

Appendix F
Geotechnical Investigation

**REPORT OF
GEOTECHNICAL EVALUATION FOR
ENVIRONMENTAL IMPACT REPORT**

**HACIENDA AT FAIRVIEW VALLEY
SAN BERNARDINO COUNTY,
CALIFORNIA**



GEOCON
INLAND EMPIRE, INC.

GEOTECHNICAL
CONSULTANTS

PREPARED FOR

**STRATA EQUITY INVESTMENTS
SAN DIEGO, CALIFORNIA**

**MARCH 25, 2009
PROJECT NO. A8528-06-01**



Project No. A8528-06-01
March 25, 2009

VIA OVERNIGHT DELIVERY

Strata Equity Investments
4370 La Jolla Village Drive, Suite 960
San Diego, California 92122

Attention: Mr. Eric Flodine

Subject: HACIENDA AT FAIRVIEW VALLEY
SAN BERNARDINO COUNTY, CALIFORNIA
REPORT OF GEOTECHNICAL EVALUATION FOR
ENVIRONMENTAL IMPACT REPORT

Dear Mr. Flodine:

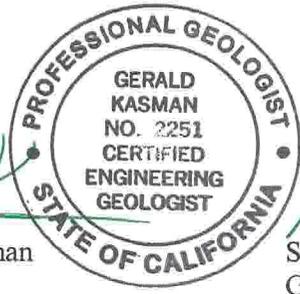
In accordance with your authorization, we have performed a geotechnical evaluation for use in an environmental impact report (EIR) for the subject project. The accompanying report presents the findings of our study and our conclusions relative to the site geologic conditions and the potential for geologic hazards at the site. The primary intent of this study was to address potential geologic hazards and geotechnical conditions that could impact the project. A more detailed, design-level geotechnical study will be required prior to finalizing design level grading plans.

Should you have any questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INLAND EMPIRE, INC.


Gerald A. Kasman
CEG 2251




Shawn Weedon
GE 2714




John Hoobs
CEG 1524



GAK:SW:JH:sc

- (3) Addressee
- (5) County of San Bernardino
Land Use Services Department, Advance Planning Division
Attention: Mr. Douglas Feremenga

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REPORT OF GEOTECHNICAL EVALUATION FOR ENVIRONMENTAL IMPACT REPORT

1. PURPOSE AND SCOPE

This report presents the results of our geotechnical evaluation for the proposed Hacienda at Fairview Valley development located near the community of Apple Valley in San Bernardino County, California. The purpose of this study is to provide the necessary geotechnical information for preparation of an Environmental Impact Report (EIR) for the planned development. In addition, we evaluated the subsurface soil and geologic conditions at the site including potential geologic hazards that may be present and based on the conditions encountered, provided preliminary recommendations pertaining to the geotechnical aspects of developing the property. A more comprehensive investigation will be required at the tentative tract map phase of site development.

The scope of our evaluation included a site reconnaissance, field investigation, laboratory testing, engineering analyses, fault lineament analysis, and the preparation of this preliminary report. As a part of our investigation, we have reviewed aerial photographs, geologic maps, published geologic reports, and previous geotechnical reports related to the property. A summary of the background information reviewed for this study is presented in the *List of References*.

The field investigation performed for this report included geologic mapping, the excavation of 17 borings, and performing 8 shallow percolation tests. A detailed discussion of the field investigation and logs of the exploratory borings are presented in Appendix A.

Geocon performed laboratory testing on representative materials of alluvial soils encountered at the site. We performed the laboratory tests in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We tested selected soil samples for in-place dry density and moisture content, maximum dry density and optimum moisture content, shear strength, expansion potential, water-soluble sulfate content, potential of hydrogen (pH), resistivity, water-soluble chloride, collapse potential, and Atterburg limits. The results of our laboratory tests are presented in Tables B-I through B-VII in Appendix B. The in-place dry density and moisture content of the samples tested are presented on the boring logs in Appendix A.

The topographic and development information used during our field investigation as well as for the preparation of the geologic map and this report is based on 2008 Master Planned Development Plans provided by Allard Engineering and Strata Equity Investments. References to elevations presented in this report are based on the referenced topographic information. Geocon does not practice in the field of land surveying and is not responsible for the accuracy of such topographic information.

2. SITE AND PROJECT DESCRIPTION

The Hacienda at Fairview Valley property is located approximately 2 miles northeast of the community of Apple Valley in San Bernardino County, California. The approximate site location is presented on the Vicinity Map, Figure 1. The site consists of 2 separate properties of land (hereinafter referenced as “northern site” and “southern site”) totaling approximately 1,557 acres located north and east of the Granite Mountains, south of Sidewinder Mountain, and southeast of the Fairview Mountains (see Figure 8). The site is accessed by Cahuilla Road and Laguna Seca Drive on the west side of the northern property with Chicago Road traversing the southern property. The site consists of two connected broad valleys that are part of Fairview Valley trending to the northwest and west that were created by local faulting, uplift and erosion. Vegetation consists of a sparse to moderate growth of native grasses, chaparral, and scattered Joshua trees. Topographically, the property consists of two broad shaped valleys sloping to the northwest on the southern property and to the south and west on the northern property. The Fairview and Granite Mountains encroach into the margins of the site. Elevations vary across the site with a high located at the southwest corner of the southern parcel of approximately 3,850 feet above Mean Sea Level (MSL) to a low of approximately 3,060 feet MSL on the southwest corner of the northern parcel.

Based on our review of the proposed Master Development Plans the property is proposed to receive an integrated master planned community that provides a mix of approximately 3,114 single-family residential homes within four villages. Approximately 336 acres have been designated for open space and recreation and 15 acres of neighborhood commercial. The land uses will be linked together through a network of roadways, multi-use trails, parks, greenbelts and natural open space. Although future site grades and building locations have not been determined, we expect that typical grading techniques of cuts and fills with maximum depths on the order of 10 feet will be required to achieve proposed finish grade elevations. Remedial grading of the alluvial soils will also be required during grading operations. We expect that lightly loaded one-to-two-story residential and commercial structures will be constructed.

The locations and descriptions herein are based on a site reconnaissance and review of the referenced plans and development information provided for our use. As previously mentioned, a geotechnical investigation will be required when a tentative map and grading plans have been developed. The future geotechnical investigation may include additional subsurface investigation, laboratory testing, engineering analyses, slope stability analyses, fault trenching and preparation of a written report presenting conclusions and site-specific design recommendations for proposed development.

3. SITE CONDITIONS AND PREVIOUS SITE DEVELOPMENT

The site is essentially undeveloped consisting of named and unnamed dirt roads providing access to several isolated single-family residences located adjacent to the property. Several remnant foundations

are present on the site indicating previous residential structures likely serviced by septic systems. Previous grading was limited to creating dirt roads and pads for the prior residential homes. We did not observe evidence of other use of the property during our site reconnaissance or noted in the references. Some minor prospecting may have occurred in the surrounding mountains; however, significant mineral deposits are not known to exist locally. Several drainages flow into the two valleys that are uncontrolled and episodically deposit soil and minor rock debris near the outlets of the canyon drainages after intense rainstorms.

4. FIELD EXPLORATION

We performed the site reconnaissance and field investigation in January 2009, April 2007 (southern site) and October 2003 (northern site). The fieldwork consisted of geologic mapping, excavating of 17 small diameter borings, and performing 8 percolation tests within the northern site. Based on the size of the project and the geologic conditions, it is our opinion that the field exploration program performed at the site is sufficient to gain a general understanding of the site geologic characteristics for use in the EIR documents. The approximate locations of the excavations and percolation tests are shown on the Geologic Map, Figures 2 through 4 (Map Pocket). The locations of the exploratory excavations and percolation tests were located in the field using a topographic map and existing man-made features; therefore, actual locations may deviate slightly. The exploratory borings extended to a maximum depth of approximately 51 feet using a truck-mounted drill rig equipped with 8-inch diameter hollow stem augers. The percolation extended to a depth of approximately 3 feet using the same size auger. The results of our percolation testing are discussed herein. We logged and observed the soil and geologic conditions encountered during drilling activities.

We visually examined, classified and logged the soil conditions encountered in the excavations in general accordance with the Unified Soil Classification System (USCS). Logs of the exploratory borings are presented on Figures A-1 through A-17 in Appendix A. The logs depict the general soil and geologic conditions encountered and the depth at which samples were obtained.

5. GEOLOGIC SETTING

The Hacienda at Fairview Valley property is located in the Mojave Desert geologic region of southern California. The region has been influenced by the geologic boundary between the Pacific and North American Plates. Earliest geologic history in the area consisted of the deposition of the Mesozoic and Pre-Mesozoic marine sedimentary and volcanic units that are exposed in the adjacent Sidewinder Mountains to the north of the site and the southeast portion of the Granite Mountains. Subsequent subduction of the Pacific Plate beneath the North American Plate during Mesozoic time created the intrusion of the granitic rocks that make up the Granite, Fairview and Sidewinder Mountains to the west, northwest and north and the metamorphism of the older, roof-pendant rock units within Sidewinder Mountain to the north. The subduction geologic regime changed in nature during the

Tertiary period to an extensional and transverse faulting environment that created a complex history of faulting and rotating blocks within a zone known as the Trans Mojave-Sierran Shear Zone (TMSSZ) (Dokka, 1998). This zone is part of a larger shear system originally hypothesized by Silver and Anderson in the late 1960's as the Mojave-Sonora Megashear (GSA, 2005).

The two parcels of land are located within a broad alluvial valley that is part of Fairview Valley. The property is surrounded by moderate- to steep-sloping mountainous terrain that are actively shedding soil with some rock materials through a series of canyon drainages creating coalescing alluvial fans along their flanks. Surface drainage occurs as sheet and channelized flow across the alluvial fans and locally created valley drainage gullies. Surface drainage is directed to the south and west sides of the northern site and to the north on the southern site. Rainfall in the area typically consists of long periods of drought interrupted by runoff caused by 10- and 50-year flood events that can cause deposition of alluvial soil.

The active Helendale Fault is the most prominent geologic feature that is affecting the site. Faulting in the area has influenced the formation of the valley terrain and the direction and offset of drainage patterns to the east of the site. The mountains adjacent to the site have been locally uplifted thus causing the shedding of alluvial soils into the adjacent valleys that is occasionally active during flood events. Several drainages have created large alluvial fan complexes that extend into the adjacent valley terrain. We observed several lineaments during our photo analysis that are in part influenced by the local faulting in the area. Old alluvial deposits that have undergone some soil densification are present in the broad shaped valleys that are covered by the younger alluvial fan deposits and wash deposits.

6. GEOLOGIC MATERIALS

6.1 General

We mapped and encountered three surficial soil types and two geologic formations at the site during our investigation. The surficial units consist of wash deposits, young alluvial fan deposits and old alluvial deposits. The two geologic formations are composed of igneous granite and quartz monzonite rocks of Jurassic and Cretaceous age. The formational and surficial units are discussed below in order of increasing age. The approximate lateral extent of these units is presented on the Geologic Map, Figures 2 through 4 (map pocket). The geologic nomenclature and age of the units have been obtained from Bortugno and Spittler, 1998 as shown on the Regional Geologic Map (Figure 8).

6.2 Wash Deposits (Qw)

Unconsolidated late Holocene age wash deposits originating from active drainages are present on the site and accommodate most of the water flow from offsite sources. The material has been deposited within incised drainages that are active during occasional periods of intense rainfall. The wash deposits generally consist of fine to coarse grained sand and fine gravel. These materials are generally

a few feet thick and due to their unconsolidated nature and potential for consolidation settlement, remedial grading of this unit will be required.

6.3 Young Alluvial Fan Deposits (Qyf)

Unconsolidated to moderately consolidated young alluvial fan deposits of Holocene to late Pleistocene age produced by water-induced sheet flow and debris flow is present across the two valley areas. These materials have been deposited across the valley floor and locally can be thicker near the outlets of existing canyon drainages. The young alluvium consists primarily of granular soils with some gravel and cobble shed from proximal rock formations consisting of loose, light brown, silty, medium to coarse sands and gravels. The thickness of the young alluvium evaluated during our investigation ranged from approximately 4 to 11 feet. Due to the relatively unconsolidated nature of the soil within the young alluvial fan deposits, these deposits may be subject to consolidation settlement. Remedial grading will be necessary in areas to receive fill or structures. Oversized material will likely be generated in this unit during remedial grading because of the high percentage of large cobbles to small boulders. Remedial grading should not be performed within the leach field areas proposed for disposal of affluent.

6.4 Old Alluvial Deposits (Qoa)

Moderately consolidated early Holocene- to late Pleistocene-age, old fluvial-derived alluvial deposits exist beneath the younger alluvial fan deposits. The old alluvium generally consists of medium dense to very dense, brown to reddish brown, dry to damp, silty, fine to medium sand with some gravel and cobble that may be locally slightly cemented. The upper portions of this unit may require remedial grading to mitigate the collapse potential of the dryer upper portions of the unit. Remedial grading depths are not known at this time but we expect the removals could extend several feet below the younger alluvium. Dense older alluvium with adequate moisture contents may be left in-place; however, further evaluation of the depth of removal and of their suitability to support fill and structures will be necessary in a subsequent investigation. The older alluvium extends to depths greater than 51 feet below grade; however, the borings were terminated in the old alluvial deposits and the maximum thickness is not known.

