4.7.1 INTRODUCTION

The purpose of this section is to describe the geologic, seismic and slope stability setting of the Project area, identify significant development constraints, and recommend mitigation measures to ensure geotechnically sound and stable approaches to grading, drainage, and building construction. Information in this section is taken from the 2005 *Geotechnical Investigation: Deutsch Property, Highland Springs Avenue and Wilson Street, Banning, California* prepared for Pardee Homes by Geocon Inland Empire, Inc. (Geocon) and the 2005 *Fault Rupture Hazard Investigation: Deutsch Property, Highland Springs Avenue and Wilson Street, Banning, California* prepared for Pardee Homes by Geocon. Additional reports were also prepared to evaluate the approximately 21-acre parcel to be included as part of the Specific Plan Area PA43B in the northwest site corner (*Scoping Study*, prepared by Geocon dated May 5, 2006) and the proposed off-site improvements (*Limited Geotechnical Observation: Proposed Off-site Sewer, Water, and Recycled Water Improvements Associated with Butterfield Property*, prepared by Geocon and dated December 11, 2007). These reports can be found in Appendix E, *Geotechnical Reports*. Additional information was provided in the *City of Banning General Plan* (January 2006), the *City of Banning General Plan EIR* (June 2005), the *City of Banning Municipal Code,* and other sources listed in the Bibliography.

4.7.2 EXISTING CONDITIONS

4.7.2.1 ENVIRONMENTAL SETTING

Regional Geologic and Seismic Setting

The City of Banning, like the rest of southern California, is located within a seismically active region near the active margin between the North American and Pacific tectonic plates. Most of the City of Banning lies within the Transverse Ranges geomorphic province, while the southern edge of the Banning area is located within the Peninsular Ranges geomorphic province, with the San Gorgonio Pass generally defining the boundary between the two regions. The San Gorgonio Pass is a down-thrown block between two faults (rock fractures) as a result of the relative right-lateral motion between the North American and Pacific tectonic plates. The valley floor is generally characterized as a series of alluvial fans comprised of sediments originating primarily from the San Bernardino Mountains.

The Project site is located in the San Gorgonio Pass fault zone (SGPFZ), which exists as an area of compression resulting from a left step in the San Andreas fault zone from the Coachella Valley segment (southeast) to the San Bernardino strand (northwest). An estimated 1.9 miles of right lateral displacement has occurred within the SGPFZ since its inception during the Quaternary period. For the SGPFZ in the Project area, the annual Quaternary slip rate is estimated to be 0.9 to 1.6 millimeters (mm) or approximately 0.035 to 0.06 inches.

The principal source of seismic activity in the area is movement along the northwest-trending regional faults such as the San Andres, San Jacinto, and Elsinore fault zones. These fault systems are estimated to produce approximately 55 millimeters (2.17 inches) of slip per year between the plates.

Sudden movement along these faults results in earthquakes. The Banning fault is the dominant fault in the immediate Project area, extending from the Indio Hills approximately 100 km (62 miles) to the San Andreas fault. The Banning fault zone consists of western, central, and eastern segments. Other faults in proximity to the Project site include the San Bernardino strand of the San Andreas fault, located 4 miles to the north; the Mission Creek fault, located 7.2 miles to the northeast; the Mill Creek fault, located 8 miles to the north; the San Jacinto fault, located 10 miles to the southwest; the Coachella Valley segment of the Banning fault, located 12 miles to the east; and the Coachella Valley segment of the San Andreas fault, located approximately 20 miles northeast of the Project site; refer to Exhibit 4.7-1, *Regional Fault Zones*.

PROJECT SOILS, TOPOGRAPHY, AND GROUNDWATER CONDITIONS

Topography

The elevation of the Project site varies from over 3,400 feet above mean sea level (amsl) in the northeastern portion to 2,560 feet amsl in the southeastern portion of the site. Its topography ranges from relatively flat to steeply sloping. The majority of the site slopes gently from north to south, with the steepest area located in its northeastern-most portion; refer to Exhibit 4.7-2, *Topographic Map*.

Groundwater

On-site borings performed by Geocon (2005) descended to a depth of approximately 65 feet beneath ground surface (bgs). No groundwater was encountered in any boring. Prior measurements of depth to groundwater on-site ranged from approximately 367 feet bgs in 1998 to over 550 feet bgs in 2005. Presently, depth to groundwater on the Project site is estimated to be greater than 300 feet bgs.

On-Site Soils

Soils encountered during Geocon's field investigation of the Project site include surficial units of undocumented fill, modern soil, slope wash, colluvium, recent and older alluvium, and Pleistocene conglomerate; refer to Exhibit 4.7-3, *Soils Map* and the description of on-site soils that follows. Landslide deposits and relatively shallow debris flow deposits were observed along the noses of several ridges in the northern area of the site. The Pleistocene conglomerate was the oldest unit encountered during the geotechnical investigation and formed the hills in the northern portion of the site. Depths to these ancient deposits range from 2 feet to over 60 feet bgs, depending upon surface elevation. The 21-acre added parcel and the off-site area are assumed to have a soils and geotechnical profile similar to that described for the adjacent portion of the Project site, given the surficial similarities.

Undocumented Fill (Qudf)

Undocumented fill occurs on-site and consists of locally derived silty sands that are generally loose to medium dense and dry to moist. The fill deposits occur as generally east-west trending berms, approximately three to five feet in height. These berms were originally constructed to minimize the potential for on-site erosion. The existing fill material may be reused as fill material within the proposed Project.

Modern Soil (Qm)

Modern soils occur on-site within the upper six to 24 inches and are estimated to be between 100 to 1,000 years old. On-site, this soil type is loose, dry, olive brown silty coarse sand with horizontal parting surfaces.

Slope Wash (Qsw)

Slope wash was identified on-site and is described as a loose to medium dense, damp, dark yellow brown silty sand with trace gravel. The slope wash was observed to be generally porous.

Colluvium (Qcol)

Colluvium was identified along the hillsides and slopes on-site and generally occurs at a depth of one to two feet. The colluvium is clast supported and consists of an olive brown, silty sand matrix that is generally loose, dry, and porous and consists of semi-rounded, moderately weathered cobbles with a general diameter of four inches. These soils are typically removed and moisture-conditioned prior to reuse as engineered fill and are generally not suitable to support structural loads.

Recent Alluvium (Qal)

Younger alluvial deposits occur in several areas on-site and generally occur at depths of approximately five to 19 feet bgs. Alluvial deposits average ten feet in depth in the southern portion of the site, south of 14th Street; five feet deep in the north-central portion of the site; ten feet deep in the northwestern portion of the site; and, 15 feet deep in the east-central portion of the site. The alluvium generally consists of brown to yellow brown silty coarse sands that are moist, loose, and porous at a depth of approximately five to nine feet bgs, with density increasing with depth. Remedial grading is typically required prior to placement of additional fill in these areas or construction of structures that are settlement-sensitive, as the upper five to nine feet of the alluvium are not suitable to provide support for fill or structural loads; however, younger alluvium may be utilized as a fill material.

