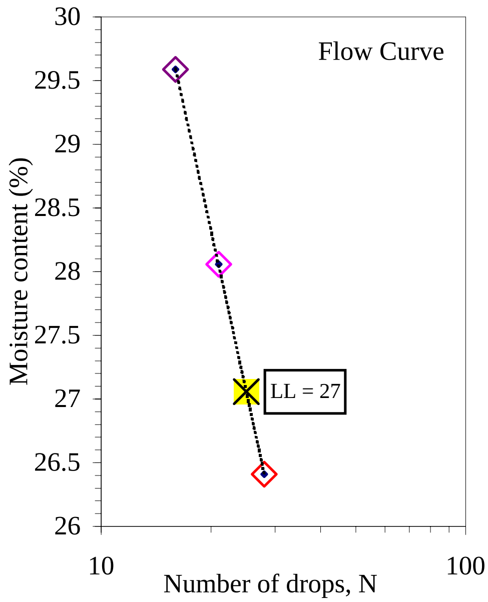
Plastic Limit

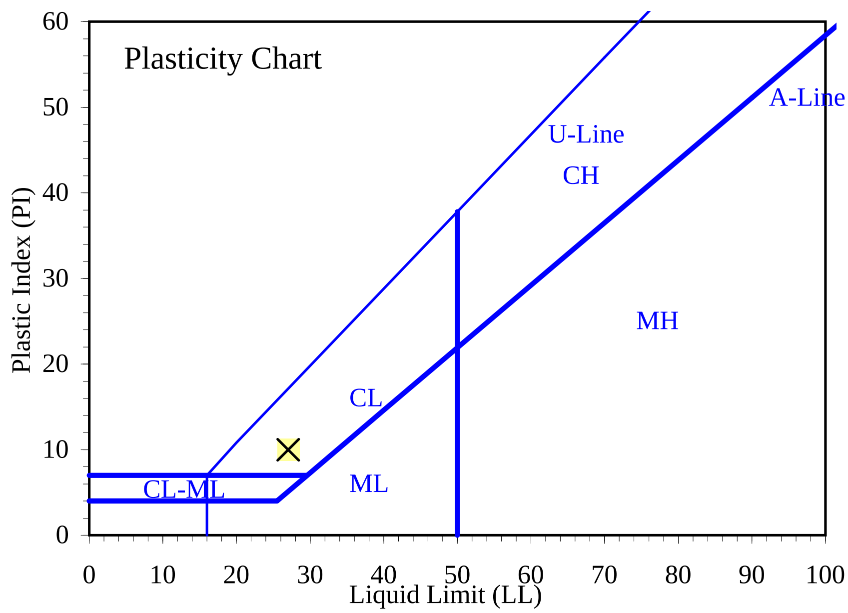
Determination No	1	2				
Wet Soil + Tare (g)	31.84	32.51				
Dry Soil + Tare (g)	30.33	30.94				
Moisture Loss (g)	1.51	1.57				
Tare (g)	21.25	21.43				
Dry Soil (g)	9.08	9.51				
Moisture Content, w (%)	16.63	16.51				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	28	21	16			
Wet Soil + Tare (g)	33.46	31.90	30.64			
Dry Soil + Tare (g)	30.93	29.56	28.56			
Moisture Loss (g)	2.53	2.34	2.08			
Tare (g)	21.35	21.22	21.53			
Dry Soil (g)	9.58	8.34	7.03			
Moisture Content, w (%)	26.41	28.06	29.59			
One-Point LL (%)	27	27				

Liquid Limit, LL (%)	**27**
Plastic Limit, PL (%)	**17**
Plasticity Index, PI (%)	**10**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: BRR

Boring No.: TP-07
Sample:
Depth: 4'
Description: Reddish brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

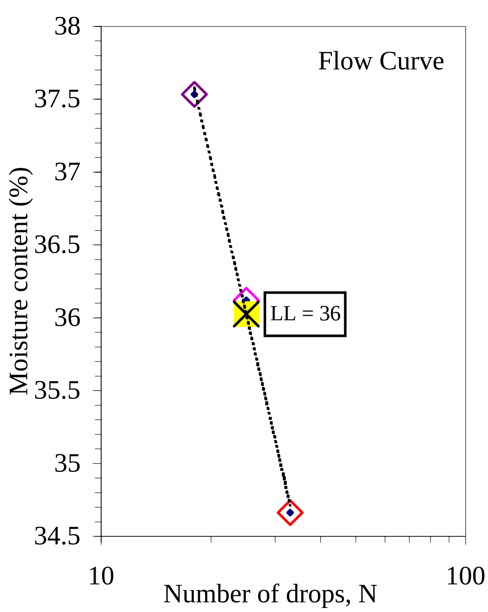
Plastic Limit

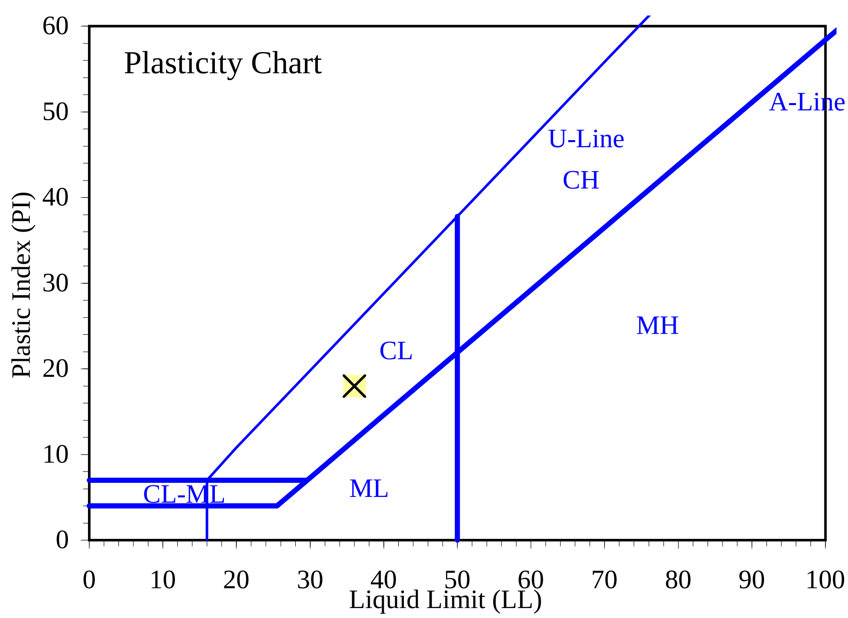
Determination No	1	2				
Wet Soil + Tare (g)	29.82	30.70				
Dry Soil + Tare (g)	28.51	29.20				
Moisture Loss (g)	1.31	1.50				
Tare (g)	21.39	21.10				
Dry Soil (g)	7.12	8.10				
Moisture Content, w (%)	18.40	18.52				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	33	25	18			
Wet Soil + Tare (g)	32.32	30.26	31.43			
Dry Soil + Tare (g)	29.54	27.84	28.72			
Moisture Loss (g)	2.78	2.42	2.71			
Tare (g)	21.52	21.14	21.50			
Dry Soil (g)	8.02	6.70	7.22			
Moisture Content, w (%)	34.66	36.12	37.53			
One-Point LL (%)		36				

Liquid Limit, LL (%)	**36**
Plastic Limit, PL (%)	**18**
Plasticity Index, PI (%)	**18**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/18/2012
By: BRR

Boring No.: TP-08
Sample:
Depth: 3'
Description: Reddish brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