6.5 Quartz Monzonite (Kjqm)

Unweathered to slightly weathered igneous quartz monzonite rock reported to be of Cretaceous to Jurassic age is mapped in the Fairview Mountains northwest of the northern property. Outcrops of these rocks are characterized as very hard, phaneritic, massive and fine to coarse-grained. Remedial grading of the unweathered granitic rock will not be necessary in areas to receive fill or structures. Perimeter cut slopes constructed of the less weathered portions of this unit and excavated at inclinations of 1.5:1 (horizontal:vertical) or flatter should be considered stable if free of adversely dipping joint patterns. Additional analyses and slope stability calculations including rock fall

evaluations will be required once cut slope locations are provided on future grading plans. The highly weathered portions of the granitic rock may be subject to remedial grading; however, we expect the depth of weathering to be fairly shallow. Excavations within the less weathered portions of this unit will be difficult and require heavy effort and generate oversized rock materials. Deeper cuts in excess of 5 feet may also require blasting to achieve proposed grades.

6.6 Granite (Jkgr)

We encountered unweathered to slightly weathered igneous granitic rock reported to be of Jurassic to Cretaceous age in the Granite Mountains on the southern and southwestern portions of the site. Rock characteristics and constructability will be similar to the rock encountered in the Fairview Mountains. Remedial grading of the slightly weathered and unweathered granitic bedrock will not be necessary in areas to receive fill or structures. Oversized material will likely be generated in this unit during grading because of the high degree of rock hardness. Portions of the weathered granitic rock may be subject to remedial grading; however, will be limited to less than 5 feet thick. Excavations in excess of 5 feet will also encounter difficulty and may require blasting.

7. GEOLOGIC STRUCTURE

The regional geologic structure is characterized by a large scale joint and fracture pattern as well as foliation exposed in the granitic batholithic rocks. Typically, these patterns will develop during cooling of the granitic plutons as well as subsequent shedding of the overburden host rock during tectonic uplift events and the resulting release of internal rock stress.

The Mojave Desert Region is influenced by a series of northwest trending sub-parallel faults roughly spaced at intervals northeast of the San Andreas Fault, which is located approximately 30 miles to the southwest. A Southern California Fault and Seismic Map has been provided on Figure 9. This figure was generated from the computer program *EZ-FRISK*. The active right-lateral, northwest-trending Helendale Fault, which is part of the Trans Mojave-Sierran Shear Zone (TMSSZ), is one of these faults that traverse the eastern portion on the site.

Geologic structure within the site includes smaller-scale structural features consisting of minor fractures and jointing within the hard granitic rock units. The orientations of geologic structure observed during our geologic reconnaissance are presented on the Geologic Map and indicate that the overall trend of joints varies between N36E to N50E with dips varying from 60 to 82 degrees to the SE within the Granite Mountains. The trend of the joints within the Fairview Mountains is similar with dip directions to the northwest, based on limited field data.

8. GROUNDWATER

The site is located in the proximity of the Mojave River groundwater regional basin roughly 8 miles northeast of the Mojave River at its closest point. The primary source of domestic water in the region is from deep groundwater extraction within the basin with many rural areas on shallower individual water wells or supplied by the import and storage of water to local residences. The Helendale Fault has created a hydrologic boundary within the basin separating two water management subareas that may impede the flow of groundwater in the deeper regional aquifer but likely not within the shallower floodplain aquifers (Stamos, 2003). This would apply to the alluvial soils that have been reported to be in excess of 3,000 feet thick where the Helendale Fault crosses the Mojave River roughly 20 miles to the northwest of the site, based on gravity data. The alluvial soils within the two valleys on the site will likely have a shallower depth of less than 1,000 feet.

We did not encounter groundwater within the borings drilled as part of this investigation. A review of data provided by the California Department of Water Resources indicates that several wells have historically been drilled near the site. The closest well to the site with available data, is Well No. 05N01W30M001S, located roughly 2.5 miles southeast of the site (at the corner of Suncrest Lane and Baldrige Drive). The depth to groundwater in this well, measured on March 23, 1957, was 297.8 feet below the existing ground surface. Other wells to the north and south measured in 1957 have the groundwater varying from 231 to 236 feet below the ground surface.

If shallow perched groundwater is encountered during development operations due to local rain events, it is our opinion that it will be localized and will not have a significant impact. It is not uncommon for groundwater or seepage conditions to develop where none previously existed. Groundwater elevations are dependent on seasonal precipitation, irrigation, land use, among other factors, and vary as a result. Proper surface drainage will be critical to the future performance of the project. Preliminary drainage recommendations are provided herein.

9. GEOLOGIC HAZARDS

9.1 Faulting

A review of the referenced geologic materials and our knowledge of the general area indicate that the eastern portion of the site is underlain by the active Helendale Fault. An active fault is defined by the California Geological Survey (CGS) as a fault showing evidence for activity within the last 11,000 years. The eastern portion of the site is located within a State of California Earthquake Fault Zone with the limits shown on the Geologic Map (Figures 2 through 4). Two inactive, northwest-trending faults are shown on the Regional Geologic Map (Figure 8) within the Granite Mountains trending toward the northern site. These faults were likely formed during Tertiary time from regional transverse faulting within the bedrock units. These inactive faults will not impact the site. A potentially active splay of the Helendale Fault (Dibblee, 1960) has also been included on the Southern Site geologic map (Figure 4).

9.2 Surface Fault Rupture - Helendale Fault

The Helendale Fault Zone in the region generally consists of a series of discontinuous subparallel strike-slip fault traces within a fault zone that varies from 10 to 100 feet wide. The Helendale Fault is considered to be active by the State of California based on previous investigation by Morton et al. (1980), Manson (1986), and others. The Helendale Fault Zone is contained within a State of California Alquist-Priolo Earthquake Fault Zone established in 1988 that is as wide as 1,800 feet. The fault zone is considered active; however, it is common to have individual fault traces that have not experienced movement in the Holocene. The California Geological Survey has categorized the Helendale Fault as a Type B Fault with an estimated length of 97 kilometers (+/- 10 kilometers) and an average slip rate of 0.6 mm/yr. Historic fault rupture on the Helendale Fault has not been documented in the literature and the last earthquake fault event has not been determined. This fault system has affected geomorphology in the region by altering the existing landforms, as expressed by diverted drainages, shutter ridges and captured canyon drainages to the east of the site. The fault zone within the site consists of several subparallel splays that are somewhat discontinuous and are locally obscured by younger alluvial fan deposits. The fault traces depicted on the Earthquake Special Study Zone Map are after those identified by Morton et al. (1980). A small portion of the northeast corner of the Northern Site and areas of the northern and northeastern portions of the Southern Site are mapped within the Earthquake Fault Zone. A concealed strand of the Helendale Fault identified by Dibblee (1960) as "potentially active" extends through the northern and northeastern portions of the Southern Site (see Figure 4). The location of the fault zone including known fault traces and the limits of the Earthquake Fault Zone is shown on the Geologic Map, Figures 2 through 4. The potential for surface fault rupture is considered significant. A detailed investigation including fault trenching for active and potentially active faults and photo observed lineaments will be required to determine building setbacks when tentative maps and grading plans are prepared for development within the Earthquake Fault Zone.

9.3 Photo Lineament Analysis

We performed a photo lineament analysis based on our review of 7 aerial photographs of the site from 1952 through 1990 and 6 sets of stereo photographs from 1989 and 2004. Development of man-made structures were absent in 1953 but started shortly thereafter.

The Granite Mountains contain numerous sublinear, non fault related lineaments that trend in multiple directions and are associated with the development of regional foliation and jointing due to uplift and release of rock stresses in pre-Holocene time. We observed photo lineaments within the rock units in the western and northwestern portions of the site. These lineaments are likely a result of Mesozoic faulting or the formation of foliation and are not associated with the Helendale Fault and do not extend from the rock units into the adjacent alluvial soils. Previous evaluations by various researchers did not map any of these lineaments shown on Figure 7 west of the site as part of the Helendale Fault Zone.

Fault lineaments associated with the Helendale Fault are fairly prominent within the Earthquake Fault Zone to the east of the site within the granitic rock units and are more poorly detailed as they extend into the alluvial soils. Lineaments that were photo observed within, and adjacent to, the eastern portion of the site have been included on a 1 inch equals 300 scale blowup of the stereo photographs included as Figures 5 through 7. The majority of the lineaments are depicted on Figure 7 northeast of the Southern Site. The lineaments are generally *en echelon* or transverse faults, possibly representing extensional components associated with a pull-apart structure between subparallel strands of the Helendale Fault mapped by Morton et al. (1980), in addition to the main shear displacement. The majority of the lineaments were photo observed within the Earthquake Special Study Zone. One lineament was observed within the property in the northern portion of the Southern Site and within the central portion of the Northern Site, but outside of the Earthquake Special Study Zone. The buried portion of the Helendale Fault mapped by Dibblee (1960) extends within the property through the northern and northeastern portions of the Southern Site. The mapped fault strands and lineaments existing on the property will require future analyses during future fault investigations.

9.4 Seismicity

According to the computer program *EZ-FRISK*, 22 known active faults are located within a search radius of 50 miles from the property. The Helendale Fault is the most dominant source of potential ground motion. Earthquakes that might occur on the Helendale Fault or other faults within the southern California area (especially the San Andreas Fault) are potential generators of significant ground motion at the site. The estimated deterministic maximum earthquake magnitude and peak ground acceleration for the Helendale Fault are 7.4 and 0.48g, respectively. Table 9.4.1 lists the estimated maximum earthquake magnitude and peak ground acceleration for the 15 closest and most dominant faults in relationship to the site location. We calculated peak ground acceleration (PGA) using Boore-Atkinson (2007) and Campbell-Bozorgnia (2008) acceleration-attenuation relationships. Figure 9 depicts the historic seismicity in the area and indicates that the Helendale Fault and surrounding area has not shown seismic activity in the last roughly 200 years.

**TABLE 9.4.1
DETERMINISTIC SPECTRA SITE PARAMETERS**

Fault Name	Distance from Site (Miles)	Maximum Earthquake Magnitude (Mw)	Peak Ground Acceleration	
			Boore-Atkinson 2007 (g)	Campbell-Bozorgnia 2008 (g)
Helendale	0	7.4	0.48	0.41
North Frontal -Western	7.5	7.2	0.27	0.24
Lenwood	15.3	7.6	0.25	0.17
Cleghorn	19.5	6.9	0.18	0.12
Landers	20.8	7.4	0.21	0.13
North Frontal-Eastern	21.5	6.8	0.16	0.11
Johnson Valley	21.6	6.8	0.16	0.11
Gravel Hills	24.1	7.2	0.18	0.11
San Andreas	27.7	8.4	0.29	0.14
S Emerson-Copper Mtn.	30.1	7.1	0.15	0.09
Calico-Hidalgo	30.2	7.4	0.17	0.10
Cucamonga	31.8	7.0	0.14	0.09
San Jacinto-San Bernardino	32.0	7.1	0.14	0.09
Blackwater	33.1	7.1	0.14	0.08
San Jacinto-San Jacinto Valley	37.6	7.3	0.14	0.08

We used the computer program *EZ-FRISK* to perform a probabilistic seismic hazard analysis. The computer program *EZ-FRISK* operates under the assumption that the occurrence rate of earthquakes on each mappable Quaternary fault is proportional to the faults slip rate. The program accounts for fault rupture length as a function of earthquake magnitude, and site acceleration estimates are made using the earthquake magnitude and distance from the site to the rupture zone. The program also accounts for uncertainty in each of following: (1) earthquake magnitude, (2) rupture length for a given magnitude, (3) location of the rupture zone, (4) maximum possible magnitude of a given earthquake, and (5) acceleration at the site from a given earthquake along each fault. By calculating the expected accelerations from considered earthquake sources, the program calculates the total average annual expected number of occurrences of site acceleration greater than a specified value. We utilized acceleration-attenuation relationships suggested by Boore-Atkinson (2007) and Campbell-Bozorgnia (2008) in the analysis. Table 9.4.2 presents the site-specific probabilistic seismic hazard parameters including acceleration-attenuation relationships and the probability of exceedence.

**TABLE 9.4.2
PROBABILISTIC SEISMIC HAZARD PARAMETERS**

Probability of Exceedence	Peak Ground Acceleration	
	Boore-Atkinson, 2007 (g)	Campbell-Bozorgnia, 2008 (g)
2% in 50 Years	0.70	0.49
5% in 50 Years	0.55	0.39
10% in 50 Years	0.45	0.32

The California Geologic Survey (CGS) has a program that calculates the ground motion for a 10 percent of probability of exceedence in 50 years based on an average of several attenuation relationships. Table 9.4.3 presents the calculated results from the Probabilistic Seismic Hazards Mapping Ground Motion Page from the CGS website.

**TABLE 9.4.3
PROBABILISTIC SITE PARAMETERS FOR SELECTED FAULTS
CALIFORNIA GEOLOGIC SURVEY**

Calculated Acceleration (g) Firm Rock	Calculated Acceleration (g) Soft Rock	Calculated Acceleration (g) Alluvium
0.35	0.36	0.40

While listing peak accelerations is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including the frequency and duration of motion and the soil conditions underlying the site. Seismic design of the structures should be performed in accordance with the 2007 California Building Code (CBC) guidelines currently adopted by the County of San Bernardino.