Older Alluvium (Qoal)

Older alluvial deposits were identified beneath the younger alluvium within a majority of the property, particularly between the Central fault zone and the slopes in the northern portion of the property. The older alluvial deposits are comprised of dark yellow brown silty coarse sands with silt and trace clay and are estimated to be approximately 40,000 years of age. An older alluvial unit, consisting of yellow red silty sand with trace blocky, cemented clay, was also identified along ridgelines and within the alluvial plain near fault zones. This unit was estimated to be approximately 100,000 years of age. The older alluvium is capable of supporting structural loads and engineered fill.

Undeveloped Soil

Undeveloped soil is found in depositional contact between two older alluvial units. The soil is generally loose, moist, dark yellow brown, and channelized.

Debris Flow Deposits (Qdf)

Debris flow deposits were identified along the hillsides and in several trenches during the site investigation to depths greater than eight feet. Additional debris flow deposits may also occur in areas where Pleistocene conglomerate occurs, in the northern portion of the property. Such debris flows may be the result of regional earthquake loading. The debris flow deposits consist of a yellow silty coarse sand matrix with saprolitic granitic and gneissic clasts, with boulder to cobble conglomerates and sand/gravel beds. Removal and replacement of the debris flow deposits with engineered fill is typically recommended in order to support structural loads.

Paleosol (Qp)

Paleosol is a layer of fossilized soil, usually buried beneath layers of rock or more recent soil. On-site, these soils are dense, dry to damp, red brown clayey silty sand with trace gravel, generally massive, and cemented with an angular blocky structure.

Pleistocene Conglomerate (Qps)

Pleistocene conglomerate occurs in the northern portion of the property along the hills, and along the fault zone in the southern portion of the site. These soils were originally deposited as an alluvial fan from a source area in the San Bernardino Mountains, and have since been faulted, uplifted, and eroded. The deposits consist of yellow, coarse silty sand, with granitic, gneissic and gabbroic clasts, which are generally three to 12 inches in diameter with boulders up to four feet in diameter. A weathered zone was identified within some area where little or no slope occurred. Pleistocene conglomerate can be used to support structural and engineered fill loads.

Off-Site Soils - Pipeline Locations

Pleistocene Age alluvial fan deposits generally underlie the areas that would be affected by the proposed off-site infrastructure improvements. The majority of these deposits consist of sand and gravel of plutonic and gneissic detritus derived from the San Bernardino Mountains to the north of the Project area. The Noble Street, Cherry Avenue, Lincoln Street, and Dutton Street right-of-ways could be affected by the proposed off-site improvements. Bedrock is not anticipated to occur along any of these street alignments. The northern portions of these three streets are underlain with dissected sand and gravel alluvial fan deposits. In the area where the pipeline alignments are proposed to meet (on Noble Street near the point of connection to the existing conveyance facilities), the northern portion of the right-of-way is underlain with alluvial gravel and sand stream channel deposits.

Geology and Seismicity

On-Site Geology and Seismicity

The central segment of the Banning fault[1], which extends from Calimesa to Whitewater Canyon, is present within the Project. The fault is obscured by Quaternary sediments in the vicinity of the Project site. The central Banning fault zone is comprised of two, parallel fault segments (Strands A and B, both located on-site) and includes the Wildwood Canyon fault, located northwest of the Project site. Strand A of the Banning fault passes beneath the Banning Bench and has been mapped as an Alquist Priolo (AP) Earthquake Fault Hazard Zone (see additional discussion below).[2] The more northerly trace of the Banning fault (Strand B) is believed to be an early trace of the San Gorgonio Pass fault zone and is considered active, though it is not mapped as an AP zone. The Highland Springs scarp is thought to be a composite scarp resulting from activity of Strand B on the Wildwood Canyon branch and is not considered active.[3] These fault zones are shown on Exhibits 4.7-1, *Regional Fault Zones*, and 4.7-5, *Fault Setback Zones*.

1 USGS Western Region Geology and Geophysics Science Center, Western Surface Processes Team, *San Andreas Fault System in the Inland Empire and Salton Trough, Banning Fault, pp 1-8, http://geomaps.wr.usgs.gov/socal/geology/inland_Empire/ie_banning_fault.htm, accessed 7/16/2010.* Additional information can be found at http://www.data.scec.org/fault_index/banning.html.

2 Details regarding the State's Alquist-Priolo Earthquake Fault Hazard Zones can be found at http://www.conservation.ca.gov/CGS/rghm/ap/Pages/Index.aspx.

3 Geocon Inland Empire, *Fault Rupture Hazard Investigation: Deutsch Property, Highland Springs Avenue and Wilson Street, Banning, California*, November 2005.

According to the Fault Rupture Hazard Investigation prepared by Geocon (November 2005) for the Project site, the San Gorgonio Pass fault zone within the site includes: the above noted Strands A and B of the Banning fault within the northern area of the property; two small fault scarps approximately 3000 feet south of the Banning fault; an unnamed north-south tear fault along the eastern property boundary; and an unnamed fault mapped near the central area of the Project site. Other faults are postulated to extend from the northwestern property corner to the eastern site boundary near 14th Street. The Project site appears to be an area of transition between the more active fault zone to the east and the inactive zone to the west.

The Banning fault has the most immediate impact on the Project site and proposed development. The fault is believed to have been the epicenter for the M5.6,[4] 1986 North Palm Springs earthquake and may have been associated with the June 16, 2005 M4.9 Yucaipa earthquake. The most significant fault with respect to potential ground motion impacts on the site is the San Bernardino segment of the San Andreas fault, which is capable of producing an M8.0 earthquake.

In 2005, Riverside County adopted, and FEMA approved, the *Riverside Operational Area Multi-Jurisdictional Local Hazard Mitigation Plan* (LHMP). As part of the LHMP planning process, each participating jurisdiction was asked to conduct an assessment of hazards for their jurisdiction. The assessment process required identification of the hazards specific to a given jurisdiction, the impact of those hazards, and the specific goals and strategies for the jurisdiction to address the hazards. The County Office of Emergency Services (OES) developed a computer based Emergency Response database that functions similar to HAZUS (**HAZ**ards **U**nited **S**tates), a database created by FEMA to assess potential losses due to natural hazards, including earthquakes. Potential loss estimates analyzed in a HAZUS-type analysis include: (1) **Physical damage** to residential and commercial buildings, schools, critical facilities, and infrastructure; (2) **Economic loss**, including lost jobs, business interruptions, repair and reconstruction costs; and (3) **Social impacts**, including estimates of shelter requirements, displaced households, and population exposed to scenario floods, earthquakes and hurricanes.

The HAZUS evaluation of seismic hazard in the City of Banning in the LHMP is predicated upon a M7.1 seismic event on the San Jacinto fault, with its epicenter between San Jacinto and Beaumont. [5]

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4 M = magnitude. The magnitude of most earthquakes is measured on the **Richter scale**. The Richter magnitudes are based on a logarithmic scale (base 10); accordingly, for each whole number increase on the Richter scale, the amplitude of the ground motion recorded by a seismograph is ten times greater. Using this scale, a magnitude 5 earthquake would result in ten times the intensity of ground shaking as a magnitude 4 earthquake, and 32 times as much energy would be released.

5 County of Riverside LHMP Part II, *Riverside County Multi-Jurisdictional Local Hazard Mitigation Agency Inventory – City of Banning*, 2005.

