GeoStrata
Engineering & Geosciences
14425 South Center Point Way Bluffdale, Utah 84065
Phone (801) 501-0583 | Fax (801) 501-0584

Geotechnical Investigation for Dauphine-Savory Piedmont Subdivision Lots 1R and 2R and adjacent 2-acre property
Weber County, Utah

GeoStrata Job No. 910-001
December 10, 2013

Prepared for:

Matt Rasmussen
2927 Melanie Lane
Ogden, UT 84403

Exhibit B-Geologic and Geotechnical Reports

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Prepared by:

J. Scott Seal, E.I.T.
Staff Engineer

Reviewed by:

12/9/13

No. 188039

Mark I. Christensen, P.E.
Senior Engineer

GeoStrata
14425 South Center Point Way
Bluffdale, UT 84065
(801) 501-0583

December 10, 2013

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APPENDICES

1.0 EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation conducted for residential building lots 1R and 2R of the proposed Dauphine-Savory Piedmont subdivision as well as an adjacent 2-acre parcel located at approximately 6500 South Bybee Drive in Weber County, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the site and to provide recommendations for general site grading and the design and construction of foundations, slabs-on-grade, and exterior concrete flatwork.

The site is mantled by a layer of topsoil composed of silt, sand, cobble and boulders that is approximately 1½ to 2 feet thick. Underlying the topsoil we encountered a layer of Holocene-aged alluvial fan deposits generally consisting dense Silty SAND (SM) with gravel, cobble and boulders to Silty GRAVEL (GM) with sand, cobble and boulders. The silts observed during our explorations were non-plastic, and appeared to be susceptible to hydro-collapse. The gravel, cobble and boulders were subangular to subrounded and had a 2- to 3- inch average diameter and a 10-inch maximum diameter. These alluvial fan deposits persisted to the full depth of the exploratory trenches and test pits. Undocumented fill material was not observed during our exploration.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed development provided that the recommendations contained in this report are incorporated into the design and construction of the project. Due to the presence of relatively collapsible soils, the proposed structures should be founded upon a minimum of 24 inches of properly placed and compacted structural fill. Conventional spread and strip footings may be used to support the proposed structures, and may be proportioned for a maximum net allowable bearing capacity of **2,200 psf.**

Strategic site grading is also recommended to aid in reducing the potential for the site to be impacted by debris flow/alluvial fan flooding. Additional information concerning this hazard can be found in the Geological Hazards report prepared for the site by GeoStrata.

NOTE: The scope of services provided within this report is 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 a geotechnical investigation conducted for Lots 1R and 2R of the proposed Dauphine-Savory Piedmont subdivision and a two acre parcel located south of the two lots. The properties are located at approximately 6500 South Bybee Drive in Weber County, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the site and to provide recommendations for general site grading and the design and construction of foundations, slabs-on-grade, and exterior concrete flatwork.

The scope of work completed for this study included a site reconnaissance, subsurface exploration, soil sampling, laboratory testing, engineering analyses, and preparation of this report. Our services were performed in accordance with our proposal, dated September 27, 2013 and your signed authorization.

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 project site is an irregularly-shaped property located in the foothills of the Wasatch Mountains at approximately 6500 South Bybee Drive in unincorporated Weber County, Utah (see Plate A-1, *Site Vicinity Map*). The subject property currently exists as undisturbed, native hillside. We understand that the development as planned will include three residential building lots with associated driveways and landscaped areas. The buildings for the proposed lots are anticipated to be a single or two story structures, on the order of 3,500 square feet in size, and will likely include basements founded on conventional spread footings.

3.0 METHODS OF STUDY

3.1 LITERATURE REVIEW

In preparation of this report, we have reviewed the Geologic Hazard Maps prepared by the Utah Geologic Survey for Weber County. These maps were assembled by the Utah Geological Survey and indicate areas in Weber County that may be subject to geological hazards. The hazards investigated by these maps include debris flow, surficial faulting, landslide susceptibility, and liquefaction (Christenson and Shaw, 2008). Review of these maps indicates that the site is located within a debris flow special study area due to the presence of channels and alluvial fans where debris flows and alluvial-fan flooding has been known to occur. The site is also located within an area mapped as having a low liquefaction potential, and is mapped as being in an area that is considered susceptible to shallow and/or deep-seated landslides. The map suggests that the site is located near a portion of the Weber Segment of the Wasatch Fault. As such, two fault investigation trenches were excavated as part of our field investigation in order to identify the presence and locations of any fault scarps located on the property. The results of our fault trenching are summarized in a separate report. A geologic map of the Ogden 7.5 Minute Quadrangle was also reviewed for additional information concerning the surficial geologic units present at the site (Yonkee and Lowe, 2004). Due to the geologic hazards identified during the literature review, a geologic hazards investigation was performed and is presented in a separate report.

3.2 FIELD INVESTIGATION

As a part of this investigation, subsurface soil conditions were explored by excavating two exploratory trenches to depths ranging from 6½ to 12½ feet in depth below the existing site grade. In addition, two exploratory test pits were advanced at the subject site to a depth of 11 feet below the existing site grade. The approximate locations of the exploratory trenches and test pits are shown on the *Exploration Location Map*, Plate A-2, in Appendix A. These exploration points were selected to provide a representative cross section of the subsurface soil conditions in the anticipated vicinity of the proposed structures. Subsurface soil conditions as encountered in the explorations were logged at the time of our investigation by a geotechnical engineer and are presented on the enclosed Test Pit and Trench Logs, Plates B-1 to B-4 in Appendix B. A *Key to Soil Symbols and Terminology* is presented on Plate B-5.

Both the trenches and the test pits were excavated using a trackhoe. Bulk samples of the subsurface soils were obtained from both the trench and test pit locations and transported to our laboratory for testing to evaluate the engineering properties of the various earth materials observed. Due to the relatively coarse-grained nature of the subsurface soils, collecting relatively "undisturbed" soil samples was not feasible. The soils were classified according to the Unified Soil Classification System (USCS) by the geotechnical engineer. Classifications for the individual soil units are shown on the attached Test Pit Logs.

3.3 LABORATORY INVESTIGATION

Geotechnical laboratory tests were conducted on selected 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:

- Grain Size Distribution Analysis (ASTM D422)
- Atterberg Limits (ASTM D4318)
- Water-soluble sulfate concentration for cement type recommendations
- Resistivity and pH to evaluate corrosion potential of ferrous metals in contact with site soils

The results of the laboratory testing are presented on the Test Pit Logs in Appendix B (Plates B-1 to B-4), and the laboratory testing result plates in Appendix C (Plates C-1 through C-3).

3.4 ENGINEERING ANALYSIS

Engineering analyses were performed using soil data obtained from the laboratory test results and empirical correlations from material density, depositional characteristics and classification. Appropriate factors of safety were applied to the results consistent with industry standards and the accepted standard of care.

Excavation stability was evaluated based on the field conditions encountered, laboratory test results, and soil type. Occupational Safety and Health (OSHA) minimum requirements are typically prescribed unless conditions warrant further flattening of excavation walls.