9.5 Liquefaction Potential

Liquefaction typically occurs when a site is located in a zone with seismic activity, onsite soils are cohesionless, groundwater is encountered within 50 feet of the surface, and soil relative densities are less than about 70 percent. If the four of the previous criteria are met, a seismic event could result in a rapid pore-water pressure increase from the earthquake-generated ground accelerations. Seismically induced settlement may occur whether the potential for liquefaction exists or not. The potential for liquefaction and seismically induced settlement occurring within the site soil is considered to be very low due to the dense nature of the older alluvium and the formational rock units and lack of groundwater within 50 feet of the ground surface.

9.6 Seismically-Induced Settlement

Due to the presence of dense to very dense older alluvial deposits and localized areas of shallow bedrock, this site is considered to possess a low potential for significant seismically-induced settlement. Geocon should evaluate the potential for seismically induced settlement in future investigations after development plans have been prepared.

9.7 Landslides and Rockfall

Based on our site geologic reconnaissance mapping and review of geologic literature and aerial photographs, there are not known landslides on or near the site, nor is the site in the path of any known or potential landslides. We do not consider the potential for landsliding to be a hazard to this project.

The Granite and Fairview Mountains encroach onto portions of the site along the northwestern and southern site boundaries. They are comprised of granitic quartz monzonite and granite bedrock and generally have slope inclinations less than 1:1 (horizontal:vertical); however, some localized areas have less weathered portions that are near vertical. The bedrock is moderately weathered at the surface. This bedrock is not expected to cause any significant landslide activity; however, rock fall or rock raveling should occasionally be expected near the steepened bedrock outcrops. The impact of rockfall will require future analysis when grading plans are made available.

9.8 Seiches and Tsunamis

A tsunami is a series of long-period waves generated in the ocean by a sudden displacement of large volumes of water. Causes of tsunamis include underwater earthquakes, volcanic eruptions, or offshore slope failures. The site is not located within a coastal area; therefore, tsunamis and seismic sea waves are not considered a significant hazard at the site.

A seiche is a run-up of water within a lake or embayment triggered by fault- or landslide-induced ground displacement. The site is not located in the vicinity of or downstream from such bodies of water. Therefore, the risk of seiches affecting the site is negligible.

9.9 Dam Inundation

The site is not located down-gradient of any existing water-retaining structure and is not within a potential inundation area for an earthquake-induced dam failure; therefore, the potential for dam inundation is considered very low.

9.10 Subsidence, Hydroconsolidation, and Peat Oxidation

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of large volumes of groundwater, oil, or natural gas. Soil that is particularly subject to subsidence includes those with high silt or clay content. The area surrounding the site is not within an area of known ground subsidence. We are not aware of large-scale extraction of groundwater, gas, oil, or geothermal energy occurring or planned at or near the site. There appears to be little or no potential for ground subsidence due to withdrawal of fluids or gases at the site.

The majority of the site is underlain by surficial soil that is subject to hydroconsolidation. The underlying soil which may be subject to hydroconsolidation predominantly occurs within the wash deposits (Qw) and young alluvial fan deposits (Qyf). The surficial units extend to depths ranging between 4 and 11 feet below existing grade. The underlying older alluvium (Qoa) is generally dense to very dense and would be less susceptible to hydroconsolidation. Hydroconsolidation is the tendency of a soil structure to collapse upon saturation resulting in the overall settlement of the effected soil. Potentially compressible surficial soil underlying the proposed structures is typically removed and recompacted during remedial site grading. However, if compressible soil is left in-place, a potential for settlement due to hydro-consolidation of the soil exists. We expect the potential for hydro-consolidation will be mitigated by remedial grading and the use of stiffer foundation systems. Additional subsurface investigation and laboratory consolidation testing will be necessary during future geotechnical investigations. Provided the geotechnical recommendations presented in future investigations are followed, the hazard associated with hydroconsolidation is considered low.

We performed several laboratory consolidation tests in conformance with ASTM D 2435 to evaluate the potential of hydroconsolidation. Based on the results of the laboratory tests, the existing soil possesses a potential of consolidating 0.7 to 5.1 percent with a vertical pressure of 2,000 pounds per square foot (psf). We evaluated the potential of hydroconsolidation with a vertical pressure of approximately 2,000 psf based on the expected vertical pressures subsequent to the planned grading operations and foundation loads. The results should not be taken as the “collapse index.” The results of the consolidation tests are presented in Appendix B.

Oxidation of peat deposits can result in a corresponding loss of volume, creating a potential for settlement in areas where structures or compacted fill are planned. We did not encounter or expect peat deposits given the geomorphology of the site; therefore, the probability of hazards associated with peat oxidation is considered very low.

9.11 Volcanic Eruptions

The Hacienda at Fairview Valley site is located approximately 60 miles west of the nearest potentially active volcanic region consisting of the Amboy Crater Area, which has had eruptions as recently as

6,000 years ago (Jennings, 1994). The most recent volcanic activity is located in the Cima Volcanic Field roughly 85 miles to the northeast with eruptions estimated at 330 to 480 years ago (Jennings, 1994). Late Quaternary volcanic deposits are also located in the Coso Volcanic Field, 110 miles north of the site, and in Owens Valley, 240 miles north of the site. Recent volcanic tephra or flow deposits and evidence of volcanic activity such as fumeroles, earthquake swarms, gas emissions, and geothermal vents were not observed at the site and are not mapped in the site vicinity. Based on the predictions of the U.S. Geological Survey, the probability of an eruption capable of producing a regional ash-fall event are one in several hundred for any given year. The prevailing winds in the region are typically from the west and occasionally from the northeast during Santa Ana wind events. An eastern or northern wind event at the time of a volcanic eruption would be necessary to deliver ash deposits to the site. Therefore, given the low probability of an ash-producing volcanic event, the unfavorable winds for delivering ash-fall to the site, and the lack of evidence for nearby volcanic activity to produce ash falls or lava flows, the hazards associated with volcanic eruptions should be considered very low.

10. GRADING CONSIDERATIONS

Preliminary development plans indicate that grading will consist of typical cutting and filling operations to achieve design elevations, and will incorporate the construction of cut and fill slopes. We expect that conventional earthmoving equipment can be used for the majority of excavations in the surficial soil and the weathered, fractured, and jointed portions of the bedrock units. However, heavy ripping, rock breaking, and blasting will likely be necessary in the competent bedrock areas and where corestones and large boulders are encountered.

We expect that most of the excavated materials can be reused as engineered fill; however, oversized material and some soil will likely be generated that will require special handling. Fill placed during grading should be placed in accordance with the regulations of the appropriate governing agencies. We do not expect grading at the site will have a detrimental effect on the site or the surrounding developments.

11. EFFECTS OF GEOLOGIC CONDITIONS ON FOUNDATIONS

Based on the types of structures proposed for this development, the majority of the structures will likely be founded on a conventional shallow foundation systems with slabs-on-grade, post-tensioned foundation systems, or mat foundation systems supported in either compacted fill or formational materials. Grading of residential buildings typically results in the construction of pads underlain entirely by either formational materials (cut pads) or compacted fill (fill pads). Occasionally, grading results in cut-fill transition pads that may be subject to differential settlement. Differential settlement along transition lots can be mitigated by undercutting of the cut portion of the pad and replacement with compacted fill so foundations are placed on a uniform material.

The soil encountered in the field investigation is considered to range between “non-expansive” and “expansive” (expansion index [EI] of 20 or less and greater than 20, respectively) as defined by 2007 California Building Code (CBC) Section 1802.3.2. Table 11 presents soil classifications based on the expansion index. We expect a majority of the existing soil will possess a “very low” to “low” expansion potential (expansion index of 50 or less). Expansion potential for soil in the upper approximately 3 to 5 feet of pad grade should be evaluated when rough pad grades have been achieved.

**TABLE 11
SOIL CLASSIFICATION BASED ON EXPANSION INDEX**

Expansion Index (EI)	Soil Classification
0 – 20	Very Low
21 – 50	Low
51 – 90	Medium
91 – 130	High
Greater Than 130	Very High

Physical and chemical characteristics of the soil underlying, and in contact with structures, slabs-on-grade, foundations, and subsurface structures may result in hazards due to expansive soil and corrosion caused by water-soluble sulfate content, potential of hydrogen (pH), electrical resistivity, and water-soluble chloride content. We performed laboratory tests on samples of the site materials to evaluate the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate content tests are presented in Appendix B and indicate that the on-site materials at the locations tested possess “negligible” sulfate exposure to concrete structures as defined by 2007 CBC Section 1904.3 and ACI 318. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration over time.

We performed laboratory tests on a sample of the site materials encountered to check the corrosion potential to subsurface metal structures. We performed the laboratory tests in accordance with California Test Method No. 643. The laboratory test results are presented in Appendix B.

Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, if improvements that could be susceptible to corrosion are planned, further evaluation by a corrosion engineer should be performed.

12. STABILITY OF GRADED SLOPES

We understand cut and fill slopes will be constructed during grading operations. The portions of the site planned for development are generally underlain by Quaternary-age surficial soil and Mesozoic-age igneous rocks. The surficial sediments are generally massive or crudely stratified and do not typically contain planes of weakness, such as bedding or joints, that could affect slope stability. The bedrock materials consist of granitic rock types with degrees of weathering ranging from slightly weathered to decomposed. Geologic structure of the hard rock units includes jointing, fracturing and localized metamorphic foliation. The stability of graded slopes composed of bedrock is highly dependent on the degree of weathering and the geologic structure of the slope face. The geologic structure of proposed bedrock cut slopes should be analyzed during the design phase.

In general, we expect permanent, graded fill slopes composed of compacted fill with gradients of 2:1 (horizontal to vertical) or flatter will possess a factors of safety of at least 1.5. Graded cut slopes in bedrock materials should possess Factors of Safety greater than 1.5 at gradients up to 1:1 for temporary slopes and 1.5:1 for permanent slopes. However, because of the potential presence of adverse geologic structures, the stability of the proposed permanent and temporary slopes should be analyzed by the project geotechnical engineer and engineering geologist during the comprehensive geotechnical investigation prior to finalization of slope design. Additional subsurface exploration including rock coring or seismic refraction surveys may be necessary. Cut and fill slopes should be designed in accordance with the requirements of the local building codes or the California Building Code (CBC). Mitigation of unstable cut slopes will be achieved by the use of drained buttress fills and stability fills.

13. FLOODING, EROSION, RUNOFF, AND SEDIMENTATION

The Fairview Valley drainage area is localized within the surrounding mountains and has a limited watershed range of only a few miles. Elevations within the Fairview and Granite Mountains range from 3,100 feet MSL adjacent to the valley floor to nearly 4,800 feet MSL at its highest peaks. The valley is characterized by granular alluvial soil derived from the weathering of igneous and metamorphic bedrock units. The permeability is expected to range from moderate to high. The local drainages have a fairly limited length and have only occasional flow during intense rainfall periods. A review of the Federal Emergency Management Agency (FEMA) flood zone maps of the area indicate that the site is located within Zone D defined as *Areas with possible but undetermined flood hazards*. The maximum expected 100-year flood elevation and the final design elevation of the structures should be addressed during the design phase of the project. The potential hazard related to flooding can be mitigated during the design phase of the project by raising the finished grade of the proposed structures above the expected level of elevation of flooding.

Erosion is generally limited to the vicinity of the existing smaller active drainages originating from the surrounding mountains. The bedrock units are highly resistant to erosion and we did not observe recent

deep erosion-related incisions in the drainages and along the slopes during our field investigation. There is a potential for erosion to occur during the grading process during periods of heavy rainfall. Provided the engineering recommendations are followed to mitigate erosion and the grading plans are prepared to generally-accepted regional standards, we do not expect erosion will be a major impact to development. Drainage control structures should be installed to intercept water flow emanating from the canyon drainages and directed to proper storm drain improvements.

The majority of the site has not been subject to development and, subsequently, the site is not covered by pavement and impervious surfaces. Runoff at the site is expected to increase during development as portions of the site are graded and paved. The majority of development is planned in the valley floor with only minor encroachment into the adjacent hillsides. On-site grading should be performed in such a manner that alteration or runoff or erosion of graded areas will not occur. Areas of construction should be fine-graded to direct water away from foundations and direct water to the nearest available storm drain or street. Runoff in the developed areas should not be allowed to flow in an uncontrolled manner, especially over any temporary or permanent slopes.

Due to the very low flow volume of water within the canyon drainages during the majority of the year, large-scale sedimentation is not expected to occur.

14. GROUNDWATER INFILTRATION AND PERCOLATION

We understand that the site may incorporate the use of septic tank and leach field systems to process effluent. The groundwater table in the vicinity of the proposed development is reported to be at depths greater than 230 feet below existing grade. Therefore, the use of septic tank and leach field systems is appropriate for this site. The future investigation and soil collapse potential analyses should incorporate the use of septic systems and their impact on building foundation design and settlement.

Geocon performed percolation testing at eight locations in the northern property (see Geologic Map, Figures 2 and 3) to evaluate the suitability of the underlying soil for on-site wastewater disposal systems. We performed the percolation tests according to the County of San Bernardino Department of Environmental Health as outlined in their manual, *Waste Disposal for Individual Homes, Commercial and Industrial*. The results of our percolation testing are summarized in Table 14. We performed percolation tests on boring excavations extending to approximately 3 feet below the existing ground surface in the alluvial soils. The percolation test locations were randomly spread across the northern site in near proximity to exploratory borings to evaluate whether suitable site conditions exist to support a septic system. The test results indicate that the percolation rates varied from approximately 2.7 minutes per inch (min/inch) to 6.7 min/inch in the locations tested and indicate that septic and leach field systems are appropriate. Individual wastewater disposal systems should be designed according to the site-specific percolation rates and the specifications of the governing agencies.

