# LIQUEFACTION-INDUCED GROUND DISPLACEMENT MAPPING FOR THE SALT LAKE VALLEY, UTAH

by

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# ABSTRACT

This paper presents liquefaction-induced lateral spread and ground settlement maps for the Salt Lake Valley for a M7.0 scenario event on the Wasatch fault and for two probabilistic-based events: (1) peak ground acceleration associated with a 2 percent probability of exceedance in 50 years and (2) peak ground acceleration associated with a 10 percent probability of exceedance in 50 years. The maps presented herein are the first liquefaction-induced ground failure maps developed for Utah using both geotechnical and geological data in conjunction with deterministic and probabilistic estimates of strong motion. These maps have been developed to aid engineers, developers and city planners identify areas that may require additional geotechnical evaluations and/or liquefaction mitigation to reduce the liquefaction hazard. The maps were developed from an extensive geotechnical database, geologic mapping and hazard calculations. Estimates of lateral spread displacement were calculated from the Youd and others regression model and ground settlement estimates were calculated from procedures developed by Tokimatsu and Seed, and Yoshimine and others. Estimates from these methods were plotted within their respective surficial geologic units, and the mapped units were subsequently assigned an estimate of ground displacement based on statistical analysis. The mapped units for the scenario event were assigned a displacement hazard that has an 85 percent probability of nonexceedance for the M7.0 Wasatch fault characteristic earthquake while the probabilistic-based events were assigned the median displacement hazard for their respective probabilistic events.  The maps show relatively high lateral spread and settlement hazards exist along and near the Jordan River and in recent alluvial/river/stream/lake deposits found in the northern part of the Salt Lake Valley.

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# ACKNOWLEDGMENTS

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# INTRODUCTION

Liquefaction can occur when excess pore pressures are generated in relatively loose, saturated, granular soil deposits that are subjected to cyclic loading resulting from moderate to large earthquakes. In the liquefied state, the soil's shear resistance is significantly reduced and such loss of strength may cause ground failure (e.g., flow failure, lateral spread and ground oscillation). In addition, ground settlement may occur as excess pore pressure dissipates and the soil reconsolidates to a denser configuration. Infrastructure, embankments and retaining walls atop liquefied ground may suffer from bearing capacity and other types of failure due to liquefied conditions of the foundation soils.

Perhaps the most damaging type of liquefaction failure is lateral spread. During lateral spread, blocks of relatively intact surficial soil atop liquefied soil displace down slope or towards a free face and such displacement can cause considerable damage. Lateral spreads generated by the 1906 San Francisco earthquake damaged or destroyed numerous buildings, bridges, roads and pipelines (Youd and Hoose, 1978). Most notably, lateral spread along Valencia Street between 17th and 18th Streets severed water lines to downtown San Francisco. The resulting interruption of water greatly hampered fire fighting during the ensuing fire and significantly added to the earthquake losses. Lateral spreads caused by the 1964 Alaska earthquake disrupted many bridges, buildings, pipelines and other lifelines in cities such as Anchorage, Homer, Kodiak, Valdez, Seward, Portage and Whittier, Alaska. Approximately $80 million of liquefaction damage (1964 value) was incurred by 266 bridges and numerous sections of embankment along the Alaska Railroad and Highway (McCulloch and Bonilla, 1970; Kachadoorian, 1968). In that same year, liquefaction caused widespread damage to buildings, roads and bridges in Niigata, Japan (Hamada and others, 1986). In addition, ground settlement associated with liquefaction has caused extensive damage (Yoshida and others, 2001; Kaneko and others, 1995).

The Wasatch Front in Utah has a relatively high liquefaction hazard due to the presence of several nearby, active faults. The Salt Lake segment of the Wasatch fault is capable of producing a M7.0 or greater event (Machette and others, 1992) which could trigger liquefaction in several locales within the valley. In addition, the Salt Lake and other valleys along the Wasatch Front are relatively deep, sedimentary basins with shallow groundwater containing loose, saturated, potentially liquefiable soil deposits. With a 2.5 percent population increase from 2007 to 2008 (Bernstein, 2008), Utah is the nation’s fastest growing state and its infrastructure is continually expanding in earthquake-prone areas. This requires continual assessment of geological hazards, urban planning and earthquake-resistant design to reduce Utah’s seismic risk.

This paper focuses on the development of liquefaction-induced lateral spread and ground settlement maps for the Salt Lake Valley, Utah for three cases: (1) a characteristic M7.0 event on the Wasatch fault, (2) the peak ground acceleration (PGA) corresponding to 2 percent probability of exceedance in 50 years and (3) the PGA corresponding to 10 percent probability of exceedance in 50 years. Additionally, recommendations on the implementation and use of these maps in hazard ordinances are presented herein.

# GEOLOGIC SETTING

Quaternary unconsolidated sediments in the Salt Lake Valley are generally between 40 and 200 m thick, except for the northeastern part of the valley, where they may be as thick as 700 m (Arnow and others, 1970; Wong and others, 2002). Localized tilting caused by faulting and deepening of the sedimentary basin has produced the deeper section of unconsolidated sediments found in this part of the Salt Lake Valley.

Holocene sediments, deposited after the last regression of late-Pleistocene Lake Bonneville, and Lake Bonneville deposits dominate the surficial geology of this intermountain basin (Figure 1, Table 1). The northern part of the Salt Lake Valley is covered by Holocene lacustrine, marsh and alluvial sediments that were deposited after the last major regression of Lake Bonneville, some 10,000 years before present (Lund, 1990). The northward flowing Jordan River and its tributary streams that generally flow northwesterly across the Salt Lake Valley are the primary source of highly liquefiable sediments (Olsen and others, 2007).

In other parts of the valley, Holocene and late-Quaternary alluvium, alluvial fan, colluvial and glacial deposits have been deposited atop Lake Bonneville lacustrine, delta and terrace deposits (Wong and others, 2002). In the southern part of the valley and along its eastern margins, surficial deltaic deposits from Lake Bonneville and pre-Bonneville alluvial-fan deposits, late Tertiary/early Pleistocene fanglomerates are morphologically distinctive and generally thick in some areas (Wong and others, 2002).

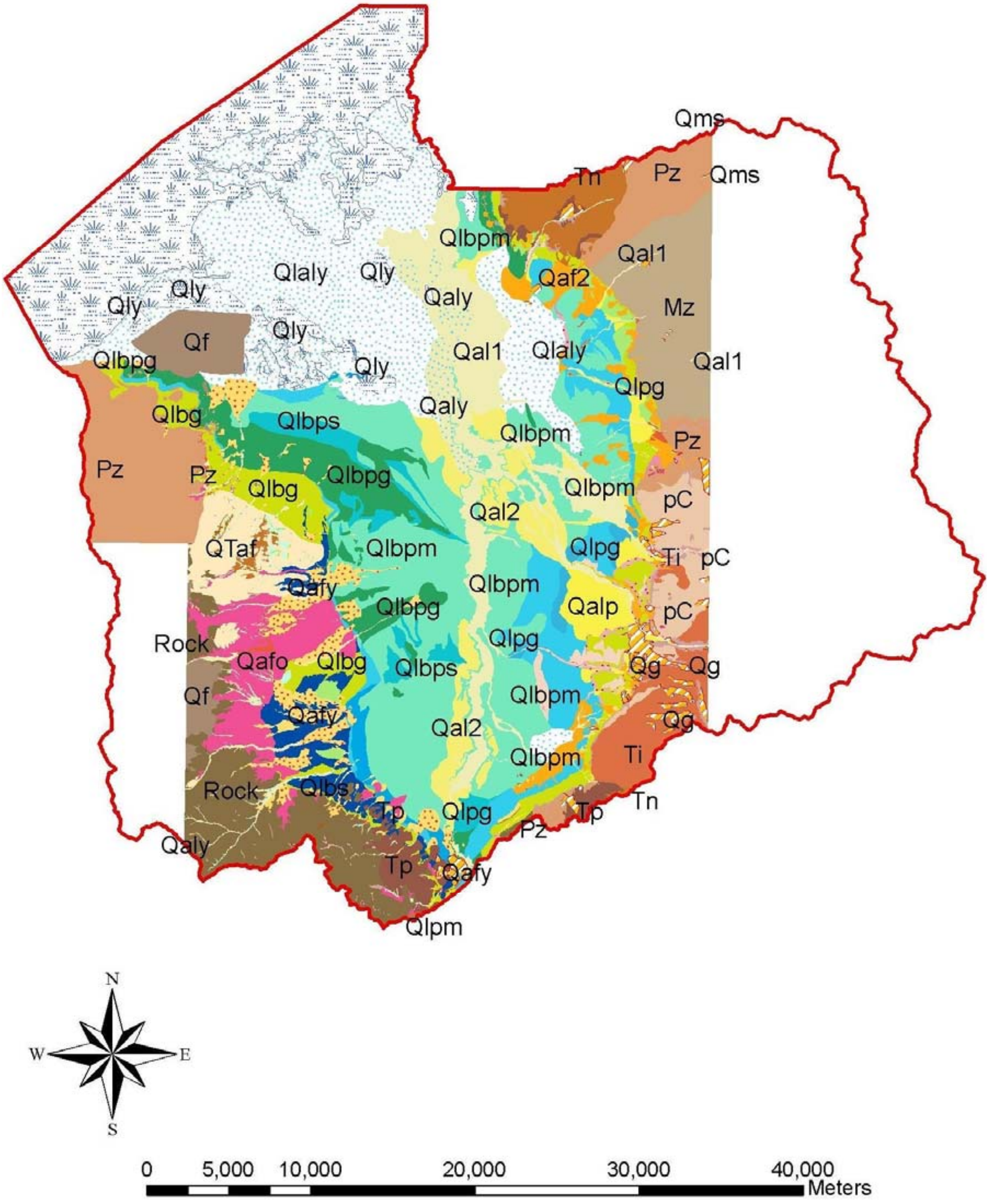

**Figure 1.** Surficial geology of the Salt Lake Valley, Utah (modified from Personius and Scott, 1992; Biek and others, 2004; and Miller, 1980). See Table 1 for descriptions of geologic units.

Table 1

Name, description and age of major surficial geologic units in the Salt Lake Valley (Personius and Scott, 1992; Biek and others, 2004; and Miller, 1980).

| Name | Description | Age |
|---|---|---|
| Stream Alluvium | | |
| Qal1 | Modern stream alluvium 1 | Upper Holocene |
| Qal2 | Modern stream alluvium 2 | Upper Holocene |
| Qalp | Stream alluvium related to the Provo (regressive) phase of Lake Bonneville | Upper Pleistocene |
| Qaly | Stream alluvial deposits, undivided | Holocene-Upper Pleistocene |
| Alluvial Fan Deposits | | |
| Qaf2 | Alluvial fan deposits 2 | Holocene |
| Qafy | Alluvial fan deposits, undivided | Holocene-Upper Pleistocene |
| Qafb | Alluvial fan deposits of the Bonneville (transgressive) ph. | Upper Pleistocene |
| Qafo | Older alluvial fan deposits, undivided | Middle Pleistocene |
| QTaf | Oldest alluvial fan deposits | Upper Pleistocene |
| Young Lacustrine and Mixed-Environment Deposits | | |
| Qly | Lacustrine and marsh deposits | Holocene |
| Qlaly | Lacustrine, marsh and alluvial deposits | Holocene-Upper Pleistocene |
| Lake Bonneville Lacustrine Deposits | | |
| Qlpd | Deltaic gravel of the Provo (regressive) phase | Upper Pleistocene |
| Qlpg | Lac. gravel and sand of the Provo (regressive) phase | Upper Pleistocene |
| Qlps | Lac. sand and silt of the Provo (regressive) phase | Upper Pleistocene |
| Qlpm | Lac. clay and silt of the Provo (regressive) phase | Upper Pleistocene |
| Qlbg | Lac. gravel and sand of the Bonneville (transgressive) ph. | Upper Pleistocene |
| Qlbs | Lac. sand and silt of the Bonneville (transgressive) phase | Upper Pleistocene |
| Qlbm | Lac. clay and silt of the Bonneville (transgressive) phase | Upper Pleistocene |
| Qlbpg | Lac. gravel and sand of the Bonneville Lake cycle, undiv. | Upper Pleistocene |
| Qlbps | Lac. sand and silt of the Bonneville Lake cycle, undiv. | Upper Pleistocene |
| Qlbpm | Lac. silt and clay of the Bonneville Lake cycle, undivided | Upper Pleistocene |
| Colluvial Deposits | | |
| Qclsp (Qmls) | Lateral spread deposits | Holocene-Upper Pleistocene |
| Qca | Colluvium and alluvium, undivided | Holocene-Mid. Pleistocene |
| Qes | Eolian sand | Holocene |
| Artificial Deposits | | |
| Qf | Artificial fill | Historical |
| Bedrock (sometimes generalized as "Rock") | | |
| Ti | Tertiary intrusive igneous rocks | Oligocene |
| Tn | Tertiary sedimentary and volcanic rocks | Neogene |
| Tp | Tertiary sedimentary and volcanic rocks | Paleogene |
| Mz | Mesozoic sedimentary rocks | Cretaceous - Triassic |
| Pz | Paleozoic sedimentary rocks | Permian - Cambrian |
| pC | Precambrian metamorphic rocks | Proterozoic and Archean |
| Rock | Limestone, shale, etc. | Pleistocene-Upper Mississippian |

The groundwater table is relatively shallow (generally less than 10 to 15 feet below the surface) in the northern part of the valley and along the Jordan River and its tributaries (Bartlett and others, 2005). The groundwater table is much deeper along the margins of the valley near the mountain fronts. Unfortunately, a reliable groundwater map does not exist for the Salt Lake Valley, thus the depth to groundwater recorded on the borehole logs from the geotechnical database was used in conjunction with an inverse distance square interpolation method to estimate the ground water level in the valley (Bartlett and others, 2005).

## FAULTING AND SEISMICITY

The Salt Lake Valley is located in the central Wasatch Front part of the Intermountain Seismic Belt which is a series of active, Quaternary normal faults extending from southern Montana to northern Arizona (Smith and Arabasz, 1991). The Salt Lake segment of the Wasatch fault poses the primary seismic hazard to the Salt Lake Valley (Scott and Shroba, 1985; Machette and others, 1992; Personius and Scott, 1992). This segment extends approximately 46 km from the Traverse Mountains salient (on the south) to the Salt Lake salient (on the north) (Personius and Scott, 1992). It is a complex normal fault system consisting of several sections that include (from north to south): (1) the Warm Springs fault along the Salt Lake salient, (2) the East Bench fault, which is located just east of downtown Salt Lake City, (3) the Cottonwood section along the southern part of the Wasatch Front in the Salt Lake Valley and (4) the western part of the Fort Canyon fault near the Traverse Mountains salient. Other faults in the north central-part of the valley form the West Valley fault zone, which is antithetic to the Salt Lake segment and may co-rupture with this segment (e.g., Youngs and others, 1987; Keaton and others, 1993).

The average recurrence of faulting on the Salt Lake segment is approximately 1,300 years (Lund, 2005) with a scenario event of approximately M7.0 or larger (Machette and others, 1992). No historical events have occurred on this segment, but well-documented evidence of prehistoric faulting has been observed in numerous paleoseismological, geological and geotechnical investigations. Expected PGA values for surficial soil conditions vary from about 0.1 to 1.1 g according to soil conditions and distance from the fault (Wong and others, 2002). Ground acceleration of this amplitude will cause liquefaction-induced ground failure in many parts of the central and northern valley, especially in the Holocene fluvial and alluvial deposits found in these areas. In addition, the strong ground motion may be amplified and prolonged due to soft soil and basin effects within the valley (Olsen and others, 1995).

# LIQUEFACTION HAZARDS

Numerous paleoseismological, geologic and geotechnical investigations conducted in the Salt Lake Valley have documented prehistoric ground failures, which in part, are caused by liquefaction-induced lateral spread (e.g., Osmond and others, 1965; Keaton and Anderson, 1995; Simon and Bymaster, 1999; Kleinfelder Inc., 1999; Cotton, Shires and Associates, 1999; Korbay and McCormick, 1999; Black el al., 2003). The ground displacement features at the Salt Palace Convention Center have been extensively studied and their causal mechanism(s) are somewhat controversial (Simon and Bymaster, 1999; Kleinfelder, 1999; Cotton, Shires and Associates, 1999; Black and others, 2003; Korbay and McCormick, 1999). These studies are important to understand the origins of prehistoric ground failures mapped in the downtown area.

On a larger scale, subsurface information in combination with surficial geologic maps can be compiled and interpreted to create liquefaction county hazard maps for development, planning and natural disaster preparation. Liquefaction hazard maps have been classified into three general types: (1) liquefaction susceptibility, (2) liquefaction potential and (3) liquefaction ground failure maps (Youd and Perkins, 1978; Power and Holzer, 1996). Liquefaction susceptibility maps describe the relative vulnerability or susceptibility of the soil to liquefaction and are based on geological mapping of depositional environments and/or descriptions of the soil’s texture and age. These maps do not consider the level or frequency of strong motion. In contrast, liquefaction potential maps combine soil susceptibility information with the seismicity of the area to describe the likelihood or potential of liquefaction for deterministic or probabilistic events. Lastly, liquefaction ground failure maps show estimates of the expected amount of permanent ground displacement associated with an event or hazard level. These latter maps are considered the most useful type of map for assessment and mitigation of liquefaction-induced damage.

The first liquefaction potential map for the Salt Lake Valley was developed by Anderson and others (1987) and later revised by Anderson and others (1994) and digitized by Jarva (1994). The Anderson and others (1994) map is currently adopted by most municipalities in Salt Lake County for hazard identification. This map was developed from geologic mapping, Standard Penetration Test (SPT) penetration resistance (blow count) N values and borehole soil descriptions using a relatively limited geotechnical database. From these data, estimates of the liquefaction potential were made and generalized to the mapped area. More recently, Solomon and others (2004) have developed a liquefaction ground failure map that presents the Liquefaction Severity Index (LSI) (Youd and Perkins, 1987) for the Salt Lake Valley. However, this approach did not implement subsurface geotechnical data, but was based solely on surficial mapping. Recently, Erickson (2007) has completed a probabilistic liquefaction potential map for the Salt Lake Valley using subsurface geotechnical data and surficial mapping that combines the input from the United States Geological Survey (USGS) probabilistic seismic hazard maps (Frankel and others, 2002) with the probability of triggering liquefaction using probabilistic curves developed by Seed and others (2003). Bartlett and others (2005) and Olsen and others (2007) have also produced a lateral spread displacement hazard map for a M7.0 Wasatch fault scenario earthquake for northern Salt Lake Valley.

This paper extends the work of Bartlett and others (2005) and Olsen and others (2007) and develops lateral spread displacement maps and liquefaction-induced ground settlement maps for the entire Salt Lake Valley based on a M7.0 Wasatch fault event (Wong and others, 2002) and for probabilistic estimates from the 2008 USGS National Seismic Hazard Mapping Project (Petersen and others, 2008). The selected PGA estimates correspond to a 2 percent probability of exceedance in 50 years and a 10 percent probability of exceedance in 50 years.

# ArcGIS® GEOTECHNICAL DATABASE

An extensive geotechnical database has been compiled in ArcGIS® for use in liquefaction analysis in the Salt Lake Valley (Bartlett and others, 2005; Olsen and others 2007; Erickson, 2007). Efforts have been made to gather subsurface information for nearly all major geologic units (Figure 1, Table 2) and to document the quality of data of the borehole information. At the time of this study, the database contained subsurface information from 963 boreholes drilled in the valley since 1959 (Figure 2; see also Appendix A). Many of the boreholes are from recent Utah Department of Transportation (UDOT) projects where explorations generally extend to depths of 15 m or greater, especially near bridge structures. In other areas of the valley, the major contributors of subsurface data were Salt Lake County, city municipalities and geotechnical consultants.

The information compiled in the ArcGIS® geotechnical database includes borehole logs, soil descriptions, groundwater levels, SPT blow counts, fines content, mean grain size and soil unit weights. Additionally, shear wave velocity ($V_s$) data for Salt Lake Valley (Ashland and McDonald, 2003) for approximately 160 locations are contained in the database. The $V_s$ dataset was reduced to representative site-response unit groups based on similar subsurface profile characteristics (e.g., near-surface soil type, origin, deposition and age). Average $V_s$ values (12 and 30 m) were determined for each site-response unit. Each surficial geologic unit was assigned to the best-paired site-response unit for use in the liquefaction analyses.

Table 2

Number of database boreholes in major surficial geologic units

| Name | Description | Boreholes |
|---|---|---|
| Stream Alluvium | | |
| Qal1 | Modern stream alluvium 1 | 288 |
| Qal2 | Modern stream alluvium 2 | 111 |
| Qalp | Stream alluvium related to the Provo (regressive) phase of Lake Bonneville | 10 |
| Qaly | Stream alluvial deposits, undivided | 15 |
| Alluvial Fan Deposits | | |
| Qaf2 | Alluvial fan deposits 2 | 28 |
| Qafy | Alluvial fan deposits, undivided | 6 |
| Qafb | Alluvial fan deposits of the Bonneville (transgressive) ph. | 3 |
| Qafo | Older alluvial fan deposits, undivided | 1 |
| QTaf | Oldest alluvial fan deposits | 1 |
| Young Lacustrine and Mixed-Environment Deposits | | |
| Qly | Lacustrine and marsh deposits | 5 |
| Qlaly | Lacustrine, marsh and alluvial deposits | 136 |
| Lake Bonneville Lacustrine Deposits | | |
| Qlpd | Deltaic gravel of the Provo (regressive) phase | 5 |
| Qlpg | Lac. gravel and sand of the Provo (regressive) phase | 40 |
| Qlps | Lac. sand and silt of the Provo (regressive) phase | 0 |
| Qlpm | Lac. clay and silt of the Provo (regressive) phase | 0 |
| Qlbg | Lac. gravel and sand of the Bonneville (transgressive) ph. | 14 |
| Qlbs | Lac. sand and silt of the Bonneville (transgressive) phase | 1 |
| Qlbm | Lac. clay and silt of the Bonneville (transgressive) phase | 5 |
| Qlbpg | Lac. gravel and sand of the Bonneville Lake cycle, undiv. | 12 |
| Qlbps | Lac. sand and silt of the Bonneville Lake cycle, undiv. | 5 |
| Qlbpm | Lac. silt and clay of the Bonneville Lake cycle, undivided | 269 |
| Colluvial Deposits | | |
| Qclsp (Qmls) | Lateral spread deposits | 2 |
| Qca | Colluvium and alluvium, undivided | 1 |
| Qes | Eolian sand | 1 |
| Artificial Deposits | | |
| Qf | Artificial fill | 0 |
| Bedrock | | |
| Ti | Tertiary intrusive igneous rocks | 0 |
| Tn | Tertiary sedimentary and volcanic rocks | 0 |
| Tp | Tertiary sedimentary and volcanic rocks | 0 |
| Mz | Mesozoic sedimentary rocks | 1 |
| Pz | Paleozoic sedimentary rocks | 2 |
| pC | Precambrian metamorphic rocks | 0 |
| Rock | Pleistocene-Upper Mississippian limestone, shale, etc. | 1 |

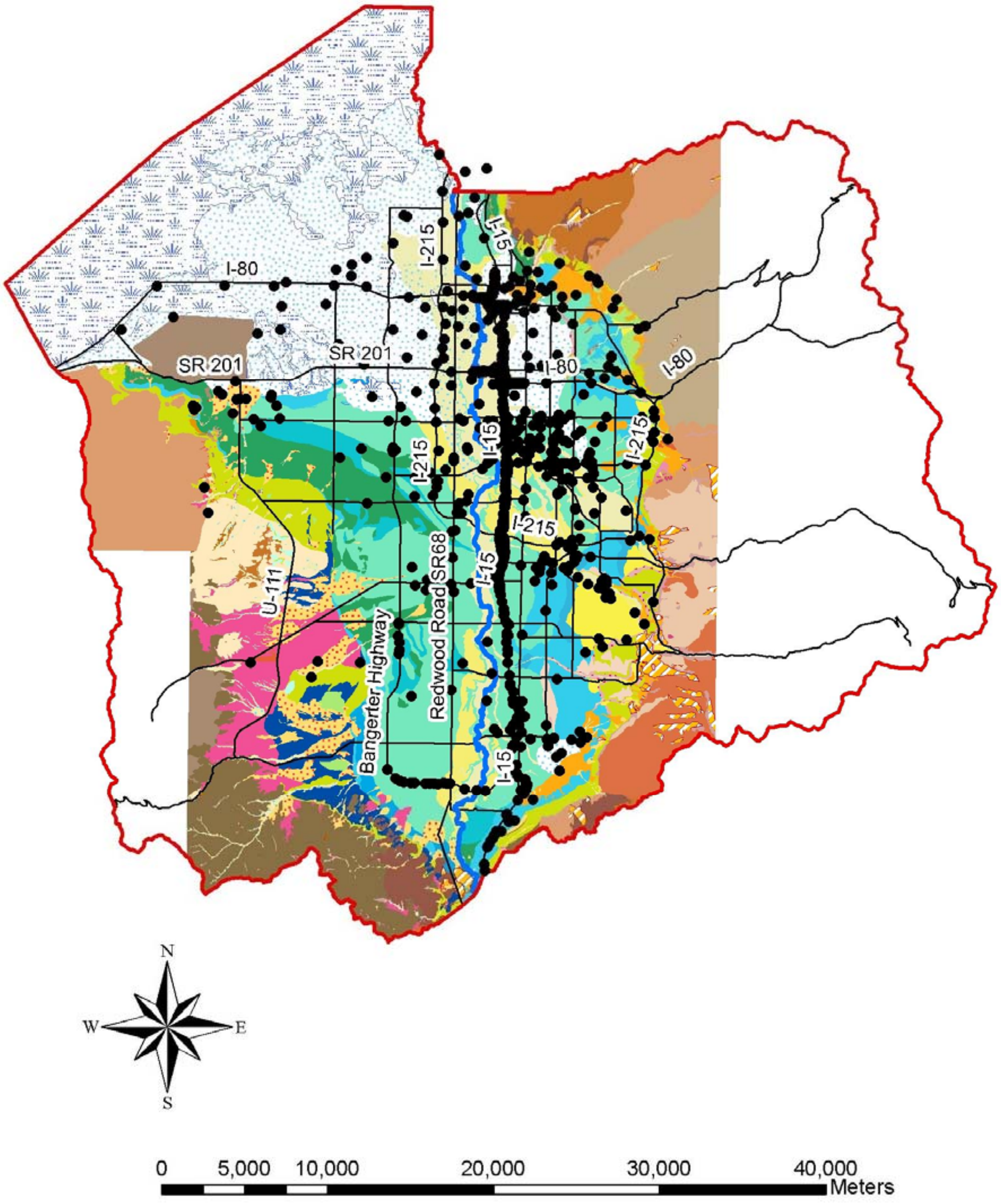

**Figure 2.** Locations of geotechnical boreholes contained in ArcGIS® geotechnical database, Salt Lake Valley, Utah.

Because the subsurface information originated from a variety of sources and data quality varied, a system was developed to assign data quality indicators to each individual datum (Bartlett and others, 2005). In this system, a “1” was assigned to data where the supporting information was well documented in the original geotechnical report. (In total there were 2,261 fines content and 315 mean grain size measurements in the database that had data quality rankings of “1.”) A data quality indicator of “2” was given to data that could be reasonably estimated from nearby borehole logs for the same site, and a “3” denoted data that were averaged from other nearby boreholes based on their soil type and geologic unit. Missing soil unit weight, fines content and mean grain size data that could not be estimated from nearby boreholes were averaged from high quality data within the entire database. For these averages, a “4” was assigned to data that represent averaged properties for the same soil type and geologic unit; and a “5” was assigned to data that represent averaged properties for the same soil type irrespective of the geologic unit. (No SPT penetration resistance data were averaged for this study; if such data were missing, the borehole information was not used.)

A groundwater depth map is required for liquefaction, lateral spread and ground settlement calculations. A comprehensive groundwater map did not exist for the mapped area, nor was there sufficient historical data to accurately model groundwater depths and fluctuations throughout the valley. Thus, the recorded groundwater depths from the borehole logs were used to generate a groundwater map using an inverse distance square interpolation method (Bartlett and others, 2005). To account for seasonal fluctuations, the depth to groundwater was conservatively decreased by 5 feet in all boreholes. In addition, if part of a soil layer was indicated on the borehole log to be saturated, the entire layer was assumed to be saturated in the analyses.

Surface slope and nearby topographical features are important factors in estimating lateral spread (Bartlett and Youd, 1992). A digital elevation model (DEM) from the USGS and free face features such as river channels and canals were used in ArcGIS® routines to approximate the surface slope and distance and height of a nearby free face, if present, for each borehole location (Bartlett and others, 2005; Olsen and others, 2007).

# LIQUEFACTION HAZARD MAPPING

Liquefaction ground failure maps were created for the Salt Lake Valley for lateral spread and liquefaction-induced ground settlement based on a scenario M7.0 Wasatch fault earthquake and for probabilistic events associated with PGA values corresponding to a 2 percent probability of exceedance in 50 years and a 10 percent probability of exceedance in 50 years. The PGA estimates for the M7.0 Wasatch fault scenario event were obtained from Wong and others (2002) and the PGA estimates for the probabilistic events were obtained from the USGS National Strong Motion Hazard Mapping Project (Petersen and others, 2008). In accordance with the method and criteria proposed by Seed and others (2001), the Petersen and others (2008) rock-based PGA estimates were adjusted for surface soil effects based on the averaged shear wave velocities ($V_s$) assigned to the several site-response units, as previously described.

## *Lateral Spread Map Development*

The lateral spread maps presented herein are a continuation of work completed for the northern part of the Salt Lake Valley by Bartlett and others (2005) and Olsen and others (2007). The methods used for this paper are consistent with the methods developed in those reports. In short, following the methods outlined in Youd and others (2001), raw SPT blow count data were normalized and corrected to $(N_1)_{60}$ clean sand values and liquefaction triggering analyses were completed at each borehole location.

Lateral spread displacements were estimated by the Youd and others (2002) regression model. The model requires the following input: earthquake magnitude, horizontal distance from the seismic source, distance to free face and height of free face (if applicable), ground slope (if applicable), and cumulative thickness, average fines content and mean grain size of all saturated granular layers with SPT $(N_1)_{60}$ blow counts less than 15. The scenario analysis was based on a M7.0 earthquake on the Wasatch fault (Wong and others, 2002) while input magnitudes and horizontal distances for the probabilistic analyses varied based on deaggregations of the data presented by Petersen and others (2008). All other input variables were obtained from the ArcGIS® geotechnical database previously described.

Displacements were estimated at each borehole location having a factor of safety against liquefaction triggering less than or equal to 1.1. All boreholes with factors of safety against liquefaction triggering greater than 1.1 were assigned a lateral spread displacement of 0 m. The estimated horizontal displacements ($D_H$) were further categorized as “minimal” (0 m); “low” (0 to 0.1 m); “moderate” (0.1 to 0.3 m); “high” (0.3 to 1.0 m); and “very high” (greater than 1.0 m).

Hazard categories were assigned to the major surficial geologic units by statistical analysis of the estimated displacements from all boreholes located within each respective geologic unit or group of units representing similar characteristics (e.g., near-surface soil type, origin, deposition and age). Using the method discussed by Bartlett and others (2005) and Olsen and others (2007), cumulative histograms of increasing hazard severity were developed to determine an 85 percent nonexceedance threshold for the scenario event (see Appendix C). The 85 percent nonexceedance criterion means that no more than 15 percent of the estimated displacements exceed the upper bound of the hazard category that was assigned to the respective geologic unit or group of units and thus approximately represents a mean plus one standard deviation criterion. For the probabilistic-based maps, the hazard category assigned to each geologic unit or group of units was based on the median estimated displacement for the respective unit.

In some areas, several clearly defined homogenous or nearly homogenous clusters of similar displacement that differed from the remaining estimates were represented in the same geologic unit. In these cases, the geologic units were subdivided prior to conducting statistical analysis, so that the displacement estimates were more homogenous locally. Several examples of statistical hazard category assessments are included in Appendix C.

The liquefaction-induced lateral spread ground displacement map for the scenario M7.0 Wasatch fault earthquake is presented in Figure 3 and the probabilistic-based maps are presented in Figures 4 and 5. These maps are useful in identifying areas of high ground displacement potential and areas where site-specific geotechnical investigation and/or liquefaction mitigation are warranted.

### *Ground Settlement Map Development*

Liquefaction-induced ground settlements were estimated by averaging the results of Tokimatsu and Seed (1987) and the Yoshimine and others (2006) method which is based on the methodology originally proposed by Ishihara and Yoshimine (1992). Both methods estimate ground settlement based on SPT N values, which conveniently suits the data

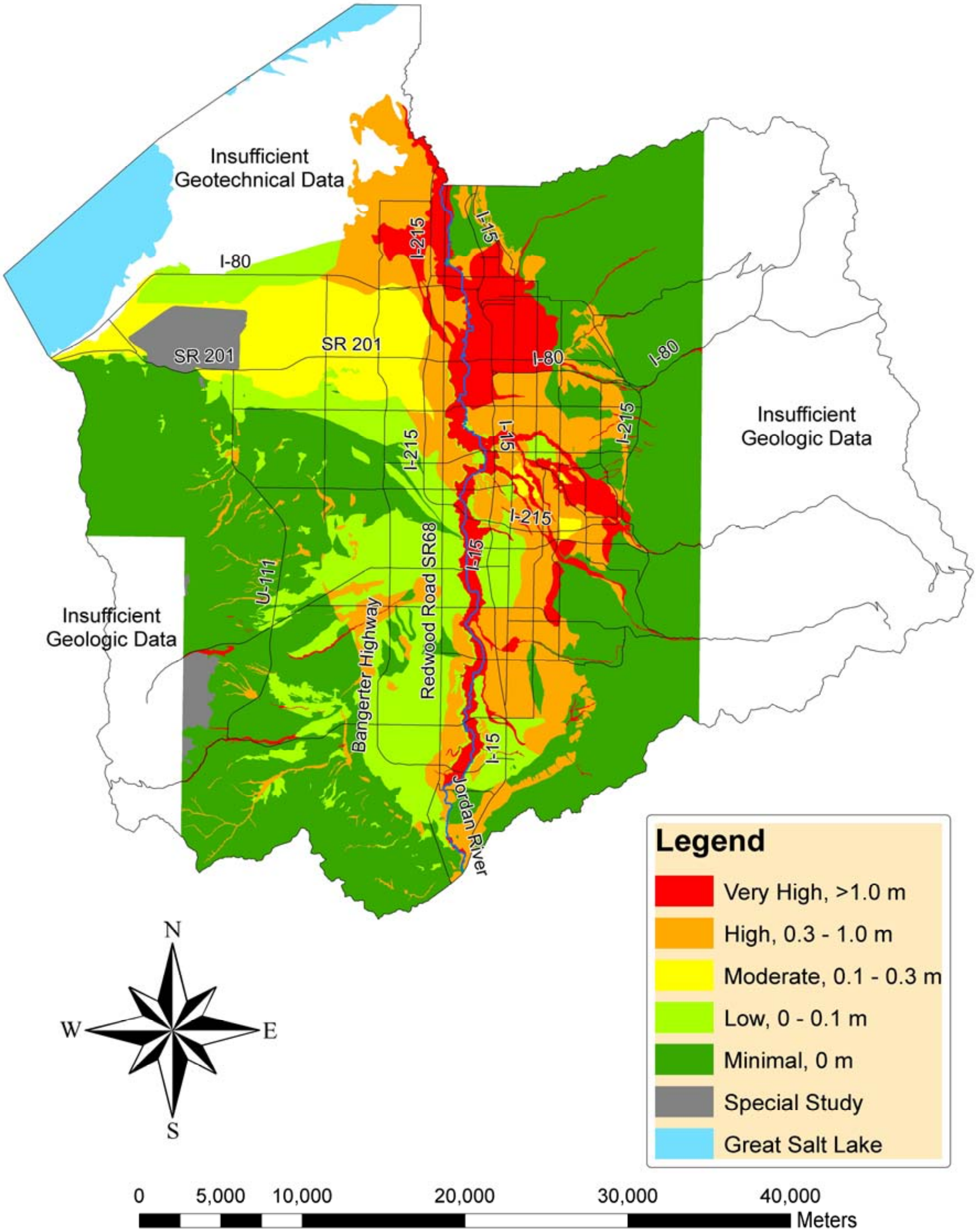

**Figure 3.** Lateral spread displacement hazard for the Salt Lake Valley, Utah based on M7.0 scenario earthquake on the Salt Lake segment of the Wasatch fault and an 85 percent nonexceedance probability threshold.

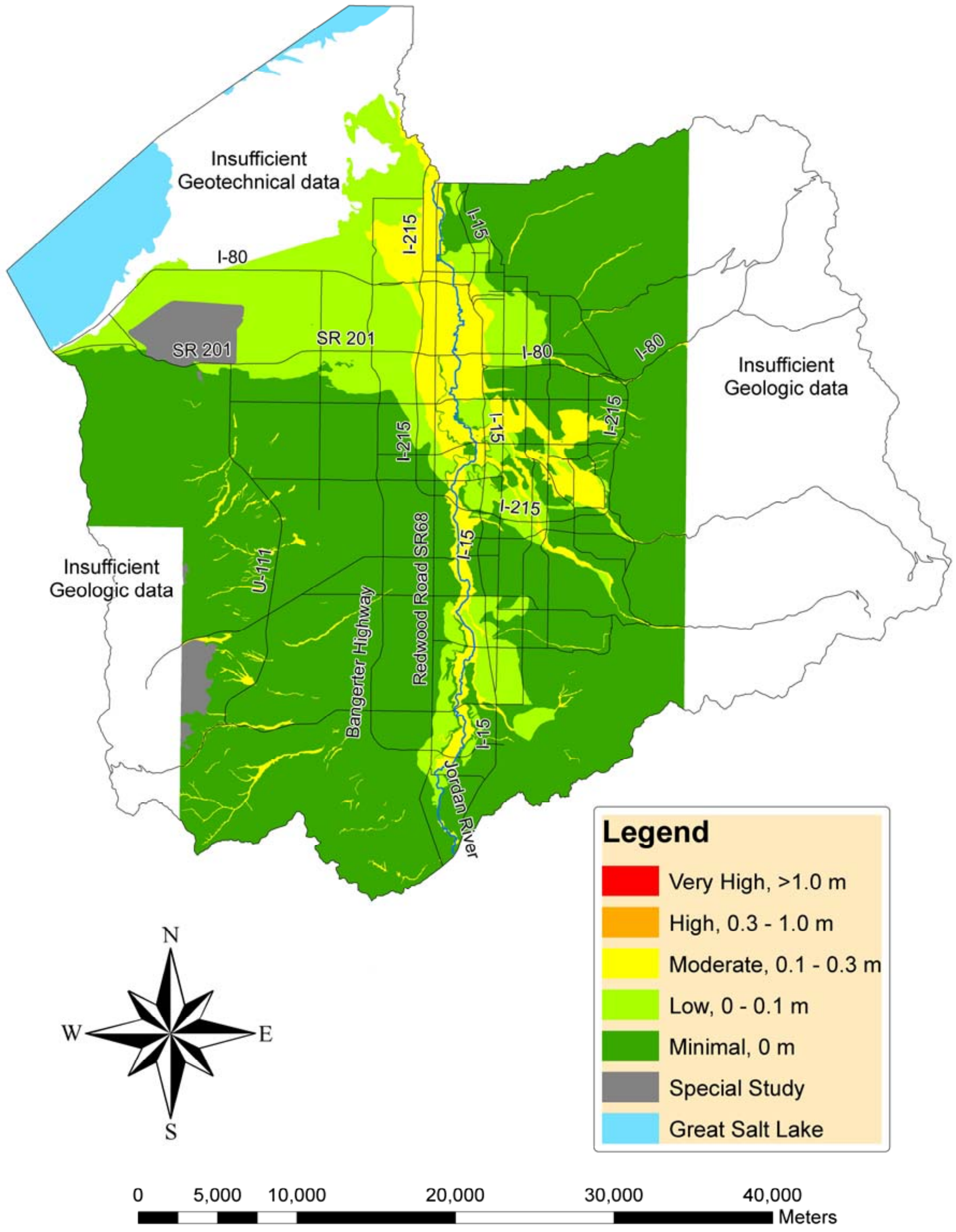

**Figure 4.** Lateral spread displacement hazard for the Salt Lake Valley, Utah based on the PGA associated with a 2 percent probability of exceedance in 50 years.

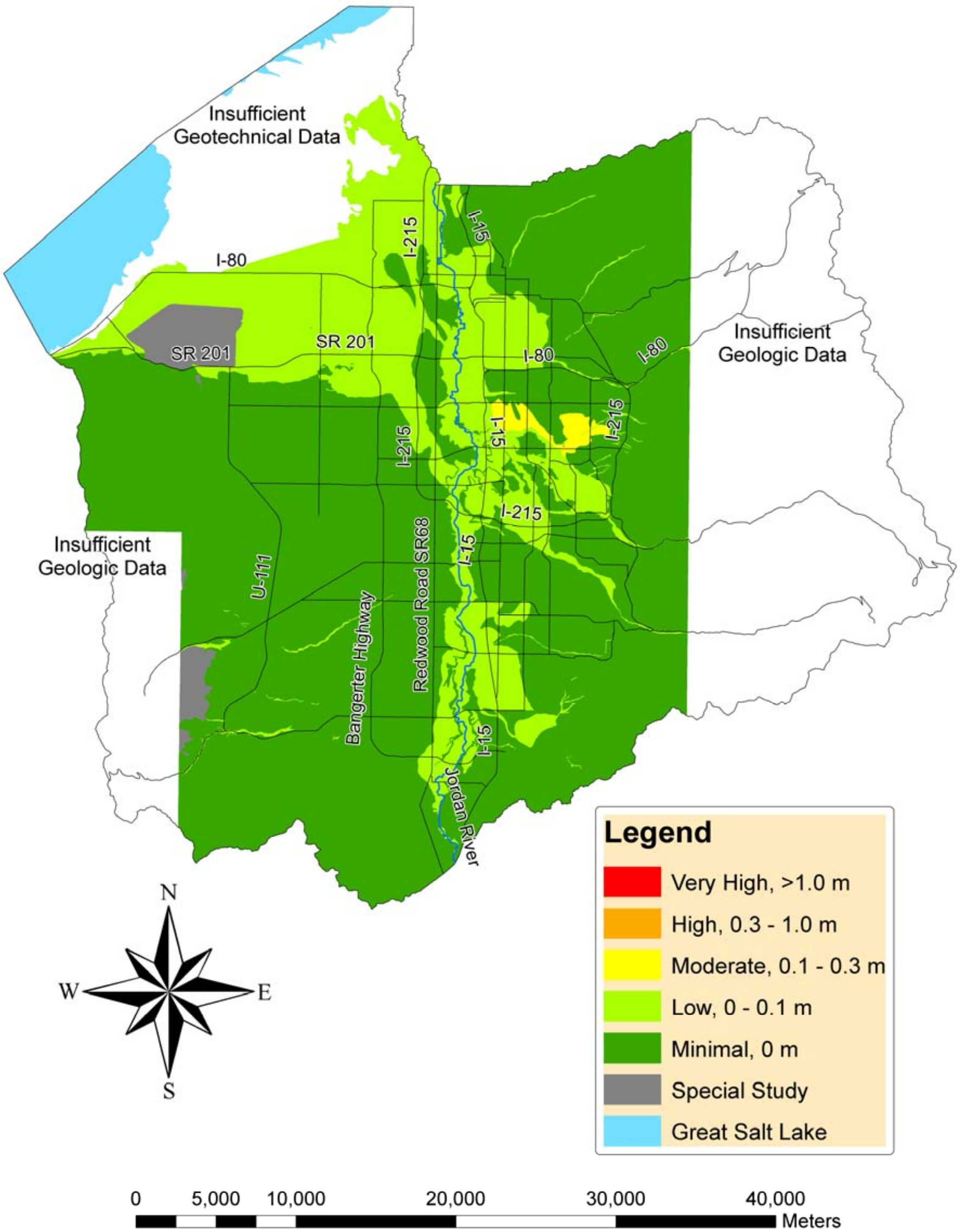

**Figure 5.** Lateral spread displacement hazard for the Salt Lake Valley, Utah based on the PGA associated with a 10 percent probability of exceedance in 50 years.

available in the ArcGIS® geotechnical database. The following paragraphs describe each method and the input data required to estimate settlement.