Off-site Geology and Seismicity

Areas where off-site improvements are proposed as part of the Project exhibit general geologic characteristics similar to those identified in the Project site; however, none of the areas where the proposed water, sewer, or recycled water lines would be constructed are located within an identified Alquist-Priolo earthquake fault hazard zone. In addition, no active faults with the potential for surface fault rupture are known to pass under the proposed alignments.

Fault Rupture

The *Alquist-Priolo (AP) Special Studies Zones Act* was approved in 1972 and requires evaluation of fault lines on individual properties that are located within AP Special Studies Zones, as defined by the Act. Such evaluations are intended to identify potentially *active* faults in an effort to restrict future construction of habitable structures on their traces so as to reduce the potential for property damage or risk to human health and safety.

An *active* fault is one that has experienced surface displacement during the Holocene Epoch, or within roughly the last 11,000 years.[6] Earthquake Fault Hazard Zones are delineated using the above cited definition of active faults. The northern portion of the Project site is located within an Earthquake Fault Hazard Zone; refer to Exhibit 4.7-5, *Fault Setback Zones.*

In 1994, the California Division of Mines and Geology (presently California Geological Survey) prepared a Fault Evaluation Report (FER-235) for the Beaumont Quadrangle, in which the Project site is located. In addition to describing the Banning fault and its segmentation, an aerial photograph and field observation summary for FER-235 also describes the Highland Springs scarp, which is concealed by Holocene fan deposits. An additional short north-south fault along Smith Creek, mapped by Matti and Morton in 1992, was not noted in FER 235 and is believed to be an erosional channel margin. The above cited unnamed north-south tear fault along the eastern property boundary was inferred by Matti & Morton but is concealed and has no current expression.

FER-235 concludes that the SGPFZ, which includes the Banning fault, shows evidence of Holocene displacement extending eastward from the Banning Bench. The SGPFZ shows no evidence of Holocene activity west of the Banning Bench; however, future ground ruptures throughout the entire extent of the zone, including the central segment located within the Project site, are considered possible.

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6 California State Mining and Geology Board http://www.consrv.ca.gov/CGS/rghm/ap/Pages/t_14_3600.aspx, accessed January 2008.

Seismic Ground Shaking

Ground motions are often measured as a percentage of gravity, where **g** (the acceleration due to gravity) is approximately 32 feet per second per second (9.8 meters per second per second). Due to the location of the Project site and the seismic characteristics of the region, ground shaking accompanying earthquakes on nearby faults is anticipated within the Project area; however, the intensity of ground shaking experienced at the Project site would be dependent upon several factors including the magnitude of the earthquake, distance from the site to the earthquake epicenter, and the geology of the area between the epicenter and the Project site.

As noted, the known active faults closest to the Project site are the on-site Banning fault strands A and B and the Highland Springs fault. The Banning fault is considered active and interacts with, and may be considered a part of, the San Andreas fault system. It is considered capable of generating an earthquake with a probable moment magnitude (i.e., an estimate of the largest probable earthquake magnitude that a particular segment of a fault is capable of producing as measured on a magnitude scale at the moment the earthquake occurs, expressed as M_w) ranging from M_w 6.0 – 7.2.[7] However, in determining the intensity of ground shaking which on-site structures should be designed to withstand (i.e., the "design basis" earthquake), Geocon did not use the on-site Banning fault; rather, it used the probable magnitude of an earthquake with its epicenter on the main strand of the San Andreas Fault, which is located approximately 4 miles north of the Project site and is estimated to be capable of generating an earthquake of greater magnitude. This "maximum credible earthquake" (i.e., the largest earthquake reasonably capable of occurring in the region based on current geological knowledge) on the most proximate segment of the San Andreas fault is estimated to have a moment magnitude of M_w 7.4. According to the Geocon report, this design basis earthquake would generate a probabilistic peak ground acceleration of 0.74 **g** at the Project site, meaning that the site would likely be subjected to significant ground shaking in the event of a major earthquake occurring on the San Andreas or other nearby regional or local faults.

Liquefaction

Soil liquefaction describes the behavior of soils that, when loaded by earthquake shaking or blasting, suddenly transition from a solid state to a liquefied state. Liquefaction is more likely to occur in loose to moderately saturated granular soils with poor drainage such as silty sands or sands and gravels capped or containing seams of impermeable sediments. Earthquake liquefaction may occur during strong ground shaking events as the shaking causes increased pore water pressure in these loose, saturated, relatively cohesionless soil deposits, resulting in a loss of shear strength. The potential for liquefaction to occur is primarily influenced by the nature of the soils and proximity of groundwater to the surface, but is also influenced by the intensity and duration of ground motion, gradation characteristics of subsurface soils, and on-

7 Southern California Earthquake Data Center, *Banning Fault Zone*, as retrieved from http://www.data.scec.org/fault_index/banning.html, 8/12/2010.

site stress conditions. Due to the density of on-site soils at depth and the depth of groundwater (greater than 300 feet bgs), the Geocon *Geotechnical Report and Fault Rupture Analysis* indicates that the potential for liquefaction on the Project site is considered to be very low. The Riverside County Pass Area Plan also indicates that the Project site is located in an area with very low liquefaction potential.[8]

Lateral Spreading

Lateral spreading occurs as the result of lateral displacement of surficial blocks of sediment due to liquefaction in a subsurface layer. The potential for lateral spreading is associated with areas that are prone to liquefaction. Liquefaction-induced lateral spreading occurs on mild slopes of 0.3 to 5 percent underlain by loose sands and a shallow water table. Such soil deposits are prone to pore pressure generation, softening, and liquefaction during large earthquakes. If liquefaction occurs, the unsaturated overburden soil can slide as intact blocks over the lower, liquefied deposit. The geologic conditions conducive to lateral spreading (gentle surface slope, shallow water table, and liquefiable cohesionless soils) are frequently found along streams and other waterfronts in recent alluvial or deltaic deposits, as well as in loosely-placed, saturated, sandy fills.

As previously described, the Project site's topography is characterized by generally flat to gently sloping terrain increasing to steep slopes in its northern area. As described under *Soils*, both old and recent alluvial deposits are found in several areas of the Project site, since the site is traversed by two drainages, and sits above the Beaumont groundwater basin. However, groundwater beneath the Project site is between 300 to 500 feet bgs and the site's liquefaction potential is considered very low; therefore, the conditions necessary for liquefaction-induced lateral spreading are unlikely to exist within the site's boundaries.

Seismic Densification

Seismic densification of dry soils occurs when loose, dry soils (primarily sands and silty sands) densify and settle when subjected to earthquake-induced ground shaking. Densification occurs more frequently in unconsolidated, loosely packed, alluvial deposits. As the Project site is located in an area where potentially strong ground shaking associated with nearby seismic activity may occur, and contains medium dense, dry alluvial deposits, portions of the Project site could be susceptible to seismic densification of dry soils; however, the potential for densification to affect structures on-site should be reduced by the compaction of soil under structures and streets during grading activities.

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8 See Figure 13, (Seismic Hazards), Hazards Section of the Pass Area Plan, Riverside County Integrated Project (RCIP).

Landslides and Debris Flows

The causes of landslides are usually related to instabilities in slopes. In the majority of cases the main trigger of landslides is heavy or prolonged rainfall; however, a second major factor in the triggering of landslides is seismicity. Landslides can occur during earthquakes as a result of two separate but interconnected processes: seismic shaking and pore water pressure generation.