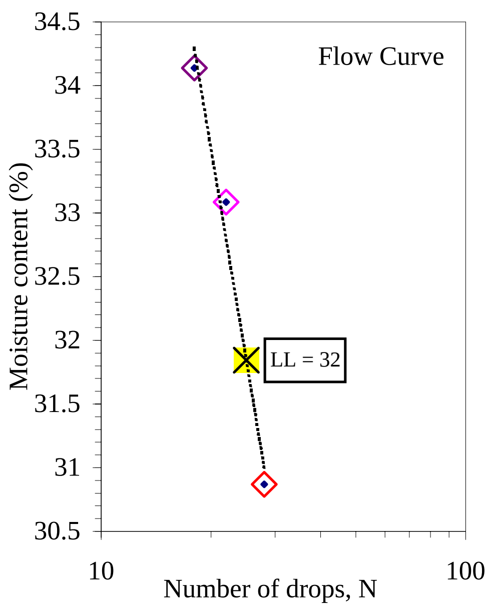
Plastic Limit

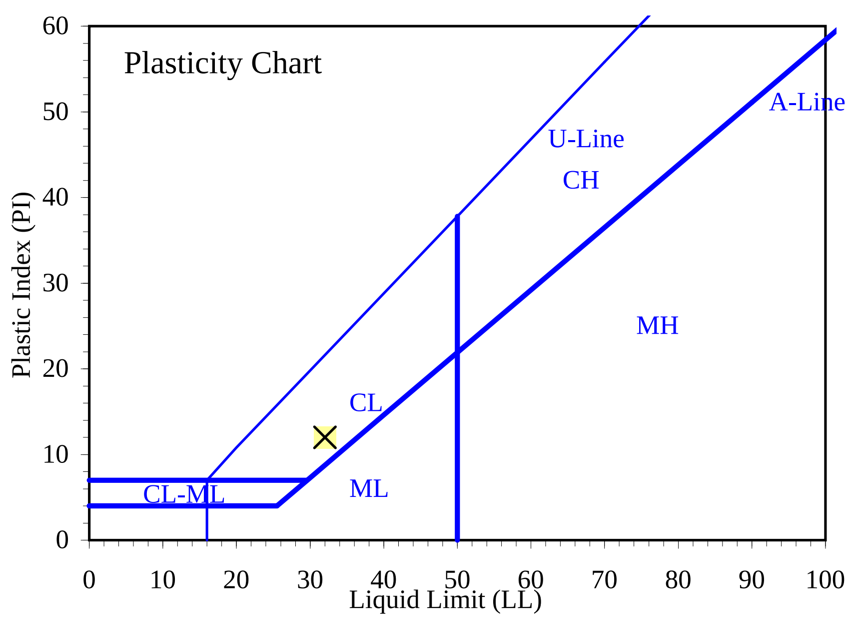
Determination No	1	2				
Wet Soil + Tare (g)	29.93	30.37				
Dry Soil + Tare (g)	28.51	28.90				
Moisture Loss (g)	1.42	1.47				
Tare (g)	21.63	21.66				
Dry Soil (g)	6.88	7.24				
Moisture Content, w (%)	20.64	20.30				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	28	22	18			
Wet Soil + Tare (g)	33.71	30.50	31.77			
Dry Soil + Tare (g)	30.87	28.28	29.08			
Moisture Loss (g)	2.84	2.22	2.69			
Tare (g)	21.67	21.57	21.20			
Dry Soil (g)	9.20	6.71	7.88			
Moisture Content, w (%)	30.87	33.08	34.14			
One-Point LL (%)	31	33				

Liquid Limit, LL (%)	**32**
Plastic Limit, PL (%)	**20**
Plasticity Index, PI (%)	**12**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: BRR

Boring No.: TP-08
Sample:
Depth: 7.5'
Description: Red/orange lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

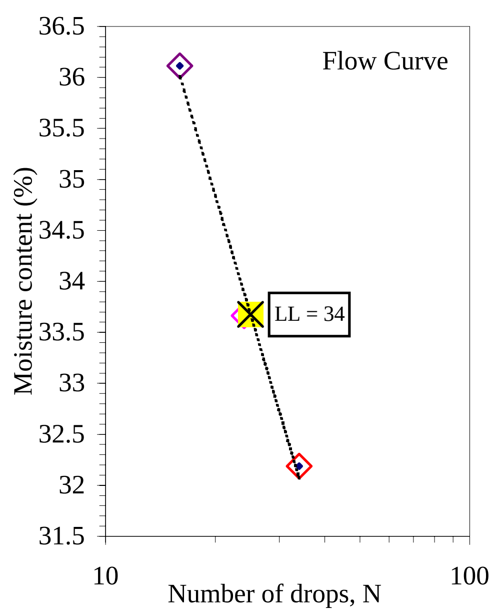
Plastic Limit

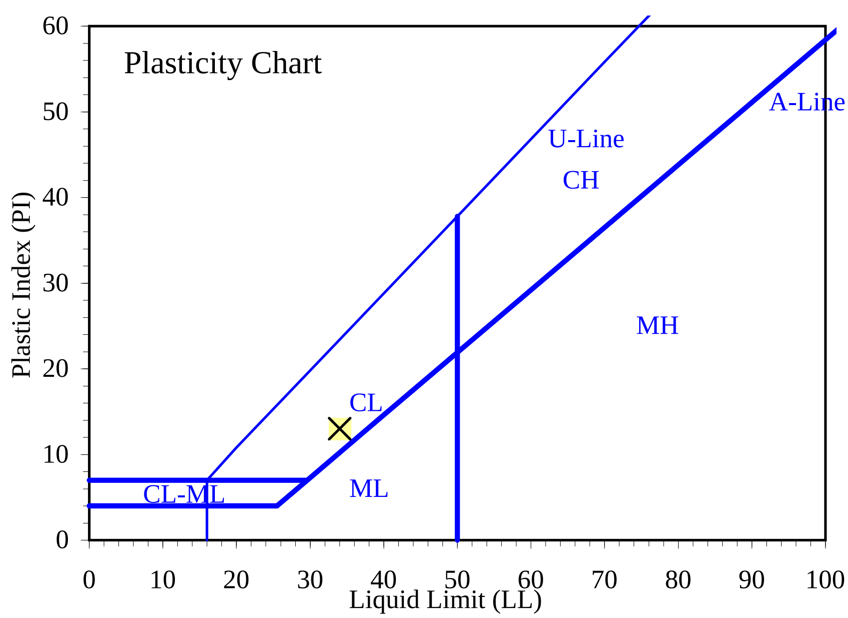
Determination No	1	2			
Wet Soil + Tare (g)	30.78	33.19			
Dry Soil + Tare (g)	29.13	31.13			
Moisture Loss (g)	1.65	2.06			
Tare (g)	21.26	21.18			
Dry Soil (g)	7.87	9.95			
Moisture Content, w (%)	20.97	20.70			

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	34	24	16			
Wet Soil + Tare (g)	32.93	32.32	31.94			
Dry Soil + Tare (g)	30.21	29.61	29.17			
Moisture Loss (g)	2.72	2.71	2.77			
Tare (g)	21.76	21.56	21.50			
Dry Soil (g)	8.45	8.05	7.67			
Moisture Content, w (%)	32.19	33.66	36.11			
One-Point LL (%)		33				

Liquid Limit, LL (%)	**34**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**13**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/18/2012
By: BRR

Boring No.: TP-10
Sample:
Depth: 4'
Description: Reddish brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

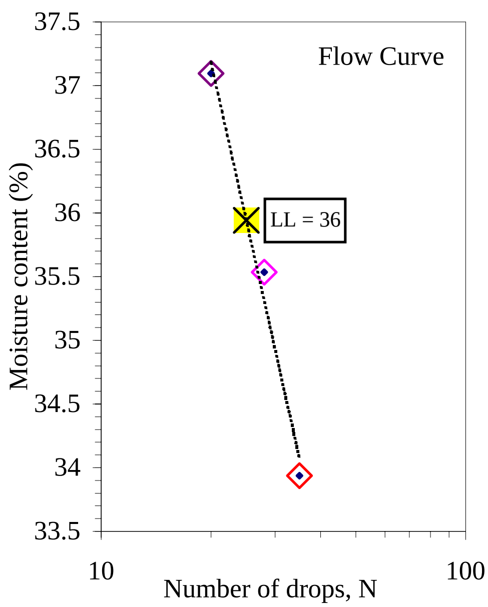
Plastic Limit

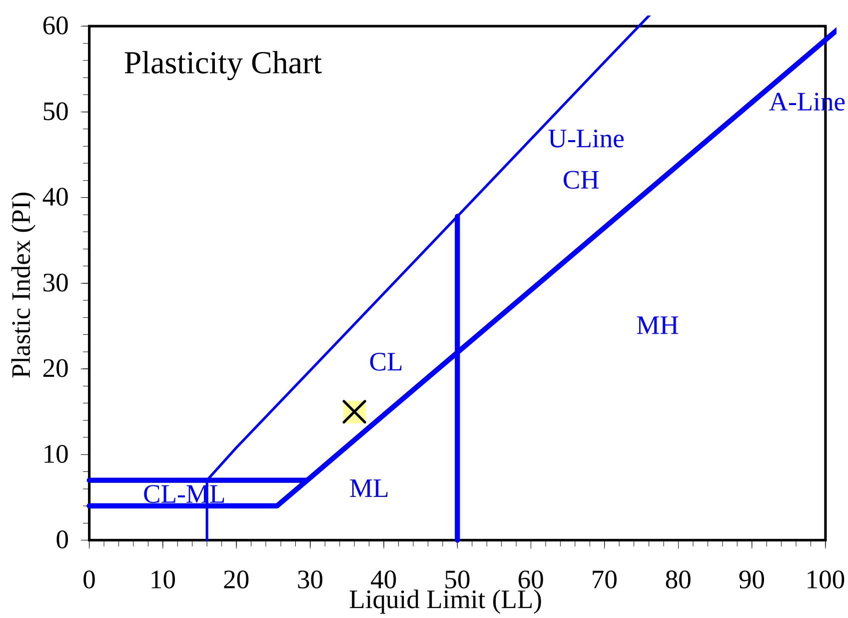
Determination No	1	2			
Wet Soil + Tare (g)	31.44	29.70			
Dry Soil + Tare (g)	29.74	28.29			
Moisture Loss (g)	1.70	1.41			
Tare (g)	21.73	21.52			
Dry Soil (g)	8.01	6.77			
Moisture Content, w (%)	21.22	20.83			