4.0 GENERALIZED SITE CONDITIONS

4.1 SURFACE CONDITIONS

At the time of our field investigation the site was in a relatively natural state and vegetated with a relatively dense growth of scrub oak as well as native shrubs and grasses. The eastern portion of the property drains towards the southwest at a moderate slope. The western portion of the property becomes increasingly flat, and drains towards the west-southwest. Maximum topographic relief across the site is estimated to be approximately 110 feet. Improvements at the site were limited to unpaved roadways. A small shed was located near the mouth of the Broad Hollow drainage on lot 2R.

4.2 SUBSURFACE CONDITIONS

As previously discussed, subsurface soil conditions were explored at the site by excavating two exploratory trenches across the westernmost lots, as well as two test pits on the eastern portions of the property. The trenches extended to depths ranging from 6½ to 12½ feet in depth below the existing site grade, whereas the test pits extended to a depth of 11 feet below the existing site grade. The soils encountered in the exploratory trenches and test pits were visually classified and logged during our field investigations and are included on the test pit and trench logs in Appendix B (Plates B-1 to B-4). The subsurface conditions encountered during our investigation are discussed below.

4.2.1 Earth Materials

Based on our observations and geologic literature review, the site is underlain by Holocene- to Upper Pleistocene-aged alluvial fan deposits likely sourced from Broad Hollow to the east of the site (Yonkee and Lowe, 2004). Descriptions of the soil units encountered are described below:

Topsoil: Generally consists of a dense, moist, brown Clayey SAND (SC) with gravel, cobble and boulders. Typically displays a trace 'pinhole' structure. This unit also has an organic appearance and texture, with both thin and larger roots throughout. Topsoil was observed throughout the entire project site, and is anticipated to overlie the majority of the site.

Holocene-aged Alluvial Fan Deposits: Where observed, these sediments generally consist of dense, moist, light brown to brown Silty GRAVEL (GM) with sand, Poorly Graded GRAVEL

(GP-GM) with silt and sand, Silty SAND (SM), and Sandy SILT (ML), each with varying amounts of gravel, cobble and occasional boulders. The gravel, cobble and boulders observed within this deposit were typically subangular to angular, composed of grey to brown schist and quartz, and had diameters ranging from ½ inch to 24 inches. All fine-grained soils observed within this deposit were non-plastic. According to Yonkee and Lowe, 2004, these alluvial fan deposits are deposited thoughout active drainage channels and are largely composed of debris flow sediments. This deposit persisted to the full depth of our investigations.

The stratification lines shown on the enclosed test pit and trench logs represent the approximate boundary between soil types (Plates B-1 to B-4). 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.

4.2.2 Groundwater

Groundwater was not encountered in any of the explorations completed for this investigation. Seasonal fluctuations in precipitation, surface runoff from adjacent properties, or other on or offsite sources may increase moisture conditions at the site; groundwater conditions can be expected to rise depending on the time of the year. We anticipate that groundwater is relatively deep in this area and should not impact the proposed construction.

5.0 GEOLOGIC CONDITIONS

5.1 GEOLOGIC SETTING

The site is located in Unincorporated Weber County (Uintah Heights), Utah at an elevation ranging from 4900 to 4970 feet above mean sea level within the northern portion of the Salt Lake Basin. The Salt Lake basin is a deep, sediment-filled structural basin of Cenozoic age flanked by the Wasatch Range and Wellsville Mountains to the east and the Promontory Mountains, the Spring Hills, and the West Hills to the west (Hintze, 1980). The southern portion of the Salt Lake Basin is bordered on the west by the east shore of the Great Salt Lake. The Wasatch Range is the easternmost expression of pronounced Basin and Range extension in north-central Utah.

The near-surface geology of the Salt Lake Valley is dominated by sediments, which were deposited within the last 30,000 years by Lake Bonneville (Scott and others, 1983; Hintze, 1993). As the lake receded, streams began to incise large deltas that had formed at the mouths of major canyons along the Wasatch Range, and the eroded material was deposited in shallow lakes and marshes in the basin and in a series of recessional deltas and alluvial fans. Sediments toward the center of the valley are predominately deep-water deposits of clay, silt and fine sand. However, these deep-water deposits are in places covered by a thin post-Bonneville alluvial cover. Surface sediments within the vicinity of Trench 1 are mapped as Pleistocene-aged lacustrine gravel-bearing deposits associated with the regressive (Provo) phase of the Bonneville lake cycle (Yonkee and Lowe, 2004). This unit is described as clast-supported, moderately to well-sorted, pebble to cobble gravel and gravelly sand, interlayered with some silt and sand; deposited and reworked in higher energy environments along the Provo and regressive shorelines near the mountain front. The thickness of this unit is generally less than 20 feet. Based on our observations, the sediment exposed in Trench 1 is more likely associated with alluvial fan processes that have reworked Bonneville-aged sediment. The surface sediments within the vicinity of Trench 2 are mapped as Holocene-aged alluvial fan deposits (Yonkee and Lowe, 2004). This unit is described as a mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; forms fans having distinct levees and channels at mouths of mountain-fronts canyons. The thickness of this unit is generally less than 20 feet. GeoStrata's observations of the subsurface sediment concur with the preceding description. The surface sediments within the vicinity of the two test pits, TP-1 and TP-2, excavated on the eastern portion of the property are mapped as Bonneville lacustrine gravel-bearing deposits as described above. Based on our observations, the sediment exposed in both of the test pits are more likely associated with alluvial fan processes that have reworked Bonneville-aged sediment.

5.2 SEISMICITY AND FAULTING

The site is located west of the mouth of Broad Hollow within the foothills of the Wasatch Mountain Range. The Weber segment of the Wasatch fault zone is mapped approximately 400 feet west of the subject lots along the toe of the steeply west dipping range front. The Weber segment of the Wasatch fault is thought to have most recently experienced a seismic event during the Quaternary Period, and there is evidence that as many as 10 to 15 events 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 measureable offset of 1.4 to 3.4 meters per event (McCalpin and others, 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 southern terminus of the Weber Segment occurs at the Salt Lake Salient, a ridge of Paleozoic and Tertiary bedrock that extends west of the Wasatch Front at the northern end of the Salt Lake rupture segment. The geometry of linkage between the main rupture zones in the Weber segment and faults in the interior of the Salt Lake salient is not clear. Surface scarps at the southern margin of the salient are discontinuous but apparently extend into the large normal fault along the eastern boundary of the segment. There is no reported evidence for Quaternary movement on this fault in the interior of the salient, so presumably the Quaternary ruptures have not reactivated most of this fault. The Pleasant View Salient marks the boundary between the Weber Segment and the Brigham City Segment to the north (Personius, 1986, Zoback, 1983).

The site is also located approximately 23 miles east of the East Great Salt Lake fault zone (Hecker, 1993). Evidence suggests that this fault zone has been active during Holocene times (0 to 10,000 years) and has segment lengths comparable to that of the Wasatch fault zone, indicating that it is capable of producing earthquakes of a comparable magnitude (7.5 Ms).

Analysis of the ground shaking hazard along the Wasatch Front suggests that the Wasatch Fault Zone is the single greatest contributor to the seismic hazard in the Salt Lake City region. Each of the faults listed above show evidence of Holocene-aged movement, and is therefore considered active.