Landslides Due to Seismic Shaking

The passage of seismic waves through the rock and soil produces a complex set of accelerations that effectively act to change the gravitational load on a slope in a manner that can be sufficient to induce slope failure, particularly in mountainous areas in which seismic waves interact with the terrain to produce increases in the magnitude of ground accelerations – a process known as "topographic amplification." The maximum acceleration is usually seen at the crest of the slope or along the ridgeline, meaning that most seismically triggered landslides extend to the top of the slope.

Landslides Due to Liquefaction

The passage of earthquake waves through a granular material can induce liquefaction, generating flow slides that can be rapid and very damaging.

For the most part, seismically generated landslides tend to be more widespread and sudden than landslide events triggered by other causes. The most abundant types of earthquake-induced landslides are rock falls, disrupted rock slides, and disrupted slides of earth and debris. Earth flows, debris flows, and avalanches of rock, earth, or debris typically transport material the farthest.

During the geotechnical field investigations and associated trenching activities, debris flow deposits were found on-site and along south facing slopes both off and on-site although no evidence of deep-seated landslides has been identified on the Project site; refer to Exhibit 4.7-4, *Slope Stability Map*. The northern reaches of the site extend into the foothills of the San Bernardino Mountains and could potentially be affected by rock falls or other seismically induced landslides occurring off-site. As previously noted, the site has a low probability for liquefaction and, therefore, on-site slopes are unlikely to be affected by liquefaction-induced landslides.

4.7.2.2 REGULATORY SETTING

Alquist Priolo Earthquake Fault Zoning Act (1972)

California adopted the *Alquist-Priolo (AP) Earthquake Fault Zoning Act* in 1972, subsequent to the 1971 San Fernando earthquake, which caused extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The Act is intended to prevent construction of buildings used for human occupancy on the surface trace of active faults, thereby reducing the potential for harm to humans and/or structures due to surface rupture. The Act addresses only the hazard of surface fault rupture and does not address other types of earthquake hazards.

An Alquist Priolo Earthquake Fault Hazard Zone is located in the northern portion of the Project site, together with several lineaments (i.e., linear topographic features that reveal a characteristic feature such as a possible fault) that were identified to the south of the AP Zone. The Alquist-Priolo Act provides that "no structure for human occupancy, identified as a project under Section 2621.6 of the Act, shall be permitted to be placed across the trace of an active fault. Furthermore, as the area within fifty (50) feet of such active faults shall be presumed to be underlain by active branches of that fault unless proven otherwise by an appropriate geologic investigation and report prepared as specified in Section 3603(d) of this subchapter, no such structures shall be permitted in this area." The proposed Project observes the required 50 foot setback from the on-site AP zone.

Seismic Hazards Mapping Act (1989)

California adopted the *Seismic Hazards Mapping Act* (SHMA) in 1989 to improve public safety and minimize the adverse effects of strong ground shaking, liquefaction, landslides, ground failure, and other earthquake-related hazards.[9] The program and actions required by the SHMA are similar to those required by the *Alquist-Priolo Earthquake Fault Zoning Act,* although the *Alquist-Priolo Earthquake Zone Act* is limited to surface fault-rupture hazards while SHMA addresses other seismic hazards as well. Significant requirements of the SHMA include:

- The State Geologist is required to delineate the various "seismic hazard zones."
    - Cities and Counties, or other local permitting authorities, are required to regulate certain development projects within these zones and must withhold the development permits for a site within a zone until its geologic and soil conditions are investigated and appropriate mitigation measures, if any, are incorporated into development plans.

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9 California Geological Survey – Department of Conservation, http://gmw.consrv.ca.gov/SHMP/webdocs/fact_sheet.pdf, accessed January 2008.

- The State Mining and Geology Board provides additional regulations, policies, and criteria to guide cities and counties in the implementation of the law, including guidelines for preparation of the Seismic Hazards Zone Maps (available at http://www.consrv.ca.gov/dmg/shezp/zoneguide.html) and for evaluating and mitigating seismic hazards; refer to Special Publication 117, Guidelines for Evaluation and Mitigating Seismic Hazards in California, CGS.

- Sellers of real property within a mapped hazard zone, and their agents, must disclose that the property lies within such a zone at the time of sale.

The Banning fault is an active fault that runs through the Project site as illustrated in Exhibit 4.7-5 and is required to comply with the provisions of the SHMA as administered by the City of Banning pursuant to its Municipal Code; also refer to page 4.7-7 discussion of on-site faults.

2010 California Building Code and 2010 California Residential Code

In 2009 the International Residential Code (IRC) serves as the basis for the 2010 California Residential Code (CRC), which replaces the 2007 California Building Code (CBC) as the basis for determining structural and other design component standards for 1-2 family residential dwellings up to 3 stories in height. In addition, the State adopted the 2010 California Building Code for all other structures. Both amend Title 24, Part 2 of the California Code of Regulations and replace the 2007 CBC. In terms of earthquake design regulations, the 2007 CBC replaced seismic zones with acceleration maps used to ascertain site seismicity and thereby determine a Seismic Design Category (SDC) based on the proposed use of the building. The 2010 Codes include additional changes in SDCs for residential buildings in California as well as other seismic requirements.

In general, the SDC drives the level of structural detailing required for seismic resistance and is determined by first classifying the structure according to its use and/or function into one of four Seismic Use Groups (SUGs). These include: (1) Standard occupancy structures, such as single family and multi-family residences and standard commercial structures; (2) Special occupancy structures, such as those used for public assembly, such as conference rooms, auditoriums, and dining rooms, and wastewater treatment facilities; (3) Hazardous facilities that support or contain sufficient quantities of toxic or explosive substances to be dangerous in the event of release; and (4) Essential facilities, which would include hospitals, fire stations, designated emergency shelters, such as schools. The proposed Project would contain structures that fit into categories I (residential structures), 2 (golf course club house, satellite waste treatment facility), and 4 (proposed schools and fire station).[10]

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10 IBC, Seismic Use Groups, Table 1-1, September 30, 1999, http://www.tpub.com/content/UFC1/ufc_3_330_03a/ufc_3_330_03a0012.htm, accessed 10/4/2010

Based on these SUGs and the applicable design ground motion, the buildings are further assigned a SDC, which is a calculated value based on the distance of a structure from an anticipated seismic source and average subsurface conditions within the upper 100 feet at the site. The soil type, groundwater elevation, and depth to bedrock also play a critical role in determining the SDC and the overall risk of damage to a structure. While the SUG classification dictates the seismic performance objective for the building, the SDC influences the permissible structural system, allowable height, and other design parameters; refer to Table 4.7-1 below.

Table 4.7-1
Basis for Seismic Design Criteria in Model Codes and Standards

	Seismic Zones	Seismic Performance Categories	Seismic Design Categories
Classifications	0, 1, 2, 3, 4	A, B, C, D, E	A, B, C, D_0, D_1, D_2, E, F
Criteria for Classification	Location	Location and Building Use	Location, Building Use, and Soil Type
Used by Model Codes and Standards	CBC 1997[11] SBC 1991[12] BOCA/NBC 1990[13] MSJC 1992	SBC 1999 BOCA/NBC 1999 MSJC 1999[14]	IRC 2009/CRC 2010[15]

In the 2010 California Residential Code the default SDC D has been subdivided into three categories based on estimated ground acceleration, as illustrated in Table 4.7-2, *Basis for Seismic Design Categories – Percentage of Gravity (g)* .