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	35	28	20			
Wet Soil + Tare (g)	31.83	30.56	31.30			
Dry Soil + Tare (g)	29.21	28.14	28.67			
Moisture Loss (g)	2.62	2.42	2.63			
Tare (g)	21.49	21.33	21.58			
Dry Soil (g)	7.72	6.81	7.09			
Moisture Content, w (%)	33.94	35.54	37.09			
One-Point LL (%)		36	36			

Liquid Limit, LL (%)	**36**
Plastic Limit, PL (%)	**21**
Plasticity Index, PI (%)	**15**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: BRR

Boring No.: TP-11
Sample:
Depth: 7'
Description: Red/orange lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

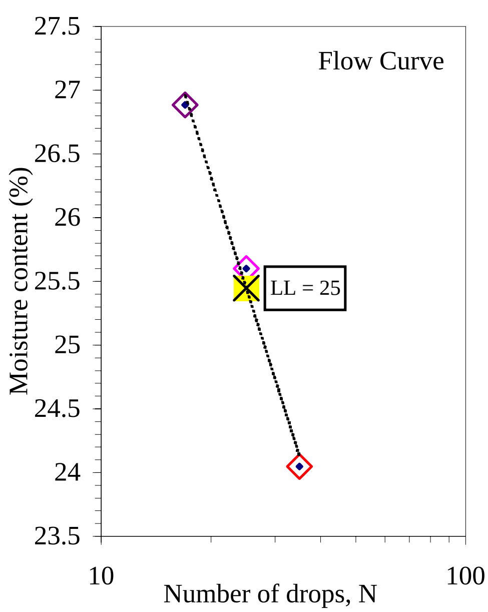
Plastic Limit

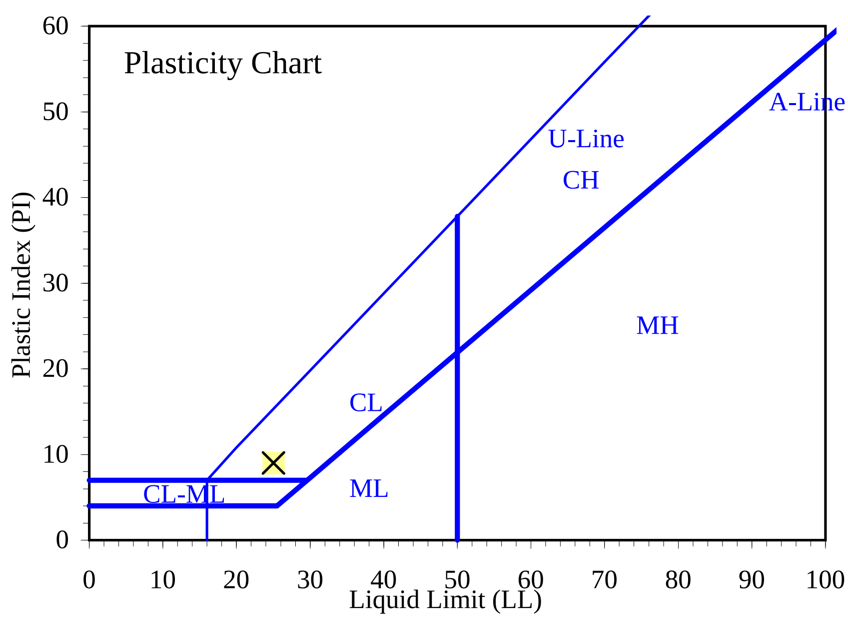
Determination No	1	2				
Wet Soil + Tare (g)	31.47	30.47				
Dry Soil + Tare (g)	30.04	29.20				
Moisture Loss (g)	1.43	1.27				
Tare (g)	21.38	21.42				
Dry Soil (g)	8.66	7.78				
Moisture Content, w (%)	16.51	16.32				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	35	25	17			
Wet Soil + Tare (g)	33.01	34.36	33.06			
Dry Soil + Tare (g)	30.80	31.70	30.60			
Moisture Loss (g)	2.21	2.66	2.46			
Tare (g)	21.61	21.31	21.45			
Dry Soil (g)	9.19	10.39	9.15			
Moisture Content, w (%)	24.05	25.60	26.89			
One-Point LL (%)		26				

Liquid Limit, LL (%)	**25**
Plastic Limit, PL (%)	**16**
Plasticity Index, PI (%)	**9**





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Particle-Size Analysis of Soils

(ASTM D422)

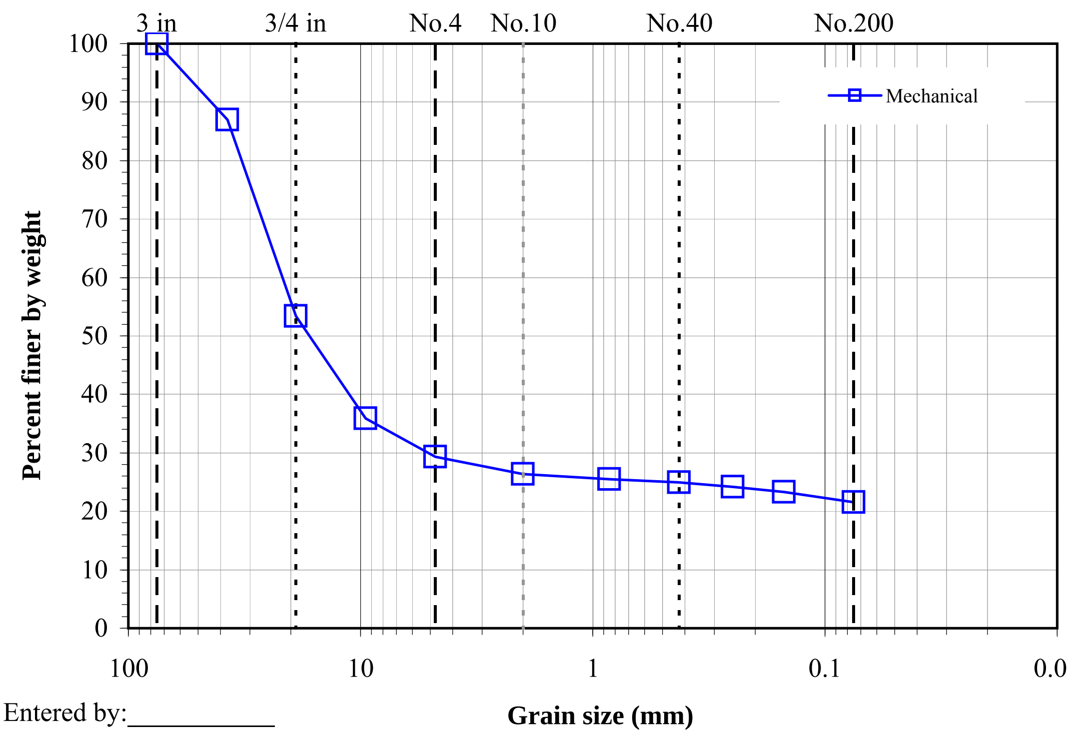
Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/12/2012
By: JDF

Boring No.: TP-01
Sample:
Depth: 4'
Description: Brown clayey gravel

	Moist	Dry
Split:	Yes	
Split sieve:	3/4"	
Total sample wt. (g):	4344.48	4160.6
+3/4" Coarse fraction (g):	1965.2	1938.1
-3/4" Split fraction (g):	1745.64	1630.61
Split fraction:	0.534	

Moisture data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	2373.22	2056.10
Dry soil + tare (g):	2346.14	1941.07
Tare (g):	408.43	310.46
Moisture content (%):	1.4	7.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
12"	-	300	-	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	542.32	37.5	87.0	
3/4"	1938.11	19	53.4	←Split
3/8"	534.40	9.5	35.9	
No.4	737.10	4.75	29.3	
No.10	826.60	2	26.3	
No.20	850.90	0.85	25.5	
No.40	869.90	0.425	24.9	
No.60	893.70	0.25	24.1	
No.100	918.40	0.15	23.3	
No.200	972.40	0.075	21.6	



Gravel (%): 70.7
Sand (%): 7.7
Fines (%): 21.6

Entered by:___________
Reviewed:___________

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Particle-Size Analysis of Soils