Seismic hazard maps depicting probabilistic ground motions and spectral response have been developed for the United States by the U.S. Geological Survey as part of NEHRP/NSHMP (Frankel et al, 1996). These maps have been incorporated into both *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* (FEMA, 1997) and the *International Building Code* (IBC) (International Code Council, 2009). Spectral responses for the Maximum Considered Earthquake (MCE) are shown in the table below. These values generally correspond to a two percent probability of exceedance in 50 years (2PE50) for a "firm rock" site. To account for site effects, site coefficients which vary with the magnitude of spectral acceleration are used. Based on our field exploration, it is our opinion that this location is best described as a Site Class D. The spectral accelerations are shown in the table below. The spectral accelerations are calculated based on the site's approximate latitude and longitude of 41.1447 and -111.9061° respectively and the United States Geological Survey 2009 ground motion calculator version 5.1.0 (USGS, 2011). Based on IBC, the site coefficients are F_a=1.00 and F_v= 1.50. From this procedure the peak ground acceleration (PGA) is estimated to be 0.57g.

MCE Seismic Response Spectrum Spectral Acceleration Values for IBC Site Class D[a]

Site Location: **Latitude = 41.1447 N** **Longitude = -111.9061W**	**Site Class D Site Coefficients:** **Fa = 1.00** **Fv = 1.50**
Spectral Period (sec)	**Response Spectrum Spectral Acceleration (g)**
0.2	$S_{MS}=(F_a*S_s=1.00*1.42) = 1.42$
1.0	$S_{M1}=(F_v*S_1=1.50*0.58) = 0.87$

[a] IBC 1615.1.3 recommends scaling the MCE values by 2/3 to obtain the design spectral response acceleration values; values reported in the table above have not been reduced.

Additional geological hazards observed at the subject site during our field investigation area discussed in a separate geologic conditions report completed by GeoStrata for the subject site.

Exhibit B-Geologic and Geotechnical Reports

6.0 ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS

Supporting data upon which the following recommendations are based have been presented in the previous sections of this report. The recommendations presented herein are governed by the physical properties of the earth materials encountered and tested as part of our subsurface exploration 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, GeoStrata should be informed so that our recommendations can be reviewed and revised as changes or conditions may require.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed development provided that the recommendations contained in this report are incorporated into the design and construction of the project.

6.2 EARTHWORK

Prior to the placement of foundations, general site grading is recommended to provide proper support for foundations, exterior concrete flatwork, and concrete slabs-on-grade. Site grading is also recommended to provide proper drainage and moisture control on the subject property and to aid in preventing differential settlement of foundations as a result of variations in subgrade moisture conditions. Strategic site grading is also recommended to aid in reducing the potential for the site to be impacted by debris flow/alluvial fan flooding. Additional information concerning this hazard can be found in the Geological Hazards report prepared for the site by GeoStrata.

6.2.1 General Site Preparation and Grading

Within areas to be graded (below proposed structures, fill sections, concrete flatwork, or pavement sections), any existing vegetation, debris, undocumented fill, or otherwise unsuitable soils should be removed. Any soft, loose, or disturbed soils (if encountered) should also be removed. Following the removal of vegetation, unsuitable soils, and loose or disturbed soils, as described above, site grading may be conducted to bring the site to design elevations. If over-excavation is required, the excavation should extend a minimum of one foot laterally for every foot of depth of over-excavation. Excavations should extend laterally at least two feet beyond flatwork, pavements, and slabs-on-grade. If materials are encountered that are not represented in the test pit logs or may present a concern, GeoStrata should be notified so observations and further recommendations as required can be made.

6.2.2 Soft Soil Stabilization

Although not anticipated, soft or pumping soils may be exposed in excavations at the site. Once exposed, all subgrade surfaces beneath proposed structure, pavements, and flat work concrete should be proof rolled with a piece of heavy wheeled-construction equipment. If soft or pumping soils are encountered, these soils should be stabilized prior to construction of footings. Stabilization of the subgrade soils can be accomplished using a clean, coarse angular material worked into the soft subgrade. We recommend the material be greater than 2 inch diameter, but less than 6 inches. A locally available pit-run gravel may be suitable but should contain a high percentage of particles larger than 2 inches and have less than 7 percent fines (material passing the No. 200 sieve). A pit-run gravel may not be as effective as a coarse, angular material in stabilizing the soft soils and may require more material and greater effort. The stabilization material should be worked (pushed) into the soft subgrade soils until a firm relatively unyielding surface is established. Once a firm, relatively unyielding surface is achieved, the area may be brought to final design grade using structural fill.

In large areas of soft subgrade soils, stabilization of the subgrade may not be practical using the method outlined above. In these areas it may be more economical to place a woven geotextile fabric against the soft soils covered by 18 inches of coarse, sub-rounded to rounded material over the woven geotextile. An inexpensive non-woven geotextile "filter" fabric should also be placed over the top of the coarse, sub-rounded to rounded fill prior to placing structural fill or pavement section soils to reduce infiltration of fines from above. The woven geotextile should be Amoco 2004 or prior approved equivalent. The filter fabric should consist of an Amoco 4506, Amoco 4508, or equivalent as approved by the Geotechnical Engineer.

6.2.3 Excavation Stability

Based on Occupational Safety and Health Administration (OSHA) guidelines for excavation safety, trenches with vertical walls up to 5 feet in depth may be occupied, however, the presence of fill soils, loose soils, or wet soils may require that the walls be flattened to maintain safe working conditions. When the trench is deeper than 5 feet, we recommend a trench-shield or shoring be used as a protective system to workers in the trench. Based on our soil observations, laboratory testing, and OSHA guidelines, native soils at the site classify as Type C soils. Deeper excavations, if required, should be constructed with side slopes no steeper than one and one-half horizontal to one vertical (1.5H:1V). If wet conditions are encountered, side slopes should be further flattened to maintain slope stability. Alternatively shoring or trench boxes may be used to improve safe work conditions in trenches. The contractor is ultimately responsible for trench and site safety. Pertinent OSHA requirements should be met to provide a safe work environment. If site specific conditions arise that require engineering analysis in accordance with OSHA regulations, GeoStrata can respond and provide recommendations as needed.

We recommend that a GeoStrata representative be on-site during all excavations to assess the exposed foundation soils. We also recommend that the Geotechnical Engineer be allowed to review the grading plans when they are prepared in order to evaluate their compatibility with these recommendations.

6.2.4 Structural Fill and Compaction

All fill placed for the support of structures, concrete flatwork or pavements should consist of structural fill. Structural fill may consist of a reworked, native gravelly soil provided that it is first screened in order to meet the requirements as follows; all structural fill should be free of vegetation, debris or frozen material, and should contain no inert materials larger than 4 inches nominal size. Native fine-grained soils may also be used as structural fill, but the contractor should be aware that these soils may be difficult to moisture condition and properly compact. Alternatively, an imported structural fill meeting the specifications below may be used. If soil is imported for use as structural fill, we recommend that it be a relatively well graded granular soil with a maximum of 50 percent passing the No. 4 mesh sieve and a maximum fines content (minus No.200 mesh sieve) of 25 percent. All structural fill soils should be approved by the Geotechnical Engineer prior to placement. Clay and silt particles in imported structural fill should have a liquid limit less than 35 and a plasticity index less than 15 based on the Atterberg Limit's test (ASTM D-4318). The contractor should anticipate testing all soils used as structural fill frequently to assess the maximum dry density, fines content, and moisture content, etc.