Tokimatsu and Seed (1987) estimate volumetric strain in saturated clean sands based on cyclic stress ratio and SPT blow counts, $(N_1)_{60}$ (see Figure 6). The method is based on correlations of field and laboratory performance data to post-liquefaction settlements recorded after the Niigata 1964, Tokachioki 1968 and Miyagiken Oki 1968 earthquakes. For the purposes of our study, the curves presented in Figure 6 were digitized into over 1,400 interpolated data points (see Appendix B).

Yoshimine and others (2006) present a series of equations to describe the liquefaction-induced volumetric strain prediction curves presented in Ishihara and Yoshimine (1992). The curves were derived from strains observed in cyclic laboratory testing performed by Nagase and Ishihara (1988) and correlate factor of safety against liquefaction triggering to the maximum single amplitude of shear strain ($\gamma_{max}$) based on relative density which is estimated from Japanese-normalized blow SPT blow counts, $N_1$ (Figure 7). The maximum single amplitude of shear strain is then used to estimate post-liquefaction volumetric strain due to reconsolidation (Figure 8). The Yoshimine and others (2006) equations were used in the ArcGIS® routines to facilitate rapid calculations (see Appendix B).

To estimate liquefaction-induced settlement by Tokimatsu and Seed (1987), the raw blow count data contained in the ArcGIS® geotechnical database were normalized and corrected to $(N_1)_{60}$ clean sand values and liquefaction triggering analyses were completed at each borehole location following the methods outlined in Youd and others (2001). A reference table created from the data points interpolated from Figure 6 was

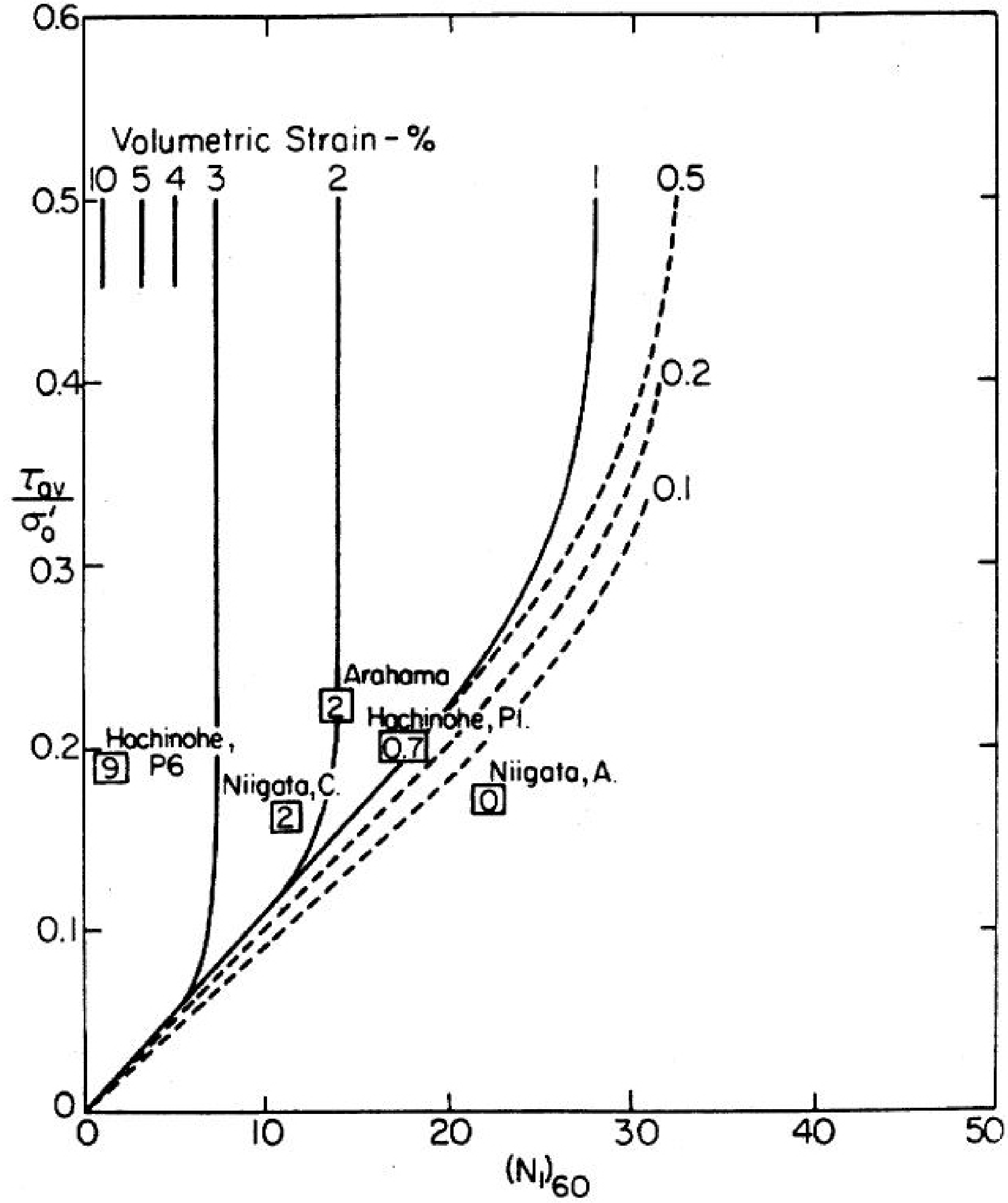

**Figure 6.** Relationships between $(N_1)_{60}$, cyclic stress ratio and volumetric strain for saturated clean sands (Tokimatsu and Seed, 1987).

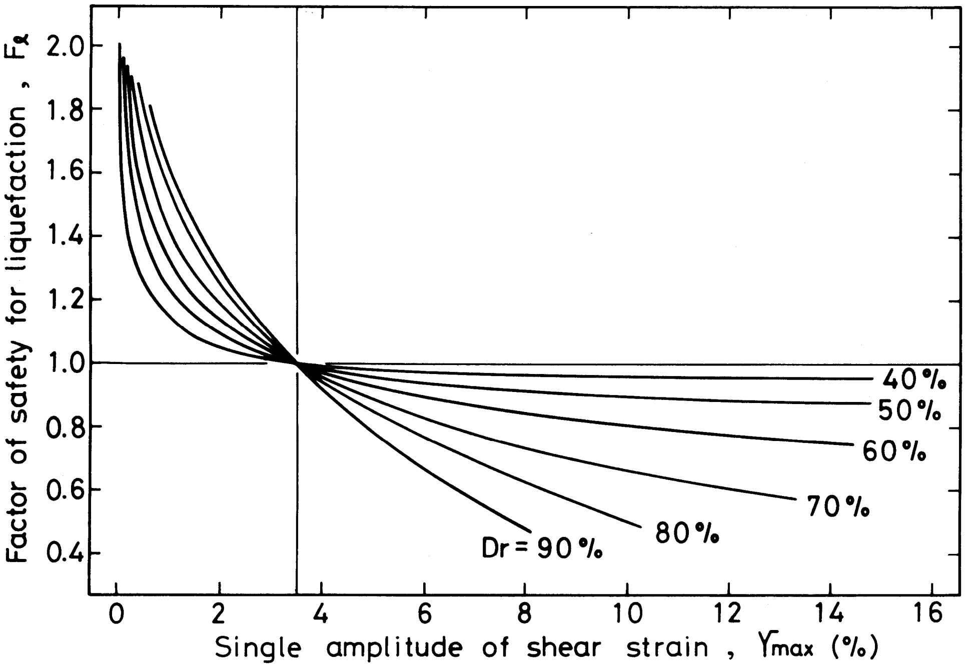

**Figure 7.** Relationships between liquefaction factor of safety and maximum shear strain (Ishihara and Yoshimine, 1992).

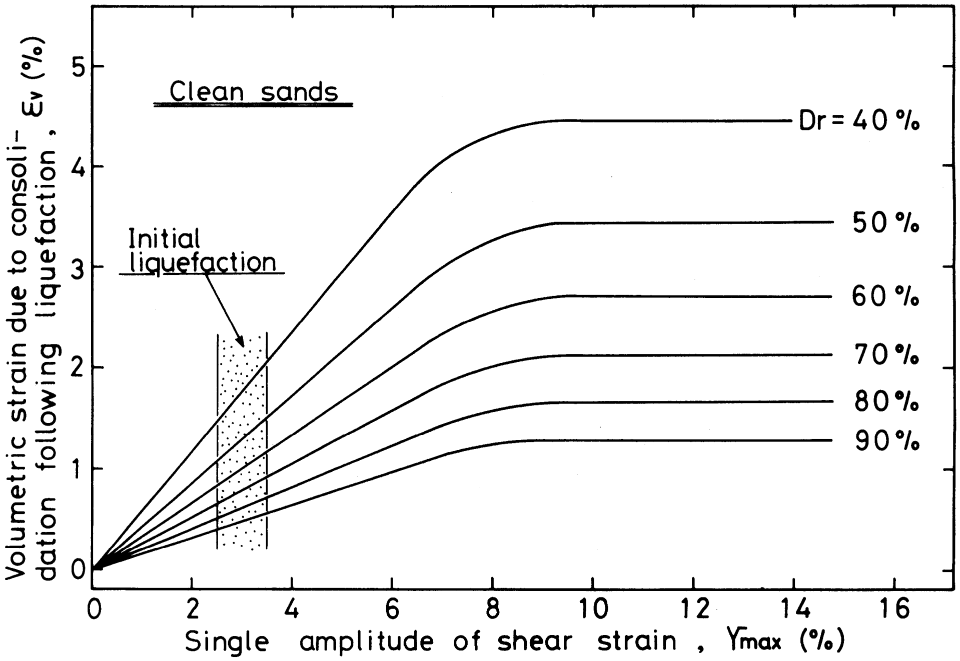

**Figure 8.** Relationships between re-consolidated volume change and shear strain (Ishihara and Yoshimine 1992).

then used to estimate liquefaction-induced volumetric strains where the factor of safety against liquefaction triggering was less than or equal to 1.1. The required input variables consisted of $(N_1)_{60}$ values normalized and corrected to clean sands by Youd and others (2001) and cyclic stress ratios calculated in accordance with the guidelines presented in Tokimatsu and Seed (1987). Due to differences in event magnitude, the cyclic stress ratios were scaled based on the magnitude scaling factors presented in Tokimatsu and Seed (1987) which were taken from Seed and others (1983). The scenario analysis was based on a M7.0 earthquake on the Wasatch fault while input magnitudes for the probabilistic analyses varied based on deaggregations of the data presented by Petersen and others (2008). Settlements were calculated by multiplying volumetric strains by the thickness of each respective liquefiable soil layer. A ground settlement value of 0 m was assigned to all locations with factors of safety for liquefaction triggering greater than 1.1.

To estimate liquefaction-induced settlement by Yoshimine and others (2006), the raw blow count data contained in the ArcGIS® geotechnical database were normalized and corrected to $(N_1)_{60}$ clean sand values following the methods outlined in Youd and others (2001). To account for traditional Japanese sampling practices and techniques, the $(N_1)_{60}$ clean sand blow count values were converted to $N_1$ values following the guidelines in Seed and others (1985). Following the method outlined by Yoshimine and others (2006), the $N_1$ values were converted to relative densities by Meyerhof (1957) and the likelihood of liquefaction triggering was calculated based on the Japanese Design Code for Highway Bridges (2000). Using the relative densities and the factors of safety against liquefaction triggering, the maximum single amplitude of shear strain was calculated for all sites with a factor of safety against liquefaction triggering less than or equal to 1.1.

Finally, liquefaction-induced volumetric strains were estimated by the relative densities and the maximum single amplitude of shear strains. Settlements were calculated by multiplying the volumetric strains by the thickness of each respective liquefiable soil layer. A ground settlement value of 0 m was assigned to all locations with factors of safety for liquefaction triggering greater than 1.1. Since earthquake magnitude was not a required input variable, no magnitude scaling factors were used in this method.

The results from each method were compared at each borehole to determine if there were significant differences in the settlement estimates. For example, the scenario M7.0 earthquake settlement dataset showed an average difference between the two methods of 0.004 m, with a maximum difference of 0.083 m. Of the 963 boreholes, Tokimatsu and Seed (1987) predicted higher settlements than Yoshimine and others (2006) in 232 boreholes and the opposite was true for 444 boreholes. Both methods predicted no settlement in 287 boreholes. A method-to-method comparison of the differences showed that 74 percent of the boreholes were within 0.01 m, 92 percent were within 0.025 m and 99 percent were within 0.05 m. Hence, it was concluded that the two methods produced relatively similar results when considering the quality of the input data and the ultimate use of the mapping. Subsequently, the average of the two methods was considered appropriate to estimate the ground settlement at each liquefiable borehole location.

The ground settlement estimates were categorized as “low” (0 to 0.05 m); “moderate” (0.05 to 0.1 m); ”high” (0.1 to 0.3 m); and “very high” (greater than 0.3 m). Similar to the lateral spread displacement maps, hazard categories were assigned to the major geologic units by statistical analysis of the estimated displacements from all boreholes located within each respective geologic unit or group of units with similar subsurface characteristics (e.g., near-surface soil type, origin, deposition and age). In brief, the hazard category assignments for the M7.0 Wasatch fault scenario map were based on an 85 percent nonexceedance criterion while the hazard categories for the probabilistic maps were based on the median displacement within the respective geologic unit or group of units.

The liquefaction-induced settlement ground displacement map for the scenario M7.0 Wasatch fault earthquake is presented in Figure 9 and the probabilistic-based maps are presented in Figures 10 and 11. These maps are useful in identifying areas of high ground displacement potential and areas where site-specific geotechnical investigation and/or liquefaction mitigation are warranted.

The 85 percent nonexceedance criterion used in the development of the scenario map and the median displacements considered in the development of the probabilistic maps represent the appropriate level of conservatism required for the proper implementation of the maps as recommended by consensus of the Utah Liquefaction Advisory Group (oral communs., 2009 and 2010). If a different degree of conservatism is requested by the end-user of a respective jurisdiction, the maps can be easily and quickly altered to reflect modified criteria. For example, a higher or lower nonexceedance criterion could be used to create a more-conservative or less-conservative map, respectively. However, it is recommended that the same map development methods be used for grouping and categorizing individual geologic units. As previously mentioned, additional details and examples of statistical hazard category assessments are included in Appendix C.

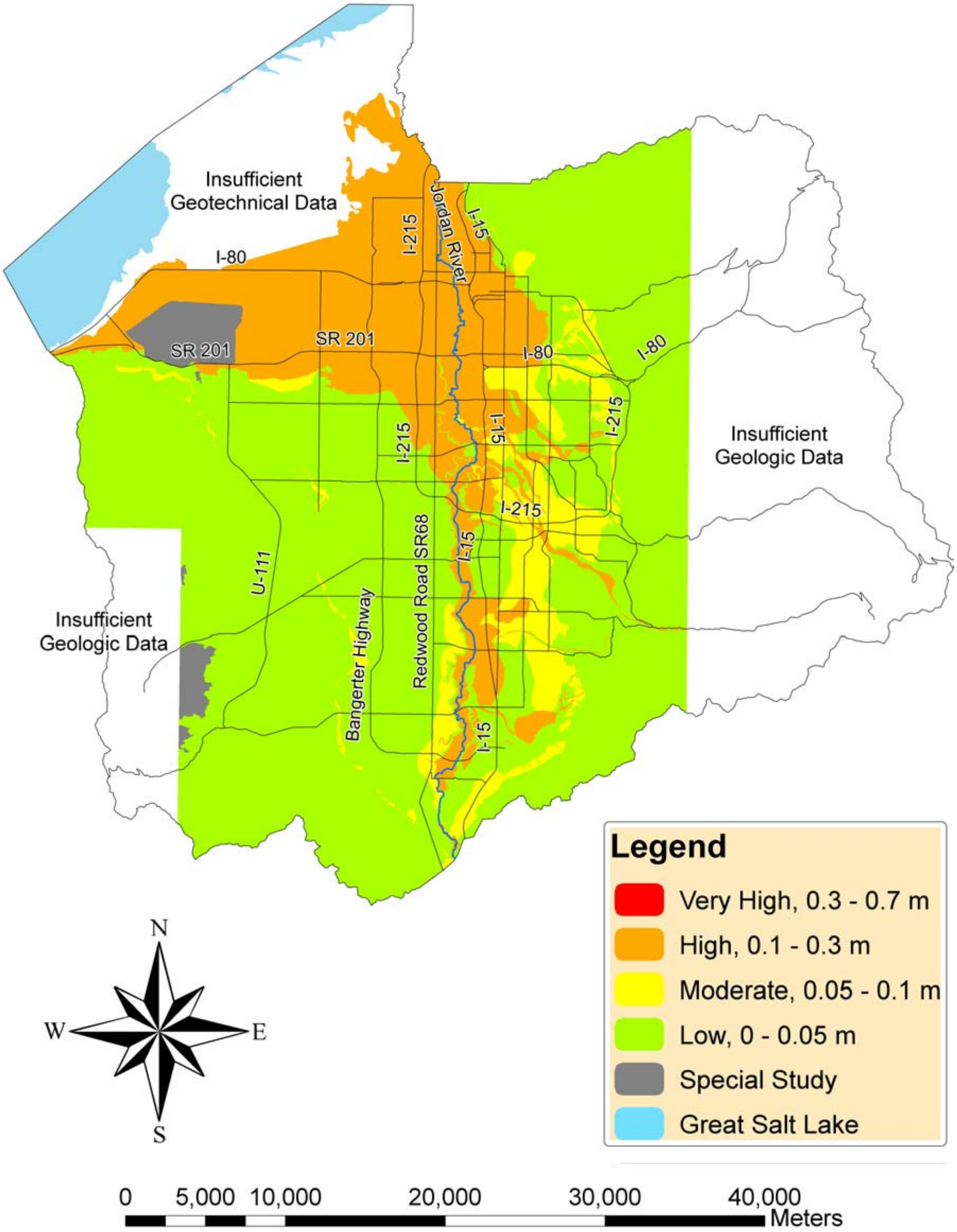

**Figure 9.** Liquefaction-induced ground settlement hazard for the Salt Lake Valley, Utah for a M7.0 scenario earthquake on the Salt Lake segment of the Wasatch fault and 85 percent nonexceedance probability threshold.

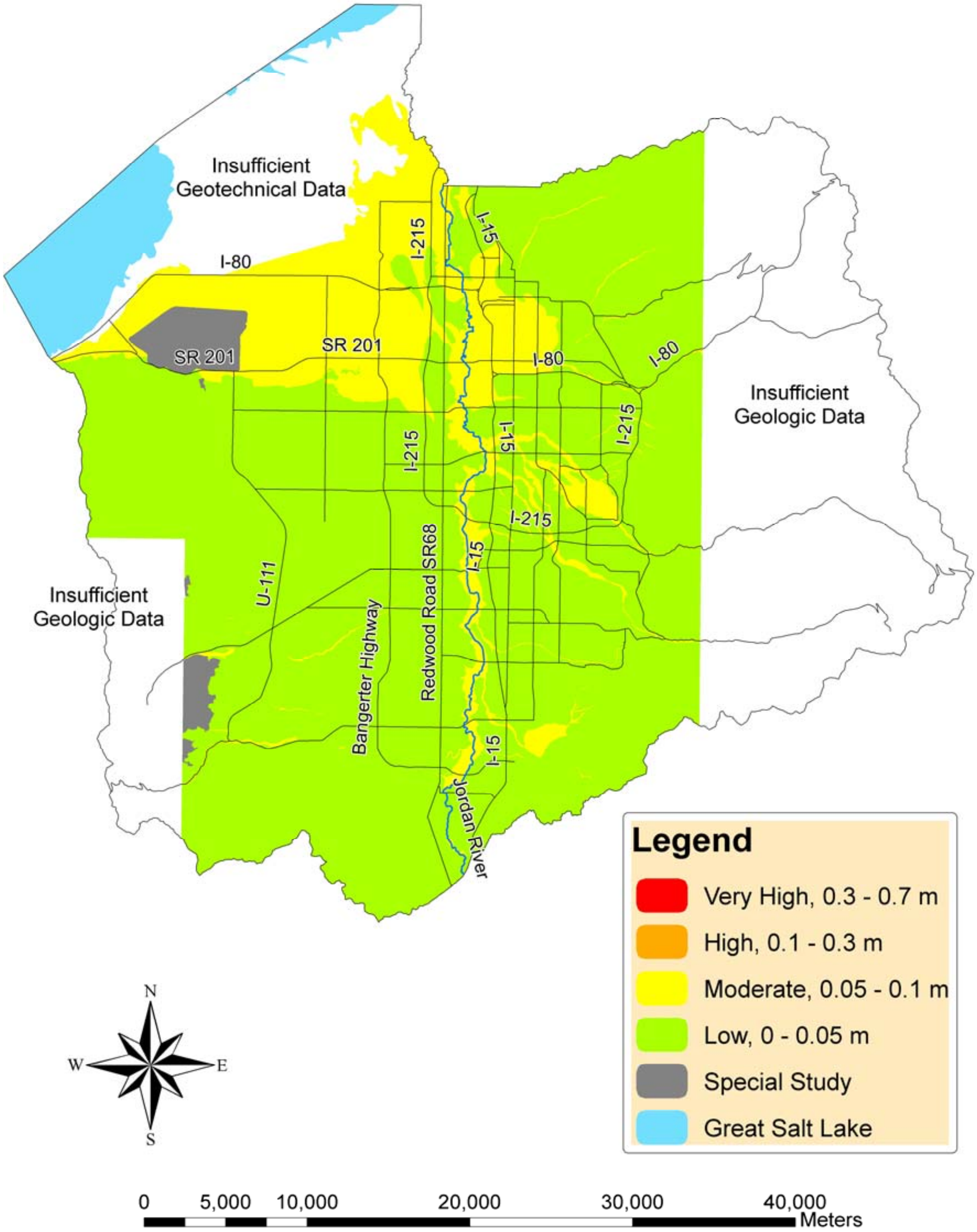

**Figure 10.** Liquefaction-induced ground settlement hazard in the Salt Lake Valley based on the PGA associated with a 2 percent probability of exceedance in 50 years.

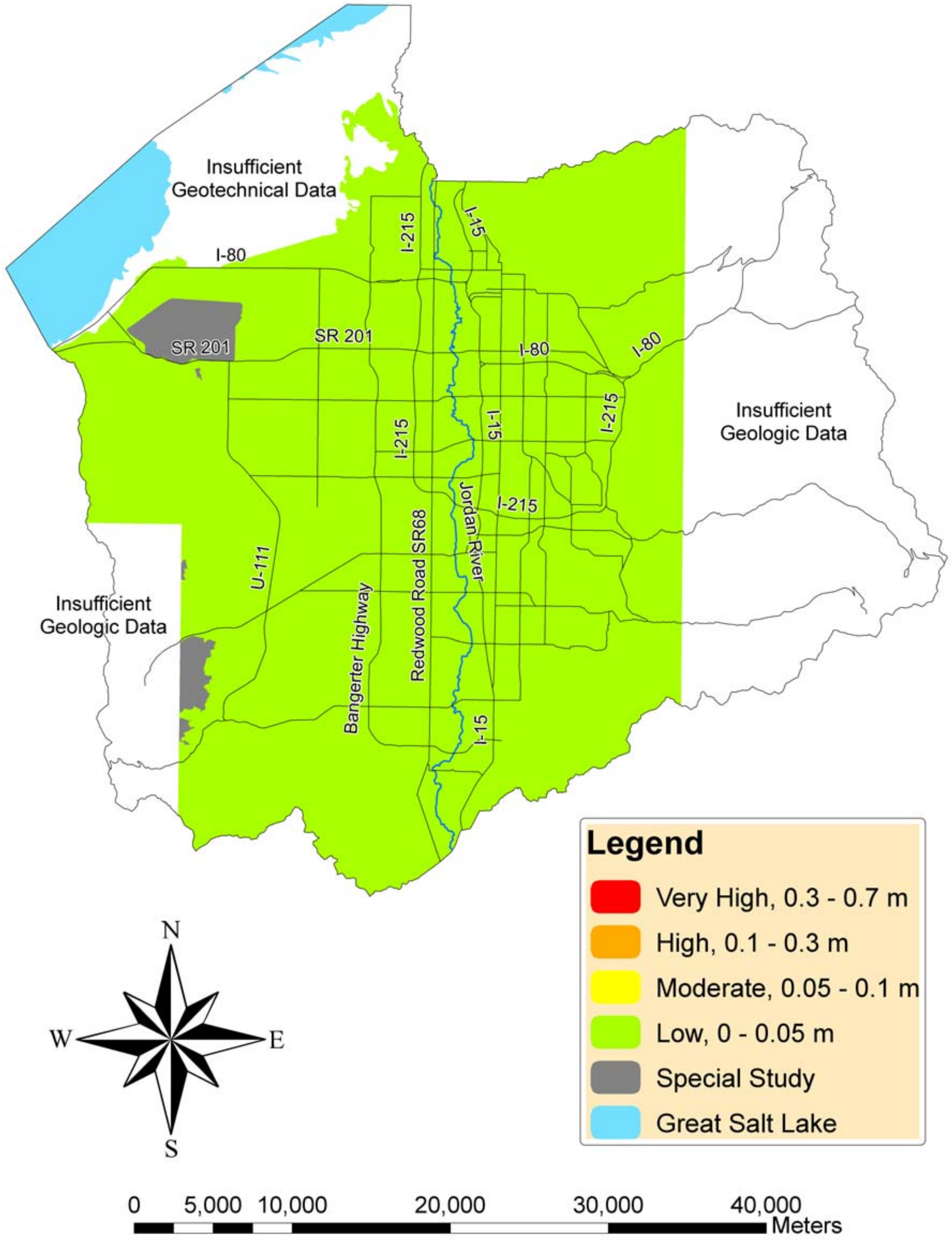

**Figure 11.** Liquefaction-induced ground settlement hazard in the Salt Lake Valley based on the PGA associated with a 10 percent probability of exceedance in 50 years.

# CONCLUSIONS

The maps presented herein are the first liquefaction-induced ground failure maps developed in Utah from an extensive geotechnical database that complements established geological mapping. The maps were developed for a M7.0 event on the Wasatch fault and two probabilistic-based events. The results of the hazard calculations suggest that increased lateral spread and ground settlement hazard exists in the central part of the valley along and near the Jordan River and in the northern eastern part of the valley. The increased hazard in these areas is due to the presence of young, relatively loose granular deposits and potentially shallow groundwater. The surficial geology in these areas predominantly consists of recent alluvial/river/stream/lake deposits.

In general, the M7.0 scenario maps, which are based on an approximate 15 percent exceedance probability for ground displacement, show higher hazard than the probabilistic-based scenario maps. In addition to nonexceedance criteria, other differences in the displacement estimates are attributed to variations in the PGA values used in developing the maps. Specifically, the M7.0 scenario event maps use PGA estimates from Wong and others (2002) which are generally higher than the PGA estimates obtained from the USGS National Seismic Hazard Mapping Project (Petersen and others, 2008) for the 2 and 10 percent probabilities of exceedance in 50 years events.

The M7.0 scenario event maps are the preferred maps for preliminary planning purposes because they have been developed for the characteristic earthquake on the Salt

Lake City segment of the Wasatch fault, and because they are conservative due to their approximate 15 percent exceedance probability for ground displacement when compared with the median displacement value used in developing the probabilistic-based maps.

However, some agencies such as UDOT, implement probabilistic-based events in their design procedures. For critical or essential UDOT structures (i.e., lifeline bridges, overpass structures and adjacent retaining walls), the 2 percent probability of exceedance in 50 years hazard maps are more useful because the input PGA values (which represent a 2,475-year return period) closely approximate the 3 percent probability of exceedance in 75 years (2,462-year return period) PGA required by UDOT (UDOT, 2009).

The two probabilistic events included in this report are for a 2,475-year return period and a 475-year return period (2 percent probability of exceedance in 50 years and 10 percent probability of exceedance in 50 years, respectively). However, for the design of normal structures (e.g., highway retaining walls that do not impact a critical or essential structure), UDOT has recently adopted the American Association of State Highway and Transportation Officials (AASHTO, 2009) seismic design provisions which are based on an approximate 1,000-year return period. Thus, it may be advantageous to develop additional probabilistic-based ground failure hazard maps. It is recommended that additional maps be developed following the analysis methods and map development methods for grouping and categorizing individual geologic units detailed herein.

Lastly, it is hoped that this series of displacement-based liquefaction ground failure maps will better aid in identifying seismic hazard and risk. Because the maps are displacement based, they better represent the potential damage to built-environment than previously published liquefaction maps.

# APPENDIX A

# DATABASE SUMMARY

The ArcGIS® geotechnical database used in this project contains 963 boreholes located in the Salt Lake Valley. Because the liquefaction hazard maps are based on established geological mapping, efforts were made to collect subsurface data from all major geological units within the valley. Table 3 shows the borehole identification number, project name, project location, date drilled (if available) and the respective surficial geologic unit for each borehole. This information can be cross-referenced to the tables in Appendix D where the calculated liquefaction-induced ground displacements are listed by borehole identification number.

Table 3

ArcGIS® Database Borehole Identification Information

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1 | SLCO- Sam Park Reservoir Improvements | 3107 S 3300 E | 3/11/1997 | Qaf2 |
| 2 | SLCO- Bennett Office | 3362 S. Main St | 3/17/1997 | Qlbpm |
| 3 | SLCO- Bennett Office | 3362 S. Main St | 3/17/1997 | Qlbpm |
| 4 | SLCO- Salt Lake County/Jail Complex | 881 W 3300 S | 2/28/1996 | Qal2 |
| 5 | SLCO- Granite School Dist-Magna Elementary | 8500 W 3100 S | 1/20/1997 | Qafy |
| 6 | SLCO- White Farm Village Sub | 8003 W 2700 S | 4/1/1999 | Qafy |
| 7 | SLCO- US West Magna Building Addition | 2662 S 9040 W | 6/28/2000 | Qafy |
| 8 | SLCO- Albertson's A-Express No. 0363-11AI | 890 E 3300 S | 10/20/1998 | Qlaly |
| 9 | SLCO- Magna Jiffy Lube | 3444 S 7200 W | 2/21/2000 | Qlbpm |
| 10 | SLCO-Bud Bailey | 3530 S Main St | 3/27/1995 | Qlbpm |
| 11 | SLCO- Michael Menlove Office/Warehouse Building | 3555 S 700 W | 12/18/1997 | Qal2 |
| 12 | SLCO- Alpha Trucking | 1900 N Redwood Rd | 6/10/1999 | Qal1 |
| 13 | SLCO-Proposed Building Addition | 1805 W 500 S | 3/12/1999 | Qaly |
| 14 | SLCO-Sorensen Technology Park-Lots 20 and 21 | 1130 S 3800 W | 6/26/1996 | Qlaly |
| 15 | SLCO-Almond Street condominiums | 255 N. Almond St | 8/21/1996 | Qaf2 |
| 16 | SLCO-Union Pacific | 100 S 400 W | 5/1/6462 | Qlaly |
| 17 | SLCO- Proposed Office Warehouse | 1850 S Freemont Drive | 10/6/1997 | Qaly |
| 18 | SLCO- Praztek Partner | 2100 S 4600 W | 5/2/1991 | Qlaly |
| 19 | SLCO- Praztek Partner | 1300 S 5600 W | 5/8/1991 | Qlaly |
| 20 | SLCO- American Plaza | 300 S Main St |  | Qaf2 |
| 21 | SLCO- Proposed Warehouse | 46 S 1900 W |  | Qaly |
| 22 | SLCO- SLC Public Utilities Water Tank | 3875 S 3800 E | 12/3/1991 | Qafb |
| 23 | SLCO- SLC Cell Tower | 2301 W 4805 S | 12/18/1990 | Qlbpm |
| 24 | SLCO- Dayna Office & Production Facility | 4398 S Riverboat Dr | 5/13/1992 | Qlbpm |
| 25 | SLCO- Beckstrand & Associates | 990 W Atherton Dr (4349 S) | 11/18/1991 | Qaly |
| 26 | SLCO- Park 'N Fly | 1950 W 500 S | 12/7/1998 | Qaly |
| 27 | DATS Trucking Inc Freight Terminal | 2800 W 500 S | 4/22/1998 | Qlaly |
| 28 | SLCO- Salt Lake Int Center Liquefaction Study | Plat 12 Lot 4 | 9/2/1997 | Qlaly |
| 29 | SLCO- Westside Dixon Development | 159 W 300 S | 10/24/1997 | Qlaly |
| 30 | SLCO- Hardman, Norman F Cell Comm. Facility | 7462 W 2820 S | 7/26/1991 | Qlaly |
| 31 | SLCO- Proposed Subdivision | 3411 S 700 E | 5/7/1997 | Qlbpm |
| 32 | SLCO- KESSLER, AL & SONS Dwelling Group | 3454 S 500 E | 11/18/1997 | Qlbpg |
| 33 | SLCO- Joe Colosimo PUD | 3362 S 1100 E | 2/10/1999 | Qlaly |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 34 | SBI- Salt Palace Expansion | 200 S West Temple | 1/18/1999 | Qaf2 |
| 35 | SLCO- US West Communications Tower | 2600 W 4700 S | 5/1/1992 | Qlbpg |
| 36 | SLCO- Superwash | 4300 S Redwood Rd | 8/19/1992 | Qal2 |
| 37 | SLCO-SLC Corp Water Tank | 4500 S 2700 E | 8/11/1998 | Qaf2 |
| 38 | SLCO- Robert Meyer Jay Sample PUD | 7730 S. Forest Creek Lane | 5/14/1999 | Qlbg |
| 39 | SLCO- SLCO Fire Station | 8295 S Wasatch Blvd (3680 E) | 2/10/1998 | Qca |
| 40 | SLCO- Kim Lamoreaux | 2200 East 8200 South | 8/5/1992 | Qalp |
| 41 | SLCO- Hercules | 4797 S 9170 W | | QTaf |
| 42 | SLCO-Metropolitan Water District Generator Building | 9000 S. Danish Rd | 8/23/1996 | Qaf2 |
| 43 | SLCO-Duaine Rasmussen Apartment Units | 7701 S Highland Dr | | Qes |
| 44 | SLCO-Duaine Rasmussen Apartment Units | 7701 S Highland Dr | | Qlpg |
| 45 | SLCO-Duaine Rasmussen Apartment Units | 7701 S Highland Dr | | Qlbg |
| 46 | SLCO-Duaine Rasmussen Apartment Units | 7701 S Highland Dr | | Qlbg |
| 47 | SLCO- Granite Dist/Keith Bradshaw | 3650 S. Montclaire St | 12/17/1998 | Qlbps |
| 48 | SLC0- Davencourt PUD | 4100 S 2200 W | 2/8/1996 | Qal2 |
| 49 | SLCO-Valley View Condominiums | 1850 E 3900 S | 3/15/1996 | Qlbpm |
| 50 | UGS- East High School | 840 S 1300 E | 5/17/1990 | Qlbpm |
| 51 | UGS- Highland High School | 2166 S 1700 E | 5/25/1990 | Qlpg |
| 52 | UGS West High School | 241 W 300 N | 5/30/1990 | Qaf2 |
| 53 | UGS- Canyon View Park Subdivision | Kennedy Drive | 3/19/1985 | Qlbg |
| 54 | UGS- Downhole Seismic Shear Wave Survey at IHC WVC, UT | 2800 S 4600 W | 4/23/1997 | Qly |
| 55 | UGS- Soils Investigation High Rise Elderly Complex | 2100 S State St | 9/19/1972 | Qlaly |
| 56 | UGS-Soil Foundation Investigation for Emergency Op Center | 400 N State Office Building | 8/1/1982 | Qlbpg |
| 57 | UGS-Soil Foundation Report South Temple Condos | 550 E South Temple | 10/19/1979 | Qmls |
| 58 | UGS-Geotechnical Investigation-Granite Furniture Dist Cent | 3200 W Parkway Blvd | 3/2/1994 | Qlaly |
| 59 | UGS- Foundation Inv. LDS Hospital Parking Lot (R-H) | B Street & 8th Ave | 3/20/1987 | Qlpg |
| 60 | UDOT- 33rd South Over I-415 | 33rd South and I-215 | 11/10/1966 | Qlbm |
| 61 | UDOT- Saltair to Airport | 5600 W I-80 | 6/1/1973 | Qlaly |
| 62 | UDOT- Saltair to Airport | 7200 W I-80 | 5/1/1972 | Qlaly |
| 63 | UDOT- I-80 2nd West to Parley's Canyon | 900 E I-80 | 5/21/1963 | Qlaly |
| 64 | UDOT- Salt Lake City Belt Route | 3500 S & I-215 | 11/27/1961 | Qlaly |
| 65 | UDOT- Salt Lake City Belt Route | 2700 S & I-215 | 12/1/1961 | Qaly |
| 66 | UDOT- Salt Lake City Belt Route | California Ave & I-215 | 12/4/1961 | Qal1 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 67 | UDOT- Salt Lake City Belt Route | 6th N & I-215 | 10/5/1961 | Qaly |
| 68 | UDOT- Salt Lake City Belt Route | 17th N &I-215 | 10/16/1961 | Qal1 |
| 69 | UDOT- Salt Lake City Belt Route | I-215 close to county border | 10/18/1961 | Qlaly |
| 72 | UDOT- Salt Lake City Belt Route | I-215 North of 39th South | 11/6/1961 | Qalp |
| 73 | UDOT- Salt Lake City Belt Route | I-215 & 3900 S | 11/1/1961 | Qalp |
| 74 | UDOT- Salt Lake City Belt Route | I-215 & 4500 S | 10/31/1961 | Qlbg |
| 75 | UGS- Air Traffic Control Tower and Base Building | 1200 N 4000 W | 7/1/1994 | Qal1 |
| 76 | UGS-SLC Water Reclamation Plant | 1700 N 900 W | 1/1/1990 | Qlbpm |
| 77 | UGS- Center Street Bridge Foundation Report | Cudnay Ave | 11/25/1992 | Qly |
| 78 | UGS-Reliance Warehouse & Office Building | 1730 S 4370 W | 5/17/1980 | Qlaly |
| 79 | UGS- UEM 4 Property | 1030 W 3110 S | 9/25/1996 | Qal1 |
| 80 | UGS- Proposed Hotel Complex for Sinclair Oil Company | 550 S Main Street | 10/25/1995 | Qlaly |
| 81 | UGS- Canyon Road Apartments Soil Investigation | 2nd Ave Canyon Rd | 1/1/1972 | Qaf2 |
| 82 | UGS-Fleming Foods Warehouse Addition | 2205 W 1500 S | 11/1/1994 | Qaly |
| 83 | SLCO- Pleasant Green Subdivision | 7306 W 3100 S |  | Qlbpm |
| 84 | SLCO- Copper Mountain Estates | 8650 W 3500 S |  | Qlbpg |
| 85 | SLCO- 811 Housing Project | 7986 W 3500 S | 1/18/1996 | Qlbps |
| 86 | SLCO- Lambert Auto | 398 E 3300 S | 8/12/1996 | Qlbpm |
| 87 | SLCO- Michael's Mill Subdivision | 900 E 3465 S | 7/31/1997 | Qlaly |
| 88 | SLCO- Ensign Development Inc | 7451 W 2820 S | 11/4/1996 | Qlpg |
| 89 | SLCO- Ruseler Multi-Family Development | 3504 S 300 E |  | Qlbpm |
| 90 | UGS- American Plaza 4&5 | 300 S Main St | 9/24/1980 | Qaf2 |
| 91 | UDOT- 21rst So. Freeway 6th West to Pioneer Road | 2100 S Redwood Rd |  | Qaly |
| 92 | UDOT-I-80 9th West to SL Airport Foundation Investigation | Jordan River I-80 |  | Qal1 |
| 93 | UDOT-I-80 9th West to SL Airport Foundation Investigation | 34th West I-80 |  | Qlaly |
| 94 | UDOT-I-80 9th West to SL Airport Foundation Investigation | Railroad I-80 |  | Qal1 |
| 95 | SLCO- Amen Exist Seminary | 3328 S 500 E |  | Qlaly |
| 96 | UGS-Utah State Fairgrounds Foundation Investigation | 1200 W 300 N | 2/3/1981 | Qal2 |
| 97 | UGS- Soils Investigation for the Proposed College Inn SLC, U | 100 S 1300 E | 12/14/1996 | Qaf2 |
| 98 | UGS- Soil & Foundation Investigation Terra Tek Research Fac | Wakara Way | 10/24/1974 | Qlbm |

## Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 99 | UGS-Soils Investigation for Fuel Op Facility UT Air National | F and E St 8th and 9th Streets SL Airport | | Qal1 |
| 100 | UGS- Soils & Foundation Investigation Artco High Rise Struct | 146 S Lincoln Ave | 7/21/1980 | Qaf2 |
| 101 | UGS- Earth Slide Investigation Ensign School | 13th Ave M St | 5/31/1977 | Qlbg |
| 102 | UGS0 Grand Salt Lake Mall | 5600 W 700 S | | Qlaly |
| 103 | UGS- Foundation Investigation Tower Apartment Building No.2 | Mouth of Emigration Canyon | | Qafb |
| 104 | UGS- S&F Investigation for LDS Church Printing Building | 1700 S Industrial Rd | 2/13/1986 | Qaly |
| 105 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 11/13/1990 | Qlaly |
| 106 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 11/15/1990 | Qlaly |
| 107 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 11/27/1990 | Qly |
| 108 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 12/1/1990 | Qlaly |
| 109 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 1/21/1991 | Qlaly |
| 110 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 1/12/1991 | Qlaly |
| 111 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 12/17/1990 | Qlaly |
| 112 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 12/7/1990 | Qly |
| 113 | Site Characterization Report for Tailings Impoundment | Kennecott Tailings Impoundment | 1/29/1991 | Qlaly |
| 134 | UDOT I15 13th South | I15 13th South | 4/24/1996 | Qal1 |
| 135 | UDOT I15 13th South | I15 13th South | 4/23/1996 | Qal1 |
| 136 | UDOT I15 13th South | I15 13th South | 7/8/1996 | Qal1 |
| 137 | UDOT I15 13th South | I15 13th South | 4/25/1996 | Qal1 |
| 138 | UDOT I15 13th South | I15 13th South | 4/26/1996 | Qal1 |
| 139 | UDOT I15 13th South | I15 13th South | 5/2/1996 | Qal1 |
| 140 | UDOT I15 13th South | I15 13th South | 5/3/1996 | Qal1 |
| 141 | UDOT I15 13th South | I15 13th South | 5/6/1996 | Qal1 |
| 142 | UDOT I15 13th South | I15 13th South | 5/7/1996 | Qal1 |
| 143 | UDOT I15 13th South | I15 13th South | 5/7/1996 | Qal1 |
| 144 | UDOT I15 13th South | I 15 13th South | 4/28/1996 | Qal1 |
| 145 | UDOT I15 13th South | I 15 13th South | 4/23/1996 | Qal1 |
| 146 | UDOT I15 13th South | I 15 13th South | 3/29/1996 | Qal1 |
| 147 | UDOT I15 13th South | I 15 13th South | 4/30/1996 | Qal1 |
| 148 | UDOT I15 13th South | I 15 13th South | 4/25/1996 | Qal1 |
| 149 | UDOT I15 13th South | I 15 13th South | 4/30/1996 | Qal1 |
| 150 | UDOT I15 13th South | I 15 13th South | 5/1/1996 | Qal1 |
| 151 | UDOT I15 13th South | I 15 13th South | 5/2/1996 | Qal1 |
| 152 | UDOT I15 13th South | I 15 13th South | 5/2/1996 | Qal1 |

## Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 153 | UDOT I15 13th South | I 15 13th South | 4/26/1996 | Qal1 |
| 154 | UDOT I15 13th South | I 15 13th South | 6/12/1996 | Qal1 |
| 172 | UDOT I15 24th South Section | I 15 2400 S | 3/18/1996 | Qal1 |
| 173 | UDOT I15 24th South Section | I 15 2400 S | 3/20/1996 | Qal1 |
| 174 | UDOT I15 24th South Section | I 15 2400 S | 4/3/1996 | Qal1 |
| 175 | UDOT I15 24th South Section | I 15 2400 S | 3/26/1996 | Qlaly |
| 176 | UDOT I15 24th South Section | I 15 2400 S | 3/29/1996 | Qlaly |
| 177 | UDOT I15 24th South Section | I 15 2400 S | 3/28/1996 | Qlaly |
| 178 | UDOT I15 24th South Section | I 15 2400 S | 3/25/1996 | Qal1 |
| 179 | UDOT I15 24th South Section | I 15 2400 S | 3/25/1996 | Qal1 |
| 180 | UDOT I15 24th South Section | I 15 2400 S | 3/22/1996 | Qal1 |
| 181 | UDOT I15 24th South Section | I 15 2400 S | 5/9/1996 | Qal1 |
| 182 | UDOT I15 24th South Section | I 15 2400 S | 5/7/1996 | Qal1 |
| 183 | UDOT I15 24th South Section | I 15 2400 S | 4/2/1996 | Qal1 |
| 184 | UDOT I15 24th South Section | I 15 2400 S | 5/6/1996 | Qal1 |
| 185 | UDOT I15 24th South Section | I 15 2400 S | 4/1/1996 | Qal1 |
| 186 | UDOT I15 24th South Section | I 15 2400 S | 4/2/1996 | Qal1 |
| 187 | UDOT I15 24th South Section | I 15 2400 S | 4/4/1996 | Qal1 |
| 188 | UDOT I15 24th South Section | I 15 2400 S | 4/3/1996 | Qal1 |
| 189 | UDOT I15 24th South Section | I 15 2400 S | 4/9/1996 | Qal1 |
| 190 | UDOT I15 24th South Section | I 15 2400 S | 4/10/1996 | Qal1 |
| 191 | UDOT I15 24th South Section | I 15 2400 S | 4/12/1996 | Qal1 |
| 192 | UDOT I15 24th South Section | I 15 2400 S | 4/11/1996 | Qal1 |
| 193 | UDOT I15 24th South Section | I 15 2400 S | 4/15/1996 | Qal1 |
| 194 | UDOT I15 24th South Section | I 15 2400 S | 4/18/1996 | Qal1 |
| 195 | UDOT I15 24th South Section | I 15 2400 S | 3/26/1996 | Qal1 |
| 196 | UDOT I15 24th South Section | I 15 2400 S | 3/20/1996 | Qal1 |
| 197 | UDOT I15 24th South Section | I 15 2400 S | 5/8/1996 | Qal1 |
| 198 | UDOT I15 24th South Section | I 15 2400 S | 3/28/1996 | Qal1 |
| 199 | UDOT I15 24th South Section | I 15 2400 S | 3/27/1996 | Qal1 |
| 200 | UDOT I15 24th South Section | I 15 2400 S | 3/21/1996 | Qal1 |
| 201 | UDOT I15 24th South Section | I 15 2400 S | 4/24/1996 | Qal1 |
| 202 | UDOT I15 24th South Section | I 15 2400 S | 4/24/1996 | Qal1 |
| 203 | UDOT I15 24th South Section | I 15 2400 S | 3/18/1996 | Qal1 |
| 204 | UDOT I15 24th South Section | I 15 2400 S | 5/13/1996 | Qal1 |
| 205 | UDOT I15 24th South Section | I 15 2400 S | 3/25/1996 | Qal1 |
| 206 | UDOT I15 24th South Section | I 15 2400 S | 3/26/1996 | Qal1 |
| 207 | UDOT I15 24th South Section | I 15 2400 S | 3/22/1996 | Qal1 |
| 208 | UDOT I15 24th South Section | I 15 2400 S | 3/26/1996 | Qal1 |
| 209 | UDOT I15 24th South Section | I 15 2400 S | 4/9/1996 | Qal1 |
| 210 | UDOT I15 24th South Section | I 15 2400 S | 4/9/1996 | Qal1 |
| 211 | UDOT I15 24th South Section | I 15 2400 S | 4/9/1996 | Qal1 |
| 212 | UDOT I15 24th South Section | I 15 2400 S | 4/5/1996 | Qal1 |
| 213 | UDOT I15 24th South Section | I 15 2400 S | 4/8/1996 | Qal1 |
| 214 | UDOT I15 24th South Section | I 15 2400 S | 4/22/1996 | Qal1 |
| 215 | UDOT I15 24th South Section | I 15 2400 S | 4/16/1996 | Qal1 |
| 216 | UDOT I15 24th South Section | I 15 2400 S | 4/15/1996 | Qal1 |
| 217 | UDOT I15 24th South Section | I 15 2400 S | 4/16/1996 | Qal1 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 218 | UDOT I15 24th South Section | I 15 2400 S | 4/19/1996 | Qal1 |
| 219 | UDOT I15 24th South Section | I 15 2400 S | 4/16/1996 | Qal1 |
| 220 | UDOT I15 24th South Section | I 15 2400 S | 4/18/1996 | Qal1 |
| 221 | UDOT I15 24th South Section | I 15 2400 S | 5/10/1996 | Qlaly |
| 222 | UDOT I15 24th South Section | I 15 2400 S | 4/1/1996 | Qal1 |
| 223 | UDOT I15 24th South Section | I 15 2400 S | 6/10/1996 | Qal1 |
| 224 | UDOT I15 24th South Section | I 15 2400 S | 4/17/1996 | Qal1 |
| 225 | UDOT I15 24th South Section | I 15 2400 S | 5/9/1996 | Qal1 |
| 226 | UDOT I15 24th South Section | I 15 2400 S | 5/13/1996 | Qal1 |
| 227 | UDOT I15 24th South Section | I 15 2400 S | 4/4/1996 | Qal1 |
| 228 | UDOT I15 24th South Section | I 15 2400 S | 5/3/1996 | Qal1 |
| 229 | UDOT I15 24th South Section | I 15 2400 S | 4/3/1996 | Qal1 |
| 230 | UDOT I15 24th South Section | I 15 2400 S | 4/11/1996 | Qal1 |
| 231 | UDOT I15 24th South Section | I 15 2400 S | 4/8/1996 | Qal1 |
| 232 | UDOT I15 24th South Section | I 15 2400 S | 4/29/1996 | Qal1 |
| 233 | UDOT I15 24th South Section | I 15 2400 S | 4/29/1996 | Qal1 |
| 234 | UDOT I15 24th South Section | I 15 2400 S | 7/11/1996 | Qal1 |
| 235 | UDOT I15 24th South Section | I 15 2400 S | 7/11/1996 | Qal1 |
| 236 | UDOT I15 24th South Section | I 15 2400 S | 4/1/1996 | Qal1 |
| 237 | UDOT I15 24th South Section | I 15 2400 S | 5/14/1996 | Qal1 |
| 238 | UDOT I15 24th South Section | I 15 2400 S | 3/21/1996 | Qlaly |
| 239 | UDOT I15 24th South Section | I 15 2400 S | 5/6/1996 | Qal1 |
| 240 | UDOT I15 24th South Section | I 15 2400 S | 4/22/1996 | Qal1 |
| 241 | UDOT I15 24th South Section | I 15 2400 S | 4/16/1996 | Qlaly |
| 277 | I-15 Corridor Reconstruction | I-15 4500 South | 5/21/1996 | Qal1 |
| 278 | I-15 Corridor Reconstruction | I-15 4500 South | 5/21/1996 | Qlbpm |
| 279 | I-15 Corridor Reconstruction | I-15 4500 South | 5/21/1996 | Qal1 |
| 280 | I-15 Corridor Reconstruction | I-15 4500 South | 6/17/1996 | Qal1 |
| 281 | I-15 Corridor Reconstruction | I-15 4500 South | 5/22/1996 | Qal1 |
| 282 | I-15 Corridor Reconstruction | I-15 4500 South | 5/23/1996 | Qal1 |
| 283 | I-15 Corridor Reconstruction | I-15 4500 South | 5/16/1996 | Qal1 |
| 284 | I-15 Corridor Reconstruction | I-15 4500 South | 6/4/1996 | Qal1 |
| 285 | I-15 Corridor Reconstruction | I-15 4500 South | 5/28/1996 | Qal1 |
| 286 | I-15 Corridor Reconstruction | I-15 4500 South | 7/14/1996 | Qal1 |
| 287 | I-15 Corridor Reconstruction | I-15 4500 South | 7/14/1996 | Qal1 |
| 288 | I-15 Corridor Reconstruction | I-15 4500 South | 5/22/1996 | Qlbpm |
| 289 | I-15 Corridor Reconstruction | I-15 4500 South | 5/23/1996 | Qal1 |
| 290 | I-15 Corridor Reconstruction | I-15 4500 South | 6/11/1996 | Qal1 |
| 291 | I-15 Corridor Reconstruction | I-15 4500 South | 5/29/1996 | Qal1 |
| 292 | I-15 Corridor Reconstruction | I-15 4500 South | 5/22/1996 | Qlbpm |
| 293 | I-15 Corridor Reconstruction | I-15 4500 South | 5/23/1996 | Qal1 |
| 294 | I-15 Corridor Reconstruction | I-15 4500 South | 6/17/1996 | Qlbpm |
| 295 | I-15 Corridor Reconstruction | I-15 4500 South | 6/17/1996 | Qal1 |
| 296 | I-15 Corridor Reconstruction | I-15 4500 South | 6/17/1996 | Qal1 |
| 297 | I-15 Corridor Reconstruction | I-15 4500 South | 5/22/1996 | Qal1 |
| 298 | I-15 Corridor Reconstruction | I-15 4500 South | 5/18/1996 | Qal1 |
| 299 | I-15 Corridor Reconstruction | I-15 4500 South | 5/28/1996 | Qal1 |
| 300 | I-15 Corridor Reconstruction | I-15 4500 South | 5/28/1996 | Qal1 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 301 | I-15 Corridor Reconstruction | I-15 4500 South | 6/3/1996 | Qal1 |
| 302 | I-15 Corridor Reconstruction | I-15 4500 South | 6/14/1996 | Qlbpm |
| 303 | I-15 Corridor Reconstruction | I-15 4500 South | 6/14/1996 | Qal1 |
| 304 | I-15 Corridor Reconstruction | I-15 4500 South | 6/3/1996 | Qal2 |
| 305 | I-15 Corridor Reconstruction | I-15 4500 South | 6/3/1996 | Qal2 |
| 306 | I-15 Corridor Reconstruction | I-15 4500 South | 6/14/1996 | Qal1 |
| 307 | I-15 Corridor Reconstruction | I-15 4500 South | 7/14/1996 | Qal1 |
| 308 | I-15 Corridor Reconstruction | I-15 4500 South | 7/14/1996 | Qal2 |
| 309 | I-15 Corridor Reconstruction | I-15 7200 South | 4/19/1996 | Qlbpm |
| 310 | I-15 Corridor Reconstruction | I-15 7200 South | 4/15/1996 | Qlbpm |
| 311 | I-15 Corridor Reconstruction | I-15 7200 South | 4/22/1996 | Qlbpm |
| 312 | I-15 Corridor Reconstruction | I-15 7200 South | 4/16/1996 | Qlbpm |
| 313 | I-15 Corridor Reconstruction | I-15 7200 South | 4/23/1996 | Qlbpm |
| 314 | I-15 Corridor Reconstruction | I-15 7200 South | 4/16/1996 | Qlbpm |
| 315 | I-15 Corridor Reconstruction | I-15 7200 South | 4/24/1996 | Qlbpm |
| 316 | I-15 Corridor Reconstruction | I-15 7200 South | 4/30/1996 | Qlbpm |
| 317 | I-15 Corridor Reconstruction | I-15 7200 South | 4/17/1996 | Qlbpm |
| 318 | I-15 Corridor Reconstruction | I-15 7200 South | 7/8/1996 | Qlbpm |
| 319 | I-15 Corridor Reconstruction | I-15 7200 South | 4/17/1996 | Qlbpm |
| 320 | I-15 Corridor Reconstruction | I-15 7200 South | 7/9/1996 | Qlbpm |
| 321 | I-15 Corridor Reconstruction | I-15 7200 South | 4/16/1996 | Qlbpm |
| 322 | I-15 Corridor Reconstruction | I-15 7200 South | 7/9/1996 | Qlbpm |
| 323 | I-15 Corridor Reconstruction | I-15 7200 South | 4/16/1996 | Qlbpm |
| 324 | I-15 Corridor Reconstruction | I-15 7200 South | 4/16/1996 | Qlbpm |
| 325 | I-15 Corridor Reconstruction | I-15 7200 South | 4/18/1996 | Qlbpm |
| 326 | I-15 Corridor Reconstruction | I-15 7200 South | 4/18/1996 | Qlbpm |
| 327 | I-15 Corridor Reconstruction | I-15 7200 South | 4/17/1996 | Qlbpm |
| 328 | I-15 Corridor Reconstruction | I-15 7200 South | 4/17/1996 | Qlbpm |
| 329 | I-15 Corridor Reconstruction | I-15 7200 South | 4/30/1996 | Qlbpm |
| 330 | I-15 Corridor Reconstruction | I-15 7200 South | 4/18/1996 | Qal1 |
| 331 | I-15 Corridor Reconstruction | I-15 7200 South | 4/30/1996 | Qlbpm |
| 332 | I-15 Corridor Reconstruction | I-15 7200 South | 4/18/1996 | Qlbpm |
| 333 | I-15 Corridor Reconstruction | I-15 7200 South | 4/18/1996 | Qlbpm |
| 334 | I-15 Corridor Reconstruction | I-15 7200 South | 4/18/1996 | Qlbpm |
| 335 | I-15 Corridor Reconstruction | I-15 7200 South | 5/6/1996 | Qlbpm |
| 336 | I-15 Corridor Reconstruction | I-15 7200 South | 5/3/1996 | Qlbpm |
| 337 | I-15 Corridor Reconstruction | I-15 7200 South | 5/3/1996 | Qlbpm |
| 338 | I-15 Corridor Reconstruction | I-15 7200 South | 5/6/1996 | Qlbpm |
| 339 | I-15 Corridor Reconstruction | I-15 7200 South | 5/7/1996 | Qlbpm |
| 340 | I-15 Corridor Reconstruction | I-15 7200 South | 5/8/1996 | Qlbpm |
| 341 | I-15 Corridor Reconstruction | I-15 7200 South | 5/8/1996 | Qlbpm |
| 342 | I-15 Corridor Reconstruction | I-15 7200 South | 5/8/1996 | Qlbpm |
| 343 | I-15 Corridor Reconstruction | I-15 7200 South | 5/10/1996 | Qlbpm |
| 344 | I-15 Corridor Reconstruction | I-15 7200 South | 5/9/1996 | Qlbpm |
| 345 | I-15 Corridor Reconstruction | I-15 7200 South | 5/10/1996 | Qlbpm |
| 346 | I-15 Corridor Reconstruction | I-15 7200 South | 5/6/1996 | Qlbpm |
| 347 | I-15 Corridor Reconstruction | I-15 7200 South | 5/2/1996 | Qal2 |
| 348 | I-15 Corridor Reconstruction | I-15 7200 South | 5/2/1996 | Qal2 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 349 | I-15 Corridor Reconstruction | I-15 7200 South | 5/3/1996 | Qal2 |
| 350 | I-15 Corridor Reconstruction | I-15 7200 South | 5/2/1996 | Qal2 |
| 351 | I-15 Corridor Reconstruction | I-15 7200 South | 5/1/1996 | Qal2 |
| 352 | I-15 Corridor Reconstruction | I-15 7200 South | 5/1/1996 | Qal2 |
| 353 | I-15 Corridor Reconstruction | I-15 7200 South | 5/1/1996 | Qal2 |
| 354 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/12/1996 | Qlbpm |
| 355 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/11/1996 | Qlbpm |
| 356 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/13/1996 | Qlbpm |
| 357 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/15/1996 | Qlbpm |
| 358 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/16/1996 | Qlbpm |
| 359 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/22/1996 | Qlbpm |
| 360 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/16/1996 | Qlbpm |
| 361 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/16/1996 | Qlbpm |
| 362 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/20/1996 | Qlbpm |
| 363 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/16/1996 | Qlbpm |
| 364 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/17/1996 | Qlbpm |
| 365 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/13/1996 | Qlbpm |
| 366 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/12/1996 | Qlbpm |
| 367 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/8/1996 | Qal1 |
| 368 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/10/1996 | Qal1 |
| 369 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/11/1996 | Qal1 |
| 370 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/19/1996 | Qlbpm |
| 371 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/20/1996 | Qal2 |
| 372 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/14/1996 | Qal1 |
| 373 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/23/1996 | Qal1 |
| 374 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/17/1996 | Qal1 |
| 375 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/15/1996 | Qal1 |
| 376 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/15/1996 | Qal1 |
| 377 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/19/1996 | Qlbpm |
| 378 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/18/1996 | Qlbpm |
| 379 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/20/1996 | Qal2 |
| 380 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/21/1996 | Qal2 |
| 381 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/13/1996 | Qlbpm |
| 382 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/14/1996 | Qlbpm |
| 383 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/6/1996 | Qlbpm |
| 384 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/6/1996 | Qal1 |
| 385 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/25/1996 | Qal1 |
| 386 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/9/1996 | Qal1 |
| 387 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/10/1996 | Qal1 |
| 388 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/25/1996 | Qal1 |
| 389 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/10/1996 | Qlbpm |
| 390 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/11/1996 | Qlbpm |
| 391 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/26/1996 | Qlbpm |
| 392 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/27/1996 | Qlbpm |
| 393 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/5/1996 | Qlbpm |
| 394 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/3/1996 | Qlbpm |
| 395 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/6/1996 | Qlbpm |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 396 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/1/1996 | Qlbpm |
| 397 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/5/1996 | Qlbpm |
| 398 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/29/1996 | Qlbpm |
| 399 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/29/1996 | Qlbpm |
| 400 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/28/1996 | Qlbpm |
| 401 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/28/1996 | Qlbpm |
| 402 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/28/1996 | Qlbpm |
| 403 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/3/1996 | Qlbpm |
| 404 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/25/1996 | Qlbpm |
| 405 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 4/19/1996 | Qlbpm |
| 406 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 4/22/1996 | Qlbpm |
| 407 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 4/23/1996 | Qlbpm |
| 408 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 4/24/1996 | Qlbpm |
| 409 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 4/25/1996 | Qlbpm |
| 410 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/23/1996 | Qlbpm |
| 411 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 4/29/1996 | Qlbpm |
| 412 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 4/27/1996 | Qlbpm |
| 413 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/24/1996 | Qlbpm |
| 414 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 4/26/1996 | Qlbpm |
| 415 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/17/1996 | Qlbpm |
| 416 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/29/1996 | Qlbpm |
| 417 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/27/1996 | Qlbpm |
| 418 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/18/1996 | Qlbpm |
| 419 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/2/1996 | Qlbpm |
| 420 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/1/1996 | Qlbpm |
| 421 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/6/1996 | Qlbpm |
| 422 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/22/1996 | Qlbpm |
| 423 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/26/1996 | Qlbpm |
| 424 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/2/1996 | Qlbpm |
| 425 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/1/1996 | Qlbpm |
| 426 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/11/1996 | Qlbpm |
| 427 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/25/1996 | Qlbpm |
| 428 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/8/1996 | Qlbpm |
| 429 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/12/1996 | Qal1 |
| 430 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/28/1996 | Qal1 |
| 431 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/24/1996 | Qal1 |
| 432 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/11/1996 | Qal1 |
| 433 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/20/1996 | Qal1 |
| 434 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/21/1996 | Qal1 |
| 435 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/31/1996 | Qal1 |
| 436 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/29/1996 | Qal1 |
| 437 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/1/1996 | Qlbpm |
| 438 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/25/1996 | Qlbpm |
| 439 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 7/26/1996 | Qal1 |
| 440 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/22/1996 | Qlbpm |
| 441 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/24/1996 | Qlbpm |
| 442 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/4/1996 | Qlbpm |
| 443 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/1/1996 | Qlbpm |

## Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 444 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/3/1996 | Qlbpm |
| 445 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/8/1996 | Qlbpm |
| 446 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/5/1996 | Qlbpm |
| 447 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 5/23/1996 | Qlbpm |
| 448 | I-15 Corridor Reconstruction | 7200 South Interstate 15 | 6/19/1996 | Qal1 |
| 459 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/2/1996 | Qal1 |
| 460 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/2/1996 | Qal1 |
| 461 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/3/1996 | Qlaly |
| 462 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/30/1996 | Qlaly |
| 463 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/12/1996 | Qlaly |
| 464 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/1/1996 | Qlaly |
| 465 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/15/1996 | Qal1 |
| 466 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/15/1996 | Qal1 |
| 467 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/13/1996 | Qal1 |
| 468 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/29/1996 | Qlaly |
| 470 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/18/1996 | Qlaly |
| 471 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/19/1996 | Qlaly |
| 472 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/5/1996 | Qlaly |
| 473 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/8/1996 | Qlaly |
| 474 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/10/1996 | Qal1 |
| 475 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/16/1996 | Qlaly |
| 476 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/15/1996 | Qlaly |
| 477 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/11/1996 | Qlaly |
| 478 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/17/1996 | Qal1 |
| 479 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 7/18/1996 | Qal1 |
| 480 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/10/1996 | Qal1 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 481 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/22/1996 | Qal1 |
| 482 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/19/1996 | Qal1 |
| 483 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/22/1996 | Qlaly |
| 484 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/23/1996 | Qlaly |
| 485 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/29/1996 | Qal1 |
| 486 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 7/19/1996 | Qal1 |
| 487 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 7/23/1996 | Qal1 |
| 488 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/23/1996 | Qal1 |
| 489 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/3/1996 | Qal1 |
| 490 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/24/1996 | Qal1 |
| 491 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/2/1996 | Qlaly |
| 492 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/30/1996 | Qlaly |
| 493 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/25/1996 | Qlaly |
| 494 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/6/1996 | Qal1 |
| 495 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/7/1996 | Qal1 |
| 496 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/9/1996 | Qal1 |
| 497 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/8/1996 | Qal1 |
| 498 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/9/1996 | Qal1 |
| 499 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 7/22/1996 | Qal1 |
| 500 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/11/1996 | Qal1 |
| 501 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/11/1996 | Qal1 |
| 502 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/28/1996 | Qal1 |
| 503 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/12/1996 | Qal1 |
| 504 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/13/1996 | Qal1 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 505 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/30/1996 | Qal1 |
| 506 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/20/1996 | Qlaly |
| 507 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/21/1996 | Qlaly |
| 508 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/19/1996 | Qlaly |
| 509 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/19/1996 | Qlaly |
| 510 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/16/1996 | Qlaly |
| 511 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/8/1996 | Qlaly |
| 512 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/18/1996 | Qlaly |
| 513 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/13/1996 | Qlaly |
| 514 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/29/1996 | Qal1 |
| 515 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/14/1996 | Qal1 |
| 516 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/19/1996 | Qal1 |
| 517 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/17/1996 | Qal1 |
| 518 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/22/1996 | Qal1 |
| 519 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/26/1996 | Qal1 |
| 520 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/25/1996 | Qal1 |
| 521 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/28/1996 | Qal1 |
| 522 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/24/1996 | Qal1 |
| 523 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/30/1996 | Qal1 |
| 524 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/27/1996 | Qal1 |
| 525 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/26/1996 | Qal1 |
| 526 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/27/1996 | Qal1 |
| 527 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 7/1/1996 | Qal1 |
| 528 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/21/1996 | Qal1 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 529 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 7/2/1996 | Qal1 |
| 530 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/23/1996 | Qal1 |
| 531 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/30/1996 | Qlaly |
| 532 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/18/1996 | Qlaly |
| 533 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 4/29/1996 | Qlaly |
| 534 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/28/1996 | Qal1 |
| 535 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/25/1996 | Qal1 |
| 536 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/13/1996 | Qal1 |
| 537 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/13/1996 | Qal1 |
| 538 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/25/1996 | Qlaly |
| 539 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/25/1996 | Qlaly |
| 540 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/29/1996 | Qal1 |
| 541 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/28/1996 | Qal1 |
| 542 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/28/1996 | Qal1 |
| 543 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/27/1996 | Qal1 |
| 544 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/25/1996 | Qal1 |
| 545 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/26/1996 | Qal1 |
| 546 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/28/1996 | Qal1 |
| 547 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/27/1996 | Qal1 |
| 548 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/27/1996 | Qal1 |
| 549 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/26/1996 | Qal1 |
| 550 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/26/1996 | Qal1 |
| 551 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/10/1996 | Qal1 |
| 552 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/6/1996 | Qal1 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 553 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/8/1996 | Qlaly |
| 554 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/10/1996 | Qlaly |
| 555 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/10/1996 | Qal1 |
| 556 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/22/1996 | Qal1 |
| 557 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/22/1996 | Qal1 |
| 558 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/8/1996 | Qal1 |
| 559 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/8/1996 | Qal1 |
| 560 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 5/8/1996 | Qal1 |
| 561 | I-15 Corridor Reconstruction Section 4: 600 South Interchange | 600 South Interstate 15 | 6/28/1996 | Qal1 |
| 562 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-01 | SR 201 | 5/4/1996 | Qal1 |
| 563 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-02 | SR 201 | 5/4/1996 | Qal1 |
| 564 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-03 | SR 201 | 5/5/1996 | Qal1 |
| 565 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-04 | SR 201 | 4/29/1996 | Qal1 |
| 566 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-05 | 900WC | 5/13/1996 | Qal1 |
| 567 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-06 | 21S 201W | 6/6/1996 | Qal1 |
| 568 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-07 | 900 WE | 6/2/1996 | Qal1 |
| 570 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-09 | 700W | 6/2/1996 | Qal1 |
| 571 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-10 | SR 201 | 6/16/1996 | Qal1 |
| 572 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-11 | SR 201 | 6/16/1996 | Qal1 |
| 573 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-12 | SR 201 | 5/5/1996 | Qal1 |
| 574 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-13 | SR 201 | 5/1/1996 | Qal1 |
| 575 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-14 | SR 201 | 5/2/1996 | Qal1 |
| 576 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-15 | 21S 201W | 5/8/1996 | Qal1 |
| 577 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-16 | SR 201 | 5/7/1996 | Qal1 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 578 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-17 | 201E 15N | 6/1/1996 | Qal1 |
| 579 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-18 | SR 201 | 5/6/1996 | Qal1 |
| 580 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-19 | 21S 201W | 5/11/1996 | Qal1 |
| 581 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-20 | 900 WA | 4/30/1996 | Qal1 |
| 582 | I-15 Corridor Reconstruction Section 10: SR 201 35-8163-21 | 900WB | 4/30/1996 | Qal1 |
| 585 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 6/5/1996 | Qlaly |
| 586 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 6/5/1996 | Qlaly |
| 587 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/16/1996 | Qlaly |
| 588 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/20/1996 | Qlaly |
| 589 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-15S80E | 5/28/1996 | Qlaly |
| 590 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/15/1996 | Qlaly |
| 591 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-15S80E | 5/14/1996 | Qlaly |
| 592 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/15/1996 | Qlaly |
| 593 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/30/1996 | Qlaly |
| 594 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 6/2/1996 | Qlaly |
| 595 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-80W15N | 6/17/1996 | Qlaly |
| 596 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-15S80E | 6/2/1996 | Qlaly |
| 597 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-15S80E | 5/16/1996 | Qlaly |
| 598 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-15S80E | 6/24/1996 | Qlaly |
| 599 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-15S80E | 6/17/1996 | Qlaly |
| 600 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/13/1996 | Qlaly |
| 601 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/15/1996 | Qlaly |
| 602 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/28/1996 | Qlaly |
| 603 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/14/1996 | Qlaly |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 604 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/30/1996 | Qlaly |
| 605 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/15/1996 | Qlaly |
| 606 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/21/1996 | Qlaly |
| 607 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 6/2/1996 | Qlaly |
| 608 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 6/3/1996 | Qlaly |
| 609 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 6/4/1996 | Qlaly |
| 610 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/17/1996 | Qlaly |
| 611 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-80W15N | 5/14/1996 | Qlaly |
| 612 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-15S80E | 5/14/1996 | Qlaly |
| 613 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/16/1996 | Qlaly |
| 614 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/13/1996 | Qlaly |
| 615 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/14/1996 | Qlaly |
| 616 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/15/1996 | Qlaly |
| 617 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/15/1996 | Qlaly |
| 618 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/30/1996 | Qlaly |
| 619 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-80W15N | 5/30/1996 | Qlaly |
| 620 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/14/1996 | Qlaly |
| 621 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 6/29/1996 | Qlaly |
| 622 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-80W15N | 5/22/1996 | Qlaly |
| 623 | I-15 Corridor Reconstruction Section 9: State Street 35-8160 | SS-I80 | 5/13/1996 | Qlaly |
| 624 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/9/1996 | Qal2 |
| 625 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/23/1996 | Qal2 |
| 626 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/8/1996 | Qal2 |
| 627 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/30/1996 | Qal2 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 628 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/22/1996 | Qal2 |
| 629 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/6/1996 | Qal2 |
| 630 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/16/1996 | Qal1 |
| 631 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/21/1996 | Qal1 |
| 632 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/15/1996 | Qal1 |
| 633 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/17/1996 | Qal1 |
| 634 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/4/1996 | Qal1 |
| 635 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/7/1996 | Qal1 |
| 636 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/3/1996 | Qal1 |
| 638 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/29/1996 | Qal2 |
| 639 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/6/1996 | Qal2 |
| 640 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 7/11/1996 | Qal2 |
| 641 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/31/1996 | Qal2 |
| 642 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/20/1996 | Qal2 |
| 643 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/19/1996 | Qal2 |
| 644 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/19/1996 | Qal2 |
| 645 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/25/1996 | Qal2 |
| 646 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/18/1996 | Qal2 |
| 647 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/18/1996 | Qal2 |
| 648 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/19/1996 | Qal2 |
| 649 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 6/9/1996 | Qal2 |
| 650 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/18/1996 | Qal2 |
| 651 | I-15 Corridor Reconstruction Section 8: 3300 South Interchange | I-15 | 5/22/1996 | Qal2 |
| 652 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/4/1996 | Qal2 |

# Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 654 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/3/1996 | Qal2 |
| 655 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/1/1996 | Qal2 |
| 656 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/6/1996 | Qal2 |
| 657 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/11/1996 | Qal2 |
| 658 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 5/31/1996 | Qal2 |
| 659 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/1/1996 | Qal2 |
| 660 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/11/1996 | Qal2 |
| 661 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/10/1996 | Qal2 |
| 662 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/11/1996 | Qal2 |
| 663 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/5/1996 | Qal2 |
| 664 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/11/1996 | Qlbpm |
| 665 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 5/30/1996 | Qal1 |
| 666 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/13/1996 | Qal1 |
| 667 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/12/1996 | Qal1 |
| 668 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/12/1996 | Qal2 |
| 669 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/16/1996 | Qal2 |
| 670 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/4/1996 | Qal2 |
| 671 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/4/1996 | Qal2 |
| 672 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 5/29/1996 | Qal2 |
| 673 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 5/30/1996 | Qal2 |
| 674 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/12/1996 | Qal2 |
| 675 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/3/1996 | Qal2 |
| 676 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/5/1996 | Qal2 |
| 677 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/1/1996 | Qal2 |

## Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 678 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/1/1996 | Qal2 |
| 679 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 5/30/1996 | Qal1 |
| 680 | I-15 Corridor Reconstruction Section 6: 5300 South Interchange | I-15 | 6/2/1996 | Qal2 |
| 681 | Industrial Center | 1925 W. Indiana Ave | 10/15/2001 | Qaly |
| 682 | Industrial Center | 1925 W. Indiana Ave | 10/15/2001 | Qaly |
| 683 | Stream Lane Subdivision | 3518 S. 2000 E | 12/23/2003 | Qaf2 |
| 684 | Bolton Place Subdivision | 1465 W 500 N | 2/9/2004 | Qlbpm |
| 685 | Fast Movers Warehouse | 3651 S 700 W | 4/20/2001 | Qal2 |
| 686 | Proposed Water Transmission Line | app 2200E 1700S | 4/23/1982 | Qlbpm |
| 687 | Proposed Water Transmission Line | app 2200E 1700S | 4/23/1982 | Qlbpm |
| 688 | Foothill Stake Center | 2100 S Between Hollywood and Westminster | 4/23/1982 | Qlbpm |
| 689 | Safeway Store | 1638 S 900 E | 12/12/1972 | Qlaly |
| 690 | Irving Commons Parking Structure | 1200 E 2100 S | | Qlpg |
| 691 | 1700 S State St | 1700 S State St | 4/27/1970 | Qlaly |
| 692 | St. Joseph Home | app 1900 S 500 E | 3/18/1982 | Qlaly |
| 693 | First Security Bank | 2100 S 1100 E | | Qaf2 |
| 694 | Foothill Drive over I-80 Structure 17 | Foothill Drive I-80 | 1/1/1960 | Mz |
| 695 | I80 and 17th East | 17th East I-80 | | Qlbm |
| 696 | Imperial 1st and 2nd Wards, Highland Stake | 2700 S Fillmore St | | Qlbpm |
| 697 | Rosslyn School | 2291 S 2000 E | | Qlpg |
| 698 | | app 2800 E Parley's Way | 7/20/1979 | Qlpg |
| 699 | I-80 2300 E Ramp | 2300 E I-80 | 1/1/1960 | Qaf2 |
| 700 | Skipper Fish and Chips | 3086 East 3300 S | | Qalp |
| 701 | Proposed Bank | 2163 E 3300 S | 11/4/1975 | Qlbpm |
| 702 | | 3175 S State Street | 7/20/1959 | Qlaly |
| 703 | Skyline High School Swimming Pool | 3251 E 3760 S | | Qalp |
| 704 | Fort Douglas | Fort Douglas | 9/20/1978 | Qaf2 |
| 705 | Trolley Corners Facility | 500 S 700 E | | Qaf2 |
| 706 | KSL Building | 200 E Social Hall Ave | | Qaf2 |
| 707 | Salt Lake Valley Ward for the Deaf | 700 S 800 E | | Qlaly |
| 708 | Donner Crest Condominiums | 850 S. Donner Way (Mouth of Emigration Canyon) | | Qafb |
| 709 | Report of Foundation investigation Gibbons and Reed Batch Pl | Gibbons and Reed Batch Plant, North Salt Lake | 2/11/1977 | Qly |
| 710 | Tischner-Busch warehouse | 1800 N 3600 W | | Qlaly |
| 711 | Tischner-Busch warehouse | 1800 N 3600 W | | Qlaly |
| 712 | Dames and Moore Job no. 5471-001-06 | 1674 N Beck Street | | Qlbpg |
| 713 | Dames and Moore AMACO report | Beck Street | | Qaf2 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 714 | Dames and Moore | | 6/16/1981 | Qlbpm |
| 715 | RBG | Sandrun Drive and Dorchester Drive | | Qlbm |
| 716 | Dames and Moore | South Temple and E street | 8/21/1978 | Qlpg |
| 717 | 21st Wards Emigration Stake | 2nd Avenue 700 E | | Qaf2 |
| 718 | Proposed 11th Avenue Extension | 11th Avenue | 8/21/1974 | Qlbg |
| 719 | Proposed 11th Avenue Extension | 11th Avenue | 8/21/1974 | Qaf2 |
| 720 | Proposed 11th Avenue Extension | 11th Avenue | 8/21/1974 | Qlbm |
| 721 | | | 12/6/1966 | Qlaly |
| 722 | International - 2.5 | North of I-80 | 12/18/1979 | Qlaly |
| 723 | SL International Center- Easton Aluminum | Donald Douglas Road and Harold Gatty Drive (575 N) | | Qlaly |
| 724 | Skagg's Office Building | Charles Lindberg Dr and Amelia Earhart Drive | | Qlaly |
| 725 | Mervyns Brickyard Plaza | 3250 S between 11th and 13th East | 8/9/1979 | Qlbpm |
| 726 | Standard Optical | 1901 W Parkway BLVD | | Qaly |
| 727 | Bradshaw Condominiums | app 10 E 400 S to 500 S | | Qaf2 |
| 728 | 2100 S 1300 E | 2100 S 1300 E | | Qlpg |
| 729 | Chen and Associates Job No. 301 U | 300 W North Temple | 4/16/1980 | Qaf2 |
| 730 | East Redwood Subdivision | 3405 S Redwood Rd | | Qal1 |
| 731 | Dura Crete Building | 1475 W 3500 S | | Qal1 |
| 732 | Chevron Gas Station | 4400 W 3500 S | 8/26/1981 | Qlbpm |
| 733 | Jordan North 5 and 12 Wards Chapel | Hawkeye West Drive (app 3800 W) 4100 S | | Qlbpm |
| 734 | Buehner Block | 2800 S 200 W | 7/18/1979 | Qlaly |
| 735 | West Lake Apartments | 3600 W 3100 S | | Qlaly |
| 736 | McDonald's Facility | 3450 W 3500 S | | Qlbpm |
| 737 | Glendale Park School Addition | 1455 W. California Ave | | Qal1 |
| 738 | Transmission Line | | | Qlaly |
| 739 | Liberty School | 1092 S 200 E | | Qlaly |
| 740 | Parkview Elementary School | 1250 W. Mead Ave (970 S) | | Qaly |
| 741 | Bonneville Concentrator | Kennecott, West of Magna, South of Tailings Pond. | | Qlbg |
| 742 | Bonneville Concentrator | Kennecott, West of Magna, South of Tailings Pond. | | Qlbg |
| 743 | Bonneville Concentrator | Kennecott, West of Magna, South of Tailings Pond. | | Qlbg |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 744 | Redwood 1st and 3rd Wards LDS Chapel | 1265 W 2320 S | | Qal1 |
| 745 | KV Transmission Line | | 3/10/1976 | Qlaly |
| 746 | Prest O Lite Warehouse | 1000 S Redwood Rd | 10/2/1972 | Qaly |
| 747 | LDS Welfare Square Dairy Addition | 770 S 800 W. app | | Qal1 |
| 748 | I-215 over 3100 S | 3100 S I-215 | 11/28/1961 | Qlaly |
| 749 | 1525 W Cheyenne Street | 466 S Cheyenne St (1525 W) | | Qal1 |
| 750 | Geotechnical Investigation MHJ Block 37 City Library | 200 E 400 S | | Qmls |
| 1000 | Tapp Family Trust Office Building | 6200 S Wasatch Blvd, Holladay UT | 4/1/1998 | Qaf2 |
| 1001 | Alan Kruckenberg | 6776 South 1300 East | 8/26/1998 | Qal2 |
| 1002 | Terry Anderton | 4445 South 1025 East | 5/5/1997 | Qlbpm |
| 1003 | Hampton Development LLC | 447 East Greenwood Avenue (7500 South) | 6/2/1997 | Qlpg |
| 1004 | Hamblin Kasco | 4573 South Highland Drive (1800 East) | 5/4/1999 | Qlbpm |
| 1005 | Joe Colosimo | 4381 South Highland Drive (1730 East) | 4/9/1997 | Qlbpm |
| 1006 | Richard Bennion | 1039 East 3900 South | 4/16/1997 | Qlbpm |
| 1007 | ROE Oaks | 6400 South 1500 East | 7/11/1996 | Qlbpm |
| 1008 | Meyer, Robert & Sample, Jay | 8071 South Highland Drive (2070 East) | 2/3/1998 | Qal1 |
| 1009 | Clark Ivory | 5101 South 1000 East | 10/30/1997 | Qlbpm |
| 1010 | Willow Park LLC/Victor j. Salm | 3281 South 200 East | 11/14/1997 | Qlbpm |
| 1011 | Contempo Tile | 3746 South 300 West | | Qal2 |
| 1012 | Menlove Construction | 3464 South Main Street | 11/4/1997 | Qlbpm |
| 1013 | Ben Logue | 693 West Fine Drive (3720 South) | 3/26/1998 | Qal2 |
| 1014 | Granite Credit Union | 3679 South 900 East | | Qlaly |
| 1015 | Excel Investment Corporation | 3738 South 900 East | 3/21/1998 | Qlbpm |
| 1016 | Andy Seppi | 579 West 3900 South | 3/28/1997 | Qal2 |
| 1017 | Royal Heritage Home Care | 3201 South 900 E | 8/7/1997 | Qlaly |
| 1018 | Arlington Association LLc | 5089 South 900 East | 1/15/1999 | Qlbpm |
| 1019 | Gary Machan | 622 East 4500 South | 3/8/1999 | Qlbpm |
| 1020 | J. McDonald Brubaker | 6727 South 1300 East | 3/31/1999 | Qal2 |
| 1021 | E. Duff Ellsworth | 4049 South Howick Street (210 West) | 2/15/1999 | Qal1 |
| 1022 | St. Marks Hospital | 1100 East 3900 South | 4/21/1999 | Qlaly |
| 1023 | Colosimo Ent. | 5499 South 1300 East | 8/10/1999 | Qlbpm |
| 1024 | Robert J DeBry | 5105 South 900 East | 4/20/1999 | Qlbpm |
| 1025 | Kirk Nielson | 4041 South Commerce Drive (300 West) | 11/18/1999 | Qal1 |
| 1026 | Mountain States Business Park | 3950 South 300 West | 2/3/2000 | Qal2 |
| 1027 | 34th Street LLC | 4062 South 500 East | 4/17/2000 | Qal1 |
| 1028 | Cambridge Square Associates | 900 East 3700 South | 2/24/2000 | Qlbpm |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1029 | Roland Webb | 33 East Columbia Avenue (4160 South) | 4/24/2000 | Qal1 |
| 1030 | WEBCO, Inc | 7364 South Creek Road (1125 East) | 2/9/2000 | Qal2 |
| 1031 | IDG Development | 4916 South Highland Circle (1800 East) | 6/21/2000 | Qal2 |
| 1032 | Dave O' Bagy | 4252 South Highland Drive (1700 East) | 3/28/2000 | Qlaly |
| 1033 | C3 Investments LLC | 3949 South 200 East | 3/8/2000 | Qlbpm |
| 1034 | Willow Park LLC | 4525 South 1300 East | 2/11/2000 | Qal1 |
| 1035 | Pacifi Corp | 87 West 3900 South | 10/13/1998 | Qal2 |
| 1036 | Brad Reynolds Construction | 1075 East 4800 South | 2/11/1999 | Qlbpm |
| 1037 | Timmons Properties LLC | 1601 East 4500 South | 9/10/1998 | Qlbpm |
| 1038 | Whitney Lane LLC | 3721 South 1300 East | 1/4/1999 | Qlaly |
| 1039 | Regent Assisted Living Inc | 7220 South Union Park Avenue (1320 East) | 6/25/1998 | Qal1 |
| 1040 | Josephine J Platt | 4645 South Highland Drive (1800 East) | 12/9/1998 | Qaf2 |
| 1041 | Tom Sdrales | 5600 South 1300 East | 5/21/1998 | Qlbpm |
| 1042 | SLCO Parks and Recreation | 1661 East Murray Holladay Blvd (4705 South) | 5/13/1998 | Qal1 |
| 1043 | Silverwood Estates II | 855 East 3900 South | 3/8/1999 | Qal1 |
| 1044 | Arthur L Flangas | 2910 South 8400 West | 10/1/1999 | Qafy |
| 1045 | Thomas R. Kendrick | 242 West 3620 South | 6/29/1995 | Qal2 |
| 1046 | Michael Menlove | 6235 South Redwood Road (1700 West) | 4/18/1996 | Qlbpm |
| 1047 | JM Dev. | 4596 South 785 East | 2/2/1998 | Qal1 |
| 1048 | Sunstone Corporation | 802 East 7800 South | 8/21/1997 | Qlpg |
| 1049 | Troy Spencer | 465 East 3900 South | 10/13/1997 | Qlbpm |
| 1050 | Village Communities LC | 6996 South 700 East | 4/3/1996 | Qal2 |
| 1051 | Utah Non Profit Housing | 8923 West 2700 South | 1/28/1997 | Qafy |
| 1052 | Daplco Builders L.C. | 3860 South McCall Street (250 East) | 1/10/1997 | Qlbpm |
| 1053 | Candlewood Hotel Corporation | 7030 South Park Centre Drive (1435 East) | 10/22/1996 | Qlpd |
| 1054 | Bushness Wells Construction | 4060 South 300 East | 7/11/1997 | Qal1 |
| 1055 | Enterprise Car Rental | 4139 South State Street | 12/4/1997 | Qal1 |
| 1056 | Hampton Development Company | 1159 East 4500 South | 6/3/1997 | Qlbpm |
| 1057 | Herms Assoc. | 7269 South Union Park Avenue (1200 East) | 8/17/1996 | Qal1 |
| 1058 | SLCO Board of Commissioners | 1500 East Murray Holladay Road (4705 South) | 4/1/1996 | Qal1 |
| 1059 | Boyer - Old Mill LC | 6200 South 3000 East | 10/4/1994 | Qaf2 |
| 1060 | CLC Associates Inc. | 6600 South Union Park Avenue (975 East) | 8/26/1996 | Qal2 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1061 | Homestead Village | 5770 South 1650 West | 10/2/1995 | Qlbpm |
| 1062 | David Platt | 1935 East Siesta Drive (7485 South) | 2/6/1997 | Qalp |
| 1063 | Ivory Homes | 790 East 4400 South | 7/26/1996 | Qlbpm |
| 1064 | Spectrum Development Corporation | 4141 South 700 East | 6/27/1996 | Qlbpm |
| 1065 | William Steve Perry | 328 East 3900 South | | Qlbpm |
| 1066 | Kim Jooms | 315 West 3300 South | 8/27/1991 | Qal2 |
| 1067 | Kim Anderson | 7155 South 540 East | 11/13/1995 | Qlpg |
| 1068 | Sorenson Associates | 815 West 4500 South | 1/12/1995 | Qal1 |
| 1069 | Arlene Carlson | 4099 South Highland Drive (1710 East) | 11/20/1995 | Qlaly |
| 1070 | Prime Commercial Partners LLC | 7351 South Union Park Avenue (1145 East) | | Qal2 |
| 1071 | Jaren L Davis | 1282 East 4500 South | 6/9/1997 | Qal2 |
| 1072 | West America Finance Corp | 4605 South 900 East | | Qlbpm |
| 1073 | Sigma Corp | 777 East 3900 South | | Qlbpm |
| 1074 | American Housing Development | 4561 South 900 East | 8/1/1995 | Qlbpm |
| 1075 | Ron Halpern | 846 East North Union Avenue (7130 South) | 5/15/1995 | Qal2 |
| 1076 | Patricia Adams | 4745 South 3200 West | 7/7/1995 | Qlbpm |
| 1077 | Trammell Crow Residential Co. | 6714 South 1300 East | 4/20/1995 | Qal2 |
| 1078 | ORD Properties Inc. | 910 West 3900 South | 3/8/1995 | Qlbpm |
| 1079 | Mark Eldredge | 1860 East 5600 South | 4/26/1995 | Qal1 |
| 1080 | Housing Authority | 290 East 4050 South | | Qal1 |
| 1081 | Smith Brubaker | 351 East 7500 South | 10/25/1996 | Qlpg |
| 1082 | Village Communities | 7351 South 300 East | 6/26/1995 | Qlbpm |
| 1083 | Hamlet Development | 4771 South 600 East | 2/21/1995 | Qal1 |
| 1084 | Salt Lake County | 177 West 3600 South | 6/27/1995 | Qal2 |
| 1085 | Fourels Investment Co. | 7000 South 1435 East | | Qlpd |
| 1086 | Jim Theusch | 7025 South 1435 East | | Qlbpm |
| 1087 | Wallnet Investments LLC | 2755 East 6580 South | 2/4/1998 | Qlpd |
| 1088 | William Oswald | 1075 West 3725 South | 11/14/1994 | Qal2 |
| 1089 | McDonald's Corporation | 3890 South 1100 East | 6/7/1994 | Qlaly |
| 1090 | Salt Lake County | 3638 South West Temple Street | 3/21/1994 | Qlbpm |
| 1091 | Kent Alred | 1349 East 4500 South | | Qal2 |
| 1092 | Asset Network of America | 1582 West 5400 South | 8/9/1990 | Qlbpm |
| 1093 | American Equity Corporation | 1052 East 7220 South | | Qal2 |
| 1094 | Neal Hammond | 3535 South 500 West | 10/28/1994 | Qal2 |
| 1095 | Western River Expeditions | 1180 East 6600 South | 6/17/1994 | Qal2 |
| 1096 | Hercules Aerospace | 9400 West 5050 South | | Qlbg |
| 1097 | Salt Lake County | 1820 East 6965 South | 9/6/1995 | Qlpg |
| 1098 | Opportunity Development | 7765 South 300 East | 1/5/1995 | Qlpg |
| 1099 | Richard Sorenson | 5400 South 1300 West | 9/2/1994 | Qlbpm |
| 1100 | Sussex Group | 4168 South 900 East | 6/10/1994 | Qlbpm |
| 1101 | Locus | 4805 South 2350 West | | Qlbpm |
| 1102 | T & Z Corporation | 3960 South 300 West | | Qal2 |
| 1103 | Colorado Land Consultants, Inc. | 7100 South 1400 East | 10/27/1993 | Qlpd |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1104 | Civil Land Consultants | 7100 South 1300 East | 10/25/1993 | Qlpd |
| 1105 | PGAW Architects | 2145 East Creek Road (8200 South) | | Qalp |
| 1106 | Mountain America Credit Union | 1298 East Murray Holladay Road (4785 South) | 12/6/1993 | Qal1 |
| 1107 | Triton Investments | 1355 West 4070 South | | Qal1 |
| 1108 | McDonala | 6280 South Redwood Road (1700 West) | 6/17/1993 | Qlbpm |
| 1109 | Holladay Hills II imited Partnership | 3714 South Highland Drive | 3/18/1993 | Qlaly |
| 1110 | River Point Associates | 925 West 3900 South | 3/4/1993 | Qal2 |
| 1111 | Gordon Gygi Architects | 6728 South 1300 East | | Qal2 |
| 1112 | Triton Investments | 4500 South 465 East | | Qal2 |
| 1113 | Triton Investments | 4070 South 1355 West | | Qlbpm |
| 1114 | E BA Berger Inc. | 5400 South 2510 West | 7/21/1993 | Qlbpm |
| 1115 | S-Devcorp | 4365 South State Street | 12/13/2004 | Qal2 |
| 1116 | Mike Polich | 3518 South 2000 East | 12/23/2003 | Qaf2 |
| 1117 | Steven T. Hunt | 5814 Haven Lane | 7/27/1998 | Qal1 |
| 1118 | Frank Perri | 3651 South 700 West | 4/20/2001 | Qal2 |
| 1119 | Prince Development | 1712 East 9800 South | 7/22/2004 | Qlpg |
| 1120 | Bill Berg | 791 West Kolten Road | 7/15/2002 | Qlbpm |
| 1121 | SLC Cellular Tower | 3699 South 300 West | 5/26/1992 | Qal2 |
| 1122 | Kelly Sheppard | 7112 South 700 East | 1/25/1993 | Qal2 |
| 1123 | Duane Wright | 4411 South 1300 East | 10/29/1992 | Qal1 |
| 1124 | Mark McDougal | 4360 South Redwood Road (1700 West) | | Qal2 |
| 1125 | US West SAL - Midvale | 910 East 6600 South | 7/28/1992 | Qal2 |
| 1126 | William Hafeman | 1200 West 5100 South | 2/10/1993 | Qlbpm |
| 1127 | First Security Mortgage | 358 East 3900 South | 10/9/1992 | Qlbpm |
| 1128 | Utah Power and Light | 1287 East 6465 South | 2/28/1992 | Qal2 |
| 1129 | Mark Blair | 771 East 4345 South | 10/29/1992 | Qlbpm |
| 1130 | Hawk Park 2 | 1150 East 4780 South | 3/19/1992 | Qal1 |
| 1131 | State of Utah DFCM | 5709 South 1500 West | | Qlbpm |
| 1132 | American Equity Corporation | 1677 East 4500 South | | Qlbpm |
| 1133 | LDS Church | 2365 West 4945 South | | Qlbpm |
| 1134 | Val Shelley | 5205 South Highland Drive | 4/22/1992 | Qal1 |
| 1135 | Pheasant Lane Estates | 7660 South Caballero Drive | 8/14/1991 | Qalp |
| 1136 | Brent Moon | 4115 South Main Street | 3/6/1992 | Qal1 |
| 1137 | Mancini & Groesbeck | 194 East 3900 South | 11/21/1990 | Qlbpm |
| 1138 | Light Touch Inc. | 3550 South 700 West | 4/5/1991 | Qal2 |
| 1139 | Salt Lake City | 184 East Gordon Lane (4190 South) | 12/18/1990 | Qal1 |
| 1140 | George Brushke | 7817 South 2000 East | 2/12/1991 | Qal1 |
| 1141 | Nanolia Investments | 725 West 3300 South | 7/27/1990 | Qal2 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1142 | Cottonwood Estates Corporation | 2250 East Creek Road (8200 South) | 2/12/1991 | Qalp |
| 1143 | Esther's Cove Subdivision | 1400 East Siesta Drive | 10/17/1989 | Qal1 |
| 1144 | Sorenson Associates | 860 West Levoy Drive (4380 South) | 10/16/1995 | Qal1 |
| 1145 | Wal-Mart Stores Inc. | 5400 South Redwood Road | 8/9/1990 | Qlbpm |
| 1146 | Guy Mendenhall | 1009 East 4800 South | 9/9/1992 | Qal1 |
| 1147 | Westech Engineering | 3639 South West Temple | 5/1/1996 | Qal2 |
| 1148 | Edinburgh Condos | 1105 East 4800 South | 5/16/1985 | Qal1 |
| 1149 | Security Capital Pacific Trust | 700 West 3727 South | 5/3/1996 | Qal2 |
| 1150 | Learning Tree Day Care | 860 East 4500 South | 2/25/1985 | Qlbpm |
| 1151 | Chadd Ford Partnership | 837 East 7440 South | | Qlpg |
| 1152 | Bonneville Inn | 315 West 3300 South | 8/27/1991 | Qal2 |
| 1153 | Aramark Uniform Service | 3679 South 700 West | | Qal2 |
| 1154 | US West | 3900 South 450 West | 6/18/1992 | Qlaly |
| 1155 | Salt Lake Medical Investors LDT | 1201 East 4500 South | 1/27/1987 | Qal2 |
| 1156 | | 9500 South 700 West | | Qlbpm |
| 1157 | LDS Institute @ SLCC | 2200 West 4600 South | | Qlbpm |
| 1158 | Bangerter Highway | SPTC Railroad over Bangerter Highway | 3/11/1996 | Qal2 |
| 1159 | Bangerter Highway | 1300 West S.R. 154 | 10/28/1996 | Qal1 |
| 1160 | Bangerter Highway | Jordan River S.R. 154 | 10/17/1996 | Qal1 |
| 1161 | Bangerter Highway | Interstate 15, S.R. 154 | 10/10/1996 | Qlbpm |
| 1162 | LDS Church | 10200 South 1300 West | 5/31/1978 | Qlbps |
| 1163 | Civil Land Consultants | 11000 South Interstate 15 | 3/6/1995 | Qlbpm |
| 1164 | Bingham Canyon Reservoir | 10200 South 7200 West | 5/22/1960 | Qafo |
| 1165 | Ballard Medical Products | 12300 South Lone Peak Parkway | 4/15/1992 | Qlbpm |
| 1166 | South Towne Office Park Partnership | 10600 South Tower Boulevard | 1/7/1990 | Qal1 |
| 1167 | Oak Financial Properties | 7800 South 1275 West | 5/30/1997 | Qlbpm |
| 1168 | Metropolitan Water District of Salt Lake and Sandy | Interstate 15 Bluffdale Interchange | 10/28/2002 | Qlpg |
| 1169 | Metropolitan Water District of Salt Lake and Sandy | 9000 South Danish Road (3000 East) | 11/29/1999 | Qal2 |
| 1170 | Metropolitan Water District of Salt Lake and Sandy | Interstate 15 Bluffdale Interchange | 10/30/2002 | Qlpg |
| 1171 | Metropolitan Water District of Salt Lake and Sandy | Interstate 15 Bluffdale Interchange | 10/30/2002 | Qlpg |
| 1172 | UDOT Bangerter Highway | SR-154 4100 South | 3/16/1999 | Qlbpm |
| 1173 | UDOT Bangerter Highway | SR-154 4100 South | 3/19/1999 | Qlbpm |
| 1174 | UDOT Bangerter Highway | SR-154 4100 South | 4/15/1999 | Qlbpm |
| 1175 | UDOT Bangerter Highway | SR-154 9000 South | 6/30/1995 | Qlbpg |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1176 | UDOT Bangerter Highway | SR-154 9000 South | 6/30/1995 | Qlbpg |
| 1177 | UDOT Bangerter Highway | SR-154 9000 South | 6/30/1995 | Qlbpm |
| 1178 | UDOT Bangerter Highway | SR-154 9000 South | 7/3/1995 | Qlbps |
| 1179 | UDOT Bangerter Highway | S.R. 154 9800 South | 7/6/1995 | Qlbpm |
| 1180 | UDOT Bangerter Highway | S.R. 154 9800 South | 7/6/1995 | Qlbpm |
| 1181 | UDOT Bangerter Highway Segment 8 | SR-154 3600 West | 8/1/1996 | Qlbpm |
| 1182 | UDOT Bangerter Highway Segment 8 | SR-154 3600 West | 8/2/1996 | Qlbpm |
| 1183 | UDOT Bangerter Highway Segment 8 | SR-154 3600 West | 8/2/1996 | Qlbpm |
| 1184 | UDOT Bangerter Highway Segment 8 | SR-154 3000 West | 7/30/1996 | Qlbpm |
| 1185 | UDOT Bangerter Highway Segment 8 | SR-154 3000 West | 7/31/1996 | Qlbpm |
| 1186 | UDOT Bangerter Highway Segment 8 | SR-154 2700 West | 7/21/1996 | Qlbpm |
| 1187 | UDOT Bangerter Highway Segment 8 | SR-154 2500 West | 7/31/1996 | Qlbpm |
| 1188 | UDOT Bangerter Highway Segment 8 | SR-154 2200 West | 8/5/1996 | Qlbpm |
| 1189 | UDOT Bangerter Highway Segment 8 | SR-154 2200 West | 8/5/1996 | Qal2 |
| 1190 | UDOT Bangerter Highway Segment 8 | SR-154 2000 West | 8/1/1996 | Qal2 |
| 1191 | UDOT Bangerter Highway Segment 8 | SR-154 2000 West | 8/6/1996 | Qal2 |
| 1192 | UDOT Bangerter Highway Segment 8 | SR-154 Redwood Road | 8/6/1996 | Qal2 |
| 1193 | UDOT Bangerter Highway Segment 8 | SR-154 13400 South | 10/20/1998 | Qlbpm |
| 1194 | UDOT Bangerter Highway Segment 8 | SR-154 13400 South | 10/28/1998 | Qlbpm |
| 1195 | UDOT I-15 Utah County Line to 10600 South | I-15 14600 South | 1/15/2003 | Qlpg |
| 1196 | UDOT I-15 Utah County Line to 10600 South | I-15 14600 South | 1/22/2003 | Qlpg |
| 1197 | UDOT I-15 Utah County Line to 10600 South | I-15 11400 South | 3/15/2000 | Qlbpm |
| 1198 | UDOT I-15 Utah County Line to 10600 South | I-15 11400 South | 3/15/2000 | Qlbpm |
| 1199 | UDOT I-15 Utah County Line to 10600 South | I-15 Salt Lake/Utah County Line | 8/20/2003 | Qlbpg |
| 1200 | UDOT I-15 Utah County Line to 10600 South | I-15 Salt Lake/Utah County Line | 8/20/2003 | Qlpg |
| 1201 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 8/19/2003 | Qlpg |
| 1202 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 8/19/2003 | Qlpg |
| 1203 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 8/20/2003 | Qlpg |
| 1204 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 8/20/2003 | Qlpg |
| 1205 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 8/20/2003 | Qlpg |
| 1206 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 8/20/2003 | Qlpg |
| 1207 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 10/21/2003 | Qlpg |
| 1208 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 10/21/2003 | Qlpg |

## Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1209 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 10/21/2003 | Qlpg |
| 1210 | UDOT I-15 Utah County Line to 10600 South | I-15 Point of the Mountain | 8/27/2003 | Qlpg |
| 1211 | UDOT I-15 Utah County Line to 10600 South | I-15 Bangerter Highway | 9/5/2003 | Qlbpm |
| 1212 | UDOT I-15 Utah County Line to 10600 South | I-15 Bangerter Highway | 8/28/2003 | Qlbpm |
| 1213 | UDOT I-15 Utah County Line to 10600 South | I-15 10800 South | 10/22/2003 | Qlbpm |
| 1214 | UDOT I-15 Utah County Line to 10600 South | I-15 10800 South | 10/23/2003 | Qlbpm |
| 1215 | UDOT I-15 Utah County Line to 10600 South | I-15 11400 South | 8/26/2003 | Qlbpm |
| 1216 | UDOT I-15 Utah County Line to 10600 South | I-15 11400 South | 8/27/2003 | Qlbpm |
| 1217 | Proposed Carwash | 1300 East Pioneer Road | 3/29/2005 | Qlpg |
| 1218 | Draper Commercial Property | 1400 East Draper Parkway | 7/29/2004 | Qlpg |
| 1219 | Draper Retail Center | 300 East 12450 South | 2/24/2005 | Qlbpm |
| 1220 | Proposed Office Building | 11650 South State Street | 5/16/2004 | Qlbpm |
| 1221 | Southfork Estates | 300 East 14200 South | 4/16/2003 | Qaf2 |
| 1222 | Proposed Office Complex | 13975 South Minuteman Drive | 6/29/1999 | Qlbpm |
| 1223 | U.S. Post Office | 700 East Locust Street (8500 South) | | Qlpg |
| 1224 | LDS Church | 4800 West 4170 South | | Qlbps |
| 1225 | Kearns District | 4015 West 4775 South | 1/19/1977 | Qlbpg |
| 1226 | LDS Church | 5255 South 3200 West | | Qlbpm |
| 1227 | LDS Church | 5415 South 4575 West | | Qlbpg |
| 1228 | Playworld | 7200 South State Street | | Qlbpm |
| 1229 | The Redwood Village Shopping Center | 7000 South Redwood Road | | Qlbpm |
| 1230 | LDS Church | 7510 South 2700 West | | Qlbpm |
| 1231 | LDS Church | 7325 South 3200 West | | Qlbpm |
| 1232 | LDS Church | 8000 South 2700 West | | Qlbpm |
| 1233 | Skaggs Super Center | 7800 South Redwood Road | | Qlbpm |
| 1234 | Hart Brothers Music | 8131 South Redwood | | Qlbpm |
| 1235 | Granite Elementary School | 4350 South 5400 West | | Qlbpg |
| 1236 | Arlington School | 5025 South State Street | | Qal1 |
| 1237 | Murray High School Gymnasium Addition | 5440 South State Street | | Qlbpm |
| 1238 | Arby's Restaurant | 5830 South State Street | | Qal2 |
| 1239 | Proposed Cashway Store | 6000 South State Street | | Qal2 |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1240 | Water Tank #3 | 10200 South 4450 West | 10/8/2003 | Qlbs |
| 1241 | Water Tank #1 | 11400 South 3200 West | 11/11/2003 | Qlbpm |
| 1242 | Water Tank #5 | 10200 South 6000 West | 10/13/2003 | Qafy |
| 1243 | 4.5 MG Reservoir | 10500 South 6300 West | 6/27/2005 | Qlbg |
| 1244 | I-15 Corridor Reconstruction | 10600 South Interstate 15 | 6/20/1996 | Qlbpm |
| 1245 | I-15 Corridor Reconstruction | 10200 South Interstate 15 | 6/20/1996 | Qal1 |
| 1246 | I-15 Corridor Reconstruction | 10000 South Interstate 15 | 6/21/1996 | Qlbpm |
| 1247 | I-15 Corridor Reconstruction | 9800 South Interstate 15 | 6/21/1996 | Qlpg |
| 1248 | I-15 Corridor Reconstruction | 9400 South Interstate 15 | 6/27/1996 | Qlpg |
| 1249 | I-15 Corridor Reconstruction | 9400 South Interstate 15 | 6/26/1996 | Qlbpm |
| 1250 | I-15 Corridor Reconstruction | 9400 South Interstate 15 | 6/24/1996 | Qlbpm |
| 1251 | I-15 Corridor Reconstruction | 9000 South Interstate 15 | 6/26/1996 | Qlbpm |
| 1252 | I-15 Corridor Reconstruction | 9000 South Interstate 15 | 6/24/1996 | Qlbpm |
| 1253 | I-15 Corridor Reconstruction | 9000 South Interstate 15 | 6/25/1996 | Qlbpm |
| 1254 | I-15 Corridor Reconstruction | 9000 South Interstate 15 | 7/8/1996 | Qlbpm |
| 1255 | I-15 Corridor Reconstruction | 9000 South Interstate 15 | 7/3/1996 | Qlbpm |
| 1256 | I-15 Corridor Reconstruction | 9000 South Interstate 15 | 6/27/1996 | Qlbpm |
| 1257 | I-15 Corridor Reconstruction | 8600 South Interstate 15 | 6/27/1996 | Qlbpm |
| 1258 | I-15 Corridor Reconstruction | 8600 South Interstate 15 | 7/1/1996 | Qlbpm |
| 1259 | I-15 Corridor Reconstruction | 8200 South Interstate 15 | 7/1/1996 | Qlbpm |
| 1260 | I-15 Corridor Reconstruction | 8100 South Interstate 15 | 7/1/1996 | Qlbpm |
| 1261 | Blessed Sacrament Catholic Church | 9800 South 1745 East | 3/16/2004 | Qlbg |
| 1262 | Proposed Residence | 2813 Ksel Drive | 8/3/2004 | Qlbg |
| 1263 | South Jordan Recreation Center | 10800 South Redwood Road | 3/4/2003 | Qlbpm |
| 1264 | Best Buy Facility | 11400 South State Street | 6/27/2001 | Qlbpm |

## Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1265 | Dimple Dell | 10600 South 1000 East | 5/11/1998 | Qlpg |
| 1266 | Albertson's | 9400 South 2000 East | 2/25/1997 | Qalp |
| 1267 | Jordan Common's | 9400 South State Street | 6/24/1997 | Qlpg |
| 1268 | Associated Food Stores | 7800 South 3200 West | 2/23/1998 | Qlbpm |
| 1269 | Smith's Food and Drug | 9000 South 4000 West | 3/19/1997 | Qlbpg |
| 1270 | In-N_Out Burger Draper | 12200 South Factory Outlet Drive | 12/16/2008 | Qlbpm |
| 1271 | Sainsbury-Simmons I Sub. | 12980 South Fort Street, Draper, Utah | 12/1/2008 | Qlaly |
| 1272 | Burger King Draper | SW Corner of Bangerter Parkway and 150 East | 10/30/2008 | Qlbpm |
| 1273 | Cowabunga Bay Project | 12101 South Factory Outlet Dr. | 9/10/2008 | Qlbpm |
| 1274 | Proposed Residence | 1709 East Pioneer Road | 6/17/2008 | Qal1 |
| 1275 | Proposed Draper Office Building | 12325 South 900 East, Draper, Utah | 5/28/2008 | Qlbpm |
| 1276 | Proposed Residence | 12483 South Relation Street, Draper, Utah | 4/11/2008 | Qal1 |
| 1277 | Proposed Residence | 1035 East 13400 South, Draper, Utah | 5/12/2008 | Qaf2 |
| 1278 | Proposed Commercial Development | 12047 Lone Peak Parkway | 3/12/2008 | Qlbpm |
| 1279 | Proposed Commercial Development | 12047 Lone Peak Parkway | 9/10/2007 | Qlbpm |
| 1280 | Office Buildings | 11980 South 700 East, Draper, Ut | 5/1/2008 | Qlbpm |
| 1281 | Beehive Assisted Living | 700 East 12400 South | 4/7/2008 | Qlbpm |
| 1282 | Proposed Addition Capital Premium Facility | 12235 South 800 East, Draper, Utah | 2/21/2008 | Qlbpm |
| 1283 | Chase Bank-Bangerter Crossing | 150 East and Bangerter Parkway | 2/4/2008 | Qlbpm |
| 1284 | Intermountain Plantings | 11623 South State, Draper, Utah | 5/20/2008 | Qlbpm |
| 1285 | Cypress Credit Union | 183 East 13800 South, Draper, Utah | 5/1/2008 | Qlbpm |
| 1286 | Auto Owners Insurance Building | 190 East 14000 South, Draper, Utah | 4/30/2008 | Qlbpm |
| 1287 | Proposed Walgreens Store | SWC 13800 Street and Bangerter Parkway, Draper, Ut | 6/27/2008 | Pz |
| 1288 | Proposed Subdivision Lot | 730 East 12690 South, Draper, Utah | 3/11/2008 | Qlaly |
| 1289 | Derbyshire Estates | 1050 East 12800 South, Draper, Utah | 3/6/2008 | Qlaly |
| 1290 | Proposed America First Credit Union | 13866 South Bangerter Parkway, Draper, Utah | 2/11/2008 | Rock |

Table 3 Continued

| Borehole ID Number | Project Name | Project Location/Address | Date of Exploration | Geologic Unit |
|---|---|---|---|---|
| 1291 | Proposed Exchange at 140th | SW Corner of 14000 South and Bangerter Pkwy | 6/2/2008 | Qlbpm |
| 1292 | Proposed New Building | 12607 South Minuteman Drive, Draper, Utah | 7/9/2007 | Qlbpm |
| 1293 | Proposed Retail Building | 136 East 13800 South, Draper, Utah | 7/6/2007 | Pz |
| 1294 | Furniture Row | IKEA Way, Draper, Utah | 6/5/2007 | Qlbpm |
| 1295 | Lone Peak Industrial Park | 12865 South 225 West, Draper, Utah | 11/10/2005 | Qlbpm |
| 1296 | Proposed Residential Subdivision | 12091 South 700 West | 8/6/2007 | Qlbpm |
| 1297 | Townhouse Development | 150 East 11800 South, Draper, Utah | 5/17/2006 | Qlbpm |
| 1298 | Corner Creek Plaza | 13420 Pony Express Road, Draper, Utah | 5/1/2007 | Qal1 |
| 1299 | South Willow Business Park | 150 West 12300 South, Draper, Utah | 1/22/2007 | Qal1 |
| 1300 | Quest Office And Training Center | 12300 South Galena Park Drive, Draper, Utah | 12/8/2006 | Qlbpm |
| 1301 | Proposed Draper Industrial Park | 125 West 12650 South, Draper, Utah | 10/16/2007 | Qlbpm |
| 1302 | Tegra Health Building | 11800 South State, Draper, Utah | 5/11/2009 | Qlbpm |

# APPENDIX B

# DEVELOPMENT OF ArcGIS® GROUND SETTLEMENT ROUTINES

Liquefaction-induced ground settlements were estimated by averaging the calculated results of Tokimatsu and Seed (1987) and Yoshimine and others (2006) for all liquefiable layers in the top 30 m of each borehole ($FS_{liq} \leq 1.1$). Both methods estimate ground settlement based on SPT N values, which conveniently suits the data available in the ArcGIS® geotechnical database. Additional parameters from the geotechnical database such as fines content, soil unit weight and depth to groundwater were also used in the settlement calculations.

The PGA estimates for the M7.0 Wasatch fault scenario event were obtained from Wong and others (2002) and the PGA estimates for the probabilistic events were obtained from the USGS National Strong Motion Hazard Mapping Project (Petersen and others, 2008). In accordance with the method and criteria proposed by Seed and others (2001), the Petersen and others (2008) rock-based PGA estimates were adjusted for surface soil effects based on the averaged shear wave velocities assigned to the several site-response units previously described. The groundwater location and soil unit weight profiles contained in the geotechnical database were used to calculate the overburden pressures.

### *Tokimatsu and Seed*

Tokimatsu and Seed (1987) estimate volumetric strain in saturated clean sands based on cyclic stress ratio (CSR) and normalized SPT blow counts, $(N_1)_{60}$. In accordance with the guidelines presented in Tokimatsu and Seed (1987), CSR values were calculated by:

$$CSR = 0.65\left(\frac{a_{\max}}{g}\right)\left(\frac{\sigma_o}{\sigma'_o}\right)r_d$$ (Equation 1)

where $a_{max}$ is the maximum horizontal acceleration at the ground surface (PGA); g is the acceleration of gravity (9.81 $m/s^2$); $\sigma_o$ is the total overburden pressure at the depth considered; $\sigma'_o$ is the effective overburden pressure at the depth considered; and $r_d$ is a stress reduction factor that varies from 1 at the ground surface to about 0.9 at a depth of approximately 9 m.

Following procedures recommended by Youd and others (2001), the raw blow count data contained in the ArcGIS® geotechnical database were normalized and corrected to $(N_1)_{60}$ values by:

$$(N_1)_{60} = N_m C_N C_E C_B C_R C_S$$ (Equation 2)

where $N_m$ is the measured standard penetration resistance (blow count); $C_N$ is used to normalize $N_m$ to a common reference effective overburden stress ($\sigma'_o$) of approximately 100 kPa (1 atm); $C_E$ varies from 0.5 to 1.3 depending on the type and efficiency of the hammer used in the SPT testing; $C_B$ ranges from 1.0 for a 65-mm diameter hole to 1.15 for a 200-mm diameter hole; $C_R$ ranges from 0.75 for less than 3 m of rod to 1.0 for 10 to 30 m of rod; and $C_S$ varies from 1.0 for samplers with liners to a value of 1.1 to 1.3 for samplers without liners. The data required to determine these factors was typically included on the borehole logs used to create the ArcGIS® geotechnical database. In the event that borehole diameter, hammer energy or sampler liner data was missing from a particular borehole log, estimates were obtained from a table of typical values for each drilling company. The typical-value tables were created based on actual data included on other borehole logs.

As previously mentioned, the geotechnical database contains the amount of material finer than the standard No. 200 sieve (FC). This data was used to correct the $(N_1)_{60}$ values to clean sand values based on (Youd and others, 2001):

$$(N_1)_{60-CS} = \alpha + \beta(N_1)_{60} \qquad \text{(Equation 3)}$$

where the $\alpha$ and $\beta$ coefficients are determined by:

$$\alpha = 0 \qquad \text{for FC} \leq 5\% \qquad \text{(Equation 4a)}$$

$$\alpha = \exp[1.76 - (190/FC^2)] \qquad \text{for } 5\% < FC < 35\% \qquad \text{(Equation 4b)}$$

$$\alpha = 5.0 \qquad \text{for FC} \geq 35\% \qquad \text{(Equation 4c)}$$

$$\beta = 1.0 \qquad \text{for FC} \leq 5\% \qquad \text{(Equation 5a)}$$

$$\beta = [0.99 + (FC^{1.5}/1{,}000)] \qquad \text{for } 5\% < FC < 35\% \qquad \text{(Equation 5b)}$$

$$\beta = 1.2 \qquad \text{for FC} \geq 35\% \qquad \text{(Equation 5c)}$$

The soil profiles for each borehole location were screened for liquefaction triggering using Youd and others (2001). A ground settlement value of 0 m was assigned to all soils layers with factors of safety against liquefaction triggering greater than 1.1. Triggering analysis was completed as follows:

$$FS_{liq} = \frac{CRR_{7.5}}{CSR} MSF \qquad \text{(Equation 6)}$$

where CSR is determined by Equation 1 above; $CRR_{7.5}$ is the minimum cyclic resistance ratio for liquefaction as defined by the SPT clean-sand base curve which is approximated by (Youd and others, 2001):

$$CRR_{7.5} = \frac{1}{34-(N_1)_{60}} + \frac{(N_1)_{60}}{135} + \frac{50}{[10 \bullet (N_1)_{60} + 45]^2} - \frac{1}{200} \qquad \text{(Equation 7)}$$

and MSF is a magnitude scaling factor used to adjust for magnitudes other than M7.5 (Seed and others, 1983). The scenario analysis was based on a M7.0 earthquake on the Wasatch fault while input magnitudes for the probabilistic analyses varied based on deaggregations of the data presented by Petersen and others (2008). The MSF's used in the Tokimatsu and Seed analysis were interpolated from the data presented in Table 4 (Seed and others, 1983).

A reference table with approximately 1,400 data points was created from the volumetric strain curves presented in Figure 12 (see Table 5). The table allowed volumetric strains to be rapidly determined based on the $(N_1)_{60}$ clean sand blow counts and CSR values. To account for the M7.5 calibration of the curves in Figure 12, the MSF's shown in Table 4 were used to adjust the CSR values to $CSR_{7.5}$ by Tokimatsu and Seed (1987):

$$CSR_{7.5} = \frac{CSR}{MSF} \qquad \text{(Equation 8)}$$

The estimated settlement, $\Delta_{TS}$, at each borehole was the summation of the thickness of each liquefiable soil layer, t, times the respective estimated volumetric strain, $\varepsilon_{vo}$:

$$\Delta_{TS} = \sum_{i=1}^{n} t_i \times \varepsilon_{vo,i} \qquad \text{(Equation 9)}$$

An estimate of zero settlement was assigned to soils with clean sand $(N_1)_{60}$ values greater than 30 (for $CSR_{7.5} \leq 0.3$) or 32 (for $CSR_{7.5} > 0.3$). The volumetric strain curves trend approximately vertical for $CSR_{7.5}$ values greater than or equal to 0.46. Therefore, the estimated volumetric strains at $CSR_{7.5}$ equal to 0.46 were used for all $CSR_{7.5}$ values greater than or equal to 0.46.