**TABLE 14
SUMMARY OF PERCOLATION TEST RESULTS**

Test Number	Geologic Unit	Percolation Rate (Minutes/Inch)
PT-1	Alluvium	2.7
PT-2	Alluvium	4.7
PT-3	Alluvium	4.0
PT-4	Alluvium	6.7
PT-5	Alluvium	5.0
PT-6	Alluvium	4.7
PT-7	Alluvium	6.7
PT-8	Alluvium	5.3

15. LANDFORM ALTERATION AND RESOURCE EXTRACTION

There are no unique geologic features in the vicinity of the site. Therefore, no unique geologic features will be modified or destroyed as a result of the proposed development. Evidence of mineral prospecting was not observed on the site. The proposed development will not result in the loss of petroleum, natural gas, mineral resources, or aggregate.

16. SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

Potential Project Impact	Risk and Mitigation Measure
Surficial soil, such as the upper portions of the alluvium and intensely weathered to decomposed bedrock, is unconsolidated and is not considered suitable for support of engineered fill or structural loads in their present condition.	Surficial soil will require remedial grading in the form of excavation, moisture conditioning, and recompaction during construction. The remedial grading will help mitigate the potential for settlement of the surficial soils, thus the potential impact to the proposed project is minimal.
Bedrock corestones and/or oversize material may be generated during grading.	The rippability of the geologic units is highly variable and blasting of the formational rock materials may be required to achieve proposed grades. Oversize material will require special handling during grading and will have minimal impact on the proposed project. The effects of blasting could include an increase in temporary construction-related noise and airborne particulate matter, but should be relatively minor due to the relatively remote location of the proposed development.
We did not observe evidence of mineral prospecting on the site.	The proposed development will not result in the loss of petroleum, natural gas, mineral resources, or aggregate. Mitigation measures are not required.

Potential Project Impact	Risk and Mitigation Measure
Surface rupture from local and regional faults.	The active Helendale Fault is located on the eastern portion of the site. Portions of the site are mapped within a State of California Alquist-Priolo Earthquake Fault Zone. A detailed fault rupture hazard investigation will be required to assess the potential hazard from fault rupture when tentative maps and grading plans are prepared. Structural setbacks from active fault strands and appropriate mitigation measures will be determined during future fault investigations.
There is a potential for moderate to severe ground shaking in the event of an earthquake.	We calculated the expected ground acceleration to range from less than 0.41g to 0.48g, depending upon the calculation method. The potential adverse impacts of ground shaking can be mitigated to an acceptable level if the proposed development is designed and constructed in conformance with current building codes and engineering practices.
Liquefaction and seismically-induced settlement.	The results of our preliminary analyses indicate that the potential for liquefaction is low. There may be a potential for seismically induce settlement; however, we will calculate the potential settlement in future investigations after development plans are prepared.
Landslide deposits are not located within the site.	Mitigation of the landslide deposits at the site will not be required due to the lack of weak soil strength materials. The potential risk for future landsliding adversely affecting improvements is very low.
Dam inundation from existing structures	The site is not located down-gradient of any existing water-retaining structure and is not within a potential inundation area for an earthquake-induced dam failure; therefore, the potential for dam inundation from existing structures is negligible.
Tsunamis	The project is not located in a coastal area; therefore, risk of a tsunami is negligible.
Seiches	The project is not located adjacent to large bodies of water that could adversely affect the site in the event of earthquake-induced seiches. The potential risk is negligible.
Ground subsidence and peat oxidation	The site is not within this area of subsidence associated with fluid withdrawal or peat oxidation. The potential impact is considered negligible.
Hydroconsolidation of soil	The surficial soil has a potential for hydro-consolidation. The remedial grading of the loose dry soil and the use of a stiffened conventional foundation system will mitigate the potential for hydro-consolidation. More detailed testing and analysis will be performed during the tentative map and grading plan phase of development.

Potential Project Impact	Risk and Mitigation Measure
Volcanic eruption	The site is not subject to any known volcanic hazards. The nearest volcanic fields are located approximately 60 miles northeast of the project site. The risk of hazards associated with volcanic eruptions is considered low.
Bedrock Rippability	Based on a review of preliminary development plans, cuts in the bedrock are planned to be limited with a maximum expected height of 10 to 20 feet. Rippability is highly dependent upon the degree of weathering, fracturing, and jointing within bedrock and the rippability of the various soil and rock units is, correspondingly variable. The rippability of the bedrock units within the upper 20-feet the proposed project varies from rippable to non-rippable. Blasting and rock breaking may be required on portions of the site to achieve proposed grades.
Differential settlement along cut/fill transition pads	Undercutting of the cut portions of the pads and replacement with compacted fill will mitigate the potential risk of differential settlement.
Expansive Soil	The results of our preliminary evaluation for expansive soil are presented in Table B-III in Appendix B and indicate that the expansion potential at this site is "very low." Mitigation methods for expansive soil will not be required.
Corrosive Soil	The results of our preliminary evaluation of soil characteristics related to corrosivity are presented in Tables B-IV and B-V in Appendix B and indicate that the site has a negligible classification for concrete corrosion due to water-soluble sulfates. Corrosion for buried metal structures should be evaluated during design of site improvements.
Stability of graded slopes	In general, cut slopes composed of properly compacted fill and weathered bedrock should be stable at inclinations of 2:1 (horizontal to vertical), or flatter. Slopes composed of competent, slightly weathered to unweathered bedrock should be stable at inclinations of 1½:1 or flatter. The potential impact is considered minimal.
The site is located within FEMA Zone D defined as <i>areas with possible flooding but undetermined flood hazards.</i>	The potential risk of flooding in the lower elevations of the site is possible but undetermined. The potential hazard related to flooding can be mitigated during the design phase of the project by raising the finished grade of the proposed structures above the expected elevation of flooding and by constructing flood control devices at the outlets of canyon drainages.
Limited erosion is occurring along canyon drainages. There is a potential for erosion to occur during the grading process during periods of heavy rainfall	Provided the engineering recommendations are followed to mitigate erosion and the grading plans are prepared to generally-accepted regional standards, erosion is not expected to be a major impact to development.

Potential Project Impact	Risk and Mitigation Measure
Runoff	Runoff in the developed areas should not be allowed to flow in an uncontrolled manner, especially over any temporary or permanent slopes.
Groundwater infiltration for on-site effluent disposal systems.	Percolation tests indicate that the alluvial soils are moderately to highly permeable. Depending on the site-specific soil characteristics as well as the proposed site usage, leach fields, seepage pits, mound systems, or other systems are considered feasible methods of on-site wastewater disposal.
Landform alteration	No unique geologic features will be modified or destroyed as a result of the proposed development. The potential impact is considered negligible.

17. CONCLUSIONS

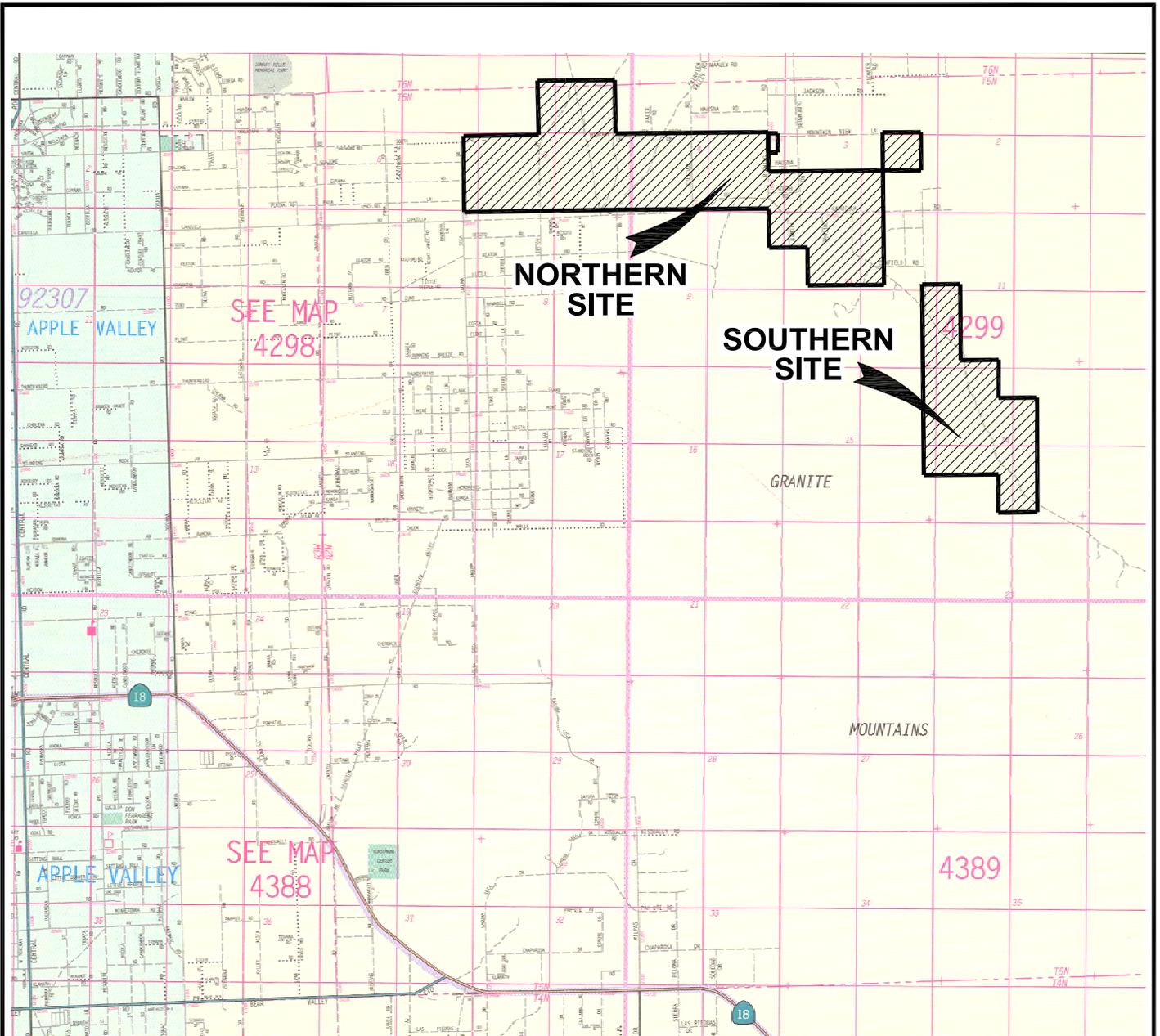
No soil or geologic conditions were encountered that would preclude the development of the property as presently planned. Further geotechnical investigation will be required when a Tentative Map and specific grading plans for the site development are prepared. This report is intended to provide geotechnical information to be used in development planning and the preparation of an Environmental Impact Report (EIR).

Potential geologic hazards at the site include surface fault rupture, seismic shaking and soil collapse. Additional subsurface investigation, laboratory testing, and engineering analysis should be performed to evaluate the potential effects of these geotechnical and geologic hazards as part of our design-level geotechnical investigation. An active fault is mapped traversing the eastern portion of the site. The potential for surface rupture from faulting at the site is considered significant. A fault hazards investigation including fault trenching should be performed to evaluate the potential for surface rupture impacting the planned development. The hazard due to seismic shaking at the site is expected to be moderate to high due to the relatively moderate to high seismic accelerations projected for the site.

The primary intent of this study was to address potential geologic hazards and geotechnical conditions that could impact the project. We understand that this report will be included in the Environmental Impact Report (EIR) for the project. We recommend that a more detailed, design level geotechnical study be performed to further evaluate the characteristics of the geologic materials prior to finalizing grading and foundation plans. Specifically, the geotechnical properties of the bedrock units will require additional evaluation to more comprehensively evaluate slope stability in accordance with standard of care and required factors of safety.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.
2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.
3. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.
4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.



SOURCE: 2007 THOMAS BROTHERS MAP
RIVERSIDE COUNTY, CALIFORNIA

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NO SCALE

VICINITY MAP

HACIENDA AT FAIRVIEW VALLEY
SAN BERNARDINO COUNTY, CALIFORNIA

GEOCON

INLANDEMPIRE INC.



GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

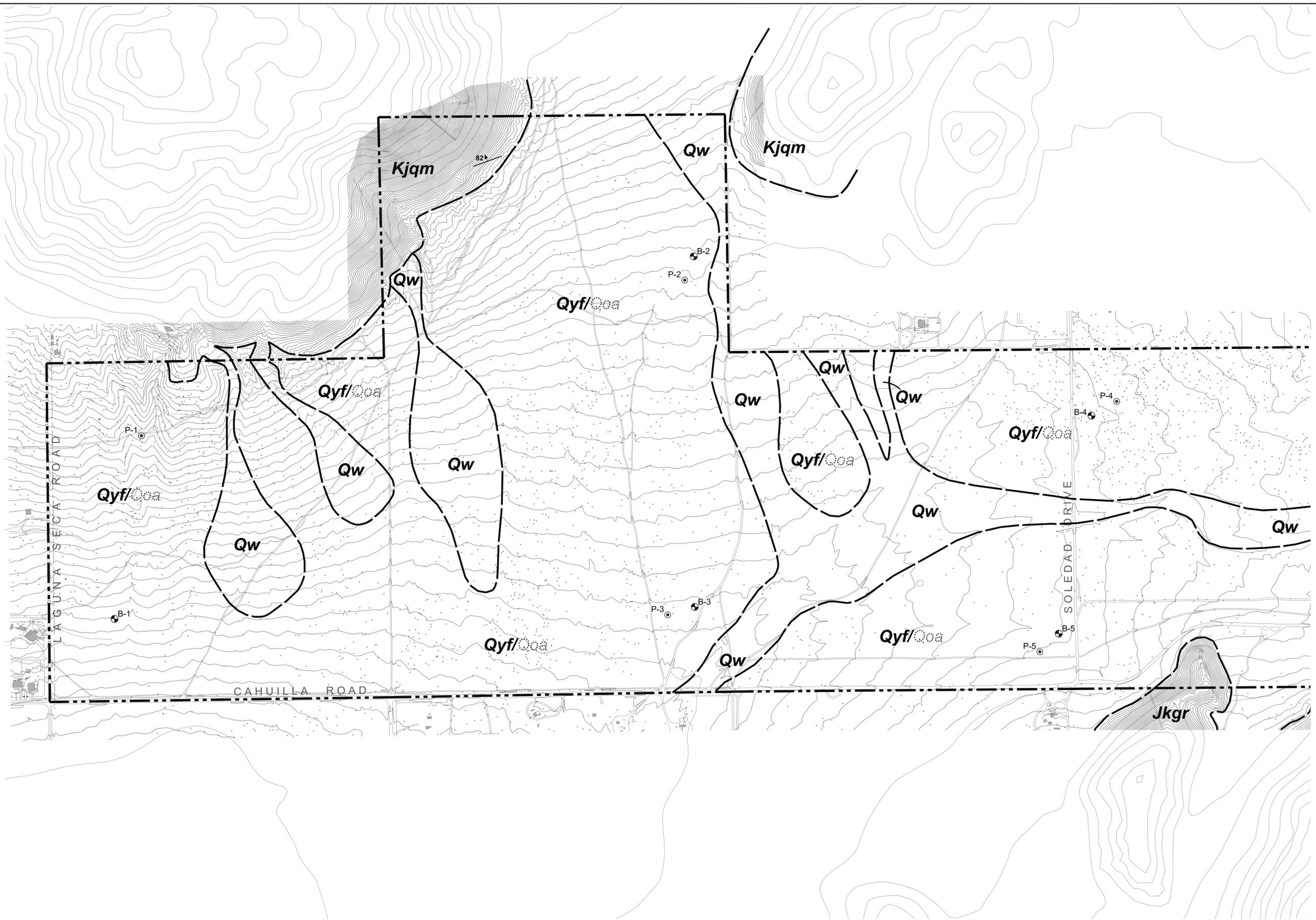
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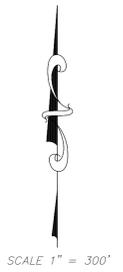
DATE 03 - 25 - 2009

PROJECT NO. A8528 - 06 - 01

FIG. 1



- GEOCON LEGEND**
- Qw** WASH DEPOSITS
 - Qyf** YOUNG ALLUVIAL FAN DEPOSITS
 - Qoa** OLD ALLUVIAL DEPOSITS (Dotted Where Buried)
 - Kjqm** CRETACEOUS OR JURASSIC QUARTZ MONZONITE
 - Jkgr** JURASSIC OR CRETACEOUS GRANITE
 - B-17** APPROX. LOCATION OF EXPLORATORY BORING
 - P-8** APPROX. LOCATION OF PERCOLATION TEST
 - 70°** STRIKE AND DIP OF FOLIATION
 - APPROX. LOCATION OF GEOLOGIC CONTACT
 - APPROX. LOCATION OF FAULT (Dashed Where Approximate; Dotted Where Buried; Queried Where Uncertain)
 - DELINEATED STRAIGHT LINE SEGMENTS THAT CONNECT CIRCLED TURNING POINTS SO AS TO DEFINE THE EARTHQUAKE SPECIAL STUDY ZONE
 - APPROX. LOCATION OF EARTHQUAKE SPECIAL STUDY ZONE



GEOLOGIC MAP
 HACIENDA AT FAIRVIEW VALLEY
 NORTHERN SITE
 SAN BERNARDINO COUNTY, CALIFORNIA

GEOCON <small>INLAND EMPIRE, INC.</small> <small>GEOTECHNICAL & ENVIRONMENTAL MATERIALS</small> <small>300 N. SAN FERNANDO BLVD., SUITE 100 - BURBANK, CA 91504</small> <small>PHONE 818 841-8388 - FAX 818 841-9704</small>	SCALE 1" = 300' PROJECT NO. ABS28 - 06 - 01 SHEET 1 OF 1	DATE 03 - 25 - 2009 FIGURE 2
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SEE FIGURE 2



GEOCON LEGEND

- Qw** WASH DEPOSITS
- Qyf** YOUNG ALLUVIAL FAN DEPOSITS
- Qoa** OLD ALLUVIAL DEPOSITS (Dotted Where Buried)
- Kjgm** CRETACEOUS OR JURASSIC QUARTZ MONZONITE
- Jkgr** JURASSIC OR CRETACEOUS GRANITE
- B-17** APPROX. LOCATION OF EXPLORATORY BORING
- P-8** APPROX. LOCATION OF PERCOLATION TEST
- APPROX. LOCATION OF GEOLOGIC CONTACT
- STRIKE AND DIP OF FOLIATION
- APPROX. LOCATION OF FAULT (Dashed Where Approximate; Dotted Where Buried; Queried Where Uncertain)
- DELINEATED STRAIGHT LINE SEGMENTS THAT CONNECT CIRCLED TURNING POINTS SO AS TO DEFINE THE EARTHQUAKE SPECIAL STUDY ZONE
- APPROX. LOCATION OF EARTHQUAKE SPECIAL STUDY ZONE

GEOLOGIC MAP
 HACIENDA AT FAIRVIEW VALLEY
 NORTHERN SITE
 SAN BERNARDINO COUNTY, CALIFORNIA

GEOCON <small>INCORPORATED</small> <small>3003 N. SAN FERNANDO BLVD., SUITE 100 - BURBANK, CA 91504</small> <small>PHONE: 818 841-8388 - FAX: 818 841-9704</small>	SCALE 1" = 300' PROJECT NO. ABS28-06-01 SHEET 1 OF 1	DATE 03-25-2009 FIGURE 3
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SCALE 1" = 300'

SEE FIGURE 4



SCALE 1" = 300'

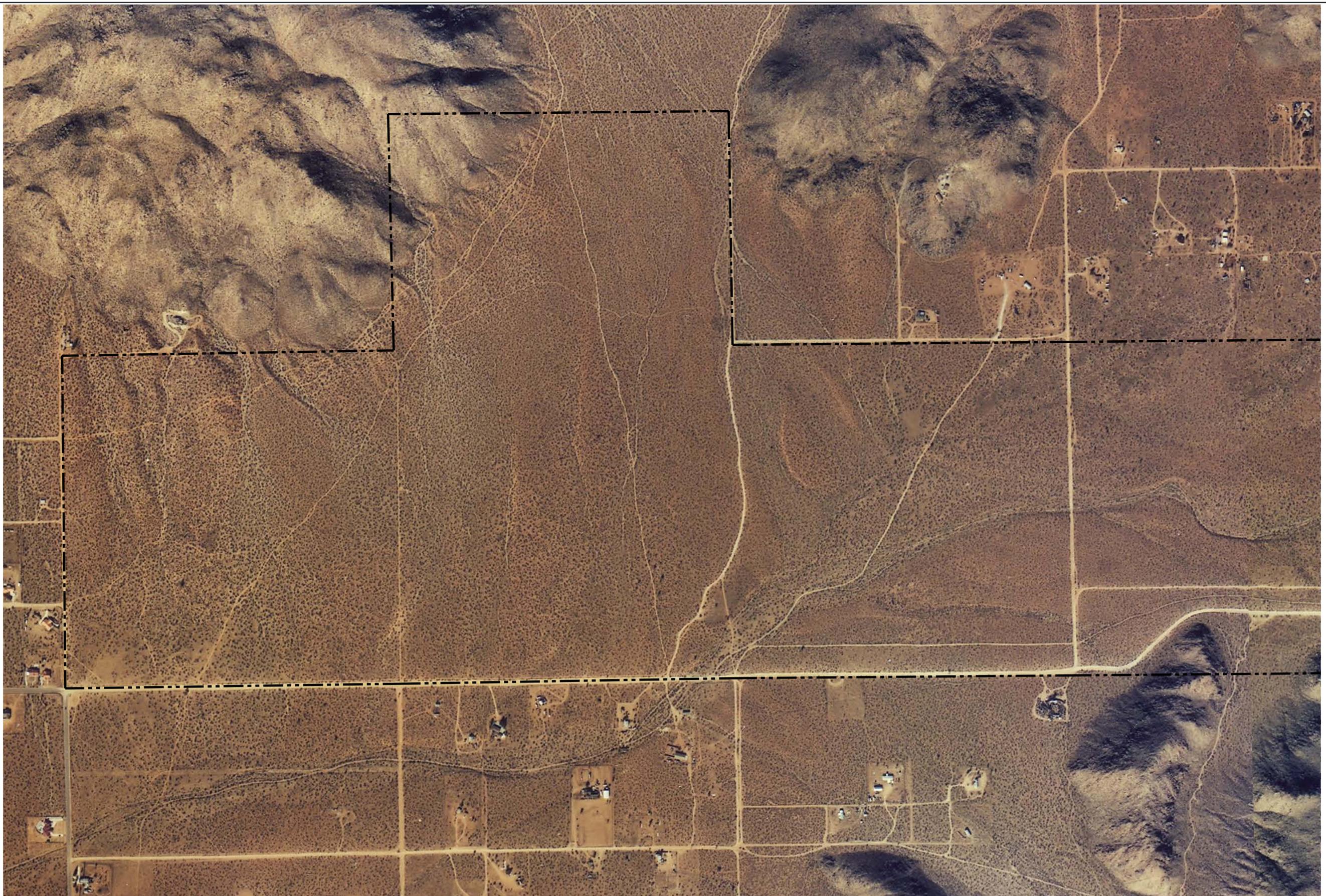
GEOCON LEGEND

- Qw** WASH DEPOSITS
- Qyf** YOUNG ALLUVIAL FAN DEPOSITS
- Qoa** OLD ALLUVIAL DEPOSITS (Dotted Where Buried)
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- 70°** STRIKE AND DIP OF FOLIATION
- APPROX. LOCATION OF FAULT (Dashed Where Approximate; Dotted Where Buried; Queried Where Uncertain)
- DELINEATED STRAIGHT LINE SEGMENTS THAT CONNECT CIRCLED TURNING POINTS SO AS TO DEFINE THE EARTHQUAKE SPECIAL STUDY ZONE
- APPROX. LOCATION OF EARTHQUAKE SPECIAL STUDY ZONE

GEOLOGIC MAP
 HACIENDA AT FAIRVIEW VALLEY
 SOUTHERN SITE
 SAN BERNARDINO COUNTY, CALIFORNIA

GEOCON LAND AND ENVIRONMENTAL SERVICES 3003 N. SAN BERNARDINO BLVD., SUITE 100 - BURBANK, CA 91504 PHONE 818 841-8388 - FAX 818 841-9704	SCALE 1" = 300'	DATE 03-25-2009
	PROJECT NO. ABS28-06-01	FIGURE 4
SHEET 1 OF 1		

V:\ABS28\06\01\ABS28\GEO\MAP\FIG3



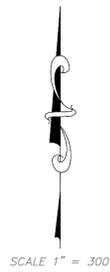
SEE FIGURE 6

GEOLOGIC FAULT AND LINEAMENT MAP
 HACIENDA AT FAIRVIEW VALLEY
 NORTHERN SITE
 SAN BERNARDINO COUNTY, CALIFORNIA

GEOCON
 LAND AND ENVIRONMENTAL SERVICES
 GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
 3003 N. SAN FERNANDO BLVD., SUITE 100 - BURBANK, CA 91504
 PHONE (818) 841-8388 - FAX (818) 841-5704