Table 4.7-2
Basis for Seismic Design Categories – Percentage of Gravity (g)[16]

Seismic Design Category	S_{ds} (g)
A	.≤0.17
B	≥0.17 ≤0.33
C	≥0.33 ≤0.50
D_0	≥0.50 ≤0.67
D_1	≥0.67 ≤0.83
D2	≥0.83 ≤1.17
E	≥1.17

11 CBC = California Building Code:
12 SBC = Standard Building Code
13 BOCA/NBC = Building Officials and Code Administrators National Building Code
14 MSJC = Masonry Standards Joint Committee
15 CRC = California Residential Code
16 Table R301.2.2.1.1 of 2006 IRC as retrieved from http://ngmdb.usgs.gov/Info/docs/DMT08 3/6/2011

The default SDC for the proposed Project site is **D_1**, based upon the maximum ground acceleration associated with the design earthquake (i.e., 0.74g) and the fact that a substantial portion of the site is influenced by Smith Creek and/or is located in a flood plain or inundation area for surface flow.[17] The SDC for any specific building pad on the site would be determined once building pad locations are set by tentative maps, and site specific geotechnical and soils testing and the appropriate calculations completed as part of the grading and building design process.

County of Riverside General Plan Pass Area Plan, Hazards Element

The Hazards Element of the County of Riverside General Plan Pass Area Plan identifies areas that are subject to hazards as the result of flooding, dam inundation, seismic occurrences, and/or wildfire. The County's General Plan Safety Element also includes goals and policies to reduce the potential for damage from such conditions or events. Figure 13 in the Hazards Section of the Pass Area Plan shows areas of the City of Banning (including the project area) and ranks their relative susceptibility to liquefaction, among other seismic hazards. Specific hazards relative to the Project site include, flooding, proximity to a high fire hazard area, seismic hazards associated with faulting, and slope instability.

The County's Multi-Hazard Functional Plan outlines the responsibilities of the various County agencies in times of disaster, including earthquakes, and is implemented on the regional and local level with the cooperation and participation of local municipalities (refer to Section 4.8, *Hazards and Hazardous Materials* for a more detailed discussion).

Within the rapidly growing County of Riverside, State AP mapping has not kept pace with development. Accordingly, the County of Riverside has zoned fault systems and required special studies similar to those required for AP zones prior to development. These County zones generally represent zones that have been identified from groundwater studies, and the County recommends that they should be viewed as a potential hazard.

The County regulates most development projects within earthquake fault zones. Regulated projects include all land divisions and most structures for human occupancy. Exempted projects include single family, wood frame and steel-frame dwellings that are one or two stories, are not part of a development of four units or more, and are not located within 50 feet of a fault. Before a project can be permitted within an AP Earthquake Fault Zone, County Fault Zone, or within 150 feet of any other potentially active or active fault mapped in published USGS or CGS (formerly California Division of Mines and Geology) reports, a geologic investigation must demonstrate that proposed buildings would not be constructed across active faults. A site-specific evaluation and written report must be prepared by a licensed geologist. If an active fault is found, a structure for human occupancy must be set back 50 feet from the fault.

[17] California Building Code section 16135.6.1, Table 16135.6(1) and (2), as retrieved from http://napasolanoicc.org/PDF_Files/Seismic%20Design%20Category%20_06%20IBC_.pdf, 8/12/2010.

Riverside County Operational Area Multi-Jurisdictional Local Hazard Mitigation Plan (LHMP) Parts 1 and 2 (Banning) 2005

In 2005, the County of Riverside updated its Multi-Jurisdictional Local Hazard Mitigation Plan (LHMP). Among the participants in the planning process was the City of Banning. The LHMP Goals and Objectives include: (1) reducing possibility of damage and loss to existing community assets, critical facilities, and infrastructure due to natural, man-made, and technological hazards by, among other things, promoting disaster-resistant future development; (2) reducing possibility of damage and loss due to floods; and (3) reducing damage and loss to existing communities assets due to landslides by better identifying the types and locations of potential landslide zones. Participating jurisdictions were asked to conduct an assessment of hazards for their jurisdiction. The City of Banning's assessment is contained in Part II of the LHMP.

Earthquake risks for each city and unincorporated areas of the county were developed in terms of the vulnerability of the population and infrastructure. Earthquake scenarios were used based on the major earthquake faults in the County of Riverside. The LHMP contains an extensive evaluation of the severity and probability potential of different hazards, and includes an assessment for the City of Banning. The LHMP identifies faults, flooding, hazardous materials storage, and pipelines as potential hazards that could affect the City of Banning. Many of these hazards are identified on-site as well and will be discussed in the impact discussion section below.

City of Banning General Plan, Geotechnical Element

The City of Banning's General Plan includes a Geotechnical Element that includes goals, policies and programs that address the existing geologic and seismic characteristics within the City of Banning, its Sphere-of-Influence, and the expanded General Plan Planning Area. The Geotechnical Element provides measures that would reduce the potential for property damage and for harm to human health or loss of life which could occur as the result of geologic or seismic activity or the condition of site soils or other geologic hazard.[18] The City's Comprehensive General Plan EIR includes mitigation measures intended to reduce potential adverse effects associated with site soils and geologic conditions, including seismic hazards that might occur as a result of the build out of the Comprehensive General Plan. While these mitigation measures generally reference the provisions of the California Building Code (CBC), they can be read to require compliance with the most current standards contained in Title 24 of the California Code of Regulations (currently the 2010 California Building Code) as adopted by the City of Banning pursuant to State requirements. These General Plan EIR mitigation measures include:

[18] City of Banning General Plan, January 2006.

Geology and Soils Mitigation Measure A

1) Prior to issuance of building permits, the property owner/developer shall demonstrate that all structures have been designed in accordance with the most recent seismic standards in the UBC and approved by the Public Works Director. The UBC contains provisions that regulate the design and construction of excavations, foundations, retaining walls and other building elements to control the effects of seismic ground shaking and adverse soil conditions.

2) Prior to approval of each grading plan, the property owner/developer shall submit a geotechnical report prepared by a licensed soils/engineering geologist and geotechnical engineer to the Public Works Director for review and approval. This report shall be prepared in accordance with California Building Code (CBC) standards and to the satisfaction of the City Engineer, and shall address soil and geology related constraints and hazards identified in this EIR, such as slope stability, settlement, liquefaction, and related secondary seismic hazards. Specifically, the report shall:

   - Include an assessment of potential soil related constraints such as stability of proposed cut, fill, and natural slopes. Conduct further subsurface exploration to refine geologic structure for cut slope stability. If the report finds stabilization necessary, grading plans shall require corrective measures to address the need for stabilization;

   - Include an assessment of on-site landslides and appropriate corrective measures, such as further subsurface exploration of landslide areas beneath planned fills and development areas. Corrective measures would include complete removal, if feasible, or stabilization or buttressing of the landslide. This would involve partial removal of the landslide and stabilizing potential future movement with earthen fill or reinforced materials;

   - Evaluate excavation characteristics of on-site earth materials;

   - Establish specific remedial grading requirements, including but not limited to establishing parameters for stabilization/buttressing of slopes, removal of unstable soil materials;