All structural fill should be placed in maximum 6-inch loose lifts if compacted by small hand-operated compaction equipment, maximum 8-inch loose lifts if compacted by light-duty rollers, and maximum 10-inch loose lifts if compacted by heavy duty compaction equipment that is capable of efficiently compacting the entire thickness of the lift. We recommend that all structural fill be compacted on a horizontal plane, unless otherwise approved by the geotechnical engineer. Structural fill should be compacted to at least 95% of the MDD, as determined by ASTM D-1557. The moisture content should be at or slightly above the OMC at the time of placement and compaction. Also, prior to placing any fill, the excavations should be observed by the geotechnical engineer to observe that any unsuitable materials or loose soils have been removed. In addition, proper grading should precede placement of fill, as described in the **General Site Preparation and Grading** subsection of this report (Section 6.2.1).

Fill soils placed for subgrade below exterior flat work and pavements, should be within 3% of the OMC when placed and compacted to at least 95% of the MDD as determined by ASTM D-1557. All utility trenches backfilled below the proposed structure, pavements, and flatwork concrete, should be backfilled with structural fill that is within 3% of the OMC when placed and compacted to at least 95% of the MDD as determined by ASTM D-1557. All other trenches, in landscape areas, should be backfilled and compacted to at least 90% of the MDD (ASTM D-1557).

The gradation, placement, moisture, and compaction recommendations contained in this section meet our minimum requirements, but may not meet the requirements of other governing agencies such as city, county, or state entities. If their requirements exceed our recommendations, their specifications should override those presented in this report.

6.3 FOUNDATIONS

All topsoil underlying any proposed foundation elements should be over-excavated. Due to the presence of potentially collapsible soils, we recommend that foundations be established on a minimum of 24 inches of properly placed and compacted structural fill. Strip and spread footings should be a minimum of 18 and 36 inches wide, respectively, and exterior shallow footings should be embedded at least 30-inches below final grade for frost protection and confinement. Interior footings not subject to frost should be embedded at least 18 inches below final grade to provide confinement.

Conventional strip footings founded entirely on properly compacted structural fill may be proportioned for a maximum net allowable bearing capacity of **2,500 psf**. The net allowable bearing capacity may be increased (typically by one-third) for temporary loading conditions such as transient wind and seismic loads. All footing excavations should be observed by the Geotechnical Engineer prior to footing placement.

Settlements of properly designed and constructed conventional footings, founded as described above, are anticipated to be less than 1 inch. Differential settlements should be on the order of half the total settlement over 30 feet.

6.5 EARTH PRESSURES AND LATERAL RESISTANCE

Lateral forces imposed upon conventional foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footing and the supporting soils. In determining the frictional resistance against concrete, a coefficient of friction of 0.43 should be used for structural fill, drain gravel, or native sandy soils against concrete. A coefficient of friction of 0.34 should be used for fine-grained soils.

Ultimate lateral earth pressures from natural soils and *granular* backfill acting against retaining walls and buried structures may be computed from the lateral pressure coefficients or equivalent fluid densities presented in the following table:

Condition	**Lateral Pressure Coefficient**	**Equivalent Fluid Density (pounds per cubic foot)**
Active*	0.39	47
At-rest**	0.56	68
Passive*	2.56	308
Seismic Active***	0.85	102
Seismic Passive***	-1.29	-155

These coefficients and densities assume level, granular backfill with no buildup of hydrostatic pressures. The force of the water should be added to the presented values if hydrostatic pressures are anticipated. If sloping backfill is present, we recommend the geotechnical engineer be consulted to provide more accurate lateral pressure parameters once the design geometry is established.

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

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

The coefficients shown assume a vertical wall face. Hydrostatic and surcharge loadings, if any, should be added. Over-compaction behind walls should be avoided. Resisting passive earth pressure from soils subject to frost or heave, or otherwise above prescribed minimum depths of embedment, should usually be neglected in design.

6.6 CONCRETE SLABS-ON-GRADE CONSTRUCTION

Concrete slabs-on-grade should be constructed over at least 4 inches of compacted gravel overlying native soils or a zone of structural fill that is at least 12 inches thick. Disturbed native soils should be compacted to at least 95% of the MDD as determined by ASTM D-1557 (modified proctor) prior to placement of gravel. The gravel should consist of road base or clean drain rock with a ¾-inch maximum particle size and no more than 12 percent fines passing the No. 200 mesh sieve. The gravel layer should be compacted to at least 95 percent of the MDD of modified proctor or until tight and relatively unyielding if the material is non-proctorable. All concrete slabs should be designed to minimize cracking as a result of shrinkage. Consideration should be given to reinforcing the slab with welded wire, re-bar, or fiber mesh.

6.7 MOISTURE PROTECTION AND SURFACE DRAINAGE

Precautions should be taken during and after construction to minimize over-wetting of soils beneath foundations, flatwork concrete, and pavements. Moisture should not be allowed to infiltrate soils in the vicinity of the proposed structure. Grading should be planned and executed to provide positive surface drainage away from fills, slopes, and the structure. We recommend using a minimum surface slope of 2 percent for graded earth surfaces. Additionally, we recommend that drains be provided to convey water a minimum of 10 feet away from all exterior walls.

Over-wetting of soils prior to or during construction may result in softening and pumping of the subgrade. This may result in equipment mobility problems and/or difficulty in achieving compaction, and consequently, necessitate soil stabilization measures.

6.8 SOIL CORROSION POTENTIAL

A representative soil sample was tested in the laboratory to evaluate the soluble sulfate content. The laboratory test results indicate that the sample tested had soluble sulfate content of 72.9 ppm. Based on this result, the soils are classified as having a low potential for sulfate attack to concrete. We anticipate that conventional Type I/II cement can be used for all of the concrete.

To evaluate the corrosion potential of ferrous metal in contact with onsite native soil, a representative soil sample was tested in our soils laboratory for soil resistivity (AASHTO T288) and pH. The tests indicated that the onsite soil tested has a minimum soil resistivity of 4,000 OHM-cm, and a pH of 7.2. Based on this result, the onsite native soil is considered **corrosive** to ferrous metal. Consideration should be given to retaining the services of a qualified corrosion engineer to provide an assessment of any metal in contact with existing site soils, particularly ancillary water lines and reinforcing steel, and valves. Otherwise, metals should be coated with an appropriate material to prevent soils-metal contact.

7.0 CLOSURE

7.1 LIMITATIONS

The recommendations contained in this report are based on our limited field exploration, laboratory testing, and 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, GeoStrata 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, GeoStrata should 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 construction. GeoStrata staff should be on site to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation, earthwork and structural fill placement.
- Observation of foundation soils to assess their suitability for footing placement.
- Observation of soft/loose soils over-excavation.
- Observation of temporary excavations and shoring.
- Consultation as may be required during construction.
- Quality control and observation of concrete placement.