(ASTM D422)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/12/2012
By: JDF

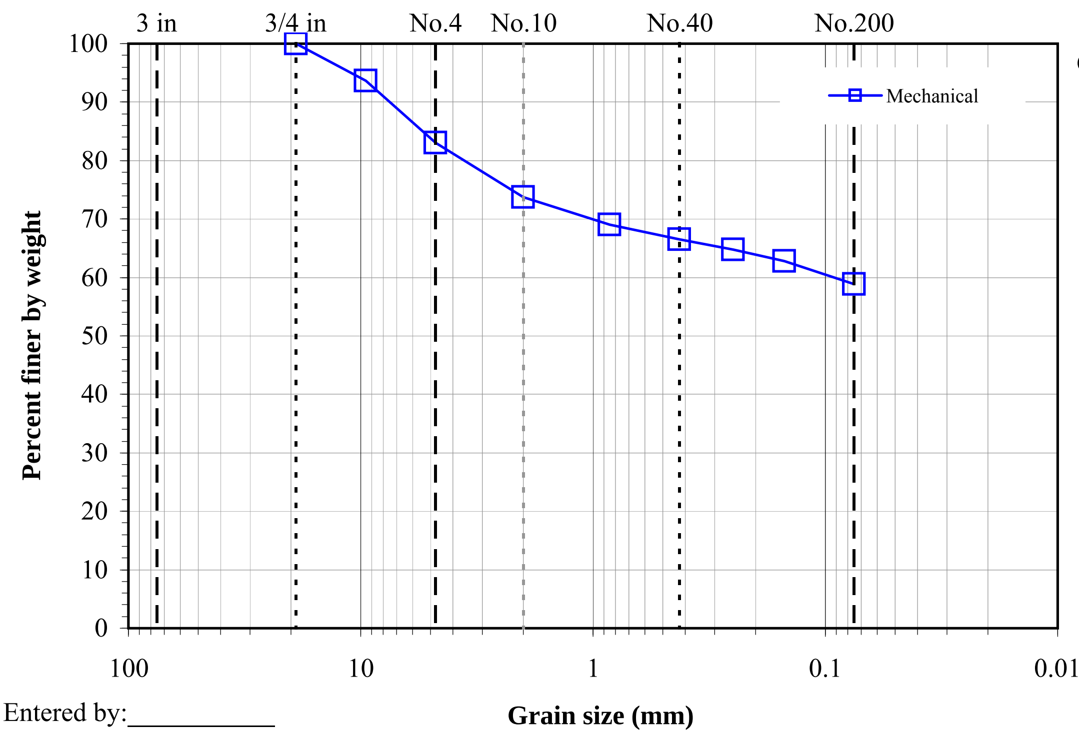
Boring No.: TP-03
Sample:
Depth: 8'
Description: Brown sandy clay with gravel

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	779.93	588.8
Split fraction:	1.000	

Moisture data

Moist soil + tare (g):	-	995.00
Dry soil + tare (g):	-	803.84
Tare (g):	-	215.07
Moisture content (%):	0.0	32.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
12"	-	300	-
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	100.0
3/8"	37.31	9.5	93.7
No.4	99.89	4.75	83.0
No.10	154.37	2	73.8
No.20	182.27	0.85	69.0
No.40	197.06	0.425	66.5
No.60	207.16	0.25	64.8
No.100	219.19	0.15	62.8
No.200	242.02	0.075	58.9



Gravel (%): 17.0
Sand (%): 24.1
Fines (%): 58.9

Entered by:___________
Reviewed:___________

Particle-Size Analysis of Soils

(ASTM D422)

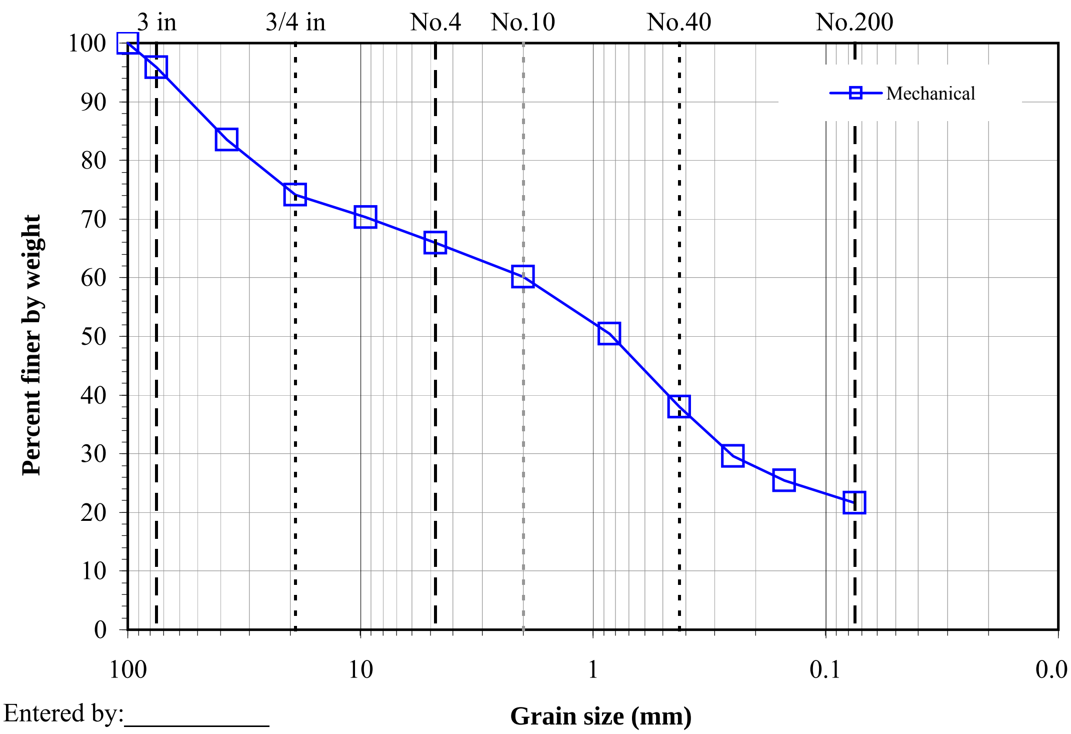
Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/18/2012
By: DKS

Boring No.: TP-08
Sample:
Depth: 3.0'
Description: Reddish brown clayey sand with gravel

	Moist	Dry
Split:	Yes	
Split sieve:	3/4"	
Total sample wt. (g):	24740.30	23549.0
+3/4" Coarse fraction (g):	6196.6	6087.3
-3/4" Split fraction (g):	665.33	626.51
Split fraction:	0.742	

Moisture data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	2629.40	1058.38
Dry soil + tare (g):	2591.24	1019.56
Tare (g):	465.90	393.05
Moisture content (%):	1.8	6.2

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
12"	-	300	-
8"	-	200	-
6"	-	150	-
4"	-	100	100.0
3"	979.81	75	95.8
1.5"	3889.76	37.5	83.5
3/4"	6087.30	19	74.2 ←Split
3/8"	32.20	9.5	70.3
No.4	69.40	4.75	65.9
No.10	118.50	2	60.1
No.20	200.50	0.85	50.4
No.40	305.90	0.425	37.9
No.60	376.10	0.25	29.6
No.100	411.60	0.15	25.4
No.200	444.30	0.075	21.6



Gravel (%): 34.1
Sand (%): 44.4
Fines (%): 21.6

Entered by:___________
Reviewed:___________

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Particle-Size Analysis of Soils

(ASTM D422)

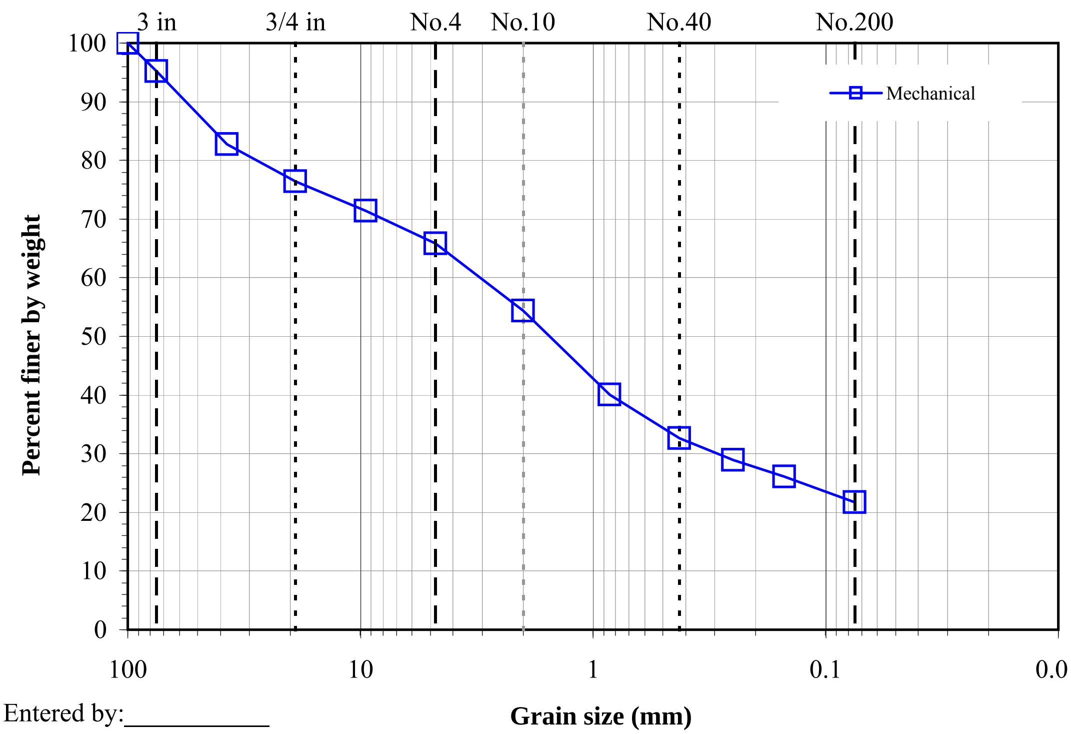
Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/18/2012
By: DKS