   - Provide grading, foundation, and structural design recommendations based on findings of future geotechnical investigations;

- Address settlement, liquefaction, and structural design recommendations. Grading plans shall incorporate removal, where feasible, of all potentially liquefiable alluvium/fan deposits and colluvium;

- Address the potential for expansive soils. Representative soil samples of near-surface soil material will be collected and tested for expansion potential after the completion of rough grading on site. Expansive soils that are detrimental to the Project shall be subject to special building/foundation design, deepened foundations, post-tension foundations, soil removal, selective grading to blend highly expansive soils with soils of low expansivity, moisture conditioning, or other corrective measures as recommended by a licensed soils/geotechnical engineer and approved by the Public Works Director prior to approval of each grading plan;

- Include an evaluation of potentially corrosive soils and recommend appropriate corrective measures. If corrosive soils are found, corrective measures shall be incorporated into the grading plans;

- Address collapsible/compressible material. This material shall be subject to removal or other corrective measures in all areas planned for structural fill. Topsoil, colluvium, alluvium, highly weathered bedrock, and landslide materials with settlement potential shall be subject to corrective measures such as removal and recompaction, surcharging, settlement monitoring, and/or other measures deemed appropriate by the geotechnical engineer of record and approved by the Public Works Director prior to approval of each grading plan;

- Include appropriate laboratory testing to define soil engineering parameters; and

- Include a review of seismic and faulting conditions on-site. Seismic design parameters identified for the project shall be incorporated into project design as applicable.

Geology and Soils Mitigation Measure B

Proper structural engineering, which takes into account the forces that will be applied to structures by anticipated ground motions, shall provide mitigation for ground shaking hazards. Seismic design shall be in accordance with the most recently adopted editions of the Uniform Building Code and the seismic design parameters of the Structural Engineers, Association of California.

Geology and Soils Mitigation Measure H

Where development is proposed adjacent to or in close proximity to steep slopes, site-specific geotechnical studies shall be conducted to evaluate the potential for rock falls and/or slope failure, and to establish mitigation measures which minimize hazards.

Geology and Soils Mitigation Measure J

During the site grading, all existing vegetation and debris shall be removed from areas that are to receive compacted fill. Any trees to be removed shall have a minimum of 95 percent of the root systems extracted. Man-made objects shall be over excavated and exported from the site. Removal of unsuitable materials may require excavation to depths ranging from 2 to 4 feet or more below the existing site grade.

Geology and Soils Mitigation Measure R

All fill soil, whether on site or imported, shall be approved by the individual project soils engineer prior to placement as compaction fill. All fill soil shall be free from vegetation, organic material, cobbles and boulders greater than 6 inches in diameter, and other debris. Approved soil shall be placed in horizontal lifts or appropriate thickness as prescribed by the soils engineer and watered or aerated as necessary to obtain near-optimum moisture-content.

Geology and Soils Mitigation Measure S

Fill materials shall be completely and uniformly compacted to not less than 90 percent of the laboratory maximum density, as determined by American Society for Testing and Materials (ASTM) Test Method D-1557-78. The project soils engineer shall observe the placement of fill and take sufficient tests to verify the moisture content, uniformity, and degree of compaction obtained. In-place soil density should be determined by the sand-cone method, in accordance with ASTM Test Method D1556-64 (74), or equivalent test method acceptable to the City Building Department.

Geology and Soils Mitigation Measure T

Finish cut slopes generally shall not be inclined steeper than 2:1 (horizontal to vertical). Attempts to excavate near-vertical temporary cuts for retaining walls or utility installation in excess of 5 feet may result in gross failure of the cut and may possibly damage equipment and injure workers. All cut slopes must be inspected during grading to provide additional recommendations for safe construction.

Geology and Soils Mitigation Measure U

Finish fill slopes shall not be inclined steeper than 2:1 (horizontal to vertical). Fill slope surfaces shall be compacted to 90 percent of the laboratory maximum density by either overfilling and cutting back to expose a compacted core or by approved mechanical methods.

Geology and Soils Mitigation Measure V

Foundation systems that utilize continuous and spread footings are recommended for the support of one- and two-story structures. Foundations for higher structures must be evaluated based on structure design and on-site soil conditions.

Geology and Soils Mitigation Measure W

Retaining walls shall be constructed to adopted building code standards and inspected by the Building Inspector.

Geology and Soils Mitigation Measure X

Positive site drainage shall be established during finish grading. Finish lot grading shall include a minimum positive gradient of 2 percent away from structures for a minimum distance of 3 feet and a minimum gradient of 1 percent to the street or other approved drainage course.

Geology and Soils Mitigation Measure Y

Utility trench excavations in slope areas or within the zone of influence of structures should be properly backfilled in accordance with the following recommendations:

(a) Pipes shall be bedded with a minimum of 6 inches of pea gravel or approved granular soil. Similar material shall be used to provide a cover of at least 1 foot over the pipe. This backfill shall then be uniformly compacted by mechanical means or jetted to a firm and unyielding condition.

(b) Remaining backfill may be fine-grained soils. It shall be placed in lifts not exceeding 6 inches in thickness or as determined appropriate, watered, or aerated to near optimum moisture content, and mechanically completed to a minimum of 90 percent of the laboratory maximum density.

(c) Pipes in trenches within 5 feet of the top of slopes or on the face of slopes shall be bedded and backfilled with pea gravel or approved granular soils as described above. The remainder of the trench backfill shall comprise typical on-site fill soil mechanically completed as described in the previous paragraph.

City of Banning Code of Ordinances (Municipal Code) Title 18

On July 14, 2009 the City of Banning adopted Ordinance No. 1388 (City of Banning Grading, Erosion, and Sediment Control Ordinance) as Title 18 of the City's Code of Ordinances. The City's Grading Standards, contained in the Public Works Department Grading Manual, became effective on August 13, 2009. The Standards incorporate all of the mitigation measures contained in the City's Comprehensive General Plan EIR cited above and address all of the Goals and Policies of the City's Comprehensive General Plan. The Standards also incorporate the policies and guidance provided by Riverside County and the requirements of the 2007 California Building Code. On January 11, 2011, the City adopted Ordinance No. 1433, Amending Chapter 15.08 of the Municipal Code, adopting by reference the entirety of the 2010 California Building Code, California Residential Code, Green Building Standards Code, Plumbing Code, Mechanical Code, Electrical Code and International Property Maintenance Code as the City's Building Code. This action included adoption of the seismic standards and related structural standards included in the 2010 CRC and CBC. By inference, Ordinance 1433 also revised Title 18 to incorporate any applicable 2010 Code. The *California Health and Safety Code* (HSC) Section 17958.5 permits local jurisdictions to amend their own building standards to be more restrictive than HSC Title 24 if such amendments are justified on the basis of local geologic, topographic, or climate conditions. Banning has not adopted additional standards, but may do so in the future.

4.7.3 SIGNIFICANCE THRESHOLD CRITERIA

The significance criteria for this analysis were developed from Appendix G of the State *CEQA Guidelines*. The Potential impacts of geotechnical, soils and seismic hazards on Project development are also analyzed based on the City of Banning's *General Plan Land Use Element* and *Title 18 of the City's Municipal Code* (Grading and Erosion Control Regulations). The proposed Project would be considered to have a significant impact relative to geology, soils, or seismicity if it would:

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

  i) Rupture of a known earthquake faults, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area, or based on other substantial evidence of a known fault (including a County of Riverside designated Fault Hazard Area, or a County of Riverside designated Potential Fault Hazard Area);

  ii) Strong seismic ground shaking;

iii) Seismic-related ground failure, including liquefaction;

iv) Landslides.

b) Result in substantial soil erosion or the loss of topsoil.