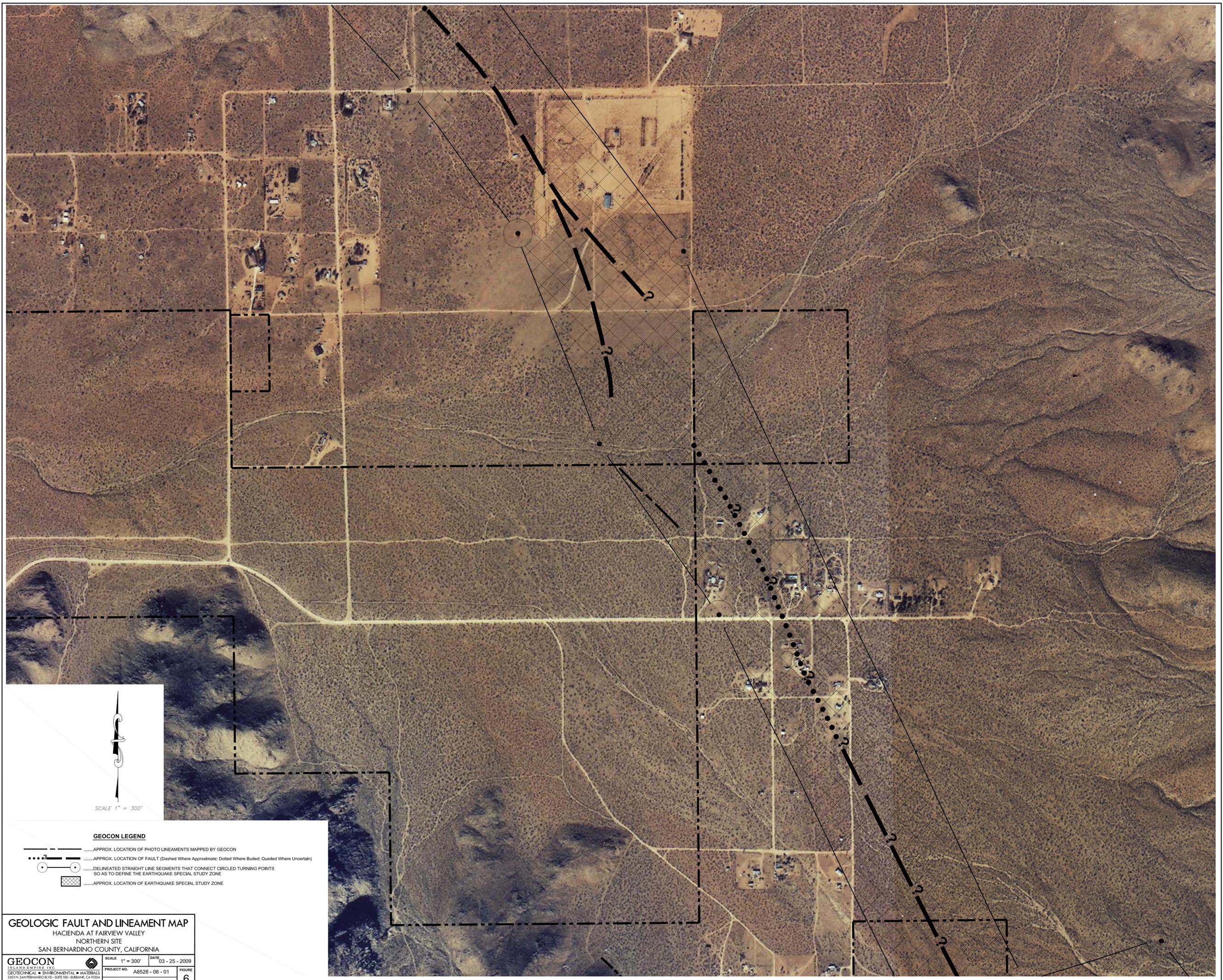
SCALE 1" = 300' DATE 03 - 25 - 2009
 PROJECT NO. A8528 - 06 - 01 FIGURE 5
 SHEET 1 OF 1

- GEOCON LEGEND**
-APPROX. LOCATION OF PHOTO LINEAMENTS MAPPED BY GEOCON
 -APPROX. LOCATION OF FAULT (Dashed Where Approximate; Dotted Where Buried; Queried Where Uncertain)
 -DELINEATED STRAIGHT LINE SEGMENTS THAT CONNECT CIRCLED TURNING POINTS SO AS TO DEFINE THE EARTHQUAKE SPECIAL STUDY ZONE
 -APPROX. LOCATION OF EARTHQUAKE SPECIAL STUDY ZONE



Y:\A8528-06-01\A8528 FAULT AND LINEAMENT MAP.DWG

SEE FIGURE 5



SCALE 1" = 300'

GEOCON LEGEND

-APPROX. LOCATION OF PHOTO LINEAMENTS MAPPED BY GEOCON
-APPROX. LOCATION OF FAULT (Dashed Where Approximate; Dotted Where Buried; Queried Where Uncertain)
-DELINEATED STRAIGHT LINE SEGMENTS THAT CONNECT CIRCLED TURNING POINTS SO AS TO DEFINE THE EARTHQUAKE SPECIAL STUDY ZONE
-APPROX. LOCATION OF EARTHQUAKE SPECIAL STUDY ZONE

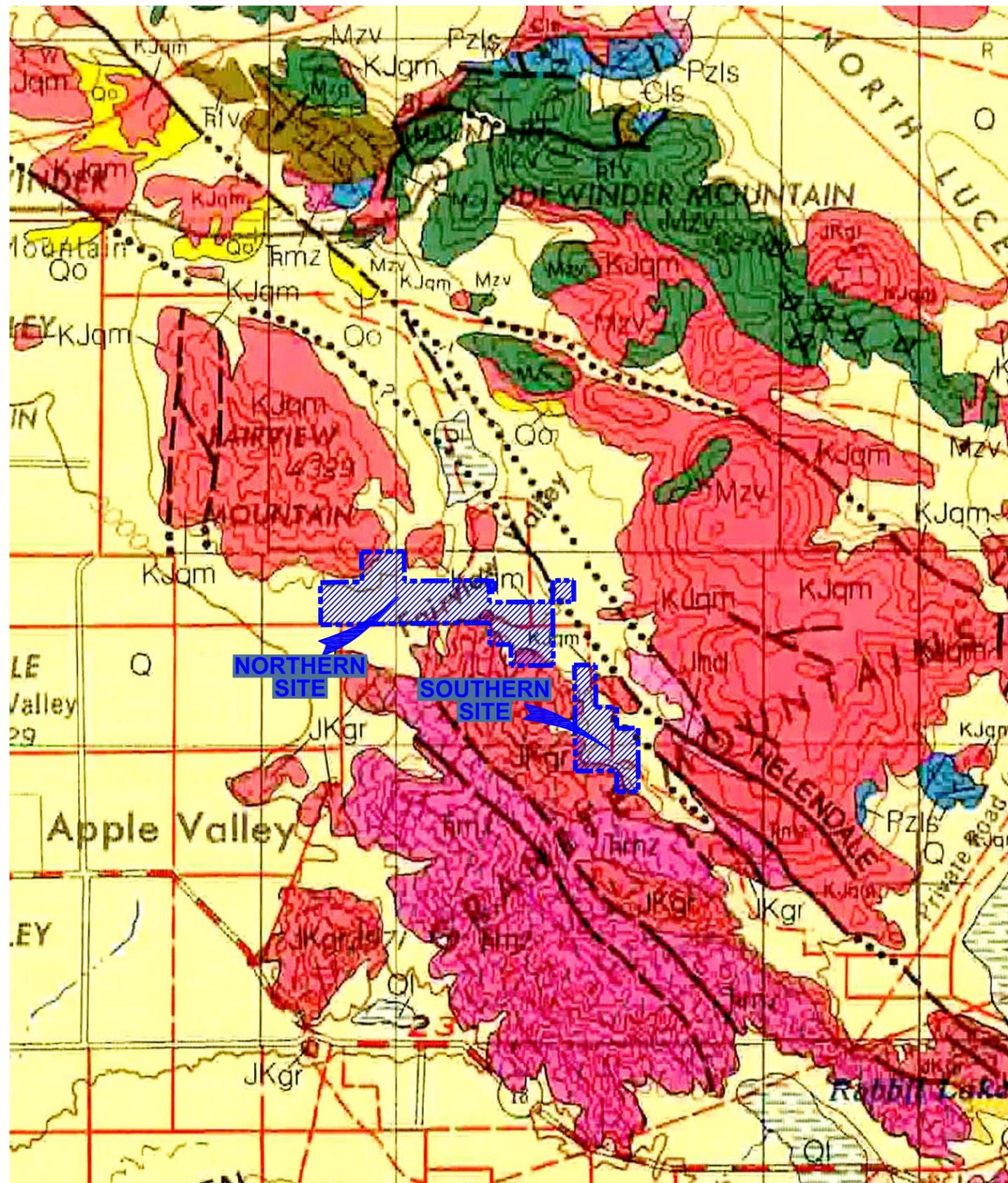
GEOLOGIC FAULT AND LINEAMENT MAP
 HACIENDA AT FAIRVIEW VALLEY
 NORTHERN SITE
 SAN BERNARDINO COUNTY, CALIFORNIA

GEOCON
 LAND AND EMBLEM INC.
 GEOTECHNICAL & ENVIRONMENTAL ■ WATERBILLS
 3007 N. SAN FERNANDO BLVD., SUITE 100 - BURBANK, CA 91504
 PHONE 818 841-8388 - FAX 818 841-0704

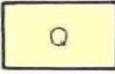
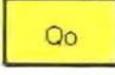
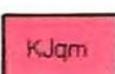
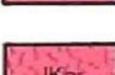
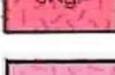
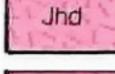
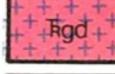
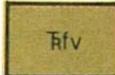
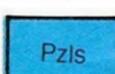
SCALE 1" = 300' DATE 03 - 25 - 2009
 PROJECT NO. ABS28 - 06 - 01 FIGURE 6
 SHEET 1 OF 1

SEE FIGURE 7

HACIENDA AT FAIRVIEW VALLEY
SAN BERNARDINO COUNTY, CALIFORNIA



LEGEND

-  HOLOCENE ALLUVIUM (Undifferentiated)
-  LAKE DEPOSITS
-  OLDER ALLUVIUM (Undifferentiated)
-  CRETACEOUS OR JURASSIC QUARTZ MONZONITE;
QUARTZ MONZONITE OF PLEASANT VIEW RIDGE
-  JURASSIC OR CRETACEOUS GRANITE
-  JURASSIC HORNBLende DIORITE AND MINOR GABBRO
-  TRIASSIC MONZONITE
-  MT. LOWE GRANODIORITE
-  MESOZOIC METAVOLCANIC ROCKS
-  FAIRVIEW VALLEY FORMATION (Limestone, Calcareous Sandstone and Siltstone)
-  UPPER PALEOZOIC LIMESTONE AND MARBLE
-  CAMBRIAN AND UPPERMOST PRECAMBRIAN METASEDIMENTARY ROCKS
Cis - CRYSTALLINE LIMESTONE



APPROX. SCALE: 1" = 8,000'

GEOCON
INLAND EMPIRE



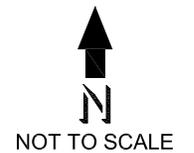
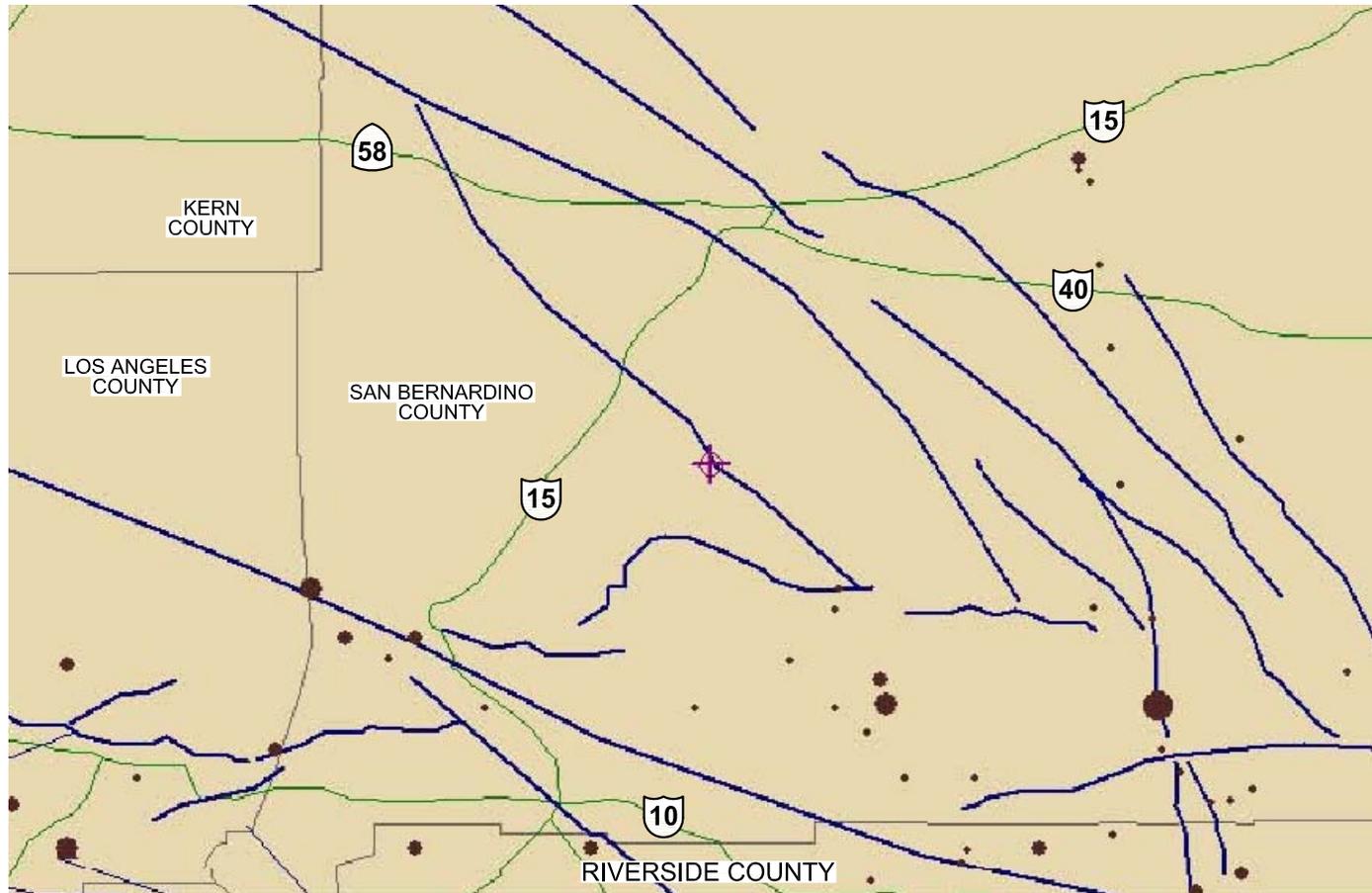
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
3303 N. SAN FERNANDO BLVD. STE. 100 - BURBANK, CA 91504 - 2531
PHONE 818 841-8388 - FAX 818 841-1704
PROJECT NO. A8528 - 06 - 01

FIGURE 8
DATE 03 - 25 - 2009

REGIONAL GEOLOGIC MAP

Source: GEOLOGIC MAP OF SAN BERNARDINO QUADRANGLE, CALIFORNIA
COMPILED BY E.J. BORTUGNO AND T.E. SPITTLER (Revised, 1998)

HACIENDA AT FAIRVIEW VALLEY
 SAN BERNARDINO COUNTY, CALIFORNIA



MAP LEGEND

- Site
- Counties
- Highways

Faults

- Included
- Not included

Historical Seismicity

- Greater than 8.5
- 7.5 to 8.5
- 6.5 to 7.5
- 5.5 to 6.5
- Less than 5.5
- Unknown Magnitude

SOUTHERN CALIFORNIA FAULT AND SEISMIC MAP

GEOCON

INLAND EMPIRE INC.