Boring No.: TP-10
Sample:
Depth: 4.0'
Description: Reddish brown clayey sand with gravel

	Moist	Dry
Split:	Yes	
Split sieve:	3/4"	
Total sample wt. (g):	20088.70	19007.3
+3/4" Coarse fraction (g):	4541	4488.5
-3/4" Split fraction (g):	1265.32	1181.59
Split fraction:	0.764	

Moisture data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1923.73	1581.10
Dry soil + tare (g):	1906.20	1497.37
Tare (g):	407.99	315.78
Moisture content (%):	1.2	7.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
12"	-	300	-	
8"	-	200	-	
6"	-	150	-	
4"	-	100	100.0	
3"	910.64	75	95.2	
1.5"	3282.39	37.5	82.7	
3/4"	4488.48	19	76.4	←Split
3/8"	76.80	9.5	71.4	
No.4	164.10	4.75	65.8	
No.10	340.10	2	54.4	
No.20	561.70	0.85	40.1	
No.40	677.10	0.425	32.6	
No.60	734.90	0.25	28.9	
No.100	777.50	0.15	26.1	
No.200	845.10	0.075	21.8	



Gravel (%): 34.2
Sand (%): 44.0
Fines (%): 21.8

Entered by:___________
Reviewed:___________

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

(ASTM D1140)

Project: **Powder Mountain**
No: **01628-001**
Location: Weber County
Date: 7/13/2012
By: JDF

Sample Info.	Boring No.	TP-03	TP-03	TP-06	TP-07	TP-07	TP-09	TP-11	TP-11
	Sample								
	Depth	0.5'	6'	5'	4'	7'	5'	2'	7'
	Split	Yes	No	No	No	No	No	No	No
	Split Sieve*	3/8"							
	Moist total sample wt. (g)	14739.90	595.33	1585.35	398.75	1076.26	1119.76	301.64	516.19
	Moist coarse fraction (g)	790.00							
	Moist split fraction + tare (g)	781.78							
	Split fraction tare (g)	288.34							
	Dry split fraction (g)	444.14							
	Dry retained No. 200 + tare (g)	385.61	210.94	1145.49	371.56	1051.48	812.23	354.29	486.11
	Wash tare (g)	288.34	122.18	215.39	219.21	221.76	214.17	288.71	223.55
	No. 200 Dry wt. retained (g)	97.27	88.76	930.10	152.35	829.72	598.06	65.58	262.56
	Split sieve* Dry wt. retained (g)	785.51							
	Dry total sample wt. (g)	13341.66	449.66	1445.89	345.14	985.35	983.43	265.40	445.75
Coarse Fraction	Moist soil + tare (g)	909.88							
	Dry soil + tare (g)	905.39							
	Tare (g)	119.97							
	Moisture content (%)	0.57							
Split Fraction	Moist soil + tare (g)	781.78	717.51	1800.74	617.96	1298.02	1333.93	590.35	739.74
	Dry soil + tare (g)	732.48	571.84	1661.28	564.35	1207.11	1197.60	554.11	669.30
	Tare (g)	288.34	122.18	215.39	219.21	221.76	214.17	288.71	223.55
	Moisture content (%)	11.10	32.40	9.65	15.53	9.23	13.86	13.65	15.80
	Percent passing split sieve* (%)	**94.1**							
	Percent passing No. 200 sieve (%)	**73.5**	**80.3**	**35.7**	**55.9**	**15.8**	**39.2**	**75.3**	**41.1**

Entered by:___________

Reviewed:___________

Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/17/2012
By: DKS

Boring No.: TP-03
Sample:
Depth: 0.5'
Sample Description: Dark brown silt
Engineering Classification: Not requested
As-received moisture content (%): 10.5

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below

Optimum moisture content (%): 21.1
Maximum dry unit weight (pcf): 95.8

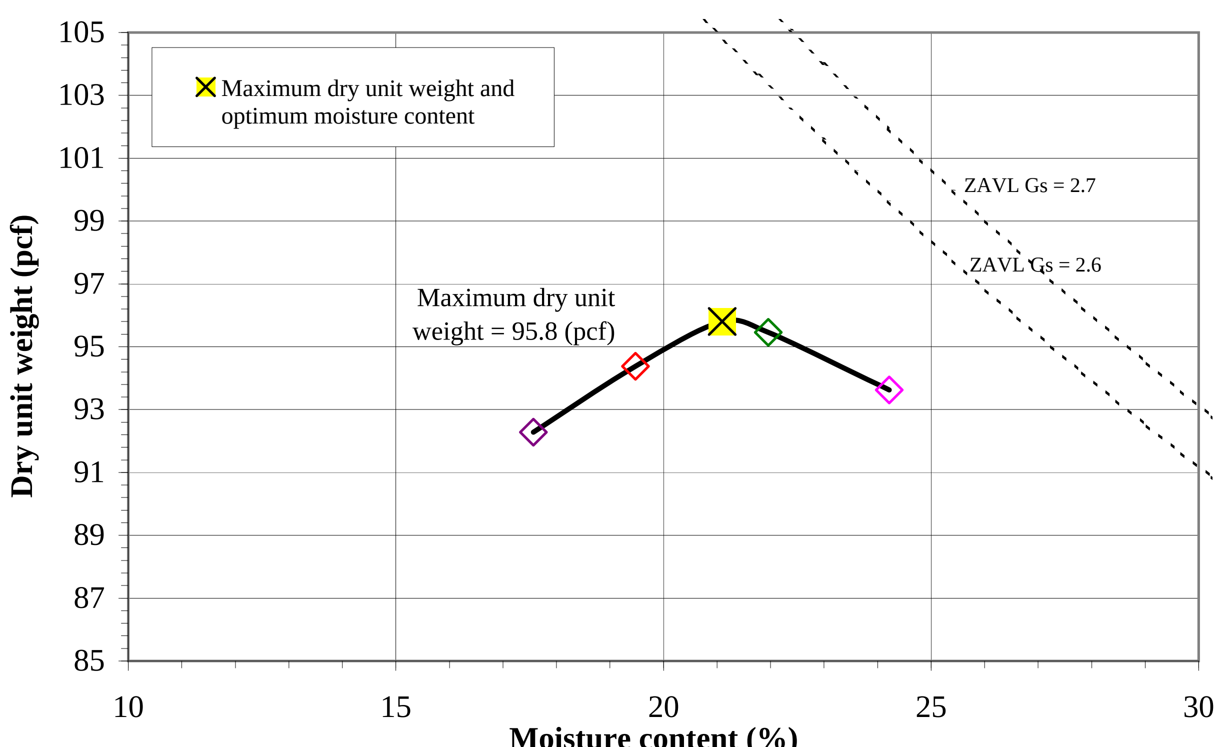
Point Number	+6%	+8%	+10%	+12%				
Wt. Sample + Mold (g)	5799.2	5863.5	5918.7	5916.8				
Wt. of Mold (g)	4164.4	4164.4	4164.4	4164.4				
Wet Unit Wt., γ_m (pcf)	108.5	112.8	116.4	116.3				
Wet Soil + Tare (g)	621.58	694.63	796.43	742.18				
Dry Soil + Tare (g)	547.9	601.57	692.37	622.39				
Tare (g)	128.53	123.74	218.43	127.72				
Moisture Content, w (%)	17.6	19.5	22.0	24.2				
Dry Unit Wt., γ_d (pcf)	92.3	94.4	95.5	93.6				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected moisture content (%): 19.9
Corrected dry unit weight (pcf): 98.2

Oversized fraction, +3/8-in. (%): 5.9
Moisture content, +3/8-in. (%): 0.6
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/18/2012
By: DKS

Boring No.: TP-08
Sample:
Depth: 3.0'
Sample Description: Reddish brown clayey sand with gravel
Engineering Classification: Not requested
As-received moisture content (%): 10.5