Table 4

Magnitude Scaling Factors presented by Seed and others (1983)

| Earthquake Magnitude | Magnitude Scaling Factor, MSF |
|---|---|
| 8.25 | 0.91 |
| 7.5 | 1.0 |
| 6.75 | 1.13 |
| 6.0 | 1.33 |
| 5.25 | 1.5 |

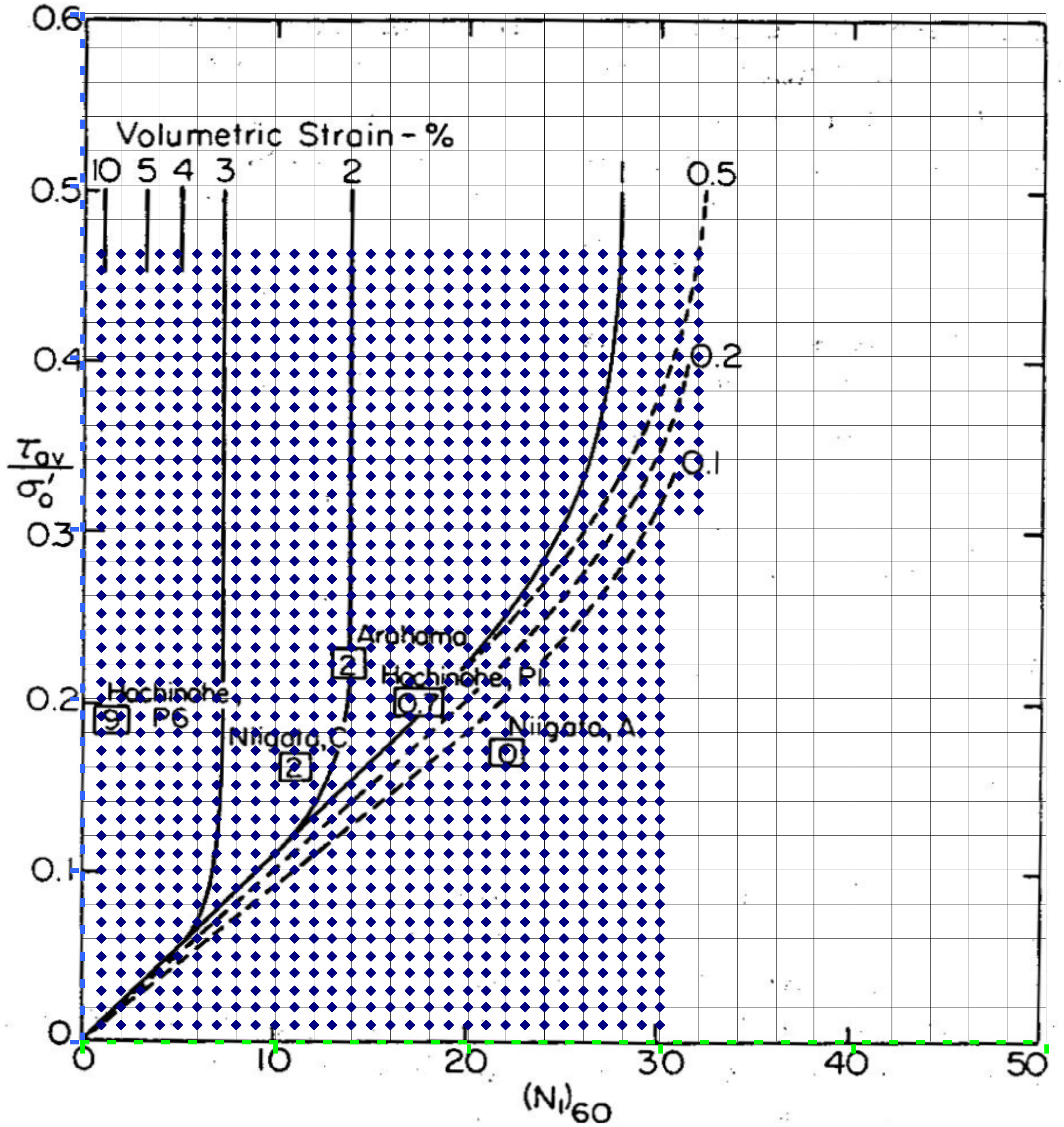

**Figure 12.** Points used to populate Table 5, modified from Tokimatsu and Seed (1987).

## Table 5

## Digitized Settlement Curves Presented in Tokimatsu and Seed (1987)

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.01 | 1 | 5.00 | 0.02 | 22 | 0.00 |
| 0.01 | 2 | 0.05 | 0.02 | 23 | 0.00 |
| 0.01 | 3 | 0.00 | 0.02 | 24 | 0.00 |
| 0.01 | 4 | 0.00 | 0.02 | 25 | 0.00 |
| 0.01 | 5 | 0.00 | 0.02 | 26 | 0.00 |
| 0.01 | 6 | 0.00 | 0.02 | 27 | 0.00 |
| 0.01 | 7 | 0.00 | 0.02 | 28 | 0.00 |
| 0.01 | 8 | 0.00 | 0.02 | 29 | 0.00 |
| 0.01 | 9 | 0.00 | 0.02 | 30 | 0.00 |
| 0.01 | 10 | 0.00 | 0.03 | 1 | 10.00 |
| 0.01 | 11 | 0.00 | 0.03 | 2 | 5.50 |
| 0.01 | 12 | 0.00 | 0.03 | 3 | 0.50 |
| 0.01 | 13 | 0.00 | 0.03 | 4 | 0.08 |
| 0.01 | 14 | 0.00 | 0.03 | 5 | 0.06 |
| 0.01 | 15 | 0.00 | 0.03 | 6 | 0.05 |
| 0.01 | 16 | 0.00 | 0.03 | 7 | 0.00 |
| 0.01 | 17 | 0.00 | 0.03 | 8 | 0.00 |
| 0.01 | 18 | 0.00 | 0.03 | 9 | 0.00 |
| 0.01 | 19 | 0.00 | 0.03 | 10 | 0.00 |
| 0.01 | 20 | 0.00 | 0.03 | 11 | 0.00 |
| 0.01 | 21 | 0.00 | 0.03 | 12 | 0.00 |
| 0.01 | 22 | 0.00 | 0.03 | 13 | 0.00 |
| 0.01 | 23 | 0.00 | 0.03 | 14 | 0.00 |
| 0.01 | 24 | 0.00 | 0.03 | 15 | 0.00 |
| 0.01 | 25 | 0.00 | 0.03 | 16 | 0.00 |
| 0.01 | 26 | 0.00 | 0.03 | 17 | 0.00 |
| 0.01 | 27 | 0.00 | 0.03 | 18 | 0.00 |
| 0.01 | 28 | 0.00 | 0.03 | 19 | 0.00 |
| 0.01 | 29 | 0.00 | 0.03 | 20 | 0.00 |
| 0.01 | 30 | 0.00 | 0.03 | 21 | 0.00 |
| 0.02 | 1 | 10.00 | 0.03 | 22 | 0.00 |
| 0.02 | 2 | 1.00 | 0.03 | 23 | 0.00 |
| 0.02 | 3 | 0.07 | 0.03 | 24 | 0.00 |
| 0.02 | 4 | 0.05 | 0.03 | 25 | 0.00 |
| 0.02 | 5 | 0.05 | 0.03 | 26 | 0.00 |
| 0.02 | 6 | 0.00 | 0.03 | 27 | 0.00 |
| 0.02 | 7 | 0.00 | 0.03 | 28 | 0.00 |
| 0.02 | 8 | 0.00 | 0.03 | 29 | 0.00 |
| 0.02 | 9 | 0.00 | 0.03 | 30 | 0.00 |
| 0.02 | 10 | 0.00 | 0.04 | 1 | 10.00 |
| 0.02 | 11 | 0.00 | 0.04 | 2 | 7.00 |
| 0.02 | 12 | 0.00 | 0.04 | 3 | 4.80 |
| 0.02 | 13 | 0.00 | 0.04 | 4 | 0.30 |
| 0.02 | 14 | 0.00 | 0.04 | 5 | 0.08 |
| 0.02 | 15 | 0.00 | 0.04 | 6 | 0.06 |
| 0.02 | 16 | 0.00 | 0.04 | 7 | 0.05 |
| 0.02 | 17 | 0.00 | 0.04 | 8 | 0.05 |
| 0.02 | 18 | 0.00 | 0.04 | 9 | 0.05 |
| 0.02 | 19 | 0.00 | 0.04 | 10 | 0.00 |
| 0.02 | 20 | 0.00 | 0.04 | 11 | 0.00 |
| 0.02 | 21 | 0.00 | 0.04 | 12 | 0.00 |

Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.04 | 13 | 0.00 | 0.06 | 7 | 0.09 |
| 0.04 | 14 | 0.00 | 0.06 | 8 | 0.07 |
| 0.04 | 15 | 0.00 | 0.06 | 9 | 0.07 |
| 0.04 | 16 | 0.00 | 0.06 | 10 | 0.06 |
| 0.04 | 17 | 0.00 | 0.06 | 11 | 0.05 |
| 0.04 | 18 | 0.00 | 0.06 | 12 | 0.05 |
| 0.04 | 19 | 0.00 | 0.06 | 13 | 0.00 |
| 0.04 | 20 | 0.00 | 0.06 | 14 | 0.00 |
| 0.04 | 21 | 0.00 | 0.06 | 15 | 0.00 |
| 0.04 | 22 | 0.00 | 0.06 | 16 | 0.00 |
| 0.04 | 23 | 0.00 | 0.06 | 17 | 0.00 |
| 0.04 | 24 | 0.00 | 0.06 | 18 | 0.00 |
| 0.04 | 25 | 0.00 | 0.06 | 19 | 0.00 |
| 0.04 | 26 | 0.00 | 0.06 | 20 | 0.00 |
| 0.04 | 27 | 0.00 | 0.06 | 21 | 0.00 |
| 0.04 | 28 | 0.00 | 0.06 | 22 | 0.00 |
| 0.04 | 29 | 0.00 | 0.06 | 23 | 0.00 |
| 0.04 | 30 | 0.00 | 0.06 | 24 | 0.00 |
| 0.05 | 1 | 10.00 | 0.06 | 25 | 0.00 |
| 0.05 | 2 | 7.00 | 0.06 | 26 | 0.00 |
| 0.05 | 3 | 5.00 | 0.06 | 27 | 0.00 |
| 0.05 | 4 | 4.00 | 0.06 | 28 | 0.00 |
| 0.05 | 5 | 0.40 | 0.06 | 29 | 0.00 |
| 0.05 | 6 | 0.09 | 0.06 | 30 | 0.00 |
| 0.05 | 7 | 0.07 | 0.07 | 1 | 10.00 |
| 0.05 | 8 | 0.06 | 0.07 | 2 | 7.00 |
| 0.05 | 9 | 0.06 | 0.07 | 3 | 5.00 |
| 0.05 | 10 | 0.05 | 0.07 | 4 | 4.40 |
| 0.05 | 11 | 0.00 | 0.07 | 5 | 3.90 |
| 0.05 | 12 | 0.00 | 0.07 | 6 | 3.00 |
| 0.05 | 13 | 0.00 | 0.07 | 7 | 0.20 |
| 0.05 | 14 | 0.00 | 0.07 | 8 | 0.10 |
| 0.05 | 15 | 0.00 | 0.07 | 9 | 0.08 |
| 0.05 | 16 | 0.00 | 0.07 | 10 | 0.07 |
| 0.05 | 17 | 0.00 | 0.07 | 11 | 0.06 |
| 0.05 | 18 | 0.00 | 0.07 | 12 | 0.06 |
| 0.05 | 19 | 0.00 | 0.07 | 13 | 0.05 |
| 0.05 | 20 | 0.00 | 0.07 | 14 | 0.05 |
| 0.05 | 21 | 0.00 | 0.07 | 15 | 0.00 |
| 0.05 | 22 | 0.00 | 0.07 | 16 | 0.00 |
| 0.05 | 23 | 0.00 | 0.07 | 17 | 0.00 |
| 0.05 | 24 | 0.00 | 0.07 | 18 | 0.00 |
| 0.05 | 25 | 0.00 | 0.07 | 19 | 0.00 |
| 0.05 | 26 | 0.00 | 0.07 | 20 | 0.00 |
| 0.05 | 27 | 0.00 | 0.07 | 21 | 0.00 |
| 0.05 | 28 | 0.00 | 0.07 | 22 | 0.00 |
| 0.05 | 29 | 0.00 | 0.07 | 23 | 0.00 |
| 0.05 | 30 | 0.00 | 0.07 | 24 | 0.00 |
| 0.06 | 1 | 10.00 | 0.07 | 25 | 0.00 |
| 0.06 | 2 | 7.00 | 0.07 | 26 | 0.00 |
| 0.06 | 3 | 5.00 | 0.07 | 27 | 0.00 |
| 0.06 | 4 | 4.30 | 0.07 | 28 | 0.00 |
| 0.06 | 5 | 3.50 | 0.07 | 29 | 0.00 |
| 0.06 | 6 | 0.20 | 0.07 | 30 | 0.00 |

# Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|
| 0.08 | 1 | 10.00 |
| 0.08 | 2 | 7.00 |
| 0.08 | 3 | 5.00 |
| 0.08 | 4 | 4.40 |
| 0.08 | 5 | 4.00 |
| 0.08 | 6 | 3.20 |
| 0.08 | 7 | 2.10 |
| 0.08 | 8 | 0.20 |
| 0.08 | 9 | 0.10 |
| 0.08 | 10 | 0.08 |
| 0.08 | 11 | 0.07 |
| 0.08 | 12 | 0.06 |
| 0.08 | 13 | 0.06 |
| 0.08 | 14 | 0.05 |
| 0.08 | 15 | 0.05 |
| 0.08 | 16 | 0.05 |
| 0.08 | 17 | 0.00 |
| 0.08 | 18 | 0.00 |
| 0.08 | 19 | 0.00 |
| 0.08 | 20 | 0.00 |
| 0.08 | 21 | 0.00 |
| 0.08 | 22 | 0.00 |
| 0.08 | 23 | 0.00 |
| 0.08 | 24 | 0.00 |
| 0.08 | 25 | 0.00 |
| 0.08 | 26 | 0.00 |
| 0.08 | 27 | 0.00 |
| 0.08 | 28 | 0.00 |
| 0.08 | 29 | 0.00 |
| 0.08 | 30 | 0.00 |
| 0.09 | 1 | 10.00 |
| 0.09 | 2 | 7.00 |
| 0.09 | 3 | 5.00 |
| 0.09 | 4 | 4.40 |
| 0.09 | 5 | 4.00 |
| 0.09 | 6 | 3.30 |
| 0.09 | 7 | 2.60 |
| 0.09 | 8 | 2.00 |
| 0.09 | 9 | 0.20 |
| 0.09 | 10 | 0.09 |
| 0.09 | 11 | 0.09 |
| 0.09 | 12 | 0.07 |
| 0.09 | 13 | 0.06 |
| 0.09 | 14 | 0.06 |
| 0.09 | 15 | 0.05 |
| 0.09 | 16 | 0.05 |
| 0.09 | 17 | 0.05 |
| 0.09 | 18 | 0.00 |
| 0.09 | 19 | 0.00 |
| 0.09 | 20 | 0.00 |
| 0.09 | 21 | 0.00 |
| 0.09 | 22 | 0.00 |
| 0.09 | 23 | 0.00 |
| 0.09 | 24 | 0.00 |
| 0.09 | 25 | 0.00 |
| 0.09 | 26 | 0.00 |
| 0.09 | 27 | 0.00 |
| 0.09 | 28 | 0.00 |
| 0.09 | 29 | 0.00 |
| 0.09 | 30 | 0.00 |
| 0.10 | 1 | 10.00 |
| 0.10 | 2 | 7.00 |
| 0.10 | 3 | 5.00 |
| 0.10 | 4 | 4.40 |
| 0.10 | 5 | 4.00 |
| 0.10 | 6 | 3.40 |
| 0.10 | 7 | 2.80 |
| 0.10 | 8 | 2.40 |
| 0.10 | 9 | 2.10 |
| 0.10 | 10 | 0.20 |
| 0.10 | 11 | 0.10 |
| 0.10 | 12 | 0.08 |
| 0.10 | 13 | 0.07 |
| 0.10 | 14 | 0.07 |
| 0.10 | 15 | 0.06 |
| 0.10 | 16 | 0.06 |
| 0.10 | 17 | 0.05 |
| 0.10 | 18 | 0.05 |
| 0.10 | 19 | 0.05 |
| 0.10 | 20 | 0.00 |
| 0.10 | 21 | 0.00 |
| 0.10 | 22 | 0.00 |
| 0.10 | 23 | 0.00 |
| 0.10 | 24 | 0.00 |
| 0.10 | 25 | 0.00 |
| 0.10 | 26 | 0.00 |
| 0.10 | 27 | 0.00 |
| 0.10 | 28 | 0.00 |
| 0.10 | 29 | 0.00 |
| 0.10 | 30 | 0.00 |
| 0.11 | 1 | 10.00 |
| 0.11 | 2 | 7.00 |
| 0.11 | 3 | 5.00 |
| 0.11 | 4 | 4.40 |
| 0.11 | 5 | 4.00 |
| 0.11 | 6 | 3.50 |
| 0.11 | 7 | 2.90 |
| 0.11 | 8 | 2.70 |
| 0.11 | 9 | 2.30 |
| 0.11 | 10 | 2.00 |
| 0.11 | 11 | 0.20 |
| 0.11 | 12 | 0.10 |
| 0.11 | 13 | 0.08 |
| 0.11 | 14 | 0.08 |
| 0.11 | 15 | 0.07 |
| 0.11 | 16 | 0.06 |
| 0.11 | 17 | 0.06 |
| 0.11 | 18 | 0.06 |

## Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.11 | 19 | 0.05 | 0.13 | 13 | 0.20 |
| 0.11 | 20 | 0.05 | 0.13 | 14 | 0.10 |
| 0.11 | 21 | 0.05 | 0.13 | 15 | 0.09 |
| 0.11 | 22 | 0.00 | 0.13 | 16 | 0.08 |
| 0.11 | 23 | 0.00 | 0.13 | 17 | 0.07 |
| 0.11 | 24 | 0.00 | 0.13 | 18 | 0.07 |
| 0.11 | 25 | 0.00 | 0.13 | 19 | 0.06 |
| 0.11 | 26 | 0.00 | 0.13 | 20 | 0.06 |
| 0.11 | 27 | 0.00 | 0.13 | 21 | 0.06 |
| 0.11 | 28 | 0.00 | 0.13 | 22 | 0.05 |
| 0.11 | 29 | 0.00 | 0.13 | 23 | 0.05 |
| 0.11 | 30 | 0.00 | 0.13 | 24 | 0.05 |
| 0.12 | 1 | 10.00 | 0.13 | 25 | 0.05 |
| 0.12 | 2 | 7.00 | 0.13 | 26 | 0.00 |
| 0.12 | 3 | 5.00 | 0.13 | 27 | 0.00 |
| 0.12 | 4 | 4.40 | 0.13 | 28 | 0.00 |
| 0.12 | 5 | 4.00 | 0.13 | 29 | 0.00 |
| 0.12 | 6 | 3.50 | 0.13 | 30 | 0.00 |
| 0.12 | 7 | 3.00 | 0.14 | 1 | 10.00 |
| 0.12 | 8 | 2.80 | 0.14 | 2 | 7.00 |
| 0.12 | 9 | 2.50 | 0.14 | 3 | 5.00 |
| 0.12 | 10 | 2.20 | 0.14 | 4 | 4.40 |
| 0.12 | 11 | 1.00 | 0.14 | 5 | 4.00 |
| 0.12 | 12 | 0.20 | 0.14 | 6 | 3.50 |
| 0.12 | 13 | 0.10 | 0.14 | 7 | 3.00 |
| 0.12 | 14 | 0.09 | 0.14 | 8 | 2.90 |
| 0.12 | 15 | 0.08 | 0.14 | 9 | 2.80 |
| 0.12 | 16 | 0.07 | 0.14 | 10 | 2.40 |
| 0.12 | 17 | 0.07 | 0.14 | 11 | 2.20 |
| 0.12 | 18 | 0.06 | 0.14 | 12 | 2.00 |
| 0.12 | 19 | 0.06 | 0.14 | 13 | 0.40 |
| 0.12 | 20 | 0.05 | 0.14 | 14 | 0.20 |
| 0.12 | 21 | 0.05 | 0.14 | 15 | 0.10 |
| 0.12 | 22 | 0.05 | 0.14 | 16 | 0.09 |
| 0.12 | 23 | 0.05 | 0.14 | 17 | 0.08 |
| 0.12 | 24 | 0.00 | 0.14 | 18 | 0.07 |
| 0.12 | 25 | 0.00 | 0.14 | 19 | 0.07 |
| 0.12 | 26 | 0.00 | 0.14 | 20 | 0.06 |
| 0.12 | 27 | 0.00 | 0.14 | 21 | 0.06 |
| 0.12 | 28 | 0.00 | 0.14 | 22 | 0.06 |
| 0.12 | 29 | 0.00 | 0.14 | 23 | 0.05 |
| 0.12 | 30 | 0.00 | 0.14 | 24 | 0.05 |
| 0.13 | 1 | 10.00 | 0.14 | 25 | 0.05 |
| 0.13 | 2 | 7.00 | 0.14 | 26 | 0.05 |
| 0.13 | 3 | 5.00 | 0.14 | 27 | 0.05 |
| 0.13 | 4 | 4.40 | 0.14 | 28 | 0.00 |
| 0.13 | 5 | 4.00 | 0.14 | 29 | 0.00 |
| 0.13 | 6 | 3.50 | 0.14 | 30 | 0.00 |
| 0.13 | 7 | 3.00 | 0.15 | 1 | 10.00 |
| 0.13 | 8 | 2.90 | 0.15 | 2 | 7.00 |
| 0.13 | 9 | 2.70 | 0.15 | 3 | 5.00 |
| 0.13 | 10 | 2.30 | 0.15 | 4 | 4.40 |
| 0.13 | 11 | 2.10 | 0.15 | 5 | 4.00 |
| 0.13 | 12 | 0.50 | 0.15 | 6 | 3.50 |

# Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.15 | 7 | 3.00 | 0.17 | 1 | 10.00 |
| 0.15 | 8 | 2.90 | 0.17 | 2 | 7.00 |
| 0.15 | 9 | 2.80 | 0.17 | 3 | 5.00 |
| 0.15 | 10 | 2.50 | 0.17 | 4 | 4.40 |
| 0.15 | 11 | 2.30 | 0.17 | 5 | 4.00 |
| 0.15 | 12 | 2.10 | 0.17 | 6 | 3.50 |
| 0.15 | 13 | 1.50 | 0.17 | 7 | 3.00 |
| 0.15 | 14 | 0.50 | 0.17 | 8 | 2.90 |
| 0.15 | 15 | 0.20 | 0.17 | 9 | 2.80 |
| 0.15 | 16 | 0.10 | 0.17 | 10 | 2.70 |
| 0.15 | 17 | 0.09 | 0.17 | 11 | 2.40 |
| 0.15 | 18 | 0.08 | 0.17 | 12 | 2.20 |
| 0.15 | 19 | 0.07 | 0.17 | 13 | 2.10 |
| 0.15 | 20 | 0.07 | 0.17 | 14 | 1.80 |
| 0.15 | 21 | 0.07 | 0.17 | 15 | 1.10 |
| 0.15 | 22 | 0.06 | 0.17 | 16 | 0.50 |
| 0.15 | 23 | 0.06 | 0.17 | 17 | 0.20 |
| 0.15 | 24 | 0.06 | 0.17 | 18 | 0.15 |
| 0.15 | 25 | 0.05 | 0.17 | 19 | 0.09 |
| 0.15 | 26 | 0.05 | 0.17 | 20 | 0.08 |
| 0.15 | 27 | 0.05 | 0.17 | 21 | 0.08 |
| 0.15 | 28 | 0.05 | 0.17 | 22 | 0.07 |
| 0.15 | 29 | 0.00 | 0.17 | 23 | 0.07 |
| 0.15 | 30 | 0.00 | 0.17 | 24 | 0.06 |
| 0.16 | 1 | 10.00 | 0.17 | 25 | 0.06 |
| 0.16 | 2 | 7.00 | 0.17 | 26 | 0.06 |
| 0.16 | 3 | 5.00 | 0.17 | 27 | 0.06 |
| 0.16 | 4 | 4.40 | 0.17 | 28 | 0.05 |
| 0.16 | 5 | 4.00 | 0.17 | 29 | 0.05 |
| 0.16 | 6 | 3.50 | 0.17 | 30 | 0.05 |
| 0.16 | 7 | 3.00 | 0.18 | 1 | 10.00 |
| 0.16 | 8 | 2.90 | 0.18 | 2 | 7.00 |
| 0.16 | 9 | 2.80 | 0.18 | 3 | 5.00 |
| 0.16 | 10 | 2.60 | 0.18 | 4 | 4.40 |
| 0.16 | 11 | 2.30 | 0.18 | 5 | 4.00 |
| 0.16 | 12 | 2.20 | 0.18 | 6 | 3.50 |
| 0.16 | 13 | 2.00 | 0.18 | 7 | 3.00 |
| 0.16 | 14 | 1.50 | 0.18 | 8 | 2.90 |
| 0.16 | 15 | 0.50 | 0.18 | 9 | 2.80 |
| 0.16 | 16 | 0.20 | 0.18 | 10 | 2.70 |
| 0.16 | 17 | 0.15 | 0.18 | 11 | 2.40 |
| 0.16 | 18 | 0.09 | 0.18 | 12 | 2.20 |
| 0.16 | 19 | 0.08 | 0.18 | 13 | 2.10 |
| 0.16 | 20 | 0.07 | 0.18 | 14 | 1.90 |
| 0.16 | 21 | 0.07 | 0.18 | 15 | 1.50 |
| 0.16 | 22 | 0.07 | 0.18 | 16 | 1.10 |
| 0.16 | 23 | 0.06 | 0.18 | 17 | 0.40 |
| 0.16 | 24 | 0.06 | 0.18 | 18 | 0.20 |
| 0.16 | 25 | 0.06 | 0.18 | 19 | 0.15 |
| 0.16 | 26 | 0.06 | 0.18 | 20 | 0.10 |
| 0.16 | 27 | 0.05 | 0.18 | 21 | 0.08 |
| 0.16 | 28 | 0.05 | 0.18 | 22 | 0.08 |
| 0.16 | 29 | 0.05 | 0.18 | 23 | 0.07 |
| 0.16 | 30 | 0.05 | 0.18 | 24 | 0.07 |

## Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.18 | 25 | 0.07 | 0.20 | 19 | 0.40 |
| 0.18 | 26 | 0.06 | 0.20 | 20 | 0.20 |
| 0.18 | 27 | 0.06 | 0.20 | 21 | 0.15 |
| 0.18 | 28 | 0.06 | 0.20 | 22 | 0.10 |
| 0.18 | 29 | 0.06 | 0.20 | 23 | 0.09 |
| 0.18 | 30 | 0.05 | 0.20 | 24 | 0.08 |
| 0.19 | 1 | 10.00 | 0.20 | 25 | 0.07 |
| 0.19 | 2 | 7.00 | 0.20 | 26 | 0.07 |
| 0.19 | 3 | 5.00 | 0.20 | 27 | 0.07 |
| 0.19 | 4 | 4.40 | 0.20 | 28 | 0.07 |
| 0.19 | 5 | 4.00 | 0.20 | 29 | 0.06 |
| 0.19 | 6 | 3.50 | 0.20 | 30 | 0.06 |
| 0.19 | 7 | 3.00 | 0.21 | 1 | 10.00 |
| 0.19 | 8 | 2.90 | 0.21 | 2 | 7.00 |
| 0.19 | 9 | 2.80 | 0.21 | 3 | 5.00 |
| 0.19 | 10 | 2.70 | 0.21 | 4 | 4.40 |
| 0.19 | 11 | 2.40 | 0.21 | 5 | 4.00 |
| 0.19 | 12 | 2.30 | 0.21 | 6 | 3.50 |
| 0.19 | 13 | 2.10 | 0.21 | 7 | 3.00 |
| 0.19 | 14 | 1.90 | 0.21 | 8 | 2.90 |
| 0.19 | 15 | 1.70 | 0.21 | 9 | 2.80 |
| 0.19 | 16 | 1.50 | 0.21 | 10 | 2.70 |
| 0.19 | 17 | 1.10 | 0.21 | 11 | 2.40 |
| 0.19 | 18 | 0.40 | 0.21 | 12 | 2.30 |
| 0.19 | 19 | 0.20 | 0.21 | 13 | 2.10 |
| 0.19 | 20 | 0.15 | 0.21 | 14 | 2.00 |
| 0.19 | 21 | 0.10 | 0.21 | 15 | 1.80 |
| 0.19 | 22 | 0.09 | 0.21 | 16 | 1.60 |
| 0.19 | 23 | 0.08 | 0.21 | 17 | 1.50 |
| 0.19 | 24 | 0.07 | 0.21 | 18 | 1.20 |
| 0.19 | 25 | 0.07 | 0.21 | 19 | 1.00 |
| 0.19 | 26 | 0.07 | 0.21 | 20 | 0.30 |
| 0.19 | 27 | 0.06 | 0.21 | 21 | 0.20 |
| 0.19 | 28 | 0.06 | 0.21 | 22 | 0.15 |
| 0.19 | 29 | 0.06 | 0.21 | 23 | 0.10 |
| 0.19 | 30 | 0.06 | 0.21 | 24 | 0.09 |
| 0.20 | 1 | 10.00 | 0.21 | 25 | 0.08 |
| 0.20 | 2 | 7.00 | 0.21 | 26 | 0.07 |
| 0.20 | 3 | 5.00 | 0.21 | 27 | 0.07 |
| 0.20 | 4 | 4.40 | 0.21 | 28 | 0.07 |
| 0.20 | 5 | 4.00 | 0.21 | 29 | 0.07 |
| 0.20 | 6 | 3.50 | 0.21 | 30 | 0.06 |
| 0.20 | 7 | 3.00 | 0.22 | 1 | 10.00 |
| 0.20 | 8 | 2.90 | 0.22 | 2 | 7.00 |
| 0.20 | 9 | 2.80 | 0.22 | 3 | 5.00 |
| 0.20 | 10 | 2.70 | 0.22 | 4 | 4.40 |
| 0.20 | 11 | 2.40 | 0.22 | 5 | 4.00 |
| 0.20 | 12 | 2.30 | 0.22 | 6 | 3.50 |
| 0.20 | 13 | 2.10 | 0.22 | 7 | 3.00 |
| 0.20 | 14 | 2.00 | 0.22 | 8 | 2.90 |
| 0.20 | 15 | 1.80 | 0.22 | 9 | 2.80 |
| 0.20 | 16 | 1.60 | 0.22 | 10 | 2.70 |
| 0.20 | 17 | 1.30 | 0.22 | 11 | 2.40 |
| 0.20 | 18 | 1.10 | 0.22 | 12 | 2.30 |

Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.22 | 13 | 2.10 | 0.24 | 7 | 3.00 |
| 0.22 | 14 | 2.00 | 0.24 | 8 | 2.90 |
| 0.22 | 15 | 1.90 | 0.24 | 9 | 2.80 |
| 0.22 | 16 | 1.70 | 0.24 | 10 | 2.70 |
| 0.22 | 17 | 1.60 | 0.24 | 11 | 2.40 |
| 0.22 | 18 | 1.40 | 0.24 | 12 | 2.30 |
| 0.22 | 19 | 1.10 | 0.24 | 13 | 2.10 |
| 0.22 | 20 | 0.50 | 0.24 | 14 | 2.00 |
| 0.22 | 21 | 0.30 | 0.24 | 15 | 1.90 |
| 0.22 | 22 | 0.20 | 0.24 | 16 | 1.80 |
| 0.22 | 23 | 0.10 | 0.24 | 17 | 1.60 |
| 0.22 | 24 | 0.10 | 0.24 | 18 | 1.50 |
| 0.22 | 25 | 0.09 | 0.24 | 19 | 1.40 |
| 0.22 | 26 | 0.08 | 0.24 | 20 | 1.20 |
| 0.22 | 27 | 0.08 | 0.24 | 21 | 1.10 |
| 0.22 | 28 | 0.07 | 0.24 | 22 | 0.40 |
| 0.22 | 29 | 0.07 | 0.24 | 23 | 0.20 |
| 0.22 | 30 | 0.07 | 0.24 | 24 | 0.15 |
| 0.23 | 1 | 10.00 | 0.24 | 25 | 0.10 |
| 0.23 | 2 | 7.00 | 0.24 | 26 | 0.09 |
| 0.23 | 3 | 5.00 | 0.24 | 27 | 0.08 |
| 0.23 | 4 | 4.40 | 0.24 | 28 | 0.08 |
| 0.23 | 5 | 4.00 | 0.24 | 29 | 0.08 |
| 0.23 | 6 | 3.50 | 0.24 | 30 | 0.07 |
| 0.23 | 7 | 3.00 | 0.25 | 1 | 10.00 |
| 0.23 | 8 | 2.90 | 0.25 | 2 | 7.00 |
| 0.23 | 9 | 2.80 | 0.25 | 3 | 5.00 |
| 0.23 | 10 | 2.70 | 0.25 | 4 | 4.40 |
| 0.23 | 11 | 2.40 | 0.25 | 5 | 4.00 |
| 0.23 | 12 | 2.30 | 0.25 | 6 | 3.50 |
| 0.23 | 13 | 2.10 | 0.25 | 7 | 3.00 |
| 0.23 | 14 | 2.00 | 0.25 | 8 | 2.90 |
| 0.23 | 15 | 1.90 | 0.25 | 9 | 2.80 |
| 0.23 | 16 | 1.70 | 0.25 | 10 | 2.70 |
| 0.23 | 17 | 1.60 | 0.25 | 11 | 2.40 |
| 0.23 | 18 | 1.50 | 0.25 | 12 | 2.30 |
| 0.23 | 19 | 1.30 | 0.25 | 13 | 2.10 |
| 0.23 | 20 | 1.10 | 0.25 | 14 | 2.00 |
| 0.23 | 21 | 0.50 | 0.25 | 15 | 1.90 |
| 0.23 | 22 | 0.30 | 0.25 | 16 | 1.80 |
| 0.23 | 23 | 0.15 | 0.25 | 17 | 1.70 |
| 0.23 | 24 | 0.10 | 0.25 | 18 | 1.60 |
| 0.23 | 25 | 0.09 | 0.25 | 19 | 1.50 |
| 0.23 | 26 | 0.09 | 0.25 | 20 | 1.30 |
| 0.23 | 27 | 0.08 | 0.25 | 21 | 1.20 |
| 0.23 | 28 | 0.08 | 0.25 | 22 | 1.00 |
| 0.23 | 29 | 0.07 | 0.25 | 23 | 0.40 |
| 0.23 | 30 | 0.07 | 0.25 | 24 | 0.20 |
| 0.24 | 1 | 10.00 | 0.25 | 25 | 0.15 |
| 0.24 | 2 | 7.00 | 0.25 | 26 | 0.10 |
| 0.24 | 3 | 5.00 | 0.25 | 27 | 0.09 |
| 0.24 | 4 | 4.40 | 0.25 | 28 | 0.08 |
| 0.24 | 5 | 4.00 | 0.25 | 29 | 0.08 |
| 0.24 | 6 | 3.50 | 0.25 | 30 | 0.08 |

# Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.26 | 1 | 10.00 | 0.27 | 25 | 0.30 |
| 0.26 | 2 | 7.00 | 0.27 | 26 | 0.20 |
| 0.26 | 3 | 5.00 | 0.27 | 27 | 0.10 |
| 0.26 | 4 | 4.40 | 0.27 | 28 | 0.09 |
| 0.26 | 5 | 4.00 | 0.27 | 29 | 0.09 |
| 0.26 | 6 | 3.50 | 0.27 | 30 | 0.08 |
| 0.26 | 7 | 3.00 | 0.28 | 1 | 10.00 |
| 0.26 | 8 | 2.90 | 0.28 | 2 | 7.00 |
| 0.26 | 9 | 2.80 | 0.28 | 3 | 5.00 |
| 0.26 | 10 | 2.70 | 0.28 | 4 | 4.40 |
| 0.26 | 11 | 2.40 | 0.28 | 5 | 4.00 |
| 0.26 | 12 | 2.30 | 0.28 | 6 | 3.50 |
| 0.26 | 13 | 2.10 | 0.28 | 7 | 3.00 |
| 0.26 | 14 | 2.00 | 0.28 | 8 | 2.90 |
| 0.26 | 15 | 1.90 | 0.28 | 9 | 2.80 |
| 0.26 | 16 | 1.80 | 0.28 | 10 | 2.70 |
| 0.26 | 17 | 1.70 | 0.28 | 11 | 2.40 |
| 0.26 | 18 | 1.60 | 0.28 | 12 | 2.30 |
| 0.26 | 19 | 1.50 | 0.28 | 13 | 2.10 |
| 0.26 | 20 | 1.40 | 0.28 | 14 | 2.00 |
| 0.26 | 21 | 1.20 | 0.28 | 15 | 1.90 |
| 0.26 | 22 | 1.10 | 0.28 | 16 | 1.80 |
| 0.26 | 23 | 0.60 | 0.28 | 17 | 1.70 |
| 0.26 | 24 | 0.30 | 0.28 | 18 | 1.65 |
| 0.26 | 25 | 0.20 | 0.28 | 19 | 1.60 |
| 0.26 | 26 | 0.15 | 0.28 | 20 | 1.40 |
| 0.26 | 27 | 0.10 | 0.28 | 21 | 1.30 |
| 0.26 | 28 | 0.09 | 0.28 | 22 | 1.20 |
| 0.26 | 29 | 0.08 | 0.28 | 23 | 1.10 |
| 0.26 | 30 | 0.08 | 0.28 | 24 | 0.90 |
| 0.27 | 1 | 10.00 | 0.28 | 25 | 0.40 |
| 0.27 | 2 | 7.00 | 0.28 | 26 | 0.20 |
| 0.27 | 3 | 5.00 | 0.28 | 27 | 0.15 |
| 0.27 | 4 | 4.40 | 0.28 | 28 | 0.10 |
| 0.27 | 5 | 4.00 | 0.28 | 29 | 0.09 |
| 0.27 | 6 | 3.50 | 0.28 | 30 | 0.09 |
| 0.27 | 7 | 3.00 | 0.29 | 1 | 10.00 |
| 0.27 | 8 | 2.90 | 0.29 | 2 | 7.00 |
| 0.27 | 9 | 2.80 | 0.29 | 3 | 5.00 |
| 0.27 | 10 | 2.70 | 0.29 | 4 | 4.40 |
| 0.27 | 11 | 2.40 | 0.29 | 5 | 4.00 |
| 0.27 | 12 | 2.30 | 0.29 | 6 | 3.50 |
| 0.27 | 13 | 2.10 | 0.29 | 7 | 3.00 |
| 0.27 | 14 | 2.00 | 0.29 | 8 | 2.90 |
| 0.27 | 15 | 1.90 | 0.29 | 9 | 2.80 |
| 0.27 | 16 | 1.80 | 0.29 | 10 | 2.70 |
| 0.27 | 17 | 1.70 | 0.29 | 11 | 2.40 |
| 0.27 | 18 | 1.65 | 0.29 | 12 | 2.30 |
| 0.27 | 19 | 1.50 | 0.29 | 13 | 2.10 |
| 0.27 | 20 | 1.40 | 0.29 | 14 | 2.00 |
| 0.27 | 21 | 1.30 | 0.29 | 15 | 1.90 |
| 0.27 | 22 | 1.20 | 0.29 | 16 | 1.80 |
| 0.27 | 23 | 1.00 | 0.29 | 17 | 1.70 |
| 0.27 | 24 | 0.50 | 0.29 | 18 | 1.65 |

## Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|
| 0.29 | 19 | 1.60 |
| 0.29 | 20 | 1.50 |
| 0.29 | 21 | 1.40 |
| 0.29 | 22 | 1.30 |
| 0.29 | 23 | 1.20 |
| 0.29 | 24 | 1.00 |
| 0.29 | 25 | 0.60 |
| 0.29 | 26 | 0.40 |
| 0.29 | 27 | 0.20 |
| 0.29 | 28 | 0.15 |
| 0.29 | 29 | 0.10 |
| 0.29 | 30 | 0.09 |
| 0.30 | 1 | 10.00 |
| 0.30 | 2 | 7.00 |
| 0.30 | 3 | 5.00 |
| 0.30 | 4 | 4.40 |
| 0.30 | 5 | 4.00 |
| 0.30 | 6 | 3.50 |
| 0.30 | 7 | 3.00 |
| 0.30 | 8 | 2.90 |
| 0.30 | 9 | 2.80 |
| 0.30 | 10 | 2.70 |
| 0.30 | 11 | 2.40 |
| 0.30 | 12 | 2.30 |
| 0.30 | 13 | 2.10 |
| 0.30 | 14 | 2.00 |
| 0.30 | 15 | 1.90 |
| 0.30 | 16 | 1.80 |
| 0.30 | 17 | 1.70 |
| 0.30 | 18 | 1.65 |
| 0.30 | 19 | 1.60 |
| 0.30 | 20 | 1.50 |
| 0.30 | 21 | 1.40 |
| 0.30 | 22 | 1.30 |
| 0.30 | 23 | 1.20 |
| 0.30 | 24 | 1.10 |
| 0.30 | 25 | 0.90 |
| 0.30 | 26 | 0.50 |
| 0.30 | 27 | 0.30 |
| 0.30 | 28 | 0.20 |
| 0.30 | 29 | 0.10 |
| 0.30 | 30 | 0.10 |
| 0.31 | 1 | 10.00 |
| 0.31 | 2 | 7.00 |
| 0.31 | 3 | 5.00 |
| 0.31 | 4 | 4.40 |
| 0.31 | 5 | 4.00 |
| 0.31 | 6 | 3.50 |
| 0.31 | 7 | 3.00 |
| 0.31 | 8 | 2.90 |
| 0.31 | 9 | 2.80 |
| 0.31 | 10 | 2.70 |
| 0.31 | 11 | 2.40 |
| 0.31 | 12 | 2.30 |
| 0.31 | 13 | 2.10 |
| 0.31 | 14 | 2.00 |
| 0.31 | 15 | 1.91 |
| 0.31 | 16 | 1.82 |
| 0.31 | 17 | 1.73 |
| 0.31 | 18 | 1.64 |
| 0.31 | 19 | 1.55 |
| 0.31 | 20 | 1.46 |
| 0.31 | 21 | 1.36 |
| 0.31 | 22 | 1.27 |
| 0.31 | 23 | 1.18 |
| 0.31 | 24 | 1.09 |
| 0.31 | 25 | 1.02 |
| 0.31 | 26 | 0.80 |
| 0.31 | 27 | 0.45 |
| 0.31 | 28 | 0.25 |
| 0.31 | 29 | 0.16 |
| 0.31 | 30 | 0.10 |
| 0.31 | 31 | 0.05 |
| 0.31 | 32 | 0.00 |
| 0.32 | 1 | 10.00 |
| 0.32 | 2 | 7.00 |
| 0.32 | 3 | 5.00 |
| 0.32 | 4 | 4.40 |
| 0.32 | 5 | 4.00 |
| 0.32 | 6 | 3.50 |
| 0.32 | 7 | 3.00 |
| 0.32 | 8 | 2.90 |
| 0.32 | 9 | 2.80 |
| 0.32 | 10 | 2.70 |
| 0.32 | 11 | 2.40 |
| 0.32 | 12 | 2.30 |
| 0.32 | 13 | 2.10 |
| 0.32 | 14 | 2.00 |
| 0.32 | 15 | 1.92 |
| 0.32 | 16 | 1.83 |
| 0.32 | 17 | 1.75 |
| 0.32 | 18 | 1.66 |
| 0.32 | 19 | 1.57 |
| 0.32 | 20 | 1.49 |
| 0.32 | 21 | 1.40 |
| 0.32 | 22 | 1.32 |
| 0.32 | 23 | 1.23 |
| 0.32 | 24 | 1.15 |
| 0.32 | 25 | 1.06 |
| 0.32 | 26 | 0.90 |
| 0.32 | 27 | 0.60 |
| 0.32 | 28 | 0.40 |
| 0.32 | 29 | 0.20 |
| 0.32 | 30 | 0.12 |
| 0.32 | 31 | 0.05 |
| 0.32 | 32 | 0.00 |
| 0.33 | 1 | 10.00 |
| 0.33 | 2 | 7.00 |

## Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.33 | 3 | 5.00 | 0.34 | 25 | 1.12 |
| 0.33 | 4 | 4.40 | 0.34 | 26 | 1.04 |
| 0.33 | 5 | 4.00 | 0.34 | 27 | 0.80 |
| 0.33 | 6 | 3.50 | 0.34 | 28 | 0.60 |
| 0.33 | 7 | 3.00 | 0.34 | 29 | 0.35 |
| 0.33 | 8 | 2.90 | 0.34 | 30 | 0.20 |
| 0.33 | 9 | 2.80 | 0.34 | 31 | 0.10 |
| 0.33 | 10 | 2.70 | 0.34 | 32 | 0.00 |
| 0.33 | 11 | 2.40 | 0.35 | 1 | 10.00 |
| 0.33 | 12 | 2.30 | 0.35 | 2 | 7.00 |
| 0.33 | 13 | 2.10 | 0.35 | 3 | 5.00 |
| 0.33 | 14 | 2.00 | 0.35 | 4 | 4.40 |
| 0.33 | 15 | 1.92 | 0.35 | 5 | 4.00 |
| 0.33 | 16 | 1.83 | 0.35 | 6 | 3.50 |
| 0.33 | 17 | 1.75 | 0.35 | 7 | 3.00 |
| 0.33 | 18 | 1.67 | 0.35 | 8 | 2.90 |
| 0.33 | 19 | 1.58 | 0.35 | 9 | 2.80 |
| 0.33 | 20 | 1.50 | 0.35 | 10 | 2.70 |
| 0.33 | 21 | 1.42 | 0.35 | 11 | 2.40 |
| 0.33 | 22 | 1.33 | 0.35 | 12 | 2.30 |
| 0.33 | 23 | 1.25 | 0.35 | 13 | 2.10 |
| 0.33 | 24 | 1.17 | 0.35 | 14 | 2.00 |
| 0.33 | 25 | 1.08 | 0.35 | 15 | 1.92 |
| 0.33 | 26 | 1.00 | 0.35 | 16 | 1.84 |
| 0.33 | 27 | 0.75 | 0.35 | 17 | 1.77 |
| 0.33 | 28 | 0.50 | 0.35 | 18 | 1.69 |
| 0.33 | 29 | 0.25 | 0.35 | 19 | 1.61 |
| 0.33 | 30 | 0.17 | 0.35 | 20 | 1.53 |
| 0.33 | 31 | 0.75 | 0.35 | 21 | 1.45 |
| 0.33 | 32 | 0.00 | 0.35 | 22 | 1.37 |
| 0.34 | 1 | 10.00 | 0.35 | 23 | 1.29 |
| 0.34 | 2 | 7.00 | 0.35 | 24 | 1.22 |
| 0.34 | 3 | 5.00 | 0.35 | 25 | 1.14 |
| 0.34 | 4 | 4.40 | 0.35 | 26 | 1.06 |
| 0.34 | 5 | 4.00 | 0.35 | 27 | 0.90 |
| 0.34 | 6 | 3.50 | 0.35 | 28 | 0.60 |
| 0.34 | 7 | 3.00 | 0.35 | 29 | 0.40 |
| 0.34 | 8 | 2.90 | 0.35 | 30 | 0.20 |
| 0.34 | 9 | 2.80 | 0.35 | 31 | 0.10 |
| 0.34 | 10 | 2.70 | 0.35 | 32 | 0.00 |
| 0.34 | 11 | 2.40 | 0.36 | 1 | 10.00 |
| 0.34 | 12 | 2.30 | 0.36 | 2 | 7.00 |
| 0.34 | 13 | 2.10 | 0.36 | 3 | 5.00 |
| 0.34 | 14 | 2.00 | 0.36 | 4 | 4.40 |
| 0.34 | 15 | 1.92 | 0.36 | 5 | 4.00 |
| 0.34 | 16 | 1.84 | 0.36 | 6 | 3.50 |
| 0.34 | 17 | 1.76 | 0.36 | 7 | 3.00 |
| 0.34 | 18 | 1.68 | 0.36 | 8 | 2.90 |
| 0.34 | 19 | 1.60 | 0.36 | 9 | 2.80 |
| 0.34 | 20 | 1.52 | 0.36 | 10 | 2.70 |
| 0.34 | 21 | 1.44 | 0.36 | 11 | 2.40 |
| 0.34 | 22 | 1.36 | 0.36 | 12 | 2.30 |
| 0.34 | 23 | 1.28 | 0.36 | 13 | 2.10 |
| 0.34 | 24 | 1.20 | 0.36 | 14 | 2.00 |

## Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.36 | 15 | 1.92 | 0.38 | 5 | 4.00 |
| 0.36 | 16 | 1.85 | 0.38 | 6 | 3.50 |
| 0.36 | 17 | 1.77 | 0.38 | 7 | 3.00 |
| 0.36 | 18 | 1.69 | 0.38 | 8 | 2.90 |
| 0.36 | 19 | 1.61 | 0.38 | 9 | 2.80 |
| 0.36 | 20 | 1.54 | 0.38 | 10 | 2.70 |
| 0.36 | 21 | 1.46 | 0.38 | 11 | 2.40 |
| 0.36 | 22 | 1.38 | 0.38 | 12 | 2.30 |
| 0.36 | 23 | 1.30 | 0.38 | 13 | 2.10 |
| 0.36 | 24 | 1.23 | 0.38 | 14 | 2.00 |
| 0.36 | 25 | 1.15 | 0.38 | 15 | 1.92 |
| 0.36 | 26 | 1.07 | 0.38 | 16 | 1.85 |
| 0.36 | 27 | 0.95 | 0.38 | 17 | 1.77 |
| 0.36 | 28 | 0.75 | 0.38 | 18 | 1.70 |
| 0.36 | 29 | 0.51 | 0.38 | 19 | 1.62 |
| 0.36 | 30 | 0.30 | 0.38 | 20 | 1.54 |
| 0.36 | 31 | 0.16 | 0.38 | 21 | 1.47 |
| 0.36 | 32 | 0.00 | 0.38 | 22 | 1.39 |
| 0.37 | 1 | 10.00 | 0.38 | 23 | 1.32 |
| 0.37 | 2 | 7.00 | 0.38 | 24 | 1.24 |
| 0.37 | 3 | 5.00 | 0.38 | 25 | 1.16 |
| 0.37 | 4 | 4.40 | 0.38 | 26 | 1.09 |
| 0.37 | 5 | 4.00 | 0.38 | 27 | 1.01 |
| 0.37 | 6 | 3.50 | 0.38 | 28 | 0.83 |
| 0.37 | 7 | 3.00 | 0.38 | 29 | 0.65 |
| 0.37 | 8 | 2.90 | 0.38 | 30 | 0.50 |
| 0.37 | 9 | 2.80 | 0.38 | 31 | 0.20 |
| 0.37 | 10 | 2.70 | 0.38 | 32 | 0.00 |
| 0.37 | 11 | 2.40 | 0.39 | 1 | 10.00 |
| 0.37 | 12 | 2.30 | 0.39 | 2 | 7.00 |
| 0.37 | 13 | 2.10 | 0.39 | 3 | 5.00 |
| 0.37 | 14 | 2.00 | 0.39 | 4 | 4.40 |
| 0.37 | 15 | 1.92 | 0.39 | 5 | 4.00 |
| 0.37 | 16 | 1.85 | 0.39 | 6 | 3.50 |
| 0.37 | 17 | 1.77 | 0.39 | 7 | 3.00 |
| 0.37 | 18 | 1.69 | 0.39 | 8 | 2.90 |
| 0.37 | 19 | 1.62 | 0.39 | 9 | 2.80 |
| 0.37 | 20 | 1.54 | 0.39 | 10 | 2.70 |
| 0.37 | 21 | 1.46 | 0.39 | 11 | 2.40 |
| 0.37 | 22 | 1.39 | 0.39 | 12 | 2.30 |
| 0.37 | 23 | 1.31 | 0.39 | 13 | 2.10 |
| 0.37 | 24 | 1.23 | 0.39 | 14 | 2.00 |
| 0.37 | 25 | 1.15 | 0.39 | 15 | 1.93 |
| 0.37 | 26 | 1.08 | 0.39 | 16 | 1.85 |
| 0.37 | 27 | 1.00 | 0.39 | 17 | 1.77 |
| 0.37 | 28 | 0.80 | 0.39 | 18 | 1.70 |
| 0.37 | 29 | 0.60 | 0.39 | 19 | 1.62 |
| 0.37 | 30 | 0.40 | 0.39 | 20 | 1.55 |
| 0.37 | 31 | 0.18 | 0.39 | 21 | 1.47 |
| 0.37 | 32 | 0.00 | 0.39 | 22 | 1.40 |
| 0.38 | 1 | 10.00 | 0.39 | 23 | 1.32 |
| 0.38 | 2 | 7.00 | 0.39 | 24 | 1.25 |
| 0.38 | 3 | 5.00 | 0.39 | 25 | 1.17 |
| 0.38 | 4 | 4.40 | 0.39 | 26 | 1.10 |

# Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|
| 0.39 | 27 | 1.02 |
| 0.39 | 28 | 0.85 |
| 0.39 | 29 | 0.70 |
| 0.39 | 30 | 0.54 |
| 0.39 | 31 | 0.23 |
| 0.39 | 32 | 0.00 |
| 0.40 | 1 | 10.00 |
| 0.40 | 2 | 7.00 |
| 0.40 | 3 | 5.00 |
| 0.40 | 4 | 4.40 |
| 0.40 | 5 | 4.00 |
| 0.40 | 6 | 3.50 |
| 0.40 | 7 | 3.00 |
| 0.40 | 8 | 2.90 |
| 0.40 | 9 | 2.80 |
| 0.40 | 10 | 2.70 |
| 0.40 | 11 | 2.40 |
| 0.40 | 12 | 2.30 |
| 0.40 | 13 | 2.10 |
| 0.40 | 14 | 2.00 |
| 0.40 | 15 | 1.93 |
| 0.40 | 16 | 1.85 |
| 0.40 | 17 | 1.78 |
| 0.40 | 18 | 1.70 |
| 0.40 | 19 | 1.63 |
| 0.40 | 20 | 1.55 |
| 0.40 | 21 | 1.48 |
| 0.40 | 22 | 1.40 |
| 0.40 | 23 | 1.33 |
| 0.40 | 24 | 1.26 |
| 0.40 | 25 | 1.18 |
| 0.40 | 26 | 1.11 |
| 0.40 | 27 | 1.03 |
| 0.40 | 28 | 0.90 |
| 0.40 | 29 | 0.72 |
| 0.40 | 30 | 0.60 |
| 0.40 | 31 | 0.40 |
| 0.40 | 32 | 0.00 |
| 0.41 | 1 | 10.00 |
| 0.41 | 2 | 7.00 |
| 0.41 | 3 | 5.00 |
| 0.41 | 4 | 4.40 |
| 0.41 | 5 | 4.00 |
| 0.41 | 6 | 3.50 |
| 0.41 | 7 | 3.00 |
| 0.41 | 8 | 2.90 |
| 0.41 | 9 | 2.80 |
| 0.41 | 10 | 2.70 |
| 0.41 | 11 | 2.40 |
| 0.41 | 12 | 2.30 |
| 0.41 | 13 | 2.10 |
| 0.41 | 14 | 2.00 |
| 0.41 | 15 | 1.93 |
| 0.41 | 16 | 1.85 |
| 0.41 | 17 | 1.78 |
| 0.41 | 18 | 1.71 |
| 0.41 | 19 | 1.63 |
| 0.41 | 20 | 1.56 |
| 0.41 | 21 | 1.48 |
| 0.41 | 22 | 1.41 |
| 0.41 | 23 | 1.34 |
| 0.41 | 24 | 1.26 |
| 0.41 | 25 | 1.19 |
| 0.41 | 26 | 1.12 |
| 0.41 | 27 | 1.04 |
| 0.41 | 28 | 0.90 |
| 0.41 | 29 | 0.78 |
| 0.41 | 30 | 0.63 |
| 0.41 | 31 | 0.45 |
| 0.41 | 32 | 0.00 |
| 0.42 | 1 | 10.00 |
| 0.42 | 2 | 7.00 |
| 0.42 | 3 | 5.00 |
| 0.42 | 4 | 4.40 |
| 0.42 | 5 | 4.00 |
| 0.42 | 6 | 3.50 |
| 0.42 | 7 | 3.00 |
| 0.42 | 8 | 2.90 |
| 0.42 | 9 | 2.80 |
| 0.42 | 10 | 2.70 |
| 0.42 | 11 | 2.40 |
| 0.42 | 12 | 2.30 |
| 0.42 | 13 | 2.10 |
| 0.42 | 14 | 2.00 |
| 0.42 | 15 | 1.93 |
| 0.42 | 16 | 1.85 |
| 0.42 | 17 | 1.78 |
| 0.42 | 18 | 1.71 |
| 0.42 | 19 | 1.64 |
| 0.42 | 20 | 1.56 |
| 0.42 | 21 | 1.49 |
| 0.42 | 22 | 1.42 |
| 0.42 | 23 | 1.34 |
| 0.42 | 24 | 1.27 |
| 0.42 | 25 | 1.98 |
| 0.42 | 26 | 1.13 |
| 0.42 | 27 | 1.05 |
| 0.42 | 28 | 0.95 |
| 0.42 | 29 | 0.75 |
| 0.42 | 30 | 0.65 |
| 0.42 | 31 | 0.51 |
| 0.42 | 32 | 0.00 |
| 0.43 | 1 | 10.00 |
| 0.43 | 2 | 7.00 |
| 0.43 | 3 | 5.00 |
| 0.43 | 4 | 4.40 |
| 0.43 | 5 | 4.00 |
| 0.43 | 6 | 3.50 |

## Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.43 | 7 | 3.00 | 0.44 | 29 | 0.88 |
| 0.43 | 8 | 2.90 | 0.44 | 30 | 0.75 |
| 0.43 | 9 | 2.80 | 0.44 | 31 | 0.63 |
| 0.43 | 10 | 2.70 | 0.44 | 32 | 0.00 |
| 0.43 | 11 | 2.40 | 0.45 | 1 | 10.00 |
| 0.43 | 12 | 2.30 | 0.45 | 2 | 7.00 |
| 0.43 | 13 | 2.10 | 0.45 | 3 | 5.00 |
| 0.43 | 14 | 2.00 | 0.45 | 4 | 4.40 |
| 0.43 | 15 | 1.93 | 0.45 | 5 | 4.00 |
| 0.43 | 16 | 1.86 | 0.45 | 6 | 3.50 |
| 0.43 | 17 | 1.78 | 0.45 | 7 | 3.00 |
| 0.43 | 18 | 1.71 | 0.45 | 8 | 2.90 |
| 0.43 | 19 | 1.64 | 0.45 | 9 | 2.80 |
| 0.43 | 20 | 1.57 | 0.45 | 10 | 2.70 |
| 0.43 | 21 | 1.50 | 0.45 | 11 | 2.40 |
| 0.43 | 22 | 1.42 | 0.45 | 12 | 2.30 |
| 0.43 | 23 | 1.35 | 0.45 | 13 | 2.10 |
| 0.43 | 24 | 1.28 | 0.45 | 14 | 2.00 |
| 0.43 | 25 | 1.21 | 0.45 | 15 | 1.92 |
| 0.43 | 26 | 1.13 | 0.45 | 16 | 1.86 |
| 0.43 | 27 | 1.06 | 0.45 | 17 | 1.79 |
| 0.43 | 28 | 0.97 | 0.45 | 18 | 1.71 |
| 0.43 | 29 | 0.80 | 0.45 | 19 | 1.64 |
| 0.43 | 30 | 0.65 | 0.45 | 20 | 1.57 |
| 0.43 | 31 | 0.54 | 0.45 | 21 | 1.50 |
| 0.43 | 32 | 0.00 | 0.45 | 22 | 1.43 |
| 0.44 | 1 | 10.00 | 0.45 | 23 | 1.36 |
| 0.44 | 2 | 7.00 | 0.45 | 24 | 1.29 |
| 0.44 | 3 | 5.00 | 0.45 | 25 | 1.21 |
| 0.44 | 4 | 4.40 | 0.45 | 26 | 1.14 |
| 0.44 | 5 | 4.00 | 0.45 | 27 | 1.07 |
| 0.44 | 6 | 3.50 | 0.45 | 28 | 1.00 |
| 0.44 | 7 | 3.00 | 0.45 | 29 | 0.88 |
| 0.44 | 8 | 2.90 | 0.45 | 30 | 0.75 |
| 0.44 | 9 | 2.80 | 0.45 | 31 | 0.63 |
| 0.44 | 10 | 2.70 | 0.45 | 32 | 0.00 |
| 0.44 | 11 | 2.40 | 0.46 | 1 | 10.00 |
| 0.44 | 12 | 2.30 | 0.46 | 2 | 7.00 |
| 0.44 | 13 | 2.10 | 0.46 | 3 | 5.00 |
| 0.44 | 14 | 2.00 | 0.46 | 4 | 4.40 |
| 0.44 | 15 | 1.92 | 0.46 | 5 | 4.00 |
| 0.44 | 16 | 1.86 | 0.46 | 6 | 3.50 |
| 0.44 | 17 | 1.79 | 0.46 | 7 | 3.00 |
| 0.44 | 18 | 1.71 | 0.46 | 8 | 2.90 |
| 0.44 | 19 | 1.64 | 0.46 | 9 | 2.80 |
| 0.44 | 20 | 1.57 | 0.46 | 10 | 2.70 |
| 0.44 | 21 | 1.50 | 0.46 | 11 | 2.40 |
| 0.44 | 22 | 1.43 | 0.46 | 12 | 2.30 |
| 0.44 | 23 | 1.36 | 0.46 | 13 | 2.10 |
| 0.44 | 24 | 1.29 | 0.46 | 14 | 2.00 |
| 0.44 | 25 | 1.21 | 0.46 | 15 | 1.92 |
| 0.44 | 26 | 1.14 | 0.46 | 16 | 1.86 |
| 0.44 | 27 | 1.07 | 0.46 | 17 | 1.79 |
| 0.44 | 28 | 1.00 | 0.46 | 18 | 1.71 |

## Table 5 Continued

| Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % | Cyclic Stress Ratio, CSR | Normalized and Corrected SPT Blow Count, $(N_1)_{60}$ | Liquefaction-Induced Volumetric Strain, % |
|---|---|---|---|---|---|
| 0.46 | 19 | 1.64 | 0.46 | 26 | 1.14 |
| 0.46 | 20 | 1.57 | 0.46 | 27 | 1.07 |
| 0.46 | 21 | 1.50 | 0.46 | 28 | 1.00 |
| 0.46 | 22 | 1.43 | 0.46 | 29 | 0.90 |
| 0.46 | 23 | 1.36 | 0.46 | 30 | 0.78 |
| 0.46 | 24 | 1.29 | 0.46 | 31 | 0.65 |
| 0.46 | 25 | 1.21 | 0.46 | 32 | 0.00 |

### *Yoshimine and others*

Yoshimine and others (2006) published a series of functions that describe the settlement curves presented by Ishihara and Yoshimine (1992). The Ishihara and Yoshimine (1992) curves (Figures 13 and 14) relate volumetric strain in clean sands to relative density (via normalized SPT blow counts, $N_1$) and factor of safety against liquefaction triggering (FS).

The raw blow count data contained in the ArcGIS® geotechnical database were normalized and corrected to $(N_1)_{60}$ clean sand values by Equations 2 and 3 (Youd and others, 2001). The soil profiles for each borehole location were then screened for liquefaction triggering using Equations 1, 6 and 7 as previously described. A ground settlement value of 0 m was assigned to all soils layers with factors of safety against liquefaction triggering greater than 1.1.

To implement Yoshimine and others (2006), the $(N_1)_{60}$ clean sand blow count values were converted to $N_1$ values using Seed and others (1985) to account for traditional Japanese sampling practices and techniques:

$$N_1 = \frac{(N_1)_{60}}{0.9} \qquad \text{for } (N_1)_{60} < 20 \qquad \text{(Equation 10a)}$$

$$N_1 = (N_1)_{60} \qquad \text{for } (N_1)_{60} \geq 20 \qquad \text{(Equation 10b)}$$

Following the method outlined by Yoshimine and others (2006), the $N_1$ values were converted to relative densities, $D_r$, by (Meyerhof, 1957):

$$D_r = 21\sqrt{\frac{N_1}{1.7}} \qquad \text{(Equation 11)}$$

and the likelihood of liquefaction triggering, FS, was calculated according to the Japanese Design Code for Highway Bridges (2000):

$$FS = \frac{R}{L} \qquad \text{(Equation 12)}$$

$$R = 0.0882\sqrt{\frac{N_1}{1.7}} \quad \text{for } N_1 < 14 \qquad \text{(Equation 13a)}$$

$$R = 0.0882\sqrt{\frac{N_1}{1.7}} + 1.6E^{-6}\left(\frac{N_1}{1.7}\right)^{4.5} \quad \text{for } N_1 \geq 14 \qquad \text{(Equation 13b)}$$

$$L = r_d\left(\frac{\sigma_v}{\sigma'_v}\right)\left(\frac{\alpha}{g}\right) \qquad \text{(Equation 14)}$$

$$r_d = 1.0 - 0.015D \qquad \text{(Equation 15)}$$

where $N_1$ is the normalized and corrected Japanese-modified SPT blow count, $\sigma_v$ and $\sigma'_v$ are the total and effective overburden pressures, respectively, $\alpha$ is the PGA for the analysis, D is the depth from ground surface and $r_d$ is a stress reduction factor.

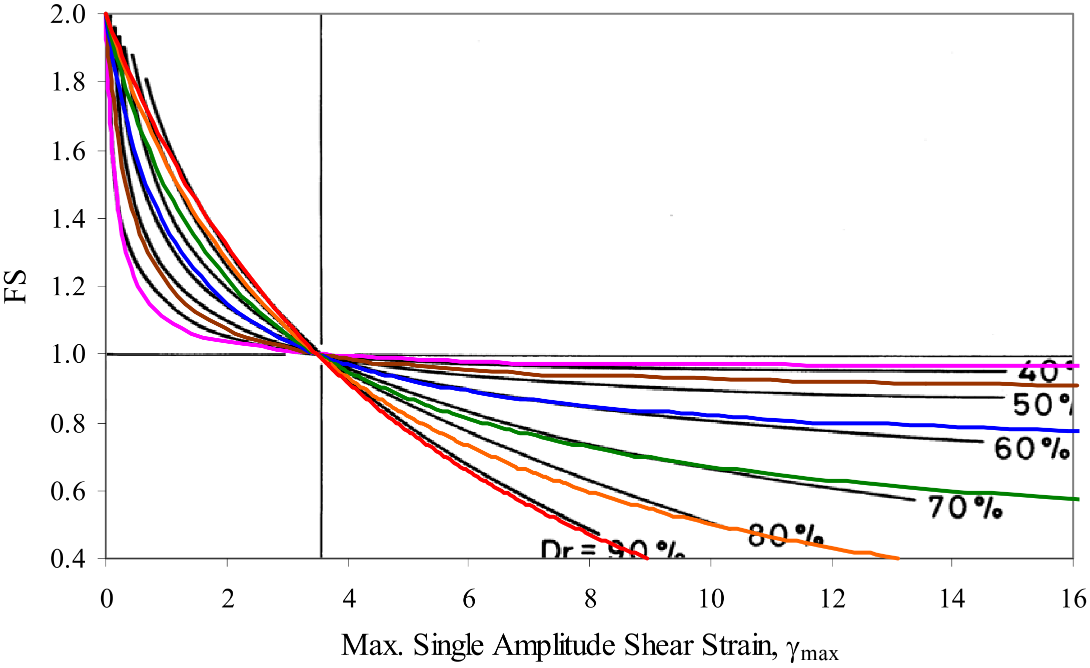

**Figure 13.** Curves used to correlate single amplitude shear strain ($\gamma_{max}$) to factor of safety against liquefaction (relative density, $D_r$, calculated from $N_1$).

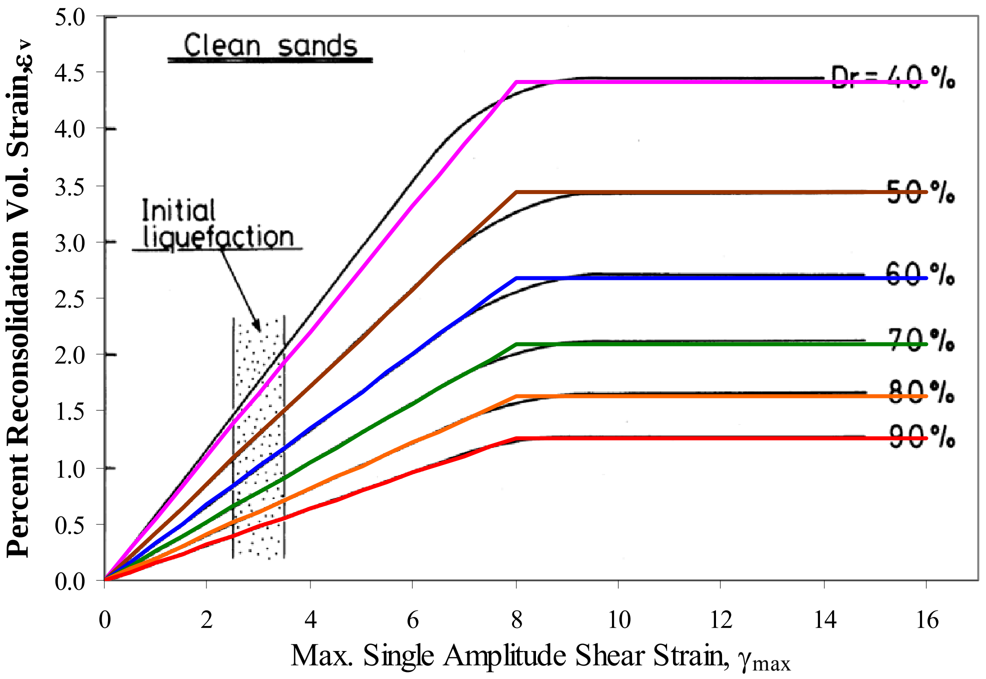

**Figure 14.** Curves used to correlate single amplitude of shear strain ($\gamma_{max}$) to post-liquefaction settlement.

The maximum single amplitude of shear strain, $\gamma_{max}$, for all sites with a factor of safety against liquefaction triggering, FS, less than or equal to 1.1 was calculated by Yoshimine and others (2006). In the following equations $F_{ult}$ is a nameless intermediate variable and the relative density prior to liquefaction, $D_{r,ini}$, is expressed as an integer (i.e., 65 percent is expressed as 65):

$$\gamma_{\max} = 3.5(2 - FS)\frac{1 - F_{ult}}{FS - F_{ult}} \qquad \text{if } F_{ult} \leq FS \leq 2.0 \qquad \text{(Equation 16a)}$$

$$\gamma_{\max} = 0 \qquad \text{if } FS \geq 2.0 \qquad \text{(Equation 16b)}$$

$$\gamma_{\max} = \infty \qquad \text{if } F_{ult} \leq FS \qquad \text{(Equation 16c)}$$

where

$$F_{ult} = -0.0006D_{r,ini}^2 + 0.047D_{r,ini} + 0.032 \qquad \text{if } D_{r,ini} \geq 39.2\% \qquad \text{(Equation 17a)}$$

$$F_{ult} = 0.9524 \qquad \text{if } D_{r,ini} < 39.2\% \qquad \text{(Equation 17b)}$$

Finally, using the initial relative densities, $D_{r,ini}$, and the maximum single amplitude of shear strains, $\gamma_{max}$, percent liquefaction-induced volumetric strains, $\varepsilon_v$, were estimated by (Yoshimine and others, 2006):

$$\varepsilon_v = 1.5[\exp(-0.025D_{r,ini})]\gamma_{max} \qquad \text{if } \gamma_{max} \leq 8\% \qquad \text{(Equation 18a)}$$

$$\varepsilon_v = 12\exp(-0.025D_{r,ini}) \qquad \text{if } \gamma_{max} > 8\% \qquad \text{(Equation 18b)}$$

The estimated settlement, $\Delta_Y$, at each borehole was the summation of the thickness of each liquefiable soil layer, t, times the respective estimated volumetric strain, $\varepsilon_V$:

$$\Delta_Y = \sum_{i=1}^{n} t_i \times \varepsilon_{v,i} \qquad \text{(Equation 19)}$$

As previously mentioned, ground settlement value of 0 m was assigned to all locations with factors of safety for liquefaction triggering greater than 1.1. Since earthquake magnitude was not a required input variable, no magnitude scaling factors were used in this method.

### *Comparison of Methods*

The calculated settlements ($\Delta_{TS}$ and $\Delta_Y$) were compared at each borehole to assess the resultant similarities and differences between the two methodologies. The results for the three analysis events are shown in Table 6. For example, the scenario M7.0 earthquake settlement data set showed an average difference between the two methods of 0.004 m, with a maximum difference of 0.083 m. Of the 963 boreholes, Tokimatsu and Seed (1987) predicted higher settlements than Yoshimine and others (2006) in 232 boreholes and the opposite was true for 444 boreholes. Both methods predicted no settlement in 287 boreholes. A method-to-method comparison of the differences showed that 74 percent of the boreholes were within 0.01 m, 92 percent were within 0.025 m and 99 percent were within 0.05 m.

It was concluded that the two methods produced relatively similar results when considering the quality of the input data and the ultimate use of the mapping. Subsequently, the average of the two methods was considered appropriate to estimate the ground settlement, $\Delta_{liq}$, at each liquefiable borehole location:

$$\Delta_{liq} = \frac{\Delta_{TS} + \Delta_{Y}}{2} \qquad \text{(Equation 20)}$$

Table 6

Comparison of $\Delta_{TS}$ and $\Delta_Y$ at each Borehole for the Three Analysis Events

| | Wasatch Fault M7.0 Event | 2 percent Prob. of Exceedance in 50 yrs | 10 percent Prob. of Exceedance in 50 yrs |
|---|---|---|---|
| Average Difference, m | 0.004 | 0.006 | 0.002 |
| Maximum Difference, m | 0.083 | 0.083 | 0.076 |
| Number of Boreholes where $\Delta_{TS} > \Delta_Y$ | 232 | 189 | 313 |
| Number of Boreholes where $\Delta_Y > \Delta_{TS}$ | 444 | 487 | 352 |
| Number of Boreholes where $\Delta_{TS} = \Delta_Y = 0$ | 287 | 287 | 298 |
| Percent of Boreholes where $\Delta_{TS}$ and $\Delta_Y$ are within 0.010 m | 73.9 | 73.7 | 78.4 |
| Percent of Boreholes where $\Delta_{TS}$ and $\Delta_Y$ are within 0.025 m | 92.3 | 91.4 | 94.3 |
| Percent of Boreholes where $\Delta_{TS}$ and $\Delta_Y$ are within 0.050 m | 99.0 | 98.8 | 99.3 |

# APPENDIX C

# HAZARD CLASS DEVELOPMENT

This report presents the first liquefaction-induced ground displacement maps developed for Utah using both geotechnical and geological data in conjunction with deterministic and probabilistic estimates of strong motion.

### *Methods and Classifications*

The lateral spread maps are a continuation of work completed for the northern part of the Salt Lake Valley by Bartlett and others (2005) and Olsen and others (2007). The methods used for this paper are consistent with the methods developed in those reports; the reader is referred to those reports for a detailed explanation of the analysis methodology. In short, lateral spread displacements were estimated by the Youd and others (2002) regression model for all borehole locations having a factor of safety against liquefaction triggering less than or equal to 1.1. The estimated horizontal displacements ($D_H$) were further categorized as “minimal” (0 m); “low” (0 to 0.1 m); “moderate” (0.1 to 0.3 m); “high” (0.3 to 1.0 m); and “very high” (greater than 1.0 m). All boreholes with factors of safety against liquefaction triggering greater than 1.1 were assigned a lateral spread displacement of 0 m.

The methods used to estimate liquefaction-induced settlement are exhaustively explained in Appendix B. Briefly, settlement estimates were averaged from settlements estimated by Tokimatsu and Seed (1987) and Yoshimine and others (2006). The ground settlement estimates were categorized as “low” (0 to 0.05 m); “moderate” (0.05 to 0.1 m); ”high” (0.1 to 0.3 m); and “very high” (greater than 0.3 m). All soil layers with factors of safety against liquefaction triggering greater than 1.1 were assigned a settlement of 0 m.

In the six ground displacement maps (see Figures 3 through 5 and 9 through 11), a hazard category was assigned to each geologic unit shown in Figure 1 by statistical analysis of the estimated displacements from all boreholes located within the respective geologic unit or group of units with similar subsurface characteristics (e.g., near-surface soil type, origin, deposition and age). A total of 24 geologic groups were assessed and assigned a hazard classification for each map. All 963 boreholes from the ArcGIS® database are contained within the 24 geologic groups.

To assess the localized hazard, the estimated displacement at each borehole location was shown as a dot that was colored according to the hazard categories previously mentioned. The dot coloring was consistent with the classification shading shown in Figures 3 through 5 and 9 through 11. In some areas, several clearly defined homogenous or nearly homogenous dot clusters representing varying hazard categories existed in the same geologic unit. In these cases, the geologic units were subdivided prior to conducting statistical analysis.

An example of a “dot map” is included as Figure 15. The geologic unit shown highlighted in the middle of the figure is the Qlaly unit (lacustrine, marsh and alluvium deposits) located in the northeast quadrant of the valley. Due to the concentration of increased hazards in the northern (upper) part and inferior hazards in the southern (lower) part, this geologic unit was subdivided along the roadway that extends across the lower-third of the unit (Interstate 80).

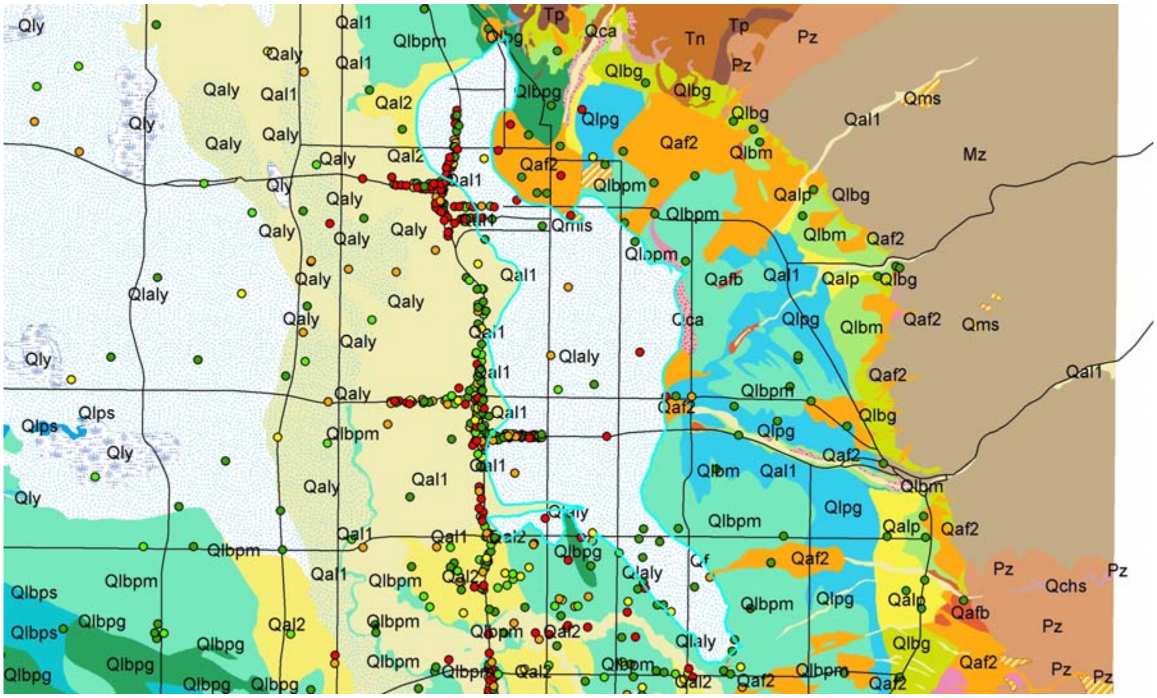

**Figure 15.** "Dot map" showing boreholes in Qlaly unit in northeast valley quadrant.

## *Deterministic Maps*

Using the method discussed by Bartlett and others (2005) and Olsen and others (2007), cumulative histograms of increasing hazard severity were developed to determine an 85 percent nonexceedance ground displacement threshold for the M7.0 Wasatch fault scenario event maps. The 85 percent nonexceedance criterion means that no more than 15 percent of the estimated displacements exceed the hazard category assigned to the respective geologic unit or group of units and thus approximates a mean plus one standard deviation criterion. A sample histogram is shown in Figure 16. This histogram corresponds to the lateral spread hazard estimated for the northern part of the Qlaly geologic unit shown in Figure 15. Based on the 85 percent criterion, the lateral spread hazard associated with this geologic unit was classified as "very high." As shown by the solid horizontal line at 85 percent, no more than 15 percent of the displacement results

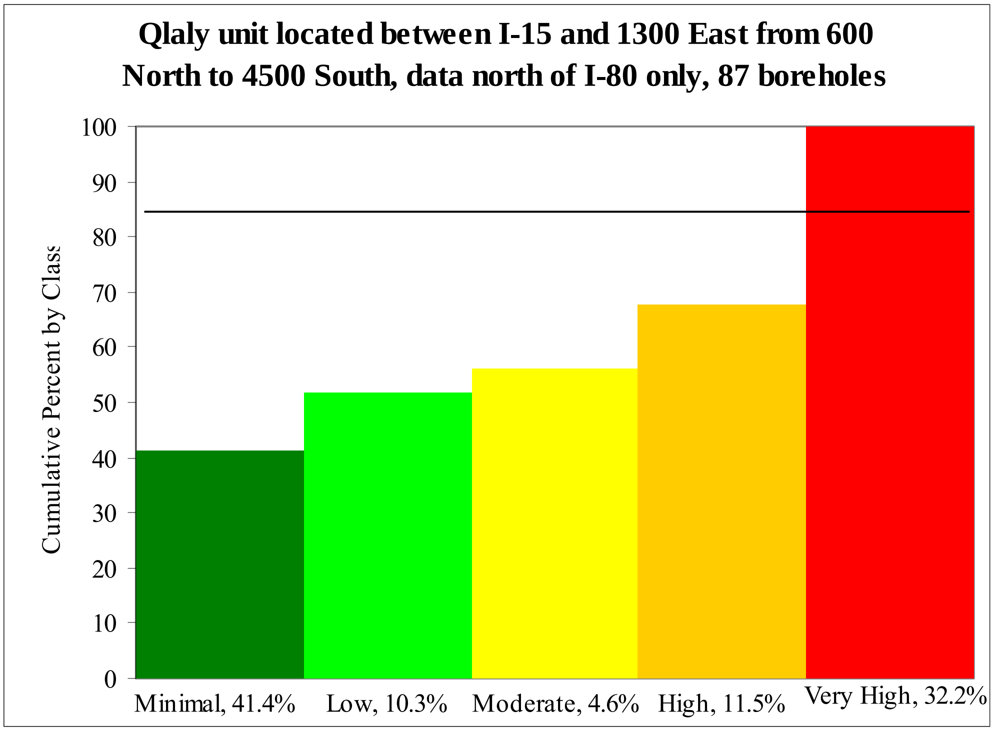

**Figure 16.** Histogram showing "very high" hazard classification for lateral spread caused by a M7.0 event on the Wasatch fault for the northern part of Qlaly unit located in northeast valley quadrant.

exceed the assigned hazard category. Several additional histograms included as Figures 17 through 21 further illustrate the 85 percent criterion and subsequent hazard classification. The analysis type and assigned hazard category are listed in each figure description.

### *Probabilistic Maps*

When the natural log of the probabilistic-based data was taken, it was observed that the datasets from well-sampled units generally demonstrated a log-normal distribution. Figure 22 shows the log-normal distribution of the natural log of the ground settlement estimates based on a 2 percent probability of exceedance in 50 years (2PE50) for the boreholes located in the northern part of the Qlaly unit shown in Figure 15. To account for 0-meter displacement estimates, 0.01 m (1 cm) was added to all settlement estimates prior to taking the natural log.

Due to the log-normal distribution, the hazard category assigned to each geologic unit or group of units for the probabilistic analyses was most appropriately indicated by the median of all estimated displacements within the respective dataset. The median means that no more than 50 percent of the estimated displacements exceed the hazard category assigned to the respective geologic unit or group of units. For the data presented in Figure 22, a median displacement of 0.054 m was used to classify the geologic unit as having a “moderate” liquefaction-induced ground settlement hazard. Figures 23 through 26 further illustrate the log-normal distributions.

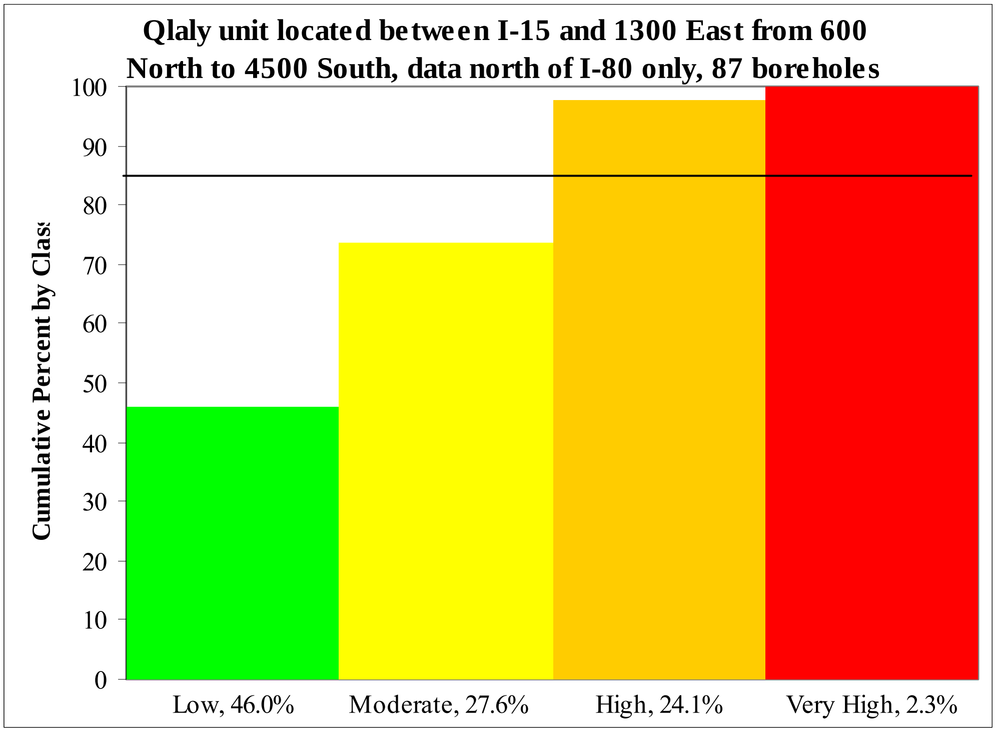

**Figure 17.** Histogram showing “high” hazard classification for ground settlement caused by a M7.0 event on the Wasatch fault.

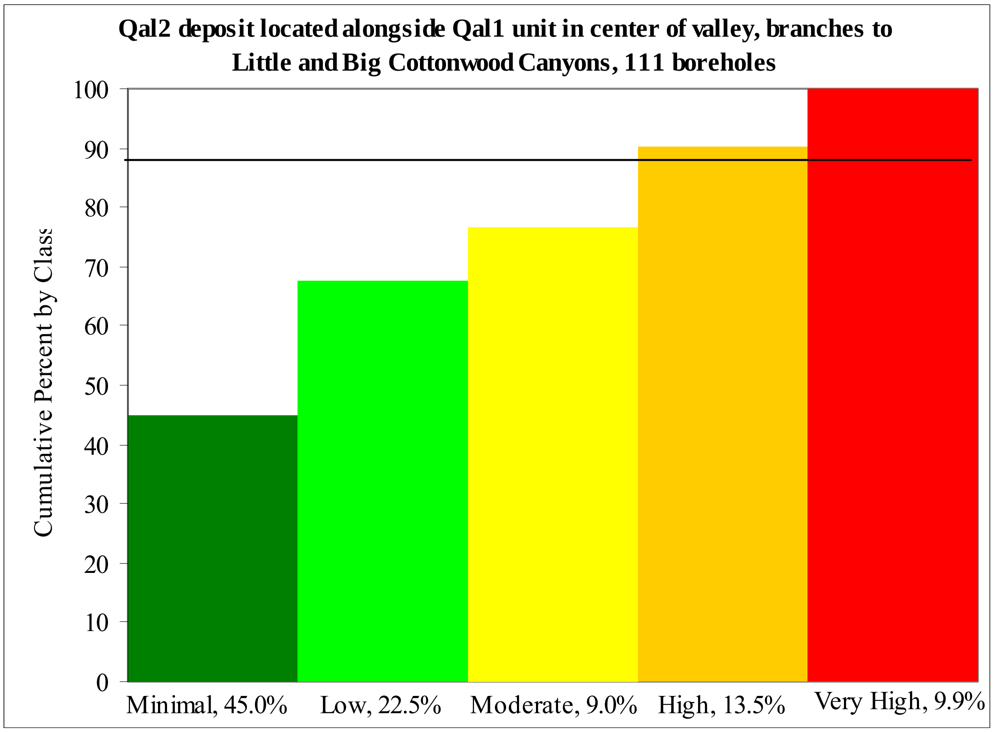

**Figure 18.** Histogram showing "high" hazard classification for lateral spread caused by a M7.0 event on the Wasatch fault.

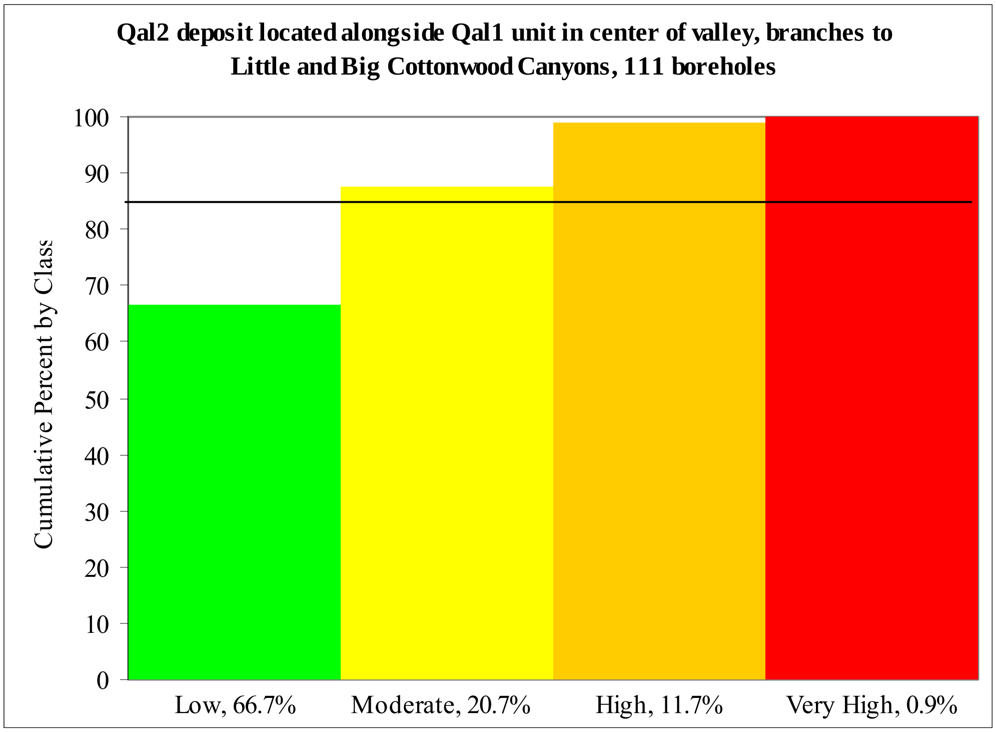

**Figure 19.** Histogram showing "moderate" hazard classification for ground settlement corresponding to a M7.0 event on the Wasatch fault.