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 3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
 PHONE (818) 841-8388 - FAX (818) 841-1704

DATE 03 - 25 - 2009

PROJECT NO. A8528 - 06 - 01

FIG. 9

APPENDIX

A

APPENDIX A

FIELD INVESTIGATION

The field investigation included the excavation of 17 small diameter borings. The approximate location of the excavations are shown on the Geologic Map, Figures 2 through 4 (map pocket). The exploratory borings were excavated to a maximum depth of 51 feet using a truck-mounted drill rig equipped with 8-inch diameter hollow stem augers. As drilling proceeded, the soil and geologic conditions encountered were logged and sampled.

The soil conditions encountered in the excavations were visually examined, classified and logged general accordance with the Unified Soil Classification System (USCS). Logs of the exploratory borings are presented on Figures A-1 through A-17. The logs depict the general soil and geologic conditions encountered and the depth at which samples were obtained

Samples were obtained during our boring excavations using a California split-spoon sampler or a Standard Penetration Test (SPT) sampler. Both samplers are composed of steel and are driven to obtain the soil samples. The California sampler has an inside diameter of 2.5 inches and an outside diameter of 2.875 inches. Up to 18 rings are placed inside the sampler that are 2.4 inches in diameter and 1 inch in height. The SPT sampler has an inside diameter of 1.5 inches and an outside diameter of 2 inches. Ring samples at appropriate intervals were retained in moisture-tight containers and transported to the laboratory for testing. Bulk samples were also retained from the borings and test pits for laboratory testing. The type of sample is noted on the exploratory boring logs.

The sampler was driven 18 inches into the bottom of the excavations with the use a 140-pound hammer with a 30-inch drop. Blow counts are recorded for every 6 inches the sampler is driven. The penetration resistances shown on the boring logs are shown in terms of blows per foot. The values indicated on the boring logs are the sum of the last 12 inches of the sampler if driven 18 inches. If the sampler was not driven for 18 inches, an approximate value is calculated in term of blows per foot or the final 6-inch interval is reported. These values are not to be taken as N-values, adjustments have not been applied.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 1		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>3085'</u>	DATE COMPLETED <u>10-03-2003</u>			
					EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u> BY: <u>M. SWEENEY</u>				
MATERIAL DESCRIPTION									
0	B1-1			SM	ALLUVIUM Loose, yellow brown, dry, Silty, fine SAND; trace medium to coarse sand - Becomes medium dense - Becomes damp				
2	B1-2					16			
4									
6	B1-3			SP		Loose to medium dense, yellow brown, damp, fine to medium SAND; trace coarse sand, silt	13	104.1	2.6
8	B1-4					17	106.3	1.4	
10	B1-5				23	111.2	2.5		
12				SM	OLDER ALLUVIUM Medium dense, yellow brown, dry to damp, Silty, fine SAND; trace medium sand				
14									
16	B1-6					18			
18				SP	Medium dense, yellow brown, damp, fine SAND; trace medium to coarse sand				
20	B1-7			SP	Dense to very dense, yellow to orange brown, dry to damp, fine to medium SAND; trace coarse sand	50/2"			
22									
24									
26	B1-8				64				
28									

Figure A-1,
Log of Boring B 1, Page 1 of 2

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 1		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>3085'</u>	DATE COMPLETED <u>10-03-2003</u>			
					EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u>		BY: <u>M. SWEENEY</u>		
MATERIAL DESCRIPTION									
30	B1-9			SP			44		
32									
34				SM	Dense to very dense, yellow to orange brown, dry to damp, Silty, fine SAND; trace medium to coarse sand				
36	B1-10						64		
38									
40	B1-11						53		
42									
44									
46	B1-12						84		
48									
50	B1-13						59		
					BORING TERMINATED AT 51 FEET No groundwater encountered				

**Figure A-1,
Log of Boring B 1, Page 2 of 2**

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 2		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>3165'</u>	DATE COMPLETED <u>10-03-2003</u>			
					EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u>		BY: <u>M. SWEENEY</u>		
MATERIAL DESCRIPTION									
0	B2-1			SM	ALLUVIUM Loose, reddish brown, dry, gravelly, Silty, fine to coarse SAND - Becomes damp, medium dense				
2	B2-2					27			
4	B2-3					19	114.0	2.6	
6	B2-4			SP	OLDER ALLUVIUM Medium dense, medium to reddish brown, damp, fine to coarse SAND with gravel; trace silt - Becomes dense				
8	B2-5					24	113.4	2.2	
10	B2-6					53	118.0	2.6	
12					-----				
14	B2-6			SP	Dense, medium brown, damp, fine SAND; trace silt				
16					-----				
18				SP	Dense, medium brown, damp, fine to coarse SAND; trace silt, fine gravel				
20	B2-7					52			
					BORING TERMINATED AT 21 FEET No groundwater encountered				

Figure A-2,
Log of Boring B 2, Page 1 of 1

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 3			PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>3085'</u>	DATE COMPLETED <u>10-03-2003</u>	EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u> BY: <u>M. SWEENEY</u>			
					MATERIAL DESCRIPTION					
0				SM	ALLUVIUM Medium dense, medium brown, dry, Silty, fine to medium SAND					
2	B3-1						40	116.4	2.2	
4										
6	B3-2			SM	OLDER ALLUVIUM Dense, dry, medium brown, Silty, fine to medium SAND			50/5"		
8	B3-3						44	108.9	2.4	
10	B3-4						22	110.6	2.4	
12										
14										
16	B3-5						41			
18										
20	B3-6						52			
					BORING TERMINATED AT 21 FEET No groundwater encountered					

**Figure A-3,
Log of Boring B 3, Page 1 of 1**

A8528-06-01 (UPDATED 12-29-2008). GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 4 ELEV. (MSL.) <u>3110'</u> DATE COMPLETED <u>10-03-2003</u> EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u> BY: <u>M. SWEENEY</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
MATERIAL DESCRIPTION								
0	B4-1			SM	ALLUVIUM Loose to medium dense, yellow to medium brown, dry, Silty, fine to medium SAND; trace coarse sand			
2	B4-2					22	110.9	2.3
4	B4-3					9		
6								
8				SP	OLDER ALLUVIUM Dense, reddish brown, dry, fine to medium SAND; trace coarse sand, silt - Coarse sand increases - Dense, reddish brown, dry, fine to coarse sand, trace silt			
10	B4-4					54	112.2	2.1
12								
14								
16	B4-5					42		1.9
18								
20	B4-6					50/6"		
22								
24								
26	B4-7					54		
					BORING TERMINATED AT 26 FEET No groundwater encountered			

Figure A-4,
Log of Boring B 4, Page 1 of 1

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	BORING B 5		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
				ELEV. (MSL.) <u>3110'</u>	DATE COMPLETED <u>10-03-2003</u>			
				EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u>		BY: <u>M. SWEENEY</u>		
MATERIAL DESCRIPTION								
0				SM	ALLUVIUM Loose, medium brown, dry, Silty, fine to medium SAND; trace coarse sand			
2	B5-1					12		1.5
4								
6	B5-2				- Becomes medium dense - Coarse sand increases	13	105.4	2.9
8	B5-3			SM	OLDER ALLUVIUM Very dense, dry, brown, Silty, fine to medium SAND	50/3"		
10	B5-4					50/6"		
12								
14								
	B5-5				BORING TERMINATED AT 15 FEET No groundwater encountered	50/5"		

Figure A-5,
Log of Boring B 5, Page 1 of 1

A8528-06-01 (UPDATED 12-29-2008) GPJ

SAMPLE SYMBOLS		... SAMPLING UNSUCCESSFUL		... STANDARD PENETRATION TEST		... DRIVE SAMPLE (UNDISTURBED)
		... DISTURBED OR BAG SAMPLE		... CHUNK SAMPLE		... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 6			PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>3140'</u>	DATE COMPLETED <u>10-03-2003</u>	EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u> BY: <u>M. SWEENEY</u>			
MATERIAL DESCRIPTION										
0	B6-1			SM	ALLUVIUM Loose, medium brown, dry, Silty, fine to medium SAND; trace coarse sand, fine gravel					
2	B6-2						20			
4	B6-3			SP	Medium dense, medium brown, dry, Gravelly, fine to coarse SAND; trace silt					
6							28			
8										
10	B6-4			SP	OLDER ALLUVIUM Very dense, dry, brown, fine to coarse SAND with gravel and trace silt					
12				SP	Very dense, reddish brown, damp, fine to coarse SAND; trace silt					
14										
16	B6-5					50/5"				
					BORING TERMINATED AT 16 FEET No groundwater encountered					

Figure A-6,
Log of Boring B 6, Page 1 of 1

A8528-06-01 (UPDATED 12-29-2008) GPJ

SAMPLE SYMBOLS		... SAMPLING UNSUCCESSFUL		... STANDARD PENETRATION TEST		... DRIVE SAMPLE (UNDISTURBED)
		... DISTURBED OR BAG SAMPLE		... CHUNK SAMPLE		... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 7			PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>3200'</u>	DATE COMPLETED <u>10-03-2003</u>	EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u> BY: <u>M. SWEENEY</u>			
					MATERIAL DESCRIPTION					
0				SM	ALLUVIUM Medium dense, medium brown, dry, Silty, fine to medium SAND; trace coarse sand, gravel					
2	B7-1							17		
4										
6	B7-2							37	118.3	2.5
8										
10	B7-3			SP	OLDER ALLUVIUM Medium dense to dense, medium brown, dry, Gravelly, fine to coarse SAND; trace silt			45	113.5	2.4
12										
14										
16	B7-4							48		2.5
					BORING TERMINATED AT 16 FEET No groundwater encountered					

Figure A-7,
Log of Boring B 7, Page 1 of 1

A8528-06-01 (UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 8		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>3205'</u>	DATE COMPLETED <u>10-03-2003</u>			
					EQUIPMENT <u>B-53 MOBILE 8" HOLLOW STEM</u>		BY: <u>M. SWEENEY</u>		
MATERIAL DESCRIPTION									
0									
2	B8-1			SP	ALLUVIUM Loose to medium dense, reddish brown, dry, fine to coarse SAND; trace gravel, silt		10		1.0
4	B8-2							24	
8				SP/SM	OLDER ALLUVIUM Medium dense, reddish brown, dry, fine to medium SAND with Silt; trace coarse sand, fine gravel				
10	B8-3							36	
14				SM	Medium dense, reddish brown, dry, Silty, fine to medium SAND; trace coarse sand, fine gravel				
16	B8-4							20	
20	B8-5				-Very dense				
BORING TERMINATED AT 21 FEET									
No groundwater encountered									

Figure A-8,
Log of Boring B 8, Page 1 of 1

A8528-06-01 (UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 9 ELEV. (MSL.) <u>~3325'</u> DATE COMPLETED <u>04-26-2007</u> EQUIPMENT <u>CME 75 HOLLOW STEM</u> BY: <u>S. PEARSON</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
MATERIAL DESCRIPTION								
0				SM	ALLUVIUM Loose, dry, brown, Silty SAND, with some gravel to 2.5"			
2								
4	B9-1 B9-2				-Medium dense	22		
6	B9-3				-Gravel encountered at 6' to 9' per driller	28		
8								
10	B9-4 B9-5			SM	OLDER ALLUVIUM Medium dense, slightly moist, dark yellowish brown, Silty SAND; micaceous	27		
12					-Significant cobbles encountered at 12' to 15'			
14								
16	B9-6				-Cobble in shoe - disturbed sample - slightly moist, granitic cobbles	50/5"		
18								
20	B9-7				-Dense, yellowish brown, medium dense, silty sand, with granitic gravel and cobble pieces	24		
22					-Some cobbles encountered at 21'			
24								
26	B9-8			SM	Very dense, brown, Silty, fine to coarse SAND; some gravel and cobble	50/5"		
28								