Method: ASTM D698 C
Mold Id. Inc 6
Mold volume (ft^3): 0.0750

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below

Optimum moisture content (%): 10.2
Maximum dry unit weight (pcf): 125

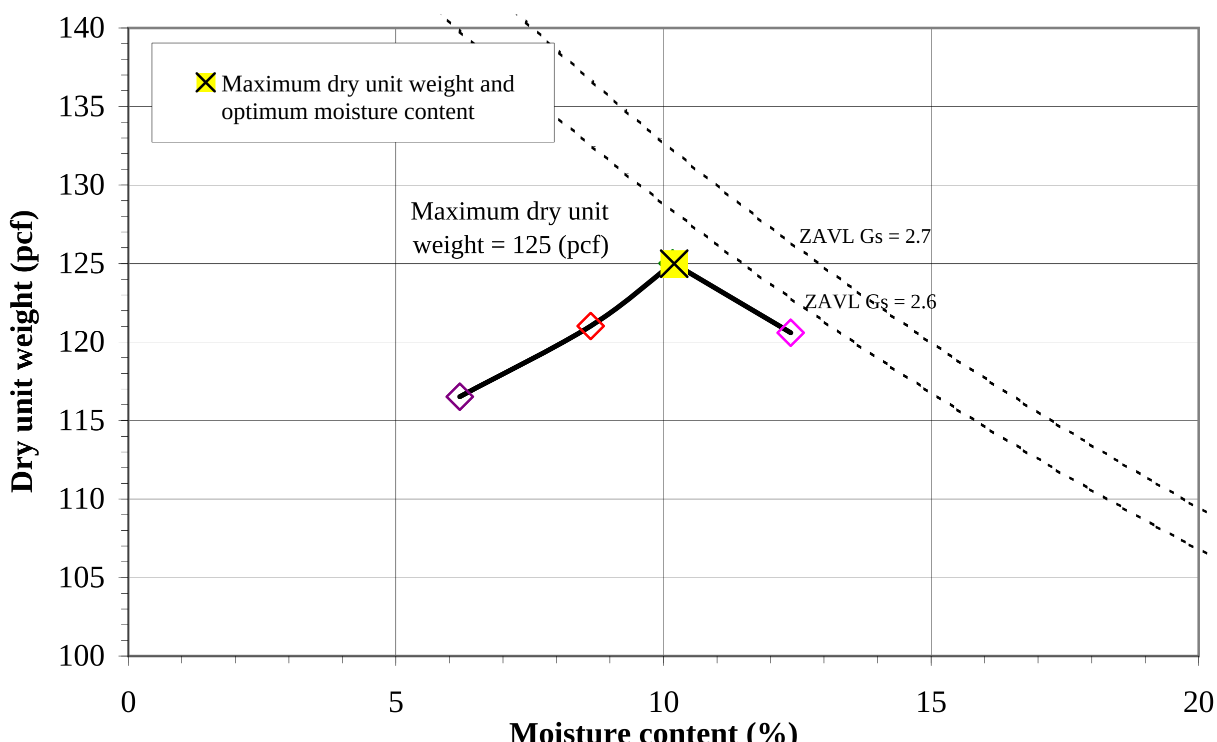
Point Number	As Is	+2%	+4%	+12%				
Wt. Sample + Mold (g)	10766.4	11029.6	11242.5	11167.6				
Wt. of Mold (g)	6554.1	6554.1	6554.1	6554.1				
Wet Unit Wt., γ_m (pcf)	123.7	131.5	137.7	135.5				
Wet Soil + Tare (g)	960.65	1080.6	1150.1	1028.7				
Dry Soil + Tare (g)	912.05	1004.8	1055.7	929				
Tare (g)	127.68	127.35	126.62	123.69				
Moisture Content, w (%)	**6.2**	**8.6**	**10.2**	**12.4**				
Dry Unit Wt., γ_d (pcf)	**116.5**	**121.0**	**125.0**	**120.6**				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected moisture content (%): 8.0
Corrected dry unit weight (pcf): 133.4

Oversized fraction, +3/4-in. (%): 25.8
Moisture content, +3/4-in. (%): 1.8
Sieve for oversized fraction: 3/4-in.
Bulk specific gravity, Gs: 2.65



Entered by:___________

Reviewed:___________

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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

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Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/13/2012
By: DKS

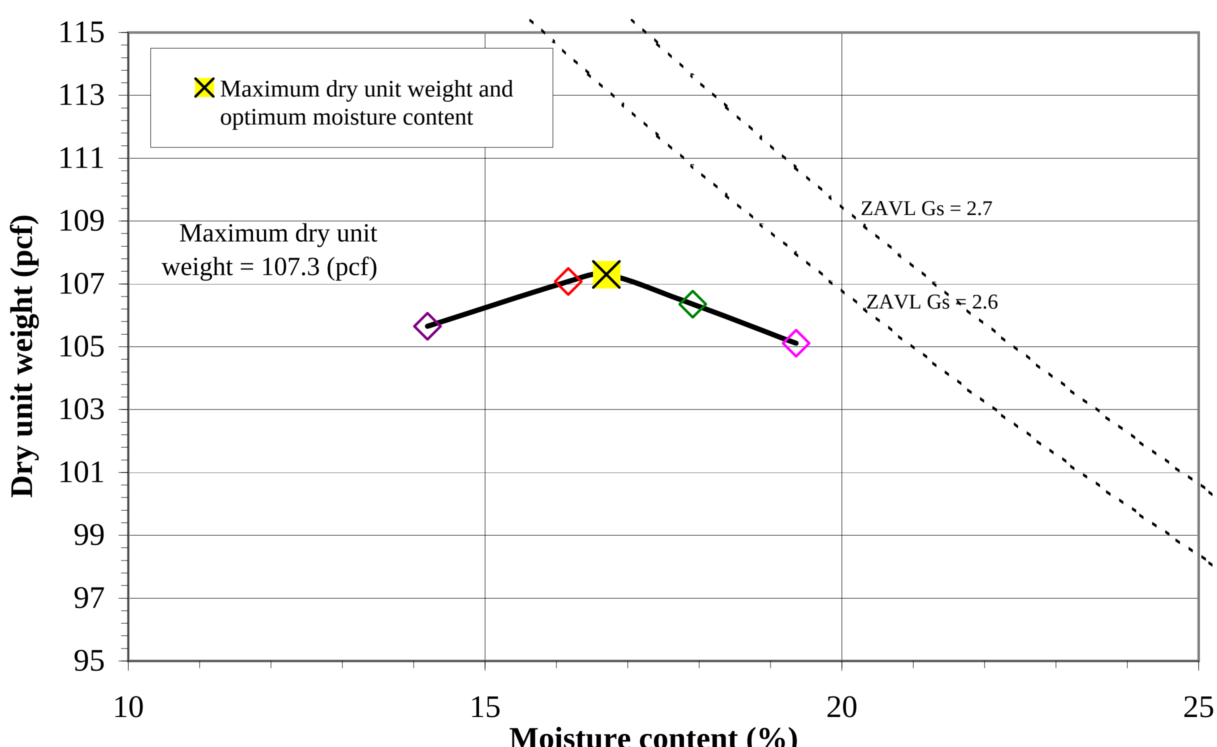
Boring No.: TP-11
Sample:
Depth: 2.0'
Sample Description: Red clay
Engineering Classification: Not requested
As-received moisture content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No * See results below

Optimum moisture content (%): 16.7
Maximum dry unit weight (pcf): 107.3

Point Number	+2%	+4%	+6%	+8%				
Wt. Sample + Mold (g)	5982.4	6038.7	6054.0	6054.8				
Wt. of Mold (g)	4164.4	4164.4	4164.4	4164.4				
Wet Unit Wt., γ_m (pcf)	120.6	124.4	125.4	125.5				
Wet Soil + Tare (g)	740.18	760.64	741.66	678.06				
Dry Soil + Tare (g)	663.89	672.6	648.34	588.02				
Tare (g)	126.38	128.06	127.31	122.86				
Moisture Content, w (%)	**14.2**	**16.2**	**17.9**	**19.4**				
Dry Unit Wt., γ_d (pcf)	**105.7**	**107.1**	**106.4**	**105.1**				



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California Bearing Ratio
(ASTM D 1883)

IGES

Project: Powder Mountain
Number: 01628-001
Location: Weber County
Date: 7/19/2012
By: DKS

Boring No.: TP-03
Sample:
Depth: 0.5'
Original Method: ASTM D698 B
Engineering Classification: Not requested
Condition of Sample: Soaked
Scalp and Replace: No

Maximum Dry Unit Weight (pcf): 95.8
Optimum Moisture Content (%): 21.1
Relative Compaction (%): 100.4
0.1 in. Corrected CBR (%): 5.5
0.2 in. Corrected CBR (%): 6.1

As Compacted Data

Wt. of Mold + Sample (g)	11284.9	Wet Soil + Tare (g)	626.98
Wt. of Mold (g)	7307.1	Dry Soil + Tare (g)	540.62
Dry Unit Weight (pcf)	96.2	Tare (g)	139.84
		Moisture Content (%)	21.5

After Soaking Data

			Average	Top 1 in.
Wt. of Mold + Sample (g)	11365.8	Wet Soil + Tare (g)	813.06	479.03
Dry Unit Weight (pcf)	95.5	Dry Soil + Tare (g)	681.34	405.42
		Tare (g)	126.89	127.67
		Moisture Content (%)	23.8	26.5