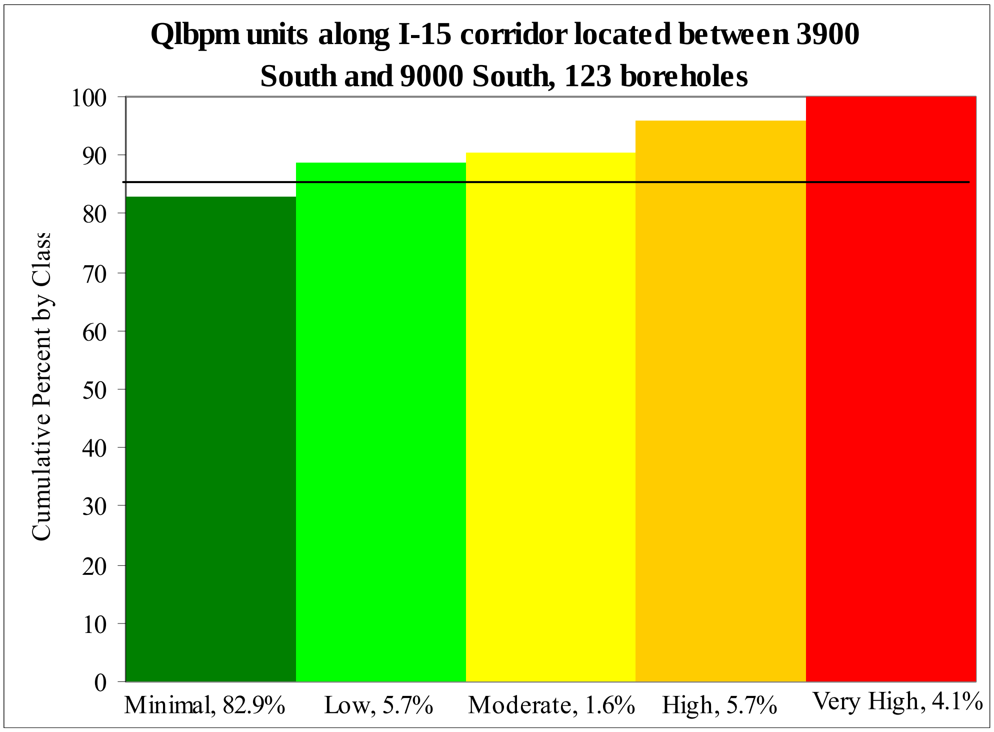

**Figure 20.** Histogram showing "low" hazard classification for lateral spread caused by a M7.0 event on the Wasatch fault.

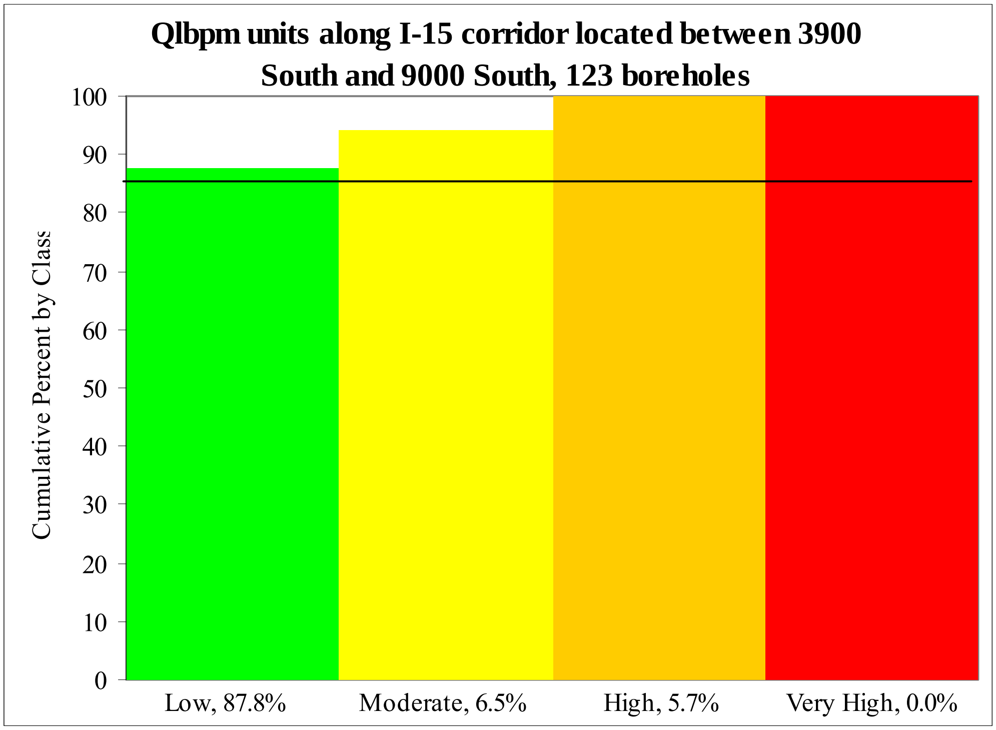

**Figure 21.** Histogram showing "low" hazard classification for ground settlement corresponding to a M7.0 event on the Wasatch fault.

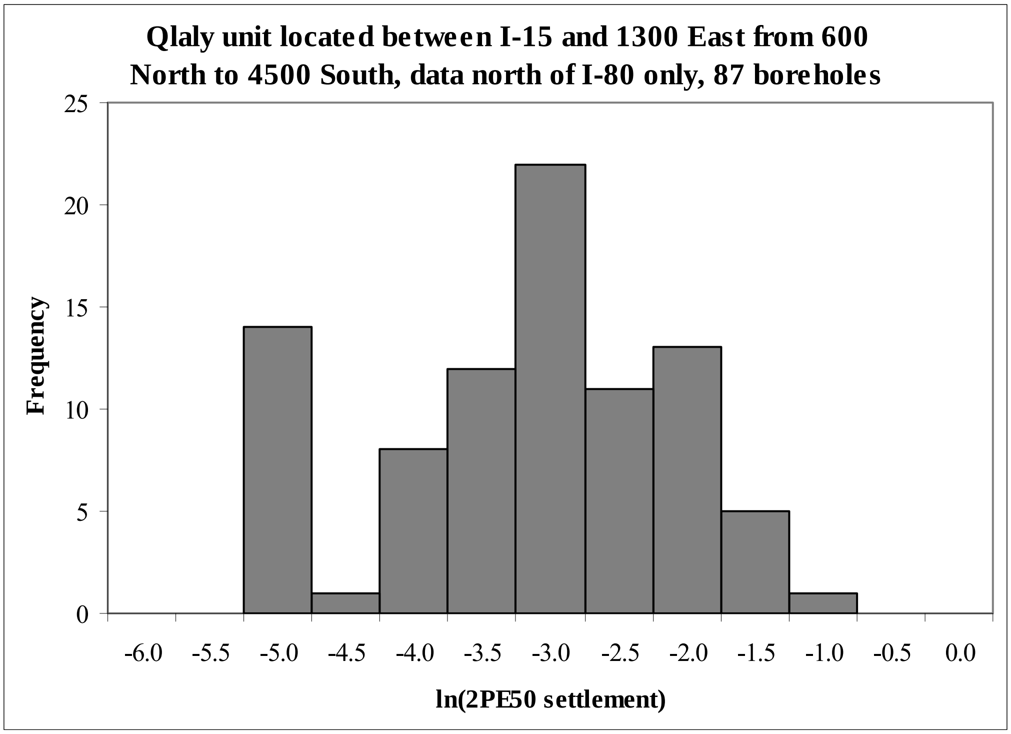

**Figure 22.** Histogram showing ground settlement displacement distribution for 2PE50. A "moderate" ground settlement hazard was assigned to this unit.

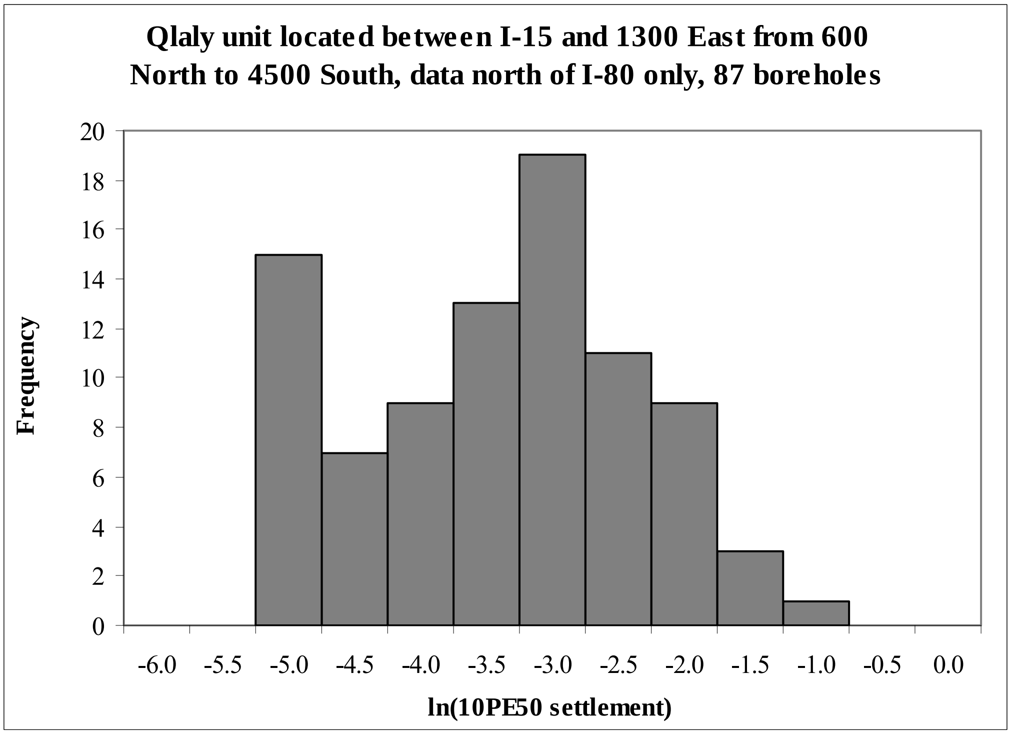

**Figure 23.** Histogram showing ground settlement displacement distribution for 10PE50. A "low" ground settlement hazard was assigned to this unit.

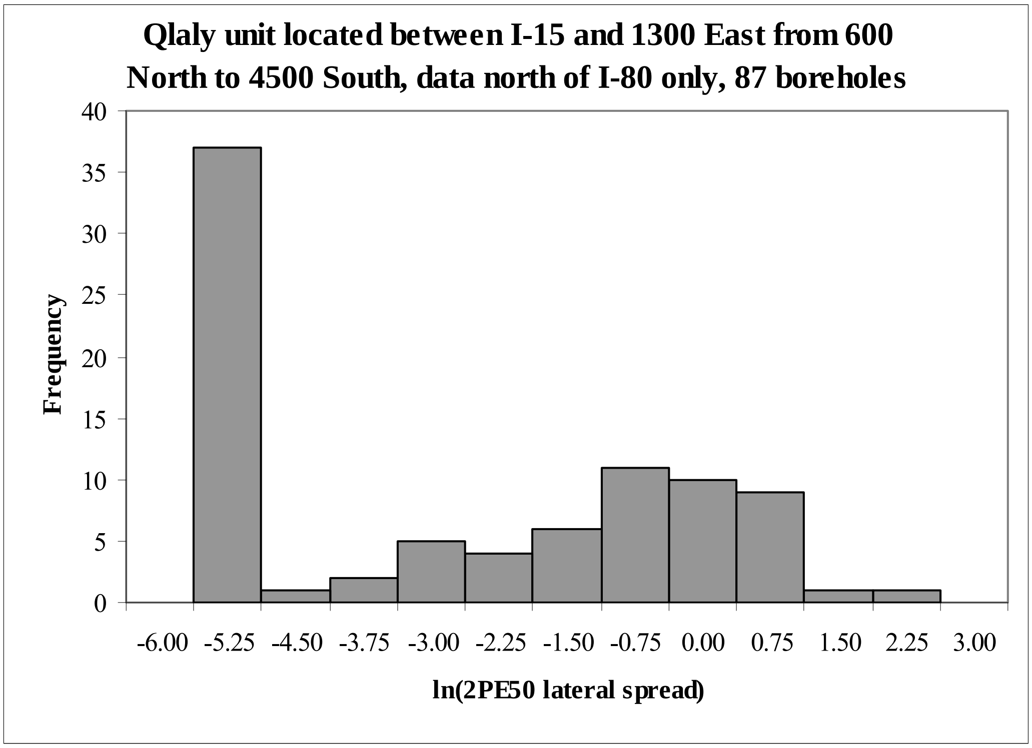

**Figure 24.** Histogram showing lateral spread displacement distribution for 2PE50. A "low" lateral spread hazard was assigned to this unit.

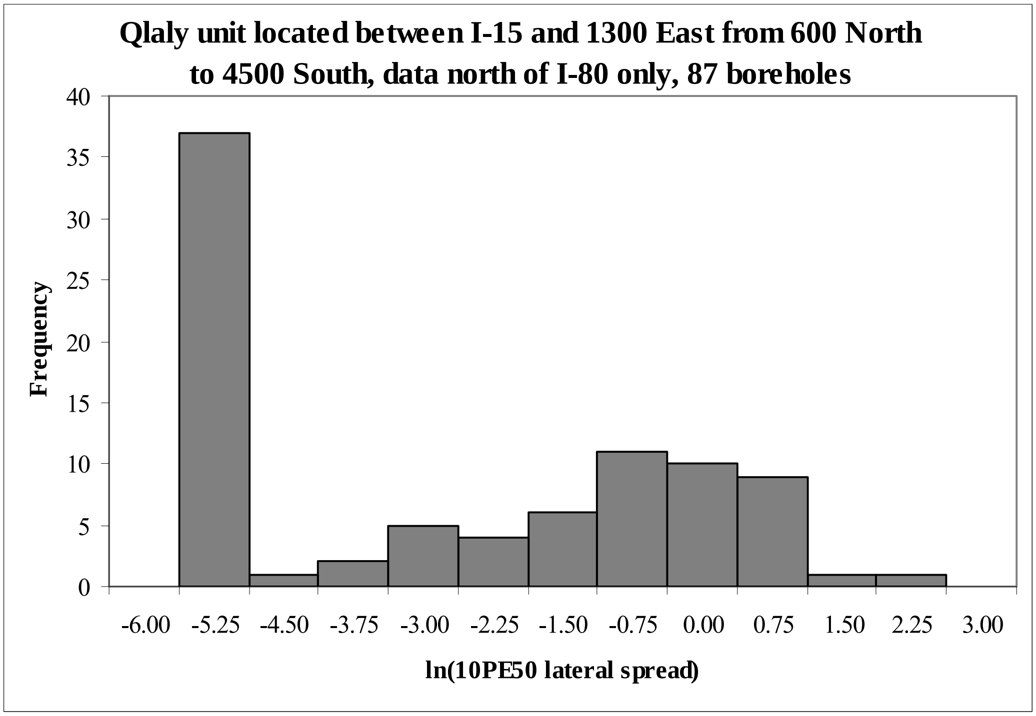

**Figure 25.** Histogram showing lateral spread displacement distribution for 10PE50. A "low" lateral spread hazard was assigned to this unit.

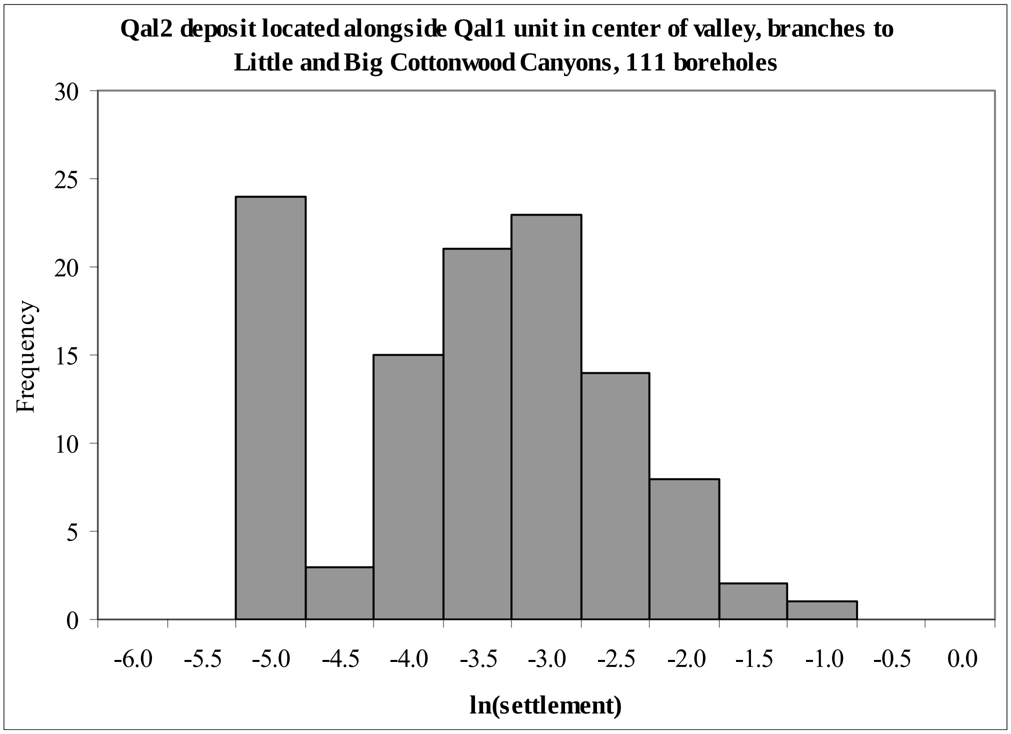

**Figure 26.** Histogram showing ground settlement displacement distribution for 10PE50. A "moderate" ground settlement hazard was assigned to this unit.

### *Summary Tables*

A hazard classification summary table for the three lateral spread maps for the 24 geologic groups is shown in Table 7. Table 8 summarizes the hazard classifications for the three ground settlement maps for the 24 geologic groups. To complement Tables 7 and 8, Appendix D contains tables of the estimated displacements in each of the 24 geologic groups. As previously mentioned, all 963 boreholes within the ArcGIS® database are contained within the 24 geologic groups. The tables in Appendix D may be cross-referenced with Table 3 in Appendix A for a description of approximate borehole location and date drilled.

# Table 7

## A Summary of Liquefaction-Induced Lateral Spread for the Salt Lake Valley

| Unit Number | Surficial Geologic Unit/Group Description | Wasatch Fault M7.0 Scenario Event | | | | | | Probabilistic 2PE50 | | Probabilistic 10PE50 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % Min. | % Low | % Mod. | % High | % V. High | Hazard Class | Median, m | Hazard Class | Median, m | Hazard Class |
| 1 | Qlaly and Qly units located in NW part of valley and Draper, 39 boreholes | 41.0 | 25.6 | 15.4 | 10.3 | 7.7 | High | 0.01 | Low | 0.01 | Low |
| 2 | Qaly between I-215 and I-15 from 600 N to 4700 S, 15 boreholes | 20.0 | 26.7 | 6.7 | 40.0 | 6.7 | High | 0.11 | Mod. | 0.06 | Low |
| 3 | Qal1 deposit in center of valley along entire length, branches to Little and Big Cottonwood Canyons, 288 boreholes | 35.4 | 12.8 | 7.6 | 12.8 | 31.3 | V. High | 0.12 | Mod. | 0.09 | Low |
| 4 | Qal2 deposit located alongside Qal1 unit in center of valley, branches to Little and Big Cottonwood Canyons, 111 boreholes | 45.0 | 22.5 | 9.0 | 13.5 | 9.9 | High | 0.01 | Low | 0.01 | Low |
| 5 | Qlaly unit located between I-15 and 1300 East from 600 North to 4500 South, data north of I-80 only, 87 boreholes | 41.4 | 10.3 | 4.6 | 11.5 | 32.2 | V. High | 0.07 | Low | 0.07 | Low |
| 6 | Qlaly unit located between I-15 and 1300 East from 600 North to 4500 South, data south of I-80 only, 15 boreholes | 60.0 | 0.0 | 13.3 | 20.0 | 6.7 | High | 0.00 | Min. | 0.00 | Min. |
| 7 | Qlbpm unit located between State Street and 2700 East from 3300 South to 4500 South, 24 boreholes | 29.2 | 12.5 | 25.0 | 20.8 | 12.5 | High | 0.14 | Mod. | 0.13 | Mod. |
| 8 | Qlbpm unit located between 500 East and 1100 East from 4200 South to 4700 South, 10 boreholes | 60.0 | 20.0 | 10.0 | 0.0 | 10.0 | Mod. | 0.00 | Min. | 0.00 | Min. |
| 9 | Qlbpm units located between 900 East and Van Winkle Expressway from 4700 South to 7000 South, 8 boreholes | 62.5 | 25.0 | 0.0 | 12.5 | 0.0 | Low | 0.00 | Min. | 0.00 | Min. |
| 10 | Qlbpm units along I-15 between 3900 S and 9000 S, 123 boreholes | 82.9 | 5.7 | 1.6 | 5.7 | 4.1 | Low | 0.00 | Min. | 0.00 | Min. |
| 11 | Qlbpm units along I-15 between 9000 S and 12300 S, 27 boreholes | 48.1 | 18.5 | 11.1 | 22.2 | 0.0 | High | 0.00 | Low | 0.00 | Low |
| 12 | Qlbpm units near I-15 between 600 N and 2300 N, 3 boreholes | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | Min. | 0.00 | Min. | 0.00 | Min. |
| 13 | Qlbpm units east of 1300 E from S Temple to 5300 S, 7 boreholes | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | Min. | 0.00 | Min. | 0.00 | Min. |
| 14 | Qlbpm units west of I-15 and units south of 12300 S, 67 boreholes | 73.1 | 16.4 | 3.0 | 3.0 | 4.5 | Low | 0.00 | Min. | 0.00 | Min. |
| 15 | Qaf2 and Qmls units City Creek fan, 10 boreholes | 60.0 | 0.0 | 0.0 | 0.0 | 40.0 | V. High | 0.00 | Min. | 0.00 | Min. |
| 16 | All Qaf2 units except City Creek fan, 20 boreholes | 85.0 | 0.0 | 0.0 | 0.0 | 15.0 | Min. | 0.00 | Min. | 0.00 | Min. |
| 17 | All Qalp units in the valley, 10 boreholes | 90.0 | 0.0 | 0.0 | 0.0 | 10.0 | Min. | 0.00 | Min. | 0.00 | Min. |
| 18 | All Qlpg units in the valley, 40 boreholes | 70.0 | 2.5 | 7.5 | 5.0 | 15.0 | High | 0.00 | Min. | 0.00 | Min. |
| 19 | All Qlbpg units in the valley, 12 boreholes | 83.3 | 0.0 | 0.0 | 8.3 | 8.3 | High | 0.00 | Min. | 0.00 | Min. |
| 20 | All Qlbps units in the valley, 5 boreholes | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | Min. | 0.00 | Min. | 0.00 | Min. |
| 21 | All Qafy units in the valley, 6 boreholes | 83.3 | 16.7 | 0.0 | 0.0 | 0.0 | Low | 0.00 | Min. | 0.00 | Min. |
| 22 | All Qlpd units in the valley, 5 boreholes | 80.0 | 0.0 | 0.0 | 0.0 | 20.0 | V. High | 0.00 | Min. | 0.00 | Min. |
| 23 | All Qlbg units in the valley, 14 boreholes | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | Min. | 0.00 | Min. | 0.00 | Min. |
| 24 | Various smaller units in foothills, 17 boreholes (Qafb, Qca, QTaf, Qes, Qlbm, Mz, Qafo, Qlbs, Pz and Rock) | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | Min. | 0.00 | Min. | 0.00 | Min. |

# Table 8

## A Summary of Liquefaction-Induced Ground Settlement for the Salt Lake Valley

| Unit Number | Surficial Geologic Unit/Group Description | Wasatch Fault M7.0 Scenario Event | | | | | Probabilistic 2PE50 | | Probabilistic 10PE50 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | % Low | % Mod. | % High | % V. High | Hazard Class | Median, m | Hazard Class | Median, m | Hazard Class |
| 1 | Qlaly and Qly units located in NW part of valley and Draper, 39 boreholes | 48.7 | 25.6 | 25.6 | 0.0 | High | 0.05 | Mod. | 0.04 | Low |
| 2 | Qaly between I-215 and I-15 from 600 N to 4700 S, 15 boreholes | 53.3 | 20.0 | 26.7 | 0.0 | High | 0.05 | Low | 0.04 | Low |
| 3 | Qal1 deposit in center of valley along entire length, branches to Little and Big Cottonwood Canyons, 288 boreholes | 49.7 | 26.4 | 22.6 | 1.4 | High | 0.05 | Mod. | 0.03 | Low |
| 4 | Qal2 deposit located alongside Qal1 unit in center of valley, branches to Little and Big Cottonwood Canyons, 111 boreholes | 66.7 | 20.7 | 11.7 | 0.9 | Mod. | 0.03 | Low | 0.01 | Low |
| 5 | Qlaly unit located between I-15 and 1300 East from 600 North to 4500 South, data north of I-80 only, 87 boreholes | 46.0 | 27.6 | 24.1 | 2.3 | High | 0.05 | Mod. | 0.04 | Low |
| 6 | Qlaly unit located between I-15 and 1300 East from 600 North to 4500 South, data south of I-80 only, 15 boreholes | 80.0 | 13.3 | 6.7 | 0.0 | Mod. | 0.01 | Low | 0.01 | Low |
| 7 | Qlbpm unit located between State Street and 2700 East from 3300 South to 4500 South, 24 boreholes | 58.3 | 16.7 | 25.0 | 0.0 | High | 0.04 | Low | 0.03 | Low |
| 8 | Qlbpm unit located between 500 East and 1100 East from 4200 South to 4700 South, 10 boreholes | 90.0 | 10.0 | 0.0 | 0.0 | Low | 0.02 | Low | 0.01 | Low |
| 9 | Qlbpm units located between 900 East and Van Winkle Expressway from 4700 South to 7000 South, 8 boreholes | 75.0 | 12.5 | 12.5 | 0.0 | Mod. | 0.01 | Low | 0.01 | Low |
| 10 | Qlbpm units along I-15 between 3900 S and 9000 S, 123 boreholes | 87.8 | 6.5 | 5.7 | 0.0 | Low | 0.00 | Low | 0.00 | Low |
| 11 | Qlbpm units along I-15 between 9000 S and 12300 S, 27 boreholes | 51.9 | 14.8 | 33.3 | 0.0 | High | 0.05 | Low | 0.02 | Low |
| 12 | Qlbpm units near I-15 between 600 N and 2300 N, 3 boreholes | 66.7 | 0.0 | 33.3 | 0.0 | High | 0.02 | Low | 0.00 | Low |
| 13 | Qlbpm units east of 1300 E from S Temple to 5300 S, 7 boreholes | 100.0 | 0.0 | 0.0 | 0.0 | Low | 0.00 | Low | 0.00 | Low |
| 14 | Qlbpm units west of I-15 and units south of 12300 S, 67 boreholes | 86.6 | 11.9 | 0.0 | 1.5 | Low | 0.00 | Low | 0.00 | Low |
| 15 | Qaf2 and Qmls units City Creek fan, 10 boreholes | 60.0 | 0.0 | 40.0 | 0.0 | High | 0.04 | Low | 0.00 | Low |
| 16 | All Qaf2 units except City Creek fan, 20 boreholes | 95.0 | 5.0 | 0.0 | 0.0 | Low | 0.00 | Low | 0.00 | Low |
| 17 | All Qalp units in the valley, 10 boreholes | 90.0 | 0.0 | 10.0 | 0.0 | Low | 0.00 | Low | 0.00 | Low |
| 18 | All Qlpg units in the valley, 40 boreholes | 80.0 | 15.0 | 5.0 | 0.0 | Mod. | 0.01 | Low | 0.00 | Low |
| 19 | All Qlbpg units in the valley, 12 boreholes | 91.7 | 0.0 | 8.3 | 0.0 | Low | 0.00 | Low | 0.00 | Low |
| 20 | All Qlbps units in the valley, 5 boreholes | 100.0 | 0.0 | 0.0 | 0.0 | Low | 0.00 | Low | 0.00 | Low |
| 21 | All Qafy units in the valley, 6 boreholes | 100.0 | 0.0 | 0.0 | 0.0 | Low | 0.01 | Low | 0.00 | Low |
| 22 | All Qlpd units in the valley, 5 boreholes | 80.0 | 20.0 | 0.0 | 0.0 | Mod. | 0.02 | Low | 0.00 | Low |
| 23 | All Qlbg units in the valley, 14 boreholes | 92.9 | 7.1 | 0.0 | 0.0 | Low | 0.00 | Low | 0.00 | Low |
| 24 | Various smaller units in foothills, 17 boreholes (Qafb, Qca, QTaf, Qes, Qlbm, Mz, Qafo, Qlbs, Pz and Rock) | 100.0 | 0.0 | 0.0 | 0.0 | Low | 0.00 | Low | 0.00 | Low |

# APPENDIX D

# TABLULATED GROUND DISPLACEMENTS

This appendix contains tables of the ground displacement values used in assigning the hazard categories shown in the lateral spread and ground settlement maps. The tables are organized according to the 24 geologic groups that are briefly described in Appendix C. The tables indicate the borehole ID number of each borehole so that the displacement estimates may be cross-referenced with Table 3 in Appendix A for a description of approximate borehole location and date drilled.

# Table 9

## Qlaly and Qly units located in northwest part of valley and Draper, 39 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 14 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| 18 | 0.23 | 0.19 | 0.18 | 0.02 | 0.02 | 0.01 |
| 19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | 0.00 | 0.00 | 0.00 | 0.13 | 0.13 | 0.13 |
| 28 | 0.63 | 0.51 | 0.50 | 0.12 | 0.12 | 0.12 |
| 30 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| 54 | 0.02 | 0.07 | 0.07 | 0.07 | 0.07 | 0.06 |
| 58 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.04 |
| 61 | 0.45 | 0.44 | 0.43 | 0.24 | 0.25 | 0.22 |
| 62 | 0.00 | 0.00 | 0.00 | 0.18 | 0.19 | 0.17 |
| 64 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 |
| 69 | 4.94 | 4.91 | 4.88 | 0.06 | 0.07 | 0.05 |
| 77 | 2.04 | 1.78 | 1.76 | 0.18 | 0.19 | 0.17 |
| 78 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 |
| 93 | 0.03 | 0.02 | 0.02 | 0.07 | 0.08 | 0.05 |
| 102 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| 105 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.01 |
| 106 | 0.00 | 0.00 | 0.00 | 0.05 | 0.07 | 0.02 |
| 107 | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.04 |
| 108 | 0.01 | 0.01 | 0.01 | 0.15 | 0.16 | 0.13 |
| 109 | 0.00 | 0.00 | 0.00 | 0.10 | 0.12 | 0.08 |
| 110 | 0.13 | 0.84 | 0.83 | 0.08 | 0.09 | 0.07 |
| 111 | 0.23 | 2.60 | 2.58 | 0.08 | 0.09 | 0.08 |
| 112 | 0.21 | 0.19 | 0.19 | 0.01 | 0.01 | 0.01 |
| 113 | 0.00 | 0.00 | 0.00 | 0.11 | 0.13 | 0.06 |
| 709 | 0.18 | 0.14 | 0.14 | 0.10 | 0.10 | 0.09 |
| 710 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 711 | 0.85 | 0.71 | 0.71 | 0.03 | 0.03 | 0.03 |
| 721 | 0.02 | 0.15 | 0.15 | 0.05 | 0.05 | 0.05 |
| 722 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 |
| 723 | 0.10 | 0.09 | 0.09 | 0.02 | 0.02 | 0.02 |
| 724 | 0.49 | 0.43 | 0.43 | 0.07 | 0.07 | 0.07 |
| 735 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 738 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.01 |
| 745 | 0.18 | 0.15 | 0.14 | 0.06 | 0.06 | 0.05 |
| 748 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Table 10

## Qaly units between I-215 and I-15 from 600 North to 4700 South, 15 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 13 | 1.01 | 0.77 | 0.76 | 0.08 | 0.08 | 0.07 |
| 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | 0.04 | 0.04 | 0.00 | 0.02 | 0.02 | 0.01 |
| 25 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 65 | 0.28 | 0.17 | 0.17 | 0.20 | 0.21 | 0.19 |
| 67 | 0.35 | 0.31 | 0.31 | 0.20 | 0.22 | 0.14 |
| 82 | 0.38 | 0.30 | 0.30 | 0.03 | 0.03 | 0.03 |
| 91 | 0.34 | 0.27 | 0.26 | 0.16 | 0.17 | 0.15 |
| 104 | 0.08 | 0.06 | 0.06 | 0.05 | 0.06 | 0.04 |
| 681 | 0.61 | 0.51 | 0.00 | 0.04 | 0.04 | 0.02 |
| 682 | 0.03 | 0.03 | 0.03 | 0.08 | 0.08 | 0.05 |
| 726 | 0.05 | 0.06 | 0.05 | 0.03 | 0.03 | 0.02 |
| 740 | 0.79 | 0.56 | 0.56 | 0.05 | 0.05 | 0.04 |
| 746 | 0.37 | 0.11 | 0.11 | 0.14 | 0.14 | 0.13 |

## Table 11

## Qal1 deposit in center of valley along entire length, branches to Little and Big Cottonwood Canyons, 288 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m | | | Ground Settlement Displacement, m | | |
|---|---|---|---|---|---|---|
| | Youd and others (2002) | | | Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 12 | 3.06 | 2.54 | 2.53 | 0.16 | 0.16 | 0.16 |
| 66 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.02 |
| 68 | 0.78 | 0.71 | 0.71 | 0.15 | 0.17 | 0.13 |
| 75 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.02 |
| 79 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.01 |
| 92 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 |
| 94 | 1.71 | 1.39 | 1.38 | 0.15 | 0.16 | 0.11 |
| 99 | 0.24 | 0.21 | 0.21 | 0.08 | 0.10 | 0.05 |
| 134 | 0.00 | 0.00 | 0.00 | 0.08 | 0.10 | 0.02 |
| 135 | 0.01 | 0.00 | 0.00 | 0.11 | 0.12 | 0.09 |
| 136 | 0.02 | 0.02 | 0.02 | 0.05 | 0.06 | 0.04 |
| 137 | 0.96 | 0.75 | 0.74 | 0.06 | 0.06 | 0.04 |
| 138 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.02 |
| 139 | 0.00 | 0.00 | 0.00 | 0.05 | 0.07 | 0.01 |
| 140 | 0.01 | 0.01 | 0.01 | 0.16 | 0.17 | 0.11 |
| 141 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.00 |
| 142 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 143 | 0.01 | 0.00 | 0.00 | 0.03 | 0.03 | 0.02 |
| 144 | 4.33 | 3.75 | 3.73 | 0.03 | 0.03 | 0.03 |
| 145 | 0.01 | 0.00 | 0.00 | 0.03 | 0.03 | 0.03 |
| 146 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 147 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 148 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.05 |
| 149 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.05 |
| 150 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 151 | 0.03 | 0.02 | 0.02 | 0.05 | 0.05 | 0.04 |
| 152 | 0.20 | 0.15 | 0.15 | 0.11 | 0.11 | 0.09 |
| 153 | 0.20 | 0.14 | 0.14 | 0.16 | 0.16 | 0.13 |
| 154 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.01 |
| 172 | 0.13 | 0.11 | 0.11 | 0.13 | 0.13 | 0.12 |
| 173 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.00 |
| 174 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.03 |
| 178 | 0.00 | 0.00 | 0.00 | 0.11 | 0.11 | 0.11 |
| 179 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 |
| 180 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 |
| 181 | 0.27 | 0.24 | 0.24 | 0.10 | 0.10 | 0.06 |
| 182 | 0.05 | 0.04 | 0.04 | 0.11 | 0.12 | 0.08 |
| 183 | 0.00 | 0.00 | 0.00 | 0.10 | 0.12 | 0.03 |
| 184 | 0.11 | 0.10 | 0.10 | 0.06 | 0.06 | 0.04 |
| 185 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 186 | 0.00 | 0.00 | 0.00 | 0.06 | 0.07 | 0.04 |
| 187 | 0.41 | 0.38 | 0.38 | 0.06 | 0.07 | 0.03 |
| 188 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 189 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.02 |
| 190 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 191 | 0.29 | 0.22 | 0.22 | 0.06 | 0.06 | 0.03 |

Table 11 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Ishihara and Yoshimine (1992) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 192 | 0.00 | 0.00 | 0.00 | 0.10 | 0.11 | 0.03 |
| 193 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 194 | 0.00 | 0.00 | 0.00 | 0.06 | 0.07 | 0.01 |
| 195 | 5.24 | 4.44 | 4.40 | 0.17 | 0.17 | 0.14 |
| 196 | 0.14 | 0.13 | 0.13 | 0.14 | 0.14 | 0.11 |
| 197 | 0.27 | 0.25 | 0.24 | 0.18 | 0.19 | 0.16 |
| 198 | 1.42 | 1.33 | 1.32 | 0.19 | 0.19 | 0.17 |
| 199 | 0.14 | 0.13 | 0.13 | 0.09 | 0.09 | 0.07 |
| 200 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 201 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 202 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 203 | 2.14 | 1.91 | 1.89 | 0.06 | 0.06 | 0.05 |
| 204 | 0.06 | 0.05 | 0.05 | 0.07 | 0.08 | 0.06 |
| 205 | 0.14 | 0.13 | 0.13 | 0.04 | 0.04 | 0.04 |
| 206 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.00 |
| 207 | 0.01 | 0.01 | 0.01 | 0.07 | 0.08 | 0.03 |
| 208 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 209 | 0.00 | 0.00 | 0.00 | 0.08 | 0.09 | 0.07 |
| 210 | 0.26 | 0.25 | 0.24 | 0.05 | 0.06 | 0.03 |
| 211 | 0.09 | 0.08 | 0.08 | 0.13 | 0.14 | 0.07 |
| 212 | 1.13 | 1.02 | 1.01 | 0.07 | 0.08 | 0.03 |
| 213 | 0.64 | 0.59 | 0.59 | 0.08 | 0.08 | 0.07 |
| 214 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 215 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 216 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 217 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.02 |
| 218 | 0.97 | 0.92 | 0.91 | 0.05 | 0.05 | 0.05 |
| 219 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 220 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.01 |
| 222 | 0.07 | 0.06 | 0.06 | 0.10 | 0.10 | 0.07 |
| 223 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 224 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 |
| 225 | 0.43 | 0.39 | 0.38 | 0.16 | 0.16 | 0.12 |
| 226 | 0.02 | 0.02 | 0.02 | 0.17 | 0.17 | 0.15 |
| 227 | 1.07 | 1.00 | 0.99 | 0.13 | 0.15 | 0.07 |
| 228 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 229 | 0.13 | 0.12 | 0.12 | 0.08 | 0.09 | 0.06 |
| 230 | 1.78 | 1.69 | 1.68 | 0.17 | 0.17 | 0.13 |
| 231 | 0.91 | 0.86 | 0.85 | 0.10 | 0.11 | 0.07 |
| 232 | 1.03 | 1.01 | 1.00 | 0.11 | 0.12 | 0.10 |
| 233 | 1.33 | 1.25 | 1.24 | 0.04 | 0.04 | 0.04 |
| 234 | 0.03 | 0.03 | 0.03 | 0.10 | 0.10 | 0.08 |
| 235 | 0.24 | 0.21 | 0.21 | 0.08 | 0.10 | 0.04 |
| 236 | 1.51 | 1.39 | 1.38 | 0.08 | 0.08 | 0.07 |
| 237 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 239 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 240 | 1.37 | 1.17 | 1.16 | 0.11 | 0.11 | 0.10 |
| 277 | 0.08 | 0.07 | 0.07 | 0.04 | 0.05 | 0.04 |
| 279 | 1.11 | 0.90 | 0.89 | 0.02 | 0.02 | 0.01 |
| 280 | 0.28 | 0.23 | 0.22 | 0.03 | 0.03 | 0.01 |

Table 11 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Ishihara and Yoshimine (1992) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 281 | 2.48 | 2.13 | 2.11 | 0.09 | 0.10 | 0.05 |
| 282 | 1.89 | 1.59 | 1.57 | 0.12 | 0.12 | 0.11 |
| 283 | 1.37 | 1.14 | 1.12 | 0.07 | 0.07 | 0.06 |
| 284 | 0.29 | 0.24 | 0.24 | 0.31 | 0.32 | 0.25 |
| 285 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 |
| 286 | 0.04 | 0.04 | 0.04 | 0.03 | 0.04 | 0.01 |
| 287 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 289 | 3.32 | 2.90 | 2.86 | 0.20 | 0.20 | 0.19 |
| 290 | 0.91 | 0.77 | 0.76 | 0.18 | 0.20 | 0.13 |
| 291 | 1.30 | 1.07 | 1.06 | 0.19 | 0.21 | 0.13 |
| 293 | 1.08 | 0.87 | 0.86 | 0.04 | 0.04 | 0.04 |
| 295 | 2.46 | 2.14 | 2.12 | 0.06 | 0.07 | 0.05 |
| 296 | 0.33 | 0.28 | 0.28 | 0.06 | 0.06 | 0.02 |
| 297 | 1.34 | 1.16 | 1.15 | 0.03 | 0.03 | 0.03 |
| 298 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.00 |
| 299 | 0.69 | 0.58 | 0.57 | 0.05 | 0.05 | 0.04 |
| 300 | 1.12 | 0.94 | 0.93 | 0.04 | 0.04 | 0.04 |
| 301 | 1.28 | 1.05 | 1.04 | 0.04 | 0.04 | 0.04 |
| 303 | 2.90 | 2.35 | 2.33 | 0.07 | 0.07 | 0.07 |
| 306 | 1.07 | 0.84 | 0.83 | 0.03 | 0.03 | 0.01 |
| 307 | 0.06 | 0.06 | 0.06 | 0.02 | 0.02 | 0.01 |
| 330 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 367 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.00 |
| 368 | 2.23 | 1.87 | 1.84 | 0.03 | 0.03 | 0.02 |
| 369 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 372 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.01 |
| 373 | 0.00 | 0.00 | 0.00 | 0.04 | 0.03 | 0.00 |
| 374 | 0.52 | 0.43 | 0.00 | 0.09 | 0.09 | 0.01 |
| 375 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 376 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 384 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 385 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 386 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 387 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 388 | 0.61 | 0.52 | 0.51 | 0.10 | 0.10 | 0.01 |
| 429 | 1.13 | 0.97 | 0.00 | 0.09 | 0.09 | 0.07 |
| 430 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |
| 431 | 0.00 | 0.00 | 0.00 | 0.07 | 0.07 | 0.02 |
| 432 | 0.92 | 0.78 | 0.77 | 0.06 | 0.06 | 0.03 |
| 433 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |
| 434 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 435 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.03 |
| 436 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 439 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 448 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 459 | 3.55 | 2.37 | 2.36 | 0.08 | 0.08 | 0.05 |
| 460 | 1.13 | 0.76 | 0.76 | 0.03 | 0.04 | 0.01 |
| 465 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 466 | 1.71 | 1.39 | 1.38 | 0.17 | 0.19 | 0.16 |
| 467 | 0.50 | 0.39 | 0.39 | 0.04 | 0.04 | 0.03 |