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as the result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse.

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property or on soils with an expansion index greater than 20 percent.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater. Refer to Section 7.0, *Effects Found Not to be Significant*).

4.7.4 IMPACT ANALYSIS AND MITIGATION MEASURES

ANALYTIC METHOD

The previously certified Deutsch Banning Specific Plan EIR addressed development of the Project site with up to 5,400 dwelling units. Impacts discussed below are generally consistent with the impacts described in the 1985 Deutsch Specific Plan EIR and subsequent EIR Update in 1993. This analysis has been updated to reflect the currently proposed Butterfield Specific Plan, including the off-site infrastructure and 21-acre unincorporated parcel. The Project site would be mass graded in approximately four phases, beginning with the golf course, Smith Creek drainage improvements and fill placement in the southerly portion of the site. Concurrent with the initial phase of mass grading, applicable portions of off-site infrastructure and both on- and off-site drainage improvements would be constructed. The EIR analysis is based on review of available documents, including the proposed Specific Plan and associated, updated tentative tract maps, as well as Project-specific technical studies contained in Appendix E, *Geotechnical Reports*.

PROJECT DESIGN FEATURES AND EXISTING REGULATIONS, RULES, AND REQUIREMENTS

Existing local, State and federal regulations noted below would avoid or mitigate potential impacts related to geology, soils and seismicity. The following Project Design Features would also reduce, avoid or off-site potentially adverse impacts:

1) The Project has been redesigned from the previously approved Deutsch Specific Plan, which proposed grading the entire Specific Plan property. The redesigned Specific Plan and associated tract maps avoid grading the more steep northern portions of the site, and also have incorporated a setback area to ensure that structures are not placed on the identified fault traces within the Alquist Priolo Zone identified on the Project site.

2) In the ultimate condition, the developed site would result in substantially reduced wind- and runoff-induced erosion.

3) The Project incorporates appropriate setbacks from the Alquist Priolo zone established for strand A and assumed for strand B of the Banning fault.

4) The Project would adhere to all of the seismic requirements incorporated into the 2010 California Residential Code and 2010 California Building Code (or most current building code) and the requirements and standards contained in the applicable chapters of the City of Banning Municipal Code.

5) The Project would include the implementation and maintenance of BMPs to reduce or avoid soil loss due to wind and water erosion.

6) Prior to development of any upstream areas of the site, the potential for conveyance of debris originating in the off-site watershed would be accounted for in the design of on-site drainage facilities.

7) The Specific Plan requires that each phase of the development include an erosion control plan, consistent with the requirements of MC Title 18

IMPACT ANALYSIS AND MITIGATION MEASURES

Impact 4.7-1a: Surface Fault Rupture

Threshold: *Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:*

i) *Rupture of a known earthquake faults, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map, or a County of Riverside designated Fault Hazard Area, or a County of Riverside designated Potential Fault Hazard Area?*

Determination: Less than Significant

The Project site lies within a seismically active region of southern California that is subject to a significant amount of seismic activity associated with the northwest-trending San Andreas, San

Jacinto and the Elsinore fault systems. As noted in the description of existing conditions on the site, the San Gorgonio Pass fault zone, a part of the San Andreas fault zone, interacts with other faults, most notably the San Jacinto fault zone and the Pinto Mountain fault, within the Pass area and becomes somewhat fractured over the 70-mile distance extension from just north of San Bernardino to just north of Indio. Ancient and inactive strands of the San Andreas fault can be found within the SGPFZ, and other localized fault segments in this area have also been identified in various studies, though researchers have used different names for the local faults and placed the dividing lines between certain named fault segments in varying places. The Banning fault is a part of this geologically fragmented system. The Project site is located between the more active Banning fault zone to the east and the inactive Banning fault zone to the west. The central segment of the Banning fault traverses the northernmost quadrant of the Project site and is comprised of two parallel fault segments, identified as strands A and B: Strand A is covered by an Alquist Priolo zone while strand B is also considered active.

As required by State law and local Building Code, building setbacks from the identified active fault zones are incorporated into the Project's site plan and were located based on an evaluation of fault character and level of activity observed during an on-site geotechnical investigation, as well as evidence gained through aerial photograph and literature review; refer to Section 8.0 of the *Fault Rupture Hazard Investigation* contained in Appendix E, *Geotechnical Reports*, for additional details on the on-site trenching analysis. Faults located within the Alquist-Priolo Zone in the northern portion of the site are no longer considered active; however, the older alluvium ($Qoal_2$) which overlies the faults to the southeast of the site in this area lacks age dating, and strand A of the Banning fault, which traverses this same area, is considered to have potential for future activity.

A zone of overlapping faults (central fault zone or CFZ), believed to join the main rupture plane at greater depths, is also present within the Project site. This zone is approximately 150 feet wide through most of its length, but widens to 600 feet within the western portion of the site. Based on the findings of the on-site geotechnical investigation, the CFZ is assumed to be active. For this reason, a 50 to 100-foot building setback along the CFZ, as measured from the fault trace, has been incorporated into the Project site plan, as shown on Exhibit 4.7-5, *Fault Setback Zones*. Two thrust faults, a north-south tear fault, and a localized fault near 14th Street, have been geologically mapped within the property. The thrust faults were mapped within the CFZ; building setbacks were recommended and incorporated into the site plan pursuant to Code requirements. Lineaments were also observed to the south of the AP zone (refer to Exhibit 4.7-5, *Fault Setback Zones*).

A series of east-west trending lineaments enter the Project site from the east. These lineaments appear to be the result of older faulting along the hills to the east and die out in the vicinity of the eastern boundary of the Project site. This localized faulting could be considered to be potentially active; however, no building setbacks are recommended as there is no evidence of Holocene displacement and no Alquist-Priolo zone has been established.

In addition to the above, a weak lineament was observed on the 21-acre parcel in the northwest portion of the Specific Plan Area, located within the County of Riverside during the aerial photograph review. The geotechnical investigation recommends completion of a subsurface fault hazard investigation during the potential future planning phase of development on this parcel, as provided for in the City's Grading Ordinance (Section 18.06.080 and 18.06.060 (B)).

As illustrated on Exhibit 4.7-5, *Fault Setback Zones*, the northern fault setback zone would affect Planning Area 73, designated as Open Space, while the southern fault setback zone would affect Planning Area 71, designated as Open Space and Basin, and Planning Area 35, designated as Open Space/Golf Course. Open Space land uses are not considered highly susceptible to fault hazards. All preliminary building setback zones are illustrated in Exhibit 4.7-5 of this EIR, which is based on Figure 3 of the Appendix E, *Fault Rupture Hazard Investigation.*

Since the site plan observes building setbacks as required by existing law and ordinance, and the potential for ground rupture to occur outside of the proposed building setback zone is considered to be low within the low-lying areas of the property, adverse impacts to structures or people due to surface fault rupture on-site would be considered less than significant.