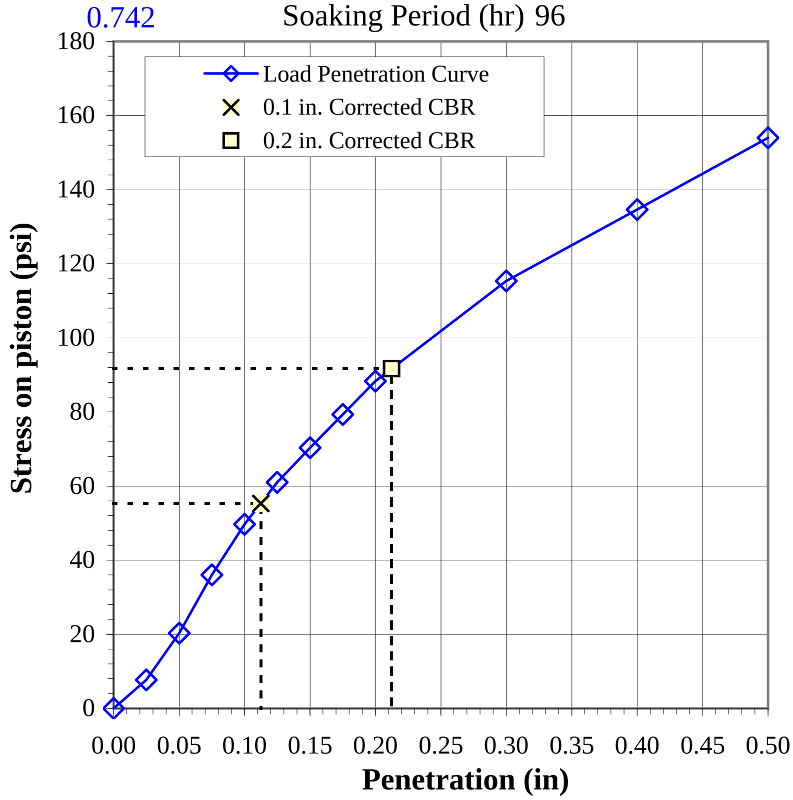
Swell Data

Date	Time	Dial		
			Surcharge (psf)	50
7/14/2012	12:22	0.699	Swell (%)	0.94
7/18/2012	12:18	0.742	Soaking Period (hr)	96

Penetration Data

Zero load (lb) = 0
Area of Piston (in^2) = 3

Penetration (in.)	Raw Load (lb)	Piston Stress (psi)	Std. Stress (psi)
0.000	0	0	
0.025	23	8	
0.050	61	20	
0.075	108	36	
0.100	149	50	1000
0.125	183	61	1125
0.150	211	70	1250
0.175	238	79	1375
0.200	265	88	1500
0.300	346	115	1900
0.400	404	135	2300
0.500	462	154	2600



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California Bearing Ratio
(ASTM D 1883)

Project: Powder Mountain
Number: 01628-001
Location: Weber County
Date: 7/19/2012
By: DKS

Boring No.: TP-11
Sample:
Depth: 2.0'
Original Method: ASTM D698 B
Engineering Classification: Not requested
Condition of Sample: Soaked
Scalp and Replace: No

Maximum Dry Unit Weight (pcf): 107.3
Optimum Moisture Content (%): 16.7
Relative Compaction (%): 102.1
0.1 in. CBR (%): 1.8
0.2 in. CBR (%): 1.8

As Compacted Data

Wt. of Mold + Sample (g)	11357.3	Wet Soil + Tare (g)	644.63
Wt. of Mold (g)	7147.5	Dry Soil + Tare (g)	584.94
Dry Unit Weight (pcf)	109.6	Tare (g)	122.65
		Moisture Content (%)	12.9

After Soaking Data

			Average	Top 1 in.
Wt. of Mold + Sample (g)	11583.6	Wet Soil + Tare (g)	799.73	395.69
Dry Unit Weight (pcf)	105.3	Dry Soil + Tare (g)	697.18	341.17
		Tare (g)	126.37	127.67
		Moisture Content (%)	18.0	25.5

Swell Data

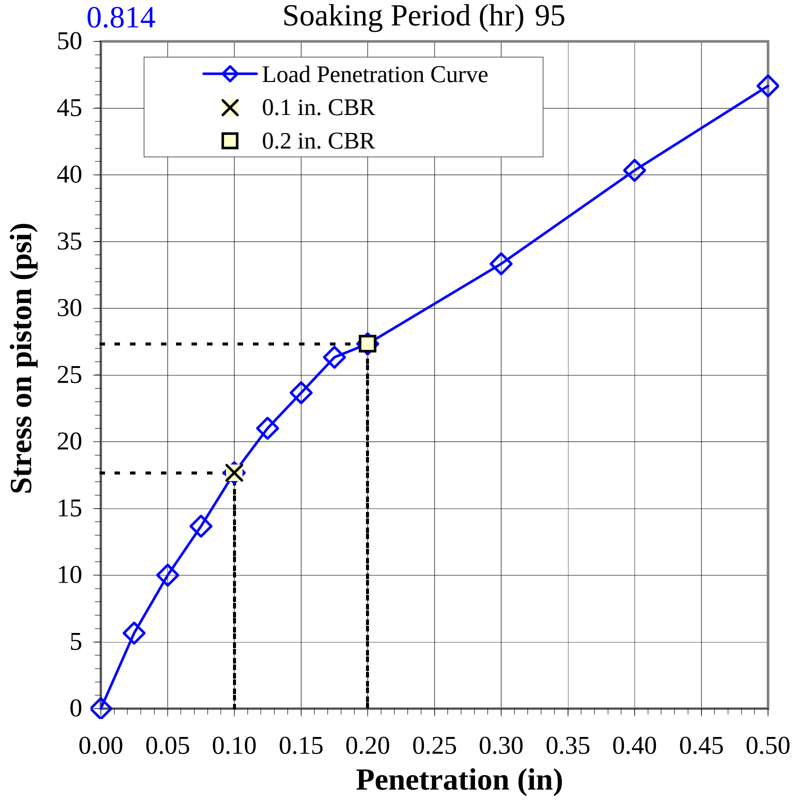
Date	Time	Dial
7/14/2012	12:55	0.586
7/18/2012	12:20	0.814

Surcharge (psf) 50
Swell (%) 4.97
Soaking Period (hr) 95

Penetration Data

Zero load (lb) = 0
Area of Piston (in^2) = 3

Penetration (in.)	Raw Load (lb)	Piston Stress (psi)	Std. Stress (psi)
0.000	0	0	
0.025	17	6	
0.050	30	10	
0.075	41	14	
0.100	53	18	1000
0.125	63	21	1125
0.150	71	24	1250
0.175	79	26	1375
0.200	82	27	1500
0.300	100	33	1900
0.400	121	40	2300
0.500	140	47	2600



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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/12/2012
By: JDF

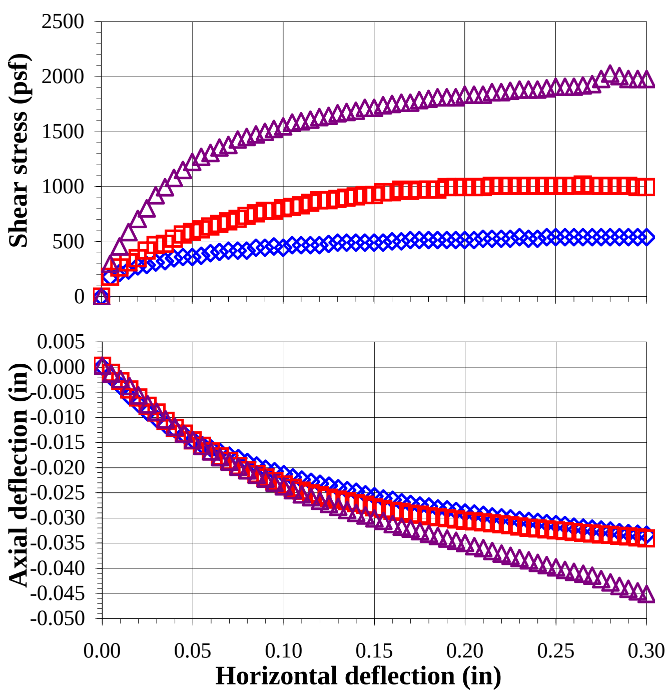
Boring No.: TP-03
Sample:
Depth: 2'
Sample Description: Brown clay with sand and gravel
Sample type: Undisturbed-trimmed from thin-wall

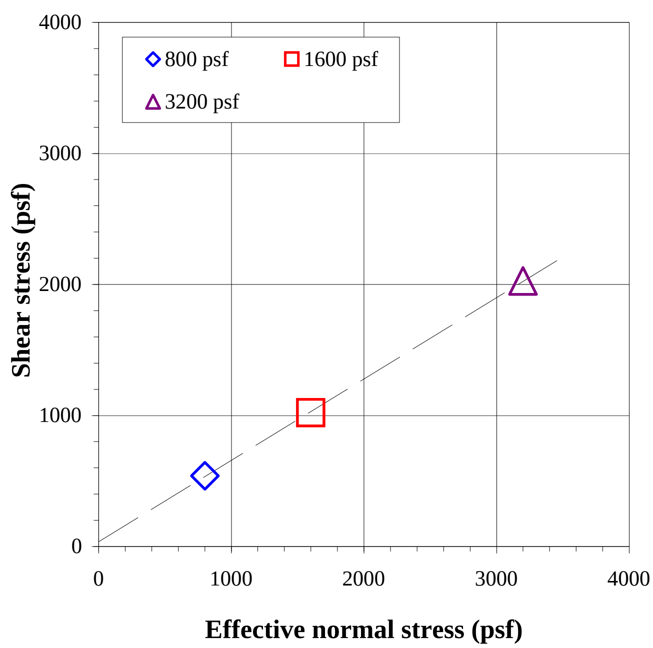
Test type: Inundated
Horizontal deformation (in.): 0.3
Shear rate (in./min): 0.0042