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

We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience at (801) 501-0583.

8.0 REFERENCES CITED

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Appendix A

1:24,000

Base Map: 2012 HRO 6 inch Orthophotography obtained from the State of Utah AGRC.

All Locations are Approximate

GeoStrata
Engineering & Geosciences

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
South Weber, Utah
Project Number: 910-001

Exploration Location Map

Plate A-1

0 75 150 300 450 600 Feet

1:3,000

Base Map: 2012 HRO 6 inch Orthophotography obtained from the State of Utah AGRC.

All Locations are Approximate

N

GeoStrata
Engineering & Geosciences

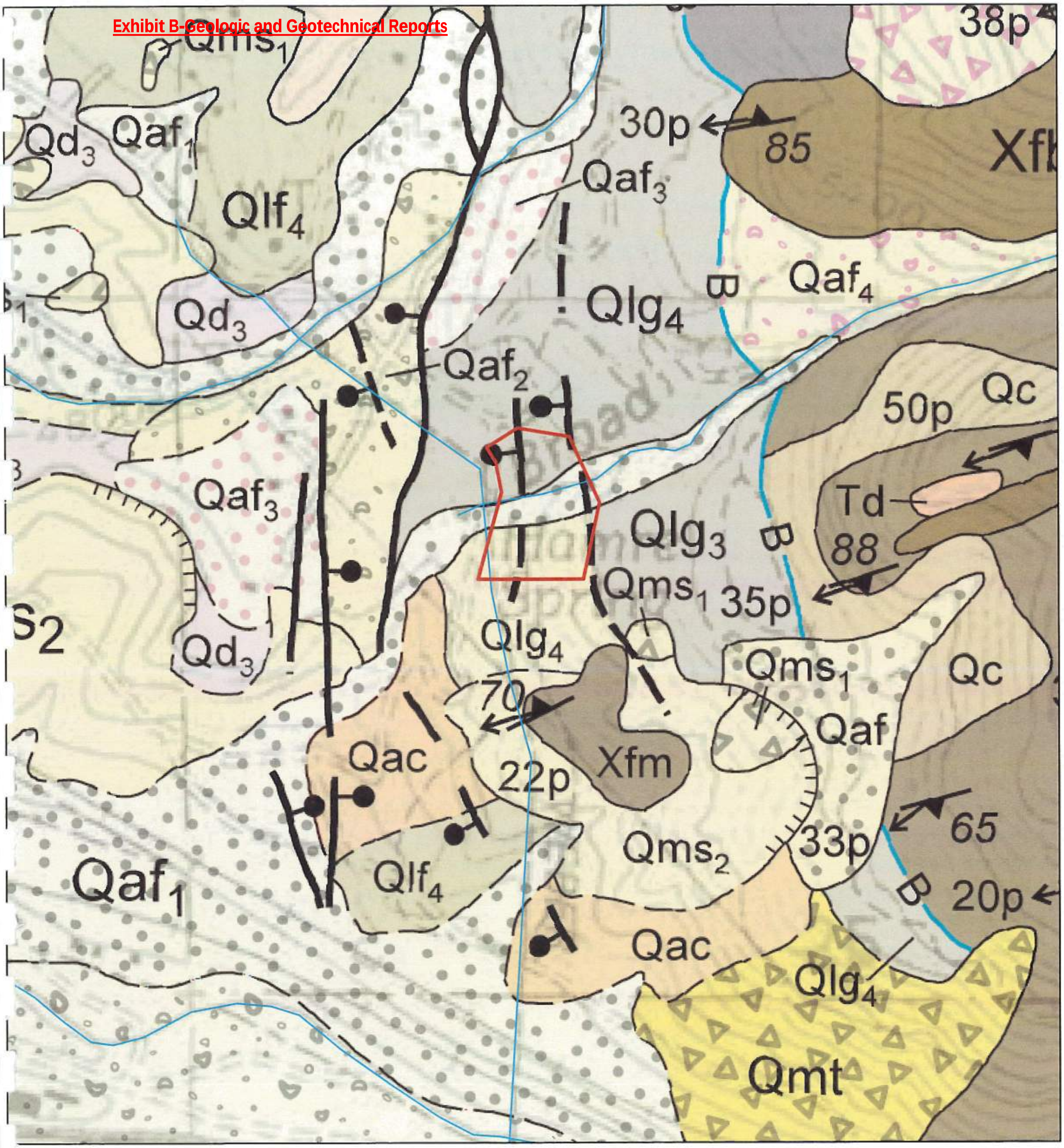
egend

- ▭ Site Boundary
- — Fault
- — Trench
- ✚ Test Pit

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
South Weber, Utah
Project Number: 910-001

Exploration Location Map

Plate
A-2



0 150 300 600 900 1,200 Feet

1:6,000

Base Map: USGS 7.5 Minute Topographic Map obtained from the State of Utah AGRC.

All Locations are Approximate

N

ac – Colluvium and Alluvium undivided

af – Alluvial fan deposits

lg – Lacustrine gravel-bearing deposits

f – lacustrine fine-grained deposits

ms – Landslide deposits

m – Migmatic gneiss

GeoStrata
Engineering & Geosciences

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
South Weber, Utah
Project Number: 910-001

Geologic Map

Plate
A-3

Appendix B

DATE		
STARTED:	10/22/13	
COMPLETED:	10/22/13	
BACKFILLED:	10/22/13	

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

TEST PIT NO:
Trench 1
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				TOPSOIL; Sandy SILT - dark brown, moist, frequent thick roots					
				ML	Sandy SILT - stiff, brown, moist - carbonate stringers					
1	5									
2				SM	Silty SAND - dense, brown, moist					
3	10				Bottom of Test Pit @ 10 Feet					
4										

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

GeoStrata
Copyright (c) 2013, GeoStrata

SAMPLE TYPE
▯ - GRAB SAMPLE
▨ - 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

Plate
B-1

DATE	
STARTED:	10/22/13
COMPLETED:	10/22/13
BACKFILLED:	10/22/13

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

TEST PIT NO:
Trench 2
Sheet 1 of 1

LOCATION

NORTHING EASTING ELEVATION

DEPTH (FEET)	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0				TOPSOIL; Silty GRAVEL with sand - dark brown, moist, roots throughout					
			GM	Silty GRAVEL with sand - dense, brown, moist, gravel is rounded to subrounded					
			SM	Silty SAND with gravel - dense, light brown, moist, gravel is subangular					
				Bottom of Test Pit @ 11 Feet					

GRAPHICAL LOG

METERS: 0, 1, 2, 3, 4
FEET: 0, 5, 10

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

GeoStrata

SAMPLE TYPE
- ▯ - GRAB SAMPLE
- ▨ - 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