**Figure A-9,
Log of Boring B 9, Page 1 of 2**

A8528-06-01 (UPDATED 12-29-2008). GPJ

SAMPLE SYMBOLS	 ... SAMPLING UNSUCCESSFUL	 ... STANDARD PENETRATION TEST	 ... DRIVE SAMPLE (UNDISTURBED)
	 ... DISTURBED OR BAG SAMPLE	 ... CHUNK SAMPLE	 ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 9 ELEV. (MSL.) <u>~3325'</u> DATE COMPLETED <u>04-26-2007</u> EQUIPMENT <u>CME 75 HOLLOW STEM</u> BY: <u>S. PEARSON</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
MATERIAL DESCRIPTION								
30	B9-9			SM	-Very dense, damp, yellowish brown, Silty SAND; slightly micaceous, poorly sorted, granitic gravel pieces, some cobbles encountered since 21'	50/1"		
32								
34								
36	B9-10					50/6"		
38								
40					-Dense, damp, light yellowish brown, cobbles encountered at 41'	40		
42	B9-11							
44								
46	B9-12				-Very dense	50/3"		
48					-Significant cobbles at 48' to 50'			
50					-Partial recovery due to cobbles			
	B9-13					50/4"		
					BORING TERMINATED AT 51 FEET No groundwater encountered			

**Figure A-9,
Log of Boring B 9, Page 2 of 2**

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	 ... SAMPLING UNSUCCESSFUL	 ... STANDARD PENETRATION TEST	 ... DRIVE SAMPLE (UNDISTURBED)
	 ... DISTURBED OR BAG SAMPLE	 ... CHUNK SAMPLE	 ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	BORING B 10		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
				SOIL CLASS (USCS)	ELEV. (MSL.) <u>~3380'</u> DATE COMPLETED <u>04-26-2007</u>			
				EQUIPMENT <u>CME 75 HOLLOW STEM</u> BY: <u>S. PEARSON</u>				
MATERIAL DESCRIPTION								
0				SM	ALLUVIUM Dry, brown, Silty SAND, with occasional cobble			
2								
4	B10-1				Medium dense, yellowish brown, silty sand, with occasional cobbles >3", very slightly moist, slightly micaceous	45		
6	B10-2				-Cobbles encountered at 6' to approx. 9'	42		
8								
10	B10-3			SP	OLDER ALLUVIUM Dense, yellowish brown, fine to medium grained SAND; moderately sorted, slight trace silt, micaceous, moist	54		
12								
14	B10-4				GRANITE Gray to brown, medium- to coarse-grained, moderately weathered, moderately hard	50/1"		
BORING TERMINATED AT 15 FEET No groundwater encountered								

**Figure A-10,
Log of Boring B 10, Page 1 of 1**

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS		... SAMPLING UNSUCCESSFUL		... STANDARD PENETRATION TEST		... DRIVE SAMPLE (UNDISTURBED)
		... DISTURBED OR BAG SAMPLE		... CHUNK SAMPLE		... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 11		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>~3430'</u>	DATE COMPLETED <u>04-26-2007</u>			
					EQUIPMENT <u>CME 75 HOLLOW STEM</u>		BY: <u>S. PEARSON</u>		
MATERIAL DESCRIPTION									
0				SP	ALLUVIUM Light yellowish brown, Gravelly SAND, dry				
2									
4	B11-1			SM	Medium dense, light yellowish brown, Silty SAND, very slightly moist, with some gravel -With gravel to 1/2"	32			
6	B11-2				-Significant cobbles encountered at 6' to 9'	30	114.2	2.9	
8									
10	B11-3			SP	OLDER ALLUVIUM Dense, yellowish brown, fine to medium SAND; trace silt, slightly micaceous moist	48			
12									
					BORING TERMINATED AT 13 FEET Due to refusal to granitic bedrock No groundwater encountered				

Figure A-11,
Log of Boring B 11, Page 1 of 1

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 12		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>~3400'</u>	DATE COMPLETED <u>04-26-2007</u>			
					EQUIPMENT <u>CME 75 HOLLOW STEM</u>		BY: <u>S. PEARSON</u>		
MATERIAL DESCRIPTION									
0				SP	ALLUVIUM Loose, dry, light yellowish brown, Gravelly, fine to coarse SAND; poorly sorted				
2					-----				
4	B12-1			SM	Medium dense, dry to damp, light yellowish brown, Silty SAND, with occasional gravel and cobbles, some cobble pieces in sampler		36		
6	B12-2				-Cobbles encountered at 4' -Dense, yellowish brown, silty sand, with gravel and cobble pieces in sampler		78		
					BORING TERMINATED AT 7 FEET Due to refusal on granitic boulder or bedrock No groundwater encountered				

Figure A-12,
Log of Boring B 12, Page 1 of 1

A8528-06-01 (UPDATED 12-29-2008), GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 13		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	
					ELEV. (MSL.) <u>~3465'</u>	DATE COMPLETED <u>04-26-2007</u>				
					EQUIPMENT <u>CME 75 HOLLOW STEM</u>		BY: <u>S. PEARSON</u>			
MATERIAL DESCRIPTION										
0				SP	ALLUVIUM Loose, dry, light yellowish brown, Gravelly SAND; occasional gravel to 2"					
2				SM	Medium dense, dry to damp, light yellowish brown, Silty SAND, with occasional gravel, poorly sorted, slightly micaceous					
4	B13-1			SP	Loose, dry to damp, light yellowish brown, SAND; trace silt, fine to coarse, poorly sorted, micaceous, with occasional gravel	18				
6	B13-2					15				
8				SM	OLDER ALLUVIUM Very dense, damp, light yellowish brown, Silty SAND; fine to coarse, poorly sorted, micaceous, with occasional gravel					
10	B13-3					50/2"				
12										
14	B13-4					50/6"				
					BORING TERMINATED AT 15 FEET No groundwater encountered					

Figure A-13,
Log of Boring B 13, Page 1 of 1

A8528-06-01(UPDATED 12-29-2008), GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 14			PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>~3465'</u>	DATE COMPLETED <u>04-26-2007</u>	EQUIPMENT <u>CME 75 HOLLOW STEM</u> BY: <u>S. PEARSON</u>			
					MATERIAL DESCRIPTION					
0				SM	ALLUVIUM Medium dense, dry to damp, light yellowish brown, Silty SAND, with gravel					
2					-Becomes yellowish brown, fine to medium grained, moderately sorted, with occasional gravel, slightly micaceous					
4	B14-1						26	119.1	3.4	
	B14-2									
6	B14-3			SM	OLDER ALLUVIUM Very dense, damp, yellowish brown, Silty, fine to medium SAND			50/3"		
8										
10					-Dense					
12	B14-4			SP	Very dense, damp, light yellowish brown SAND; trace silt, slightly micaceous			74		
14										
	B14-5				BORING TERMINATED AT 15½ FEET No groundwater encountered			50/5"		

Figure A-14,
Log of Boring B 14, Page 1 of 1

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 15 ELEV. (MSL.) <u>~3460'</u> DATE COMPLETED <u>04-26-2007</u> EQUIPMENT <u>CME 75 HOLLOW STEM</u> BY: <u>S. PEARSON</u>	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
MATERIAL DESCRIPTION								
0				SM	ALLUVIUM Loose, dry, light yellowish brown, Silty SAND, with gravel; poorly sorted			
2				SP	Loose, dry to damp, yellowish brown, fine to medium SAND; slightly micaceous; occasional gravel			
4	B15-1			SM	Loose, dry to damp, yellowish brown, Silty SAND; micaceous; occasional gravel; interbedded with yellowish brown, medium to coarse sand	11		
6	B15-2			SP	OLDER ALLUVIUM Medium dense, damp, dark yellowish brown, fine to coarse SAND; micaceous; trace gravel and cobble pieces			
8								
10	B15-3					46		
12								
14					-Trace silt, moist			
16	B15-4					47		
BORING TERMINATED AT 16 FEET No groundwater encountered								

Figure A-15,
Log of Boring B 15, Page 1 of 1

A8528-06-01(UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 16		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) <u>~3490'</u>	DATE COMPLETED <u>04-26-2007</u>			
					EQUIPMENT <u>CME 75 HOLLOW STEM</u>		BY: <u>S. PEARSON</u>		
MATERIAL DESCRIPTION									
0				SM	ALLUVIUM Dense, dry, yellowish brown, Silty SAND; some gravel and occasional cobbles to 10"				
2					-Becomes dense, light yellowish brown -Disturbed sample, partial recovery				
4	B16-1						63/10"		
6	B16-2			SP	OLDER ALLUVIUM Very dense, damp, light yellowish brown, fine to coarse SAND; micaceous				
8					-Driller reported very hard, dry drilling at 6' down		50/4"		
10	B16-3						50/1½"		
12									
14					-Possible bedrock encountered at 15'		50/1"		
					BORING TERMINATED AT 15 FEET No groundwater encountered				

Figure A-16,
Log of Boring B 16, Page 1 of 1

A8528-06-01 (UPDATED 12-29-2008).GPJ

SAMPLE SYMBOLS	<input type="checkbox"/> ... SAMPLING UNSUCCESSFUL	<input type="checkbox"/> ... STANDARD PENETRATION TEST	<input checked="" type="checkbox"/> ... DRIVE SAMPLE (UNDISTURBED)
	<input checked="" type="checkbox"/> ... DISTURBED OR BAG SAMPLE	<input checked="" type="checkbox"/> ... CHUNK SAMPLE	<input checked="" type="checkbox"/> ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	BORING B 17		PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	
				SOIL CLASS (USCS)	ELEV. (MSL.) <u>~3505'</u> DATE COMPLETED <u>04-26-2007</u> EQUIPMENT <u>CME 75 HOLLOW STEM</u> BY: <u>S. PEARSON</u>				
MATERIAL DESCRIPTION									
0				SM	ALLUVIUM Medium dense, dry to damp, light yellowish brown, Silty, fine to coarse SAND; trace gravel; micaceous; poorly sorted				
2									
4	B17-1 B17-2					18			
6	B17-3			SP	OLDER ALLUVIUM Very dense, damp, yellowish brown, fine to coarse SAND	79/8"			
8									
10	B17-4 B17-5				-Becomes light yellowish brown sand, fine to coarse, micaceous	82/7"			
12									
14	B17-6					50/5"			
					BORING TERMINATED AT 15 FEET Due to refusal granitic cobble in sampler No groundwater encountered				

**Figure A-17,
Log of Boring B 17, Page 1 of 1**

A8528-06-01 (UPDATED 12-29-2008). GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

APPENDIX

B

APPENDIX B

LABORATORY TESTING

We performed laboratory tests in accordance with the current, generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We tested selected samples for their in-place dry density and moisture content, maximum dry density and optimum moisture content, shear strength, expansion index, water-soluble sulfate, water-soluble chloride, potential of hydrogen (pH) and resistivity, consolidation characteristics, and Atterberg limits. The results of our laboratory tests are presented in Tables B-I through B-VII. In addition, the in-place dry density and moisture content test results are presented on the exploratory boring logs, located in Appendix A.

**TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY
AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557**

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
B1-1	Yellow brown, Silty, fine SAND	116.1	12.6
B4-1	Brown, Silty, fine to medium SAND	129.4	8.2
B9-1	Brown, Silty, fine to coarse SAND with little gravel	137.5	6.9
B17-2	Brown, Silty, fine to coarse SAND with little gravel	136.2	6.9

**TABLE B-II
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080**

Sample No.	Dry Density (pcf)	Final Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
B1-1	105.0	16.8	250	33
B4-1	116.8	12.0	670	28
B9-2*	130.0	12.6	0	39
B11-2	122.3	16.0	0	44
B14-1	128.3	15.0	0	39
B17-2*	130.1	13.2	100	37

*Sample was remolded to a dry density of about 90 percent of the laboratory maximum dry density prior to performing laboratory testing.

**TABLE B-III
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829**

Sample No.	Moisture Content (%)		Dry Density (pcf)	Expansion Index	Expansion Classification
	Before Test	After Test			
B1-1	11.3	22.6	110.1	3	Very Low
B9-2	7.2	13.8	120.4	0	Very Low

**TABLE B-IV
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417**

Sample No.	Water-Soluble Sulfate (%)	Classification
B1-1	0.011	Negligible
B4-1	0.015	Negligible
B14-2	0.006	Negligible

**TABLE B-V
SUMMARY OF LABORATORY pH, CHLORIDE AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NOS. 634 AND 422**

Sample No.	pH	Resistivity (Ohm-cm)	Chloride ppm (%)
B14-2	6.9	2,231	5 (0.001)

**TABLE B-VI
SUMMARY OF SINGLE-POINT CONSOLIDATION (COLLAPSE) TESTS
ASTM D 2435**

Sample Number	In-situ Dry Density (pcf)	Moisture Content Before Test	Axial Load with Water Added (psf)	Consolidation Before Water Added (%)	Percent Collapse (After Water Added)
B1-3	104.1	2.6	2,000	1.6	2.0
B1-4	106.3	1.4	2,000	3.1	2.3
B2-3	114.0	2.6	2,000	2.2	1.7
B2-4	113.4	2.2	2,000	1.2	0.7
B5-2	105.4	2.9	2,000	2.7	1.1
B7-3	113.5	2.4	2,000	2.8	0.7
B8-3	109.5	2.7	2,000	3.2	5.1
B9-3	115.7	3.9	2,000	1.2	3.7
B13-3	126.7	3.9	2,000	1.4	0.9
B15-2	112.2	4.3	2,000	0.8	2.4

TABLE B-VII
SUMMARY OF ATTERBERG LIMITS (PLASTICITY INDEX)
ASTM D4318

Sample Number	Test Results
B9-2	Samples are Non Plastic (NP), will not roll to an 1/8" column
B11-1	
B14-2	
B17-2	

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