A *Limited Geotechnical Investigation* (see Appendix E) was prepared by Geocon to evaluate potential geotechnical constraints that may potentially affect the areas where off-site improvements are proposed. The proposed pipeline alignments for water, sewer, and recycled water do not lie within an Alquist-Priolo earthquake fault zone nor were any active or potentially active faults identified along the proposed pipeline alignments. Accordingly, the potential for damage to off-site underground pipelines for water and sewer due to fault rupture would be less than significant.

Impact 4.7-1b: Ground Shaking

Threshold: *Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:*

> ***ii)*** *Strong seismic ground shaking?*

Determination: Less than Significant with Mitigation Incorporated

As previously discussed, the Project site is located within a seismically active region of southern California, is traversed by various faults, and would likely be subjected to strong seismic ground shaking, which is considered the most serious seismic hazard likely to impact the Project. In addition to the on-site Banning fault, the active faults located in closest proximity to the site include the San Jacinto fault (10 miles southwest); Mill Creek fault (8 miles north); Mission Creek fault (7.2 miles northeast); Coachella Valley segment of the Banning fault (12 miles east); and the San Bernardino strand of the San Andreas fault (four miles north) and the Coachella Valley segment of the San Andreas fault (20 miles northeast).

In order to assess the potential impact of ground shaking on the site's built environment and to make recommendations regarding structural design of buildings on the site, Geocon estimated potential on-site ground motion assuming the occurrence of an earthquake along the San Bernardino segment of the San Andreas Fault, approximately 4 miles north of the site. The 2010 California Building Code and 2010 California Residential Code define the Design Basis Ground Motion (often accepted as the minimum standard) as the maximum *probable* event that could potentially affect a particular site along the closest active fault. Probabilistic peak ground acceleration at the site estimated by Geocon, using this approach, indicated a maximum acceleration of approximately 0.74g with a 10% probability of being exceeded in a 50-year period, assuming a magnitude M_w 7.4 earthquake on the San Bernardino segment of the San Andreas fault.

While the effect of seismic ground shaking cannot be entirely avoided in seismically active regions such as southern California, these effects maybe reduced to a less than significant level through the design of structures in compliance with the structural requirements contained in the 2010 California Building Code and 2010 California Residential Code. The purpose of the required design parameters is to ensure construction of buildings that will resist collapse during an earthquake. The 2005 Geocon report also recommended implementation of the seismic design parameters suggested by the Structural Engineers Association of California (SEAC). The majority of these (SEAC) design parameters have since been incorporated into the 2010 CBC and CRC.

Chapter 18.06.060 of the City's Municipal Code requires preparation of a seismicity report as a condition for the issuance of a grading permit for all grading applications associated with subdivisions as well as all grading projects that propose development with occupancy category II, III, IV structures as defined by the CBC and all real estate development that lies within an earthquake fault zone. The Municipal Code also requires these reports to comply with the requirements of the *Alquist-Priolo Earthquake Fault Zoning Act* and the requirements specified in the City's Grading Manual. Accordingly, in addition to the *Preliminary Geotechnical Report* for the site prepared in 2005 by Geocon, individual, site-specific geotechnical and seismic reports would be required by the City for each tract, as it is developed, over the life of the Project. Each report would include specific recommendations regarding foundation design and structural requirements for buildings proposed to be constructed within the subdivision consistent with the CBC and/or CRC.

Pursuant to the requirements of the Municipal Code, the City's Department of Building and Safety would ensure that building plans conform to all applicable structural requirements prior to the issuance of a building permit for any structure to be constructed on the Project site. Conformance with these requirements would be monitored during construction by City building inspectors and would be confirmed prior to the issuance of certificate of occupancy for any structure. These measures would ensure that all Project structures are designed and built in conformance with the recommendations contained in the applicable geotechnical study and the most current seismic requirements of the adopted State of California building codes and any additional code requirements adopted by the City of Banning.

No specific seismic conditions that would restrict or prohibit the proposed on- and off-site infrastructure improvements have been identified during the geotechnical or fault rupture hazard investigations conducted to date. Compliance with the 2010 or most current CBC, and local ordinances that regulate site design and construction of such facilities would be required for all improvements constructed with Phase 1A and/or any other phase of the Project.

Compliance with site-specific structural recommendations and the requirements of the City's Code and the most current California Residential Code and/or California Building Code would reduce potential adverse effects on structures due to ground shaking to a less than significant level. That compliance would be ensured at the design stage and monitored through the construction stage by the City of Banning.

Mitigation Measures

In addition to compliance with the above cited requirements, the Project has reduced, avoided or offset potentially adverse impacts to geology, soils and seismicity through Project Design Features noted above (all of which are summarized in Section 3.7, *Project Design Features*). The following mitigation measure would further reduce potentially significant impacts. :

GEO-1: All structures on the Project site shall be constructed pursuant to the most current applicable seismic standards, as determined by the City as part of the tract map, grading plan, and building permit review processes, with building setbacks as recommended by the Project's Seismic Hazard Analysis (Geocon 2005). Design criteria developed for Project structures shall also be based on the most current standards of practice and design parameters suggested by the Structural Engineers Association of California based on the recommendations and amendments to the CBC by the Division of State Architect for specific types of buildings and occupancies.

Impact 4.7-1c: Seismically-Induced Ground Failure

Threshold: *Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:*

iii) Seismic-related ground failure, including liquefaction; subsidence, and lateral spreading?

Determination: Less than Significant; also refer to Impact Analysis 4.7-1d – Landslides

Earthquakes can result in secondary ground failure such as local subsidence, soil liquefaction, lateral spreading, lurch cracking, and densification. These hazards are related to topographic, soil, and groundwater conditions and their potential to occur would l depend upon the composition of the near-surface sediments, the depth of the water table, and the ground acceleration experienced at the site in any specific seismic event.

As noted previously, the RCIP Pass Area Plan indicates that the Project site is located in an area with moderate liquefaction potential. When considered with the density of on-site soils at depth and the depth of groundwater, the potential for liquefaction on the Project site is considered to be very low. In addition, the potential for lateral spreading is associated with areas that are prone to liquefaction. Since the potential for liquefaction at the Project site is considered to be very low, the probability of lateral spreading occurring on-site is also considered very low, and no mitigation measures are required.

Seismically induced settlement can occur in areas where earthquake shaking causes densification of relatively loose sediments. Settlement can cause damage to surface and near-surface structures. Since the site also contains medium dense alluvial deposits, the Project site would be considered potentially susceptible to seismic densification. The Geocon study estimated a total seismic-induced settlement (dynamic densification) of less than ¾ inch for a ground acceleration of 0.74g. Geocon indicated that a maximum seismically induced differential settlement of less than ½ inch should be considered in the structural design of any structure on the site.[19] Appropriate site preparation pursuant to the recommendations of the Project's geotechnical engineer as required by the City's Grading Standards and appropriate structural design as recommended by the Geocom study, any subsequent required studies, and as required by the 2010 CBC and CRC and the City of Banning Building Code would reduce potential impacts to structures as a result of seismically-induced settlement due to densification to a less then significant level.

A technical memorandum prepared by Geoscience Support Services in 2007 to evaluate the artificial recharge potential of the proposed Butterfield Project estimated the depth to groundwater on the Project site at between 377 feet bgs south of Wilson