Plate

B-2

LOG OF TEST PITS (B) TEST PIT LOGS - GEOTECH.GPJ GEOSTRATA.GDT 12/10/13

DATE
STARTED: 10/22/13
COMPLETED: 10/22/13
BACKFILLED: 10/22/13

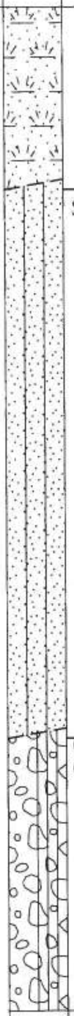
Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

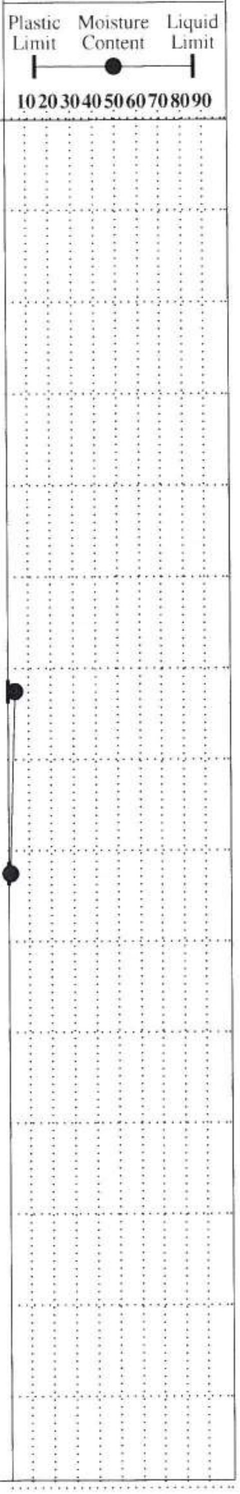
TEST PIT NO:
TP-1
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH (FEET)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			TOPSOIL; Clayey SAND with gravel, cobbles, and boulders - with roots and pinholes throughout					
		SM	Silty SAND with gravel and cobbles - dense, brown, moist to slightly moist, gravel is subrounded, cobbles observed up to 10" in diameter					
	▯				3.2	12.3	NP	NP
	▯	GP-GM	Poorly Graded GRAVEL with silt and sand - dense, brown, moist to slightly moist, gravels are subrounded, gravel observed up to 3" in diameter		0.8	7.9	NP	NP
			@ 9.5 ft - material is angular, gravel observed up to 6" in diameter					
11			Bottom of Test Pit @ 11 Feet					



Moisture Content and Atterberg Limits



GeoStrata

SAMPLE TYPE
▯ - GRAB SAMPLE
▨ - 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

Plate
B-3

DATE	
STARTED:	10/22/13
COMPLETED:	10/22/13
BACKFILLED:	10/22/13

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

TEST PIT NO:
TP-2
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

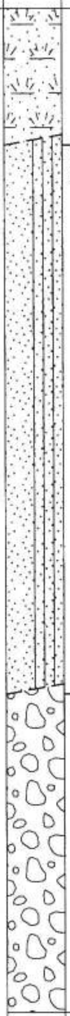
MATERIAL DESCRIPTION

UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
	TOPSOIL; Silty SAND with gravel, cobble, and boulders - with roots and pinholes throughout					
SP-SM	Poorly Graded SAND with silt, gravel, and cobbles - dense, brown, moist to slightly moist, gravel is subrounded to subangular, cobbles observed up to 6" in diameter		2.0	10.9	NP	NP
GP	Poorly Graded GRAVEL with sand and cobbles - dense, brown, moist to slightly moist, gravel is subangular, gravel observed up to 6" in diameter		0.8	3.8	NP	NP

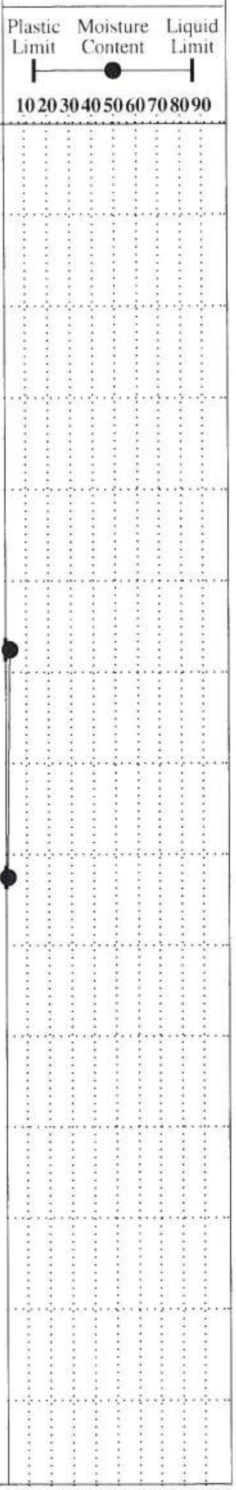
Bottom of Test Pit @ 11 Feet

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

SAMPLES / WATER LEVEL / GRAPHICAL LOG



Moisture Content and Atterberg Limits



LOG OF TEST PITS (B) TEST PIT LOGS - GEOTECH.GPJ GEOSTRATA.GDT 12/5/13

GeoStrata

SAMPLE TYPE
- ▯ - GRAB SAMPLE
- ▨ - 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

Plate
B-4

UNIFIED SOIL CLASSIFICATION SYSTEM

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

LOG KEY SYMBOLS

⊕ BORING SAMPLE LOCATION

⧗ TEST-PIT SAMPLE LOCATION

▼ WATER LEVEL (level after completion)

▽ WATER LEVEL (level where first encountered)

CEMENTATION

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

OTHER TESTS KEY

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

MODIFIERS

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

MOISTURE CONTENT

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

STRATIFICATION

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

GENERAL NOTES

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

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

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

CONSISTENCY - FINE-GRAINED SOIL

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

GeoStrata

Soil Symbols Description Key

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
South Weber, UT
Project Number: 910-001