Table 11 Continued

| | Lateral Spread Horizontal Displacement, m | | | Ground Settlement Displacement, m | | |
|---|---|---|---|---|---|---|
| Borehole ID Number | Youd and others (2002) | | | Average of Tokimatsu and Seed (1987) and Ishihara and Yoshimine (1992) | | |
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 474 | 2.69 | 2.04 | 2.03 | 0.15 | 0.15 | 0.13 |
| 478 | 2.12 | 1.79 | 1.78 | 0.14 | 0.15 | 0.13 |
| 479 | 2.96 | 1.80 | 1.79 | 0.28 | 0.28 | 0.26 |
| 480 | 3.23 | 2.19 | 2.18 | 0.11 | 0.11 | 0.08 |
| 481 | 0.00 | 0.00 | 0.00 | 0.10 | 0.10 | 0.05 |
| 482 | 1.19 | 0.75 | 0.75 | 0.04 | 0.04 | 0.02 |
| 485 | 3.50 | 2.49 | 2.48 | 0.11 | 0.11 | 0.09 |
| 486 | 1.70 | 1.18 | 1.17 | 0.23 | 0.24 | 0.19 |
| 487 | 2.30 | 1.88 | 1.87 | 0.04 | 0.04 | 0.04 |
| 488 | 0.09 | 0.07 | 0.07 | 0.13 | 0.13 | 0.08 |
| 489 | 0.73 | 0.57 | 0.57 | 0.06 | 0.06 | 0.06 |
| 490 | 2.46 | 1.89 | 1.89 | 0.18 | 0.18 | 0.09 |
| 494 | 3.35 | 2.27 | 2.26 | 0.19 | 0.20 | 0.17 |
| 495 | 7.29 | 4.77 | 4.74 | 0.08 | 0.08 | 0.08 |
| 496 | 1.49 | 1.20 | 1.19 | 0.04 | 0.04 | 0.04 |
| 497 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.02 |
| 498 | 3.11 | 2.09 | 0.09 | 0.21 | 0.23 | 0.13 |
| 499 | 2.99 | 1.90 | 1.89 | 0.17 | 0.18 | 0.13 |
| 500 | 0.00 | 0.00 | 0.00 | 0.14 | 0.14 | 0.08 |
| 501 | 1.18 | 0.96 | 0.96 | 0.13 | 0.14 | 0.11 |
| 502 | 4.05 | 3.10 | 3.08 | 0.13 | 0.13 | 0.12 |
| 503 | 3.24 | 2.47 | 2.45 | 0.24 | 0.24 | 0.23 |
| 504 | 0.64 | 0.49 | 0.49 | 0.08 | 0.09 | 0.05 |
| 505 | 2.91 | 2.26 | 2.25 | 0.05 | 0.06 | 0.03 |
| 514 | 0.56 | 0.42 | 0.42 | 0.06 | 0.08 | 0.02 |
| 515 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 516 | 1.58 | 1.14 | 1.14 | 0.05 | 0.06 | 0.04 |
| 517 | 2.48 | 1.82 | 1.81 | 0.07 | 0.07 | 0.07 |
| 518 | 0.00 | 0.00 | 0.00 | 0.13 | 0.14 | 0.08 |
| 519 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 520 | 0.00 | 0.00 | 0.00 | 0.10 | 0.11 | 0.08 |
| 521 | 1.03 | 0.79 | 0.79 | 0.03 | 0.04 | 0.01 |
| 522 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.00 |
| 523 | 1.73 | 1.18 | 1.17 | 0.12 | 0.15 | 0.04 |
| 524 | 1.55 | 1.22 | 0.00 | 0.02 | 0.03 | 0.00 |
| 525 | 1.92 | 1.49 | 1.48 | 0.07 | 0.08 | 0.06 |
| 526 | 2.14 | 1.70 | 1.69 | 0.26 | 0.26 | 0.25 |
| 527 | 1.52 | 1.21 | 1.20 | 0.03 | 0.04 | 0.01 |
| 528 | 1.07 | 0.83 | 0.83 | 0.06 | 0.07 | 0.04 |
| 529 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.01 |
| 530 | 1.44 | 1.18 | 1.18 | 0.04 | 0.04 | 0.03 |
| 534 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 535 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 536 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 537 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.02 |
| 540 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 541 | 1.24 | 0.91 | 0.91 | 0.04 | 0.04 | 0.02 |
| 542 | 0.06 | 0.04 | 0.04 | 0.03 | 0.04 | 0.02 |
| 543 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 544 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 11 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m | | | Ground Settlement Displacement, m | | |
|---|---|---|---|---|---|---|
| | Youd and others (2002) | | | Average of Tokimatsu and Seed (1987) and Ishihara and Yoshimine (1992) | | |
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 545 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 546 | 0.03 | 0.03 | 0.03 | 0.01 | 0.01 | 0.01 |
| 547 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 548 | 0.09 | 0.07 | 0.07 | 0.01 | 0.01 | 0.01 |
| 549 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 550 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 551 | 4.35 | 2.88 | 2.86 | 0.12 | 0.12 | 0.11 |
| 552 | 0.85 | 0.67 | 0.67 | 0.01 | 0.01 | 0.00 |
| 555 | 2.93 | 2.40 | 2.39 | 0.02 | 0.02 | 0.01 |
| 556 | 1.97 | 1.58 | 1.57 | 0.03 | 0.03 | 0.02 |
| 557 | 1.48 | 1.16 | 1.15 | 0.04 | 0.04 | 0.04 |
| 558 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 559 | 1.54 | 1.30 | 1.29 | 0.05 | 0.05 | 0.04 |
| 560 | 0.43 | 0.32 | 0.32 | 0.01 | 0.01 | 0.00 |
| 561 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 562 | 0.10 | 0.09 | 0.00 | 0.03 | 0.04 | 0.01 |
| 563 | 5.15 | 4.34 | 4.29 | 0.13 | 0.13 | 0.12 |
| 564 | 1.35 | 1.13 | 1.11 | 0.04 | 0.04 | 0.04 |
| 565 | 0.52 | 0.49 | 0.49 | 0.18 | 0.18 | 0.16 |
| 566 | 0.46 | 0.43 | 0.42 | 0.19 | 0.20 | 0.16 |
| 567 | 0.41 | 0.38 | 0.37 | 0.11 | 0.12 | 0.09 |
| 568 | 0.00 | 0.00 | 0.00 | 0.07 | 0.07 | 0.07 |
| 570 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.03 |
| 571 | 0.01 | 0.01 | 0.01 | 0.03 | 0.03 | 0.03 |
| 572 | 0.47 | 0.41 | 0.40 | 0.05 | 0.08 | 0.02 |
| 573 | 2.74 | 2.33 | 2.31 | 0.31 | 0.31 | 0.25 |
| 574 | 0.00 | 0.00 | 0.00 | 0.18 | 0.19 | 0.15 |
| 575 | 0.61 | 0.53 | 0.53 | 0.06 | 0.06 | 0.04 |
| 576 | 0.00 | 0.00 | 0.00 | 0.18 | 0.19 | 0.12 |
| 577 | 0.07 | 0.07 | 0.07 | 0.09 | 0.11 | 0.05 |
| 578 | 0.70 | 0.63 | 0.62 | 0.11 | 0.12 | 0.07 |
| 579 | 1.22 | 1.04 | 1.03 | 0.32 | 0.34 | 0.27 |
| 580 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 581 | 0.16 | 0.13 | 0.13 | 0.05 | 0.05 | 0.04 |
| 582 | 2.05 | 1.72 | 1.70 | 0.05 | 0.05 | 0.05 |
| 630 | 0.03 | 0.03 | 0.03 | 0.50 | 0.52 | 0.48 |
| 631 | 1.60 | 1.33 | 1.32 | 0.07 | 0.07 | 0.02 |
| 632 | 1.51 | 1.28 | 1.27 | 0.17 | 0.17 | 0.16 |
| 633 | 0.55 | 0.46 | 0.46 | 0.13 | 0.13 | 0.09 |
| 634 | 1.10 | 0.91 | 0.91 | 0.11 | 0.12 | 0.10 |
| 635 | 1.08 | 0.91 | 0.90 | 0.11 | 0.11 | 0.07 |
| 636 | 2.24 | 1.88 | 1.86 | 0.13 | 0.13 | 0.11 |
| 665 | 0.66 | 0.55 | 0.54 | 0.04 | 0.04 | 0.03 |
| 666 | 0.38 | 0.31 | 0.30 | 0.05 | 0.06 | 0.02 |
| 667 | 0.67 | 0.55 | 0.55 | 0.07 | 0.07 | 0.03 |
| 679 | 1.17 | 0.98 | 0.97 | 0.06 | 0.07 | 0.03 |
| 730 | 0.06 | 0.05 | 0.05 | 0.02 | 0.03 | 0.01 |
| 731 | 0.44 | 0.37 | 0.37 | 0.02 | 0.02 | 0.02 |
| 737 | 0.05 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 |
| 744 | 0.74 | 0.70 | 0.69 | 0.09 | 0.09 | 0.08 |

Table 11 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Ishihara and Yoshimine (1992) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 747 | 0.59 | 0.44 | 0.44 | 0.08 | 0.08 | 0.04 |
| 749 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1008 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |
| 1021 | 0.98 | 0.82 | 0.81 | 0.06 | 0.06 | 0.04 |
| 1025 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.02 |
| 1027 | 1.94 | 1.76 | 1.75 | 0.02 | 0.02 | 0.02 |
| 1029 | 0.37 | 0.35 | 0.34 | 0.09 | 0.09 | 0.08 |
| 1034 | 2.59 | 1.78 | 1.78 | 0.02 | 0.02 | 0.02 |
| 1039 | 2.99 | 2.66 | 2.64 | 0.06 | 0.06 | 0.05 |
| 1042 | 0.24 | 0.13 | 0.13 | 0.07 | 0.07 | 0.05 |
| 1043 | 4.93 | 4.40 | 4.38 | 0.20 | 0.21 | 0.17 |
| 1047 | 0.50 | 0.44 | 0.43 | 0.05 | 0.05 | 0.04 |
| 1054 | 0.10 | 0.08 | 0.08 | 0.10 | 0.11 | 0.06 |
| 1055 | 1.12 | 1.00 | 0.99 | 0.06 | 0.07 | 0.05 |
| 1057 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 1058 | 7.60 | 4.58 | 4.57 | 0.15 | 0.16 | 0.11 |
| 1068 | 1.55 | 1.23 | 1.22 | 0.13 | 0.14 | 0.10 |
| 1079 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1080 | 2.33 | 1.90 | 1.89 | 0.06 | 0.06 | 0.06 |
| 1083 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1106 | 0.17 | 0.12 | 0.12 | 0.09 | 0.09 | 0.06 |
| 1107 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 |
| 1117 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1123 | 2.00 | 1.41 | 1.40 | 0.07 | 0.07 | 0.05 |
| 1130 | 2.04 | 1.46 | 1.45 | 0.02 | 0.02 | 0.02 |
| 1134 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1136 | 1.01 | 0.81 | 0.80 | 0.06 | 0.06 | 0.04 |
| 1139 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1140 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1143 | 1.00 | 0.85 | 0.85 | 0.07 | 0.07 | 0.03 |
| 1144 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 1146 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1148 | 0.16 | 0.11 | 0.11 | 0.02 | 0.02 | 0.01 |
| 1159 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1160 | 0.03 | 0.03 | 0.03 | 0.07 | 0.07 | 0.03 |
| 1166 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 |
| 1236 | 0.87 | 0.76 | 0.75 | 0.01 | 0.02 | 0.00 |
| 1245 | 1.12 | 1.17 | 1.16 | 0.09 | 0.09 | 0.08 |
| 1274 | 0.00 | 0.00 | 0.00 | 0.07 | 0.06 | 0.01 |
| 1276 | 7.94 | 7.44 | 7.42 | 0.21 | 0.21 | 0.12 |
| 1298 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1299 | 1.29 | 1.19 | 1.18 | 0.07 | 0.07 | 0.07 |

# Table 12

# Qal2 deposit located alongside Qal1 unit in center of valley, branches to Little and Big Cottonwood Canyons, 111 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m Youd and others (2002) | | | Ground Settlement Displacement, m Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 4 | 0.95 | 0.78 | 0.77 | 0.08 | 0.08 | 0.05 |
| 11 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 36 | 2.01 | 1.56 | 1.54 | 0.23 | 0.23 | 0.21 |
| 48 | 0.02 | 0.02 | 0.02 | 0.04 | 0.04 | 0.02 |
| 96 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 304 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 305 | 0.68 | 0.53 | 0.52 | 0.07 | 0.07 | 0.07 |
| 308 | 0.20 | 0.15 | 0.15 | 0.05 | 0.05 | 0.04 |
| 347 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.02 |
| 348 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 349 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 350 | 0.32 | 0.26 | 0.26 | 0.03 | 0.03 | 0.03 |
| 351 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 352 | 0.19 | 0.14 | 0.14 | 0.07 | 0.07 | 0.06 |
| 353 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 371 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 379 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 380 | 0.00 | 0.00 | 0.00 | 0.05 | 0.04 | 0.01 |
| 624 | 1.27 | 0.96 | 0.95 | 0.09 | 0.10 | 0.06 |
| 625 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.00 |
| 626 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.04 |
| 627 | 0.00 | 0.00 | 0.00 | 0.12 | 0.13 | 0.07 |
| 628 | 0.00 | 0.00 | 0.00 | 0.09 | 0.11 | 0.05 |
| 629 | 0.01 | 0.01 | 0.00 | 0.04 | 0.04 | 0.02 |
| 638 | 1.68 | 1.34 | 1.33 | 0.11 | 0.13 | 0.05 |
| 639 | 0.46 | 0.35 | 0.35 | 0.04 | 0.04 | 0.04 |
| 640 | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 | 0.01 |
| 641 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 |
| 642 | 1.12 | 0.92 | 0.91 | 0.16 | 0.16 | 0.14 |
| 643 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 644 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 645 | 0.16 | 0.12 | 0.12 | 0.03 | 0.03 | 0.02 |
| 646 | 0.29 | 0.22 | 0.22 | 0.03 | 0.03 | 0.02 |
| 647 | 0.35 | 0.29 | 0.28 | 0.07 | 0.07 | 0.07 |
| 648 | 1.32 | 1.07 | 1.06 | 0.13 | 0.13 | 0.12 |
| 649 | 0.87 | 0.69 | 0.68 | 0.03 | 0.04 | 0.03 |
| 650 | 0.07 | 0.04 | 0.04 | 0.05 | 0.05 | 0.02 |
| 651 | 0.87 | 0.63 | 0.63 | 0.07 | 0.07 | 0.06 |
| 652 | 0.02 | 0.02 | 0.02 | 0.11 | 0.11 | 0.07 |
| 654 | 0.04 | 0.03 | 0.03 | 0.13 | 0.15 | 0.05 |
| 655 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 656 | 1.92 | 1.54 | 1.52 | 0.06 | 0.07 | 0.05 |
| 657 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 658 | 0.75 | 0.62 | 0.62 | 0.11 | 0.11 | 0.09 |
| 659 | 0.24 | 0.19 | 0.19 | 0.06 | 0.07 | 0.02 |
| 660 | 0.05 | 0.03 | 0.03 | 0.05 | 0.06 | 0.03 |

# Table 12 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m Youd and others (2002) | | | Ground Settlement Displacement, m Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 661 | 0.05 | 0.04 | 0.04 | 0.16 | 0.17 | 0.14 |
| 662 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 663 | 0.21 | 0.17 | 0.17 | 0.11 | 0.12 | 0.08 |
| 668 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.03 |
| 669 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 670 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 671 | 0.87 | 0.72 | 0.71 | 0.27 | 0.28 | 0.15 |
| 672 | 1.86 | 1.51 | 1.49 | 0.05 | 0.05 | 0.05 |
| 673 | 0.03 | 0.02 | 0.02 | 0.04 | 0.04 | 0.03 |
| 674 | 0.03 | 0.02 | 0.02 | 0.06 | 0.09 | 0.01 |
| 675 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 676 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 677 | 0.50 | 0.39 | 0.38 | 0.03 | 0.03 | 0.03 |
| 678 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.01 |
| 680 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 685 | 0.01 | 0.01 | 0.01 | 0.37 | 0.37 | 0.35 |
| 1001 | 0.05 | 0.04 | 0.04 | 0.01 | 0.01 | 0.01 |
| 1011 | 0.01 | 0.00 | 0.00 | 0.07 | 0.08 | 0.04 |
| 1013 | 1.80 | 1.54 | 1.53 | 0.02 | 0.02 | 0.02 |
| 1016 | 0.16 | 0.10 | 0.10 | 0.07 | 0.08 | 0.02 |
| 1020 | 0.02 | 0.02 | 0.02 | 0.08 | 0.09 | 0.06 |
| 1026 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1030 | 0.01 | 0.01 | 0.01 | 0.03 | 0.03 | 0.01 |
| 1031 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.01 |
| 1035 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1045 | 0.29 | 0.13 | 0.12 | 0.05 | 0.05 | 0.05 |
| 1050 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1060 | 2.00 | 1.49 | 1.48 | 0.05 | 0.05 | 0.04 |
| 1066 | 1.60 | 1.19 | 1.18 | 0.02 | 0.02 | 0.02 |
| 1070 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1071 | 0.19 | 0.11 | 0.11 | 0.06 | 0.06 | 0.05 |
| 1075 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1077 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1084 | 0.09 | 0.06 | 0.06 | 0.09 | 0.09 | 0.09 |
| 1088 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1091 | 0.24 | 0.13 | 0.13 | 0.06 | 0.06 | 0.06 |
| 1093 | 0.04 | 0.03 | 0.03 | 0.05 | 0.06 | 0.02 |
| 1094 | 0.01 | 0.01 | 0.01 | 0.04 | 0.04 | 0.03 |
| 1095 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1102 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.00 |
| 1110 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.01 |
| 1111 | 1.02 | 0.87 | 0.87 | 0.03 | 0.03 | 0.01 |
| 1112 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1115 | 0.04 | 0.03 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1118 | 0.03 | 0.02 | 0.02 | 0.15 | 0.15 | 0.14 |
| 1121 | 0.02 | 0.02 | 0.02 | 0.05 | 0.06 | 0.02 |
| 1122 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| 1124 | 0.57 | 0.51 | 0.50 | 0.01 | 0.01 | 0.01 |
| 1125 | 0.39 | 0.34 | 0.33 | 0.01 | 0.01 | 0.00 |
| 1128 | 0.03 | 0.03 | 0.03 | 0.09 | 0.09 | 0.02 |

# Table 12 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 1138 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1141 | 0.06 | 0.04 | 0.04 | 0.06 | 0.06 | 0.06 |
| 1147 | 0.02 | 0.01 | 0.01 | 0.04 | 0.04 | 0.03 |
| 1149 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1152 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1153 | 0.53 | 0.44 | 0.00 | 0.01 | 0.02 | 0.00 |
| 1155 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.01 |
| 1158 | 0.53 | 0.48 | 0.48 | 0.17 | 0.17 | 0.14 |
| 1169 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1189 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1190 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1191 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1192 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1238 | 0.63 | 0.50 | 0.50 | 0.03 | 0.03 | 0.01 |
| 1239 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 13

## Qlaly unit located between I-15 and 1300 East from 600 North to 4500 South, data north of I-80 only, 87 boreholes

| | Lateral Spread Horizontal Displacement, m | | | Ground Settlement Displacement, m | | |
|---|---|---|---|---|---|---|
| Borehole ID Number | Youd and others (2002) | | | Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 16 | 0.19 | 0.13 | 0.13 | 0.12 | 0.12 | 0.07 |
| 29 | 2.93 | 1.92 | 1.92 | 0.13 | 0.14 | 0.07 |
| 55 | 0.09 | 0.08 | 0.08 | 0.05 | 0.05 | 0.05 |
| 63 | 3.88 | 3.36 | 3.35 | 0.42 | 0.42 | 0.41 |
| 80 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.05 |
| 175 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 176 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 177 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 221 | 0.44 | 0.37 | 0.37 | 0.08 | 0.08 | 0.06 |
| 238 | 0.02 | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 |
| 241 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.03 |
| 461 | 1.44 | 1.09 | 1.09 | 0.03 | 0.03 | 0.03 |
| 462 | 0.52 | 0.40 | 0.39 | 0.10 | 0.10 | 0.08 |
| 463 | 5.61 | 4.07 | 4.05 | 0.23 | 0.23 | 0.23 |
| 464 | 1.25 | 0.87 | 0.86 | 0.26 | 0.27 | 0.21 |
| 468 | 1.26 | 0.96 | 0.96 | 0.12 | 0.12 | 0.09 |
| 470 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 471 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 472 | 1.23 | 0.89 | 0.88 | 0.20 | 0.20 | 0.17 |
| 473 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.03 |
| 475 | 3.73 | 2.89 | 2.88 | 0.06 | 0.06 | 0.05 |
| 476 | 0.06 | 0.04 | 0.04 | 0.11 | 0.11 | 0.10 |
| 477 | 3.39 | 2.39 | 2.39 | 0.08 | 0.08 | 0.05 |
| 483 | 1.37 | 0.82 | 0.81 | 0.07 | 0.07 | 0.07 |
| 484 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 491 | 0.76 | 0.55 | 0.55 | 0.06 | 0.06 | 0.04 |
| 492 | 0.09 | 0.06 | 0.06 | 0.28 | 0.28 | 0.27 |
| 493 | 1.33 | 0.87 | 0.87 | 0.17 | 0.17 | 0.16 |
| 506 | 1.15 | 0.86 | 0.86 | 0.17 | 0.17 | 0.16 |
| 507 | 0.00 | 0.00 | 0.00 | 0.08 | 0.08 | 0.07 |
| 508 | 0.13 | 0.10 | 0.10 | 0.02 | 0.02 | 0.02 |
| 509 | 10.13 | 7.45 | 7.41 | 0.33 | 0.33 | 0.29 |
| 510 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 511 | 3.94 | 3.04 | 3.02 | 0.06 | 0.06 | 0.05 |
| 512 | 3.82 | 2.90 | 2.88 | 0.05 | 0.05 | 0.05 |
| 513 | 4.10 | 3.09 | 3.08 | 0.15 | 0.16 | 0.12 |
| 531 | 0.05 | 0.03 | 0.03 | 0.05 | 0.06 | 0.03 |
| 532 | 19.39 | 13.74 | 13.69 | 0.18 | 0.18 | 0.15 |
| 533 | 4.62 | 3.51 | 3.50 | 0.06 | 0.06 | 0.04 |
| 538 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 539 | 0.07 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 |
| 553 | 2.30 | 1.93 | 1.92 | 0.04 | 0.04 | 0.02 |
| 554 | 0.31 | 0.23 | 0.23 | 0.08 | 0.08 | 0.08 |
| 585 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.01 |
| 586 | 0.00 | 0.00 | 0.00 | 0.09 | 0.09 | 0.08 |
| 587 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.01 |

Table 13 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 588 | 4.21 | 3.63 | 3.61 | 0.15 | 0.15 | 0.14 |
| 589 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 590 | 1.44 | 1.28 | 1.28 | 0.06 | 0.06 | 0.05 |
| 591 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 592 | 0.92 | 0.85 | 0.85 | 0.06 | 0.06 | 0.06 |
| 593 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 594 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 595 | 0.11 | 0.10 | 0.10 | 0.13 | 0.13 | 0.13 |
| 596 | 0.49 | 0.46 | 0.45 | 0.15 | 0.16 | 0.07 |
| 597 | 0.00 | 0.00 | 0.00 | 0.15 | 0.16 | 0.09 |
| 598 | 0.08 | 0.07 | 0.07 | 0.08 | 0.09 | 0.07 |
| 599 | 0.00 | 0.00 | 0.00 | 0.21 | 0.21 | 0.17 |
| 600 | 0.34 | 0.30 | 0.30 | 0.07 | 0.07 | 0.06 |
| 601 | 1.43 | 1.28 | 1.27 | 0.02 | 0.02 | 0.02 |
| 602 | 0.00 | 0.00 | 0.00 | 0.16 | 0.17 | 0.13 |
| 603 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.05 |
| 604 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.01 |
| 605 | 0.02 | 0.01 | 0.01 | 0.10 | 0.12 | 0.08 |
| 606 | 1.34 | 1.11 | 1.10 | 0.14 | 0.15 | 0.12 |
| 607 | 0.00 | 0.00 | 0.00 | 0.05 | 0.06 | 0.03 |
| 608 | 0.00 | 0.00 | 0.00 | 0.04 | 0.06 | 0.01 |
| 609 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.04 |
| 610 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.04 |
| 611 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 612 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 613 | 0.80 | 0.70 | 0.70 | 0.02 | 0.02 | 0.01 |
| 614 | 0.21 | 0.19 | 0.19 | 0.01 | 0.01 | 0.01 |
| 615 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 616 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 617 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 618 | 1.21 | 1.03 | 1.03 | 0.03 | 0.03 | 0.03 |
| 619 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 620 | 1.01 | 0.96 | 0.96 | 0.04 | 0.04 | 0.02 |
| 621 | 1.95 | 1.67 | 1.66 | 0.03 | 0.03 | 0.03 |
| 622 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 623 | 1.42 | 1.17 | 1.17 | 0.02 | 0.02 | 0.02 |
| 689 | 1.10 | 1.00 | 1.00 | 0.14 | 0.15 | 0.11 |
| 691 | 0.44 | 0.42 | 0.42 | 0.03 | 0.04 | 0.02 |
| 692 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 707 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 739 | 0.77 | 0.63 | 0.63 | 0.05 | 0.05 | 0.05 |

## Table 14

## Qlaly unit located between I-15 and 1300 East from 600 North to 4500 South, data south of I-80 only, 15 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 87 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 95 | 0.35 | 0.25 | 0.24 | 0.06 | 0.06 | 0.06 |
| 702 | 1.16 | 0.96 | 0.96 | 0.07 | 0.07 | 0.05 |
| 734 | 0.37 | 0.33 | 0.33 | 0.03 | 0.03 | 0.03 |
| 1014 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1017 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1022 | 0.28 | 0.25 | 0.25 | 0.03 | 0.03 | 0.02 |
| 1032 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1038 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1069 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1089 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1109 | 0.33 | 0.31 | 0.00 | 0.01 | 0.02 | 0.00 |
| 1154 | 0.11 | 0.09 | 0.09 | 0.16 | 0.16 | 0.16 |

# Table 15

## Qlbpm unit located between State Street and 2700 East from 3300 South to 4500 South, 24 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m | | | Ground Settlement Displacement, m | | |
|---|---|---|---|---|---|---|
| | Youd and others (2002) | | | Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 2 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.02 |
| 3 | 0.22 | 0.15 | 0.15 | 0.09 | 0.09 | 0.08 |
| 10 | 0.20 | 0.15 | 0.15 | 0.10 | 0.10 | 0.08 |
| 31 | 0.00 | 0.00 | 0.00 | 0.12 | 0.12 | 0.11 |
| 49 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 86 | 1.25 | 0.79 | 0.79 | 0.04 | 0.04 | 0.04 |
| 89 | 1.90 | 1.35 | 1.34 | 0.06 | 0.06 | 0.05 |
| 1004 | 0.83 | 0.48 | 0.48 | 0.13 | 0.13 | 0.11 |
| 1005 | 0.21 | 0.14 | 0.13 | 0.04 | 0.04 | 0.02 |
| 1006 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1010 | 0.68 | 0.52 | 0.52 | 0.01 | 0.01 | 0.01 |
| 1012 | 0.57 | 0.41 | 0.40 | 0.20 | 0.20 | 0.18 |
| 1015 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1028 | 1.11 | 0.96 | 0.95 | 0.06 | 0.06 | 0.03 |
| 1033 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1037 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1049 | 0.49 | 0.39 | 0.39 | 0.02 | 0.02 | 0.02 |
| 1052 | 0.20 | 0.15 | 0.15 | 0.18 | 0.18 | 0.18 |
| 1065 | 0.32 | 0.23 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1073 | 0.17 | 0.13 | 0.13 | 0.05 | 0.05 | 0.05 |
| 1090 | 0.26 | 0.21 | 0.20 | 0.14 | 0.14 | 0.11 |
| 1127 | 0.04 | 0.03 | 0.03 | 0.10 | 0.11 | 0.09 |
| 1132 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1137 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |

# Table 16

## Qlbpm unit located between 500 East and 1100 East from 4200 South to 4700 South, 10 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m Youd and others (2002) | | | Ground Settlement Displacement, m Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 1002 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1019 | 0.02 | 0.01 | 0.01 | 0.05 | 0.05 | 0.03 |
| 1056 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1063 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1064 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1072 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1074 | 0.11 | 0.07 | 0.07 | 0.04 | 0.05 | 0.03 |
| 1100 | 1.49 | 1.38 | 1.38 | 0.02 | 0.03 | 0.01 |
| 1129 | 0.08 | 0.06 | 0.06 | 0.09 | 0.09 | 0.06 |
| 1150 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 |

# Table 17

## Qlbpm units located between 900 East and Van Winkle Expressway from 4700 South to 7000 South, 8 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 1007 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1009 | 0.34 | 0.26 | 0.26 | 0.07 | 0.08 | 0.03 |
| 1018 | 0.02 | 0.01 | 0.01 | 0.12 | 0.11 | 0.09 |
| 1023 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1024 | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.02 |
| 1036 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1041 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1086 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.02 |

## Table 18

## Qlbpm units along I-15 corridor located between 3900 South and 9000 South, 123 boreholes

| | Lateral Spread Horizontal Displacement, m | | | Ground Settlement Displacement, m | | |
|---|---|---|---|---|---|---|
| Borehole ID Number | Youd and others (2002) | | | Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 278 | 0.00 | 0.00 | 0.00 | 0.16 | 0.16 | 0.16 |
| 288 | 1.76 | 1.52 | 1.51 | 0.15 | 0.15 | 0.14 |
| 292 | 0.85 | 0.68 | 0.67 | 0.02 | 0.03 | 0.01 |
| 294 | 0.59 | 0.45 | 0.46 | 0.15 | 0.15 | 0.15 |
| 302 | 3.22 | 2.63 | 2.60 | 0.07 | 0.07 | 0.07 |
| 309 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 310 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 311 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 312 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 313 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 314 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 315 | 0.58 | 0.50 | 0.49 | 0.06 | 0.06 | 0.05 |
| 316 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 317 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 318 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.01 |
| 319 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 320 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 321 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 322 | 0.68 | 0.58 | 0.57 | 0.07 | 0.06 | 0.02 |
| 323 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 324 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 325 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 326 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 327 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 328 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 329 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 331 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 332 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 333 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 334 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 335 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 336 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 337 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 338 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 339 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 340 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 341 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 342 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 343 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 344 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 345 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 346 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 354 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 355 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 356 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 357 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Table 18 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m | | | Ground Settlement Displacement, m | | |
|---|---|---|---|---|---|---|
| | Youd and others (2002) | | | Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 358 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 359 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 360 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 361 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 362 | 0.00 | 0.00 | 0.00 | 0.08 | 0.07 | 0.01 |
| 363 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 364 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.00 |
| 365 | 1.36 | 1.15 | 1.14 | 0.10 | 0.10 | 0.03 |
| 366 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 370 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 377 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 378 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 381 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 382 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 383 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 389 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 390 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 391 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 392 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 393 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 394 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 395 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 396 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 397 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |
| 398 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 399 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 400 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 401 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 402 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 403 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 404 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 405 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 |
| 406 | 0.00 | 0.00 | 0.00 | 0.11 | 0.11 | 0.09 |
| 407 | 0.59 | 0.53 | 0.52 | 0.06 | 0.06 | 0.04 |
| 408 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 409 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.00 |
| 410 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 411 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 412 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 413 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 414 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 415 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 416 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 417 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 418 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 419 | 0.00 | 0.00 | 0.00 | 0.07 | 0.07 | 0.04 |
| 420 | 0.55 | 0.43 | 0.43 | 0.02 | 0.02 | 0.00 |
| 421 | 0.00 | 0.00 | 0.00 | 0.05 | 0.04 | 0.00 |
| 422 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 423 | 0.01 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 |

Table 18 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 424 | 1.03 | 0.80 | 0.00 | 0.03 | 0.02 | 0.00 |
| 425 | 0.29 | 0.22 | 0.00 | 0.04 | 0.03 | 0.00 |
| 426 | 0.70 | 0.54 | 0.00 | 0.02 | 0.02 | 0.00 |
| 427 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 428 | 0.27 | 0.20 | 0.20 | 0.18 | 0.17 | 0.14 |
| 437 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 438 | 1.54 | 1.30 | 1.28 | 0.08 | 0.07 | 0.05 |
| 440 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.03 |
| 441 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 442 | 0.05 | 0.04 | 0.04 | 0.02 | 0.03 | 0.01 |
| 443 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 444 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 |
| 445 | 0.00 | 0.00 | 0.00 | 0.03 | 0.06 | 0.01 |
| 446 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 447 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 664 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.03 |
| 1078 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.03 |
| 1082 | 0.01 | 0.01 | 0.01 | 0.04 | 0.04 | 0.03 |
| 1228 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1237 | 0.06 | 0.05 | 0.05 | 0.03 | 0.03 | 0.02 |
| 1254 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1255 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1256 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1257 | 0.00 | 0.00 | 0.00 | 0.18 | 0.18 | 0.18 |
| 1258 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1259 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1260 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 19

## Qlbpm units along I-15 corridor located between 9000 South and 12300 South, 27 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m Youd and others (2002) | | | Ground Settlement Displacement, m Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 1156 | 0.03 | 0.03 | 0.03 | 0.04 | 0.03 | 0.02 |
| 1163 | 0.65 | 0.60 | 0.59 | 0.11 | 0.11 | 0.11 |
| 1165 | 0.83 | 0.79 | 0.79 | 0.11 | 0.11 | 0.10 |
| 1197 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1198 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.01 |
| 1212 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1213 | 0.27 | 0.27 | 0.27 | 0.05 | 0.05 | 0.05 |
| 1214 | 0.26 | 0.25 | 0.25 | 0.24 | 0.24 | 0.23 |
| 1215 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1216 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1220 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1244 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1246 | 0.32 | 0.32 | 0.32 | 0.15 | 0.15 | 0.15 |
| 1249 | 0.08 | 0.07 | 0.07 | 0.14 | 0.14 | 0.14 |
| 1250 | 0.37 | 0.37 | 0.37 | 0.12 | 0.12 | 0.09 |
| 1251 | 0.69 | 0.65 | 0.64 | 0.18 | 0.18 | 0.14 |
| 1252 | 0.00 | 0.00 | 0.00 | 0.08 | 0.08 | 0.08 |
| 1253 | 0.00 | 0.00 | 0.00 | 0.13 | 0.13 | 0.13 |
| 1264 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1270 | 0.44 | 0.45 | 0.44 | 0.05 | 0.05 | 0.03 |
| 1273 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1278 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.02 |
| 1279 | 0.02 | 0.02 | 0.02 | 0.12 | 0.12 | 0.11 |
| 1280 | 0.15 | 0.13 | 0.13 | 0.08 | 0.08 | 0.06 |
| 1284 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1297 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1302 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 20

## Qlbpm units near I-15 corridor located between 600 North and 2300 North, 3 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 76 | 0.00 | 0.00 | 0.00 | 0.16 | 0.16 | 0.16 |
| 684 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 714 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |

## Table 21

## Qlbpm units located along east bench (east of 1300 East) from South Temple to 5300 South, 7 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 686 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 687 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 688 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 696 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 701 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 725 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 22

## Qlbpm units located west of I-15 corridor and units located south of 12300 South, 67 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 83 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 732 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| 733 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 736 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| 1046 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.01 |
| 1061 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1076 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1092 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1099 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1101 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1108 | 0.57 | 0.46 | 0.45 | 0.08 | 0.08 | 0.03 |
| 1113 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1114 | 0.02 | 0.01 | 0.00 | 0.03 | 0.03 | 0.00 |
| 1120 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1126 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1131 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1133 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.03 |
| 1145 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1157 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1161 | 0.02 | 0.01 | 0.01 | 0.05 | 0.05 | 0.04 |
| 1167 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1172 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1173 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1174 | 0.02 | 0.02 | 0.02 | 0.04 | 0.03 | 0.01 |
| 1177 | 0.02 | 0.02 | 0.02 | 0.06 | 0.06 | 0.06 |
| 1179 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1180 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1181 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1182 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1183 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1184 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1185 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1186 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1187 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1188 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1193 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1194 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1211 | 0.97 | 0.84 | 0.83 | 0.03 | 0.03 | 0.02 |
| 1219 | 0.02 | 0.01 | 0.01 | 0.04 | 0.04 | 0.04 |
| 1222 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1226 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1229 | 0.02 | 0.02 | 0.02 | 0.05 | 0.05 | 0.04 |
| 1230 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Table 22 Continued

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 1231 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1232 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1233 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1234 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1241 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 | 0.01 |
| 1263 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.00 |
| 1268 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1272 | 0.02 | 0.02 | 0.02 | 0.34 | 0.34 | 0.32 |
| 1275 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.01 |
| 1281 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.02 |
| 1282 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1283 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1285 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1286 | 2.70 | 2.44 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1291 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1292 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1294 | 0.28 | 0.25 | 0.25 | 0.09 | 0.09 | 0.05 |
| 1295 | 0.02 | 0.02 | 0.02 | 0.06 | 0.06 | 0.02 |
| 1296 | 1.73 | 1.70 | 1.68 | 0.08 | 0.08 | 0.04 |
| 1300 | 0.10 | 0.10 | 0.10 | 0.04 | 0.04 | 0.02 |
| 1301 | 1.42 | 1.34 | 1.33 | 0.07 | 0.07 | 0.06 |

## Table 23

## Qaf2 and Qmls units located between North Temple and 400 South from 400 West to 300 East (City Creek fan), 10 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m Youd and others (2002) | | | Ground Settlement Displacement, m Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | 0.00 | 0.00 | 0.00 | 0.17 | 0.17 | 0.06 |
| 52 | 1.96 | 1.66 | 1.65 | 0.14 | 0.13 | 0.06 |
| 57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 81 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 90 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 |
| 706 | 2.33 | 2.21 | 2.21 | 0.04 | 0.04 | 0.00 |
| 729 | 1.14 | 0.82 | 0.82 | 0.15 | 0.15 | 0.13 |
| 750 | 2.01 | 1.69 | 1.68 | 0.13 | 0.12 | 0.05 |

## Table 24

## All Qaf2 units except City Creek fan, 20 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 |
| 42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 97 | 0.00 | 0.00 | 0.00 | 0.07 | 0.06 | 0.00 |
| 100 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 683 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 693 | 1.64 | 1.60 | 0.00 | 0.02 | 0.02 | 0.00 |
| 699 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 704 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 705 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 713 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 717 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 719 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 727 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1000 | 4.39 | 4.28 | 0.00 | 0.04 | 0.04 | 0.00 |
| 1040 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1059 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1116 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1221 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1277 | 4.62 | 3.76 | 0.00 | 0.05 | 0.04 | 0.00 |

Table 25

All Qalp units located along east bench from 6th Avenue to 10600 South, 10 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 73 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 700 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 703 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1062 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1105 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1135 | 1.44 | 1.23 | 1.22 | 0.12 | 0.12 | 0.10 |
| 1142 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1266 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 26

## All Qlpg units in the valley, 40 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m | | | Ground Settlement Displacement, m | | |
|---|---|---|---|---|---|---|
| | Youd and others (2002) | | | Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 51 | 0.00 | 0.00 | 0.00 | 0.06 | 0.03 | 0.00 |
| 59 | 3.37 | 4.46 | 4.46 | 0.05 | 0.04 | 0.00 |
| 88 | 0.14 | 0.12 | 0.12 | 0.03 | 0.03 | 0.02 |
| 690 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |
| 697 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 698 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 716 | 0.16 | 0.18 | 0.18 | 0.04 | 0.04 | 0.02 |
| 728 | 0.66 | 0.75 | 0.75 | 0.05 | 0.05 | 0.01 |
| 1003 | 0.04 | 0.03 | 0.03 | 0.16 | 0.16 | 0.13 |
| 1048 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1067 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1081 | 0.00 | 0.00 | 0.00 | 0.08 | 0.07 | 0.03 |
| 1097 | 2.53 | 2.13 | 2.11 | 0.03 | 0.03 | 0.01 |
| 1098 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1119 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1151 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.01 |
| 1168 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1170 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1171 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1195 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1196 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1200 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1201 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1202 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1203 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1204 | 0.17 | 0.09 | 0.09 | 0.01 | 0.01 | 0.00 |
| 1205 | 1.81 | 1.14 | 1.12 | 0.04 | 0.04 | 0.03 |
| 1206 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1207 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 |
| 1208 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| 1209 | 0.99 | 0.92 | 0.91 | 0.02 | 0.02 | 0.01 |
| 1210 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1217 | 3.16 | 2.71 | 2.70 | 0.14 | 0.14 | 0.12 |
| 1218 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.02 |
| 1223 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1247 | 2.63 | 2.69 | 2.65 | 0.08 | 0.07 | 0.03 |
| 1248 | 1.49 | 1.44 | 1.42 | 0.06 | 0.06 | 0.04 |
| 1265 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1267 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |

## Table 27

## All Qlbpg units in the valley, 12 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 35 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.02 |
| 56 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.00 |
| 84 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 712 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1175 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1176 | 0.33 | 0.34 | 0.33 | 0.03 | 0.03 | 0.01 |
| 1199 | 3.82 | 3.58 | 3.51 | 0.21 | 0.21 | 0.20 |
| 1225 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1227 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1235 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1269 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Table 28

## All Qlbps units in the valley, 5 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 85 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1162 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1178 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1224 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |

## Table 29

## All Qafy units in the valley, 6 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1044 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1051 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 |
| 1242 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |

## Table 30

## All Qlpd units in the valley, 5 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 1053 | 2.03 | 1.78 | 0.06 | 0.07 | 0.07 | 0.03 |
| 1085 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.01 |
| 1087 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 |
| 1103 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1104 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 31

## All Qlbg units in the valley, 14 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 46 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 53 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 |
| 74 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 |
| 101 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 718 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 741 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 |
| 742 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 743 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.01 |
| 1096 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1243 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1261 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1262 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Table 32

## Various smaller units* in foothills, 17 boreholes

| Borehole ID Number | Lateral Spread Horizontal Displacement, m<br>Youd and others (2002) | | | Ground Settlement Displacement, m<br>Average of Tokimatsu and Seed (1987) and Yoshimine and others (2006) | | |
|---|---|---|---|---|---|---|
| | M7.0 Scenario | 2PE50 | 10PE50 | M7.0 Scenario | 2PE50 | 10PE50 |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 98 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 103 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 694 | 0.00 | 0.00 | 0.00 | 0.04 | 0.03 | 0.00 |
| 695 | 0.00 | 0.00 | 0.00 | 0.04 | 0.03 | 0.02 |
| 708 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 715 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 720 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1164 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 0.00 |
| 1240 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 1287 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1290 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1293 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Geologic units include: Qafb, Qca, QTaf, Qes, Qlbm, Mz, Qafo, Qlbs, Pz and Rock

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