	Sample 1		Sample 2		Sample 3	
Effective normal stress (psf)	800		1600		3200	
Peak shear stress (psf)	540		1020		2028	
Horizontal deformation at peak(in)	0.230		0.265		0.280	
	Initial	Final	Initial	Final	Initial	Final
Sample height (in)	1.0000	0.9448	1.0000	0.8496	1.0000	0.8214
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	165.19	170.32	151.32	154.25	155.36	157.23
Wt. rings (g)	43.28	43.28	43.18	43.18	42.03	42.03
Wet soil + tare (g)	325.73	145.41	325.73	132.97	325.73	136.26
Dry soil + tare (g)	285.92	116.52	285.92	108.27	285.92	112.02
Tare (g)	126.75	21.07	126.75	21.30	126.75	22.49
Water content (%)	25.0	30.3	25.0	28.4	25.0	27.1
Dry unit weight (pcf)	81.0	85.8	71.9	84.6	75.3	91.7

ϕ' (deg)	32
c' (psf)	36

Average of 3 samples	Initial	Final
Water content (%)	25.0	28.6
Dry unit weight (pcf)	76.1	87.4





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Minimum Laboratory Soil Resistivity, pH of Soil for Use in Corrosion Testing, and Ions in Water by Chemically Suppressed Ion Chromatography *(AASHTO T 288, ASTM D4972, D4327, and C1580)*

IGES

Project: Powder Mountain
No: 01628-001
Location: Weber County
Date: 7/18/2012
By: MP

Section		TP-02		TP-05		TP-09		TP-11	
Sample info.	Boring No.	TP-02		TP-05		TP-09		TP-11	
	Sample								
	Depth	1.0'		6.0'		3.0'		7.0'	
Moisture data	Wet soil + tare (g)	116.27		68.53		109.88		83.75	
	Dry soil + tare (g)	92.19		64.66		102.22		78.76	
	Tare (g)	30.03		29.42		30.37		30.32	
	Moisture content (%)	38.7		11.0		10.7		10.3	
Chemical data	pH distilled water	5.2		4.0		4.1		4.7	
	pH, $CaCl_2$ solution	4.8		3.3		3.8		3.9	
	Soluble chloride* (ppm)	< 54.4		< 55.4		< 53.0		< 57.7	
	Soluble sulfate** (ppm)	< 5.44		32.1		24.6		47.9	
Resistivity data		Soil condition (%)	Resistivity (Ω-cm)	Soil condition (%)	Resistivity (Ω-cm)	Soil condition (%)	Resistivity (Ω-cm)	Soil condition (%)	Resistivity (Ω-cm)
		As Is	52000	As Is	41000	As Is	23000	As Is	11000
		+3	24000	+3	17000	+3	13000	+3	6300
		+6	19000	+6	14000	+6	13000	+6	5800
		+9	11000	+9	14000	+9	14000	+9	6100
		+12	6700						
		+15	5900						
		+18	5800						
		+21	5600						
		+24	5600						
	Minimum resistivity (Ω-cm)	**5600**		**14000**		**13000**		**5800**	

* Performed by AWAL using EPA 300.0

** Performed by AWAL using ASTM C1580

Comments: Moisture content was performed upon completion of test.

Entered by:___________

Reviewed:___________

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APPENDIX C

SUMMARY OF GEOLOGIC HAZARDS

Powder Mountain, Weber County, Utah **Project Number 01628-001**

Hazard	Hazard Rating*				Further Study Recommended**
	Not Assessed	Probable	Possible	Unlikely	
Earthquake					
Ground Shaking		X			
Surface Faulting				X	
Tectonic Subsidence				X	
Liquefaction				X	
Slope Stability		X			
Flooding (Including Seiche)				X	
Slope Failure					
Rock Fall				X	
Landslide		X			See Geotechnical Report
Debris Flow			X		
Avalanche	X				
Problem Soils					
Collapsible				X	
Soluble			X		See Geotechnical Report
Expansive			X		See Geotechnical Report
Organic				X	
Piping				X	
Non-Engineered Fill				X	
Erosion				X	
Active Sand Dune				X	
Mine Subsidence				X	
Shallow Bedrock		X			See Geotechnical Report
Shallow Groundwater				X	
Flooding					
Streams				X	
Alluvial Fans				X	
Lakes				X	
Dam Failure				X	
Canals/Ditches				X	
Radon	X				

* Hazard Rating :
Not assessed - report does not consider this hazard and no inference is made as to the presence or absence of the hazard at the site
Probable -Evidence is strong that the hazard exists and mitigation measures should be taken
Possible - hazard may exist, but the evidence is equivocal, based only on theoretical studies, or was not observed and furthes study is necessary as noted
Unlikely - no evidence was found to indicate that the hazard is present, hazard not known or suspected to be present

Further Study :
E - geotechnical/engineering, H - hydrologic, A - Avalanche, G - Additional detailed geologic hazard study out of the scope of this study

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SITE GROUND MOTION [IBC SECTION 1615]

Project: **Powder Mountain** **Number:** **01628-001**
Latitude = **41.36101** **Date:** **7/20/12**
Longitude = **-111.74651** **By:** **JMG**

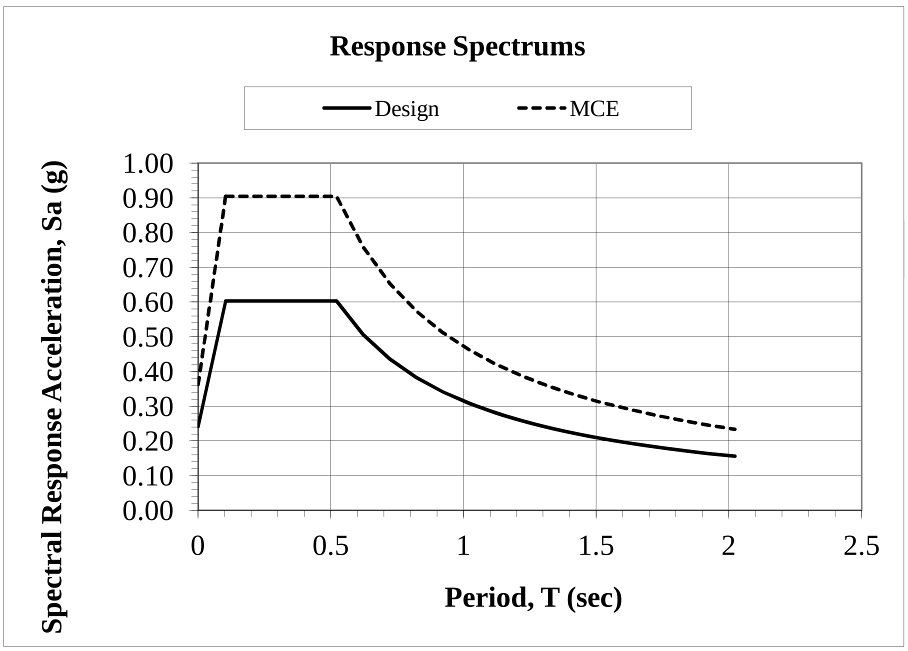
Ss = 0.855 (g) The mapped spectral accleration for short periods [1615.1]
S_1 = 0.319 (g) The mapped spectral accleration for a 1-second period

Site Class = C Table 16.15.1.1
Fa = 1.06 Table 1615.1.2(1)
Fv = 1.48 Table 1615.1.2(2)

S_{MS} = 0.905 S_{MS} = Fa*Ss *The maximum considered E.Q. spectral resonse accelerations
S_{M1} = 0.472 S_{M1} = Fv*S_1 for short and 1-second periods [1615.1.2]
MCE/PGA = 0.362 **0.4*S_{MS} [Equation 16-42 in accordance with 1802.2.7 and 1615.2.1]**

S_{DS} = 0.603 S_{DS} = 2/3*S_{MS} *The design spectral response acceleration
S_{D1} = 0.315 S_{D1} = 2/3*S_{M1} at short and 1-second periods

T_0 = 0.104 $T_0 = 0.2*S_{D1}/S_{DS}$
T_s = 0.522 $T_s = S_{D1}/S_{DS}$
ΔT = 0.1 Time step for diagram



T (sec)	Sa (g)	Sa (MCE) (g)
0	0.24	0.36
0.10	0.60	0.90
0.52	0.60	0.90
0.62	0.51	0.76
0.72	0.44	0.65
0.82	0.38	0.57
0.92	0.34	0.51
1.02	0.31	0.46
1.12	0.28	0.42
1.22	0.26	0.39
1.32	0.24	0.36
1.42	0.22	0.33
1.52	0.21	0.31
1.62	0.19	0.29
1.72	0.18	0.27
1.82	0.17	0.26
1.92	0.16	0.25
2.02	0.16	0.23