Plate
B-5

Appendix C

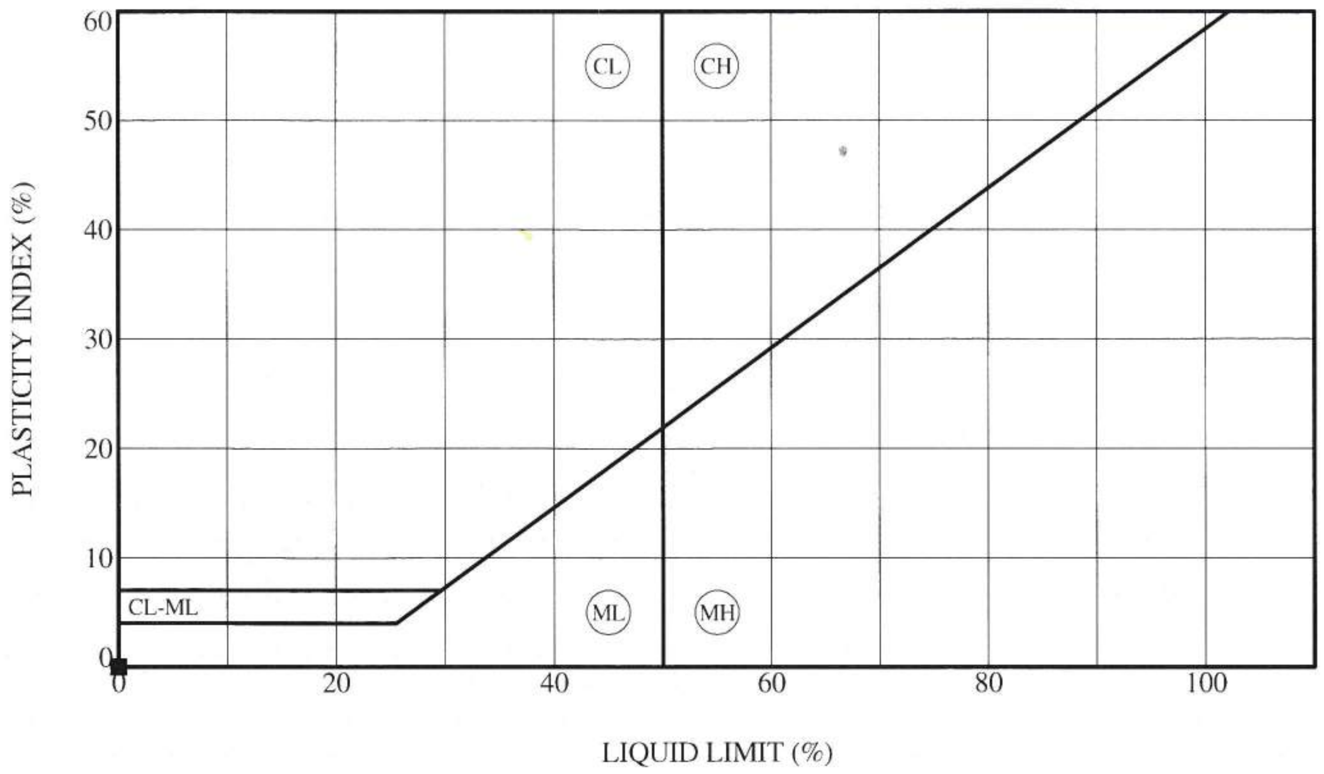
Test Pit No.	USCS Classification	Sample Depth (feet)	Natural Moisture Content (%)	Gradation			Atterberg		Sulfate Content (ppm)	Resistivity (Ω-cm)	pH
				Gravel (%)	Sand (%)	Fines (%)	LL	PI			
TP-1	SM	6.0	3.2	34.7	53.0	12.3	NP	NP			
TP-1	GP-GM	8.0	0.8	63.3	28.8	7.9	NP	NP	72.3	4000	7.2
TP-2	SP-SM	5.5	2.0	30.4	58.7	10.9	NP	NP			
TP-2	GP	8.0	0.8	71.2	25.0	3.8	NP	NP			

GeoStrata

Lab Summary Report

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number: 910-001

Plate
C - 1



	Sample Location	Depth (ft)	LL (%)	PL (%)	PI (%)	Fines (%)	Classification
●	**TP-1**	**6.0**	**NP**	**NP**	**NP**		**Silty SAND with gravel**
☒	**TP-1**	**8.0**	**NP**	**NP**	**NP**		**Poorly Graded GRAVEL with silt and sand**
▲	**TP-2**	**5.5**	**NP**	**NP**	**NP**		**Poorly Graded SAND with silt and gravel**
★	**TP-2**	**8.0**	**NP**	**NP**	**NP**		**Poorly Graded GRAVEL with sand**

GeoStrata

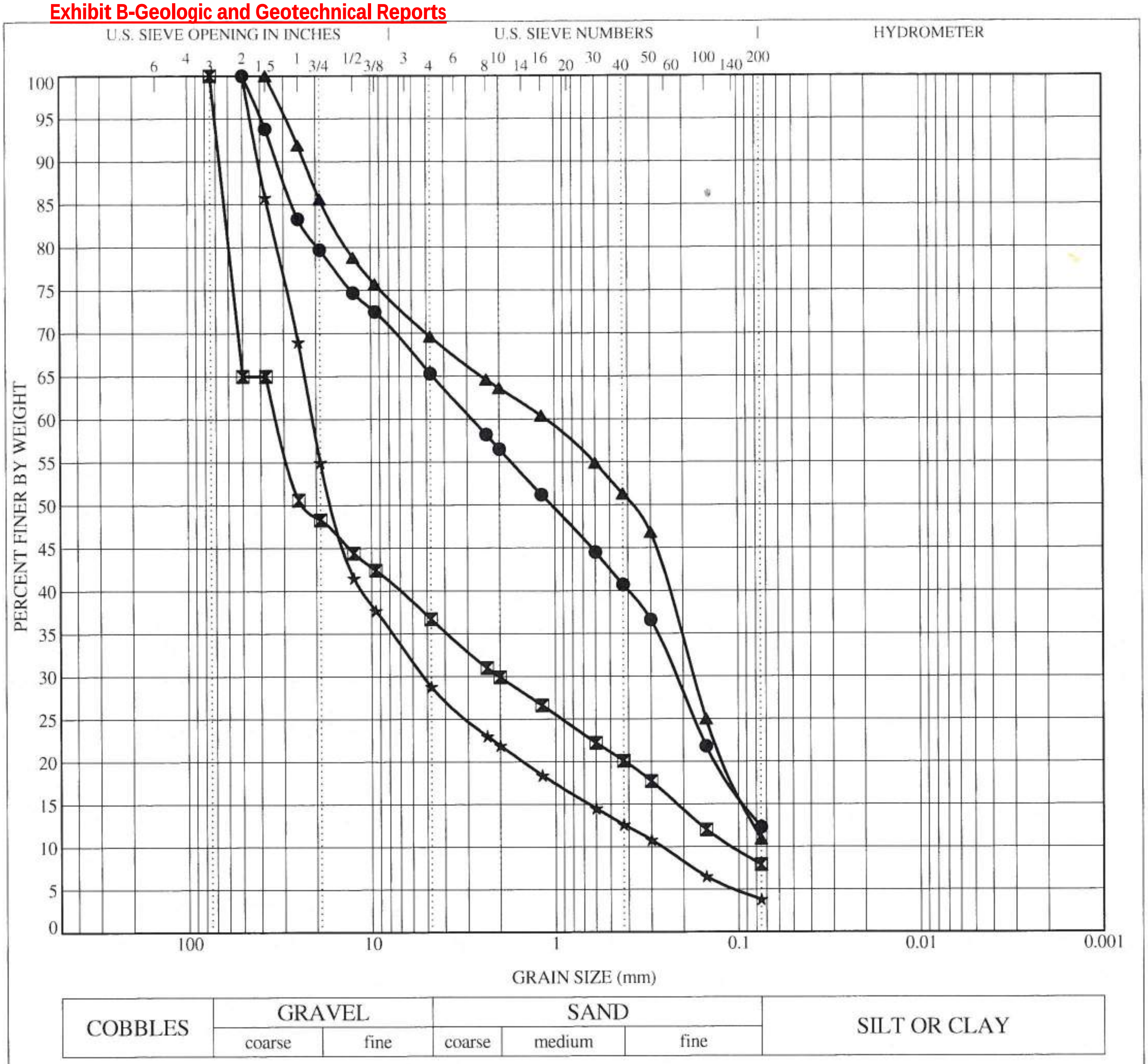
ATTERBERG LIMITS' RESULTS - ASTM D 4318

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number: 910-001

Plate

C - 2

C_ATTERBERG TEST PIT LOGS - GEOTECH.GPJ GEOSTRATA.GDT 12/5/13



	Sample Location	Depth	Classification	LL	PL	PI	Cc	Cu
●	**TP-1**	**6.0**	**Silty SAND with gravel**	**NP**	**NP**	**NP**	**0.27**	**44.44**
⧗	**TP-1**	**8.0**	**Poorly Graded GRAVEL with silt and sand**	**NP**	**NP**	**NP**	**1.18**	**304.54**
▲	**TP-2**	**5.5**	**Poorly Graded SAND with silt and gravel**	**NP**	**NP**	**NP**	**0.38**	**15.66**
★	**TP-2**	**8.0**	**Poorly Graded GRAVEL with sand**	**NP**	**NP**	**NP**	**4.92**	**79.47**

	Sample Loctaion	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-1**	**6.0**	**50**	**2.818**	**0.22**		**34.7**	**53.0**	**12.3**	
⧗	**TP-1**	**8.0**	**75**	**32.575**	**2.03**	**0.107**	**63.3**	**28.8**	**7.9**	
▲	**TP-2**	**5.5**	**37.5**	**1.123**	**0.176**		**30.4**	**58.7**	**10.9**	
★	**TP-2**	**8.0**	**50**	**20.957**	**5.215**	**0.264**	**71.2**	**25.0**	**3.8**	

GRAIN SIZE DISTRIBUTION - ASTM D422

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number: 910-001

Plate

C - 3

C_GSD TEST PIT LOGS - GEOTECH.GPJ GEOSTRATA.GDT 12/5/13

Appendix D

Seismic Ground Motion Values: USGS, 2009; Dobry and others, 2000

Project: Dauphine-Savory Piedmont Subdivision
Geotechnical Investigation
Project No.: 910-001
Project Location: Weber County, Utah
Date: Wednesday, December 04, 2013
Engineer: JSS

Site Coordinates:
Latitude: **40.3218** degrees
Longitude: **-111.8233** degrees

Exceedance Probability: **2** %
Exposure Time: **50** years
S_s = **1.416** From USGS 2002 Probabilistic Seismic
S_1 = **0.583** Hazard Maps for 2475-year Return Period

Site Soil Class: **D** (Stiff soil)
F_a = 1.00
F_v = 1.50

Site Class	Values of Site Factor, F_a, for Short-Period Range of Spectral Acceleration				
	$S_S \le 0.25$	$S_S = 0.5$	$S_S = 0.75$	$S_S = 1.0$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	*	*	*	*	*

(*)Site-specific geotechnical investigation and dynamic site response analyses shall be performed

Site Class	Values of Site Factor, F_v, for Long-Period Range of Spectral Acceleration				
	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	*	*	*	*	*

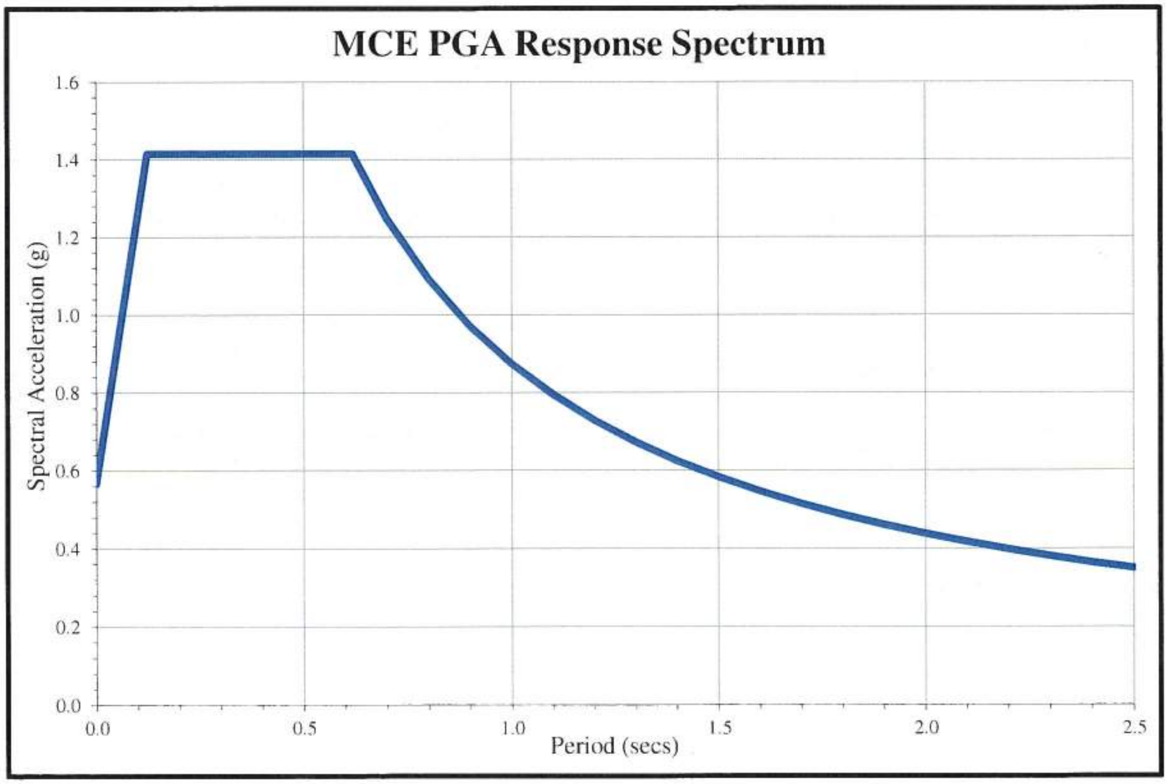
(*)Site-specific geotechnical investigation and dynamic site response analyses shall be performed

Adjusted for Site Conditions:
$S_{MS} = F_a \times S_S =$ (1.00 x 1.42) = 1.41 g
$S_{M1} = F_v \times S_1 =$ (1.50 x 0.58) = 0.87 g

MCE PGA = 0.4 x S_{MS} = (0.4 x 1.41) = **0.57** **g**
MCE $T_0 = 0.2 \times (S_{M1}/S_{MS}) =$ (0.2 x [0.87/1.41]) = 0.12 secs
MCE $T_S = (S_{M1}/S_{MS}) =$ (0.87/1.41) = 0.62 secs

Response Time Step, ΔT = **0.1**

Period (sec)	MCE Spectral Acceleration (g)
0.00	0.57
0.12	1.41
0.62	1.41
0.70	1.25
0.80	1.09
0.90	0.97
1.00	0.87
1.10	0.80
1.20	0.73
1.30	0.67
1.40	0.62
1.50	0.58
1.60	0.55
1.70	0.51
1.80	0.49
1.90	0.46
2.00	0.44
2.10	0.42
2.20	0.40
2.30	0.38
2.40	0.36
2.50	0.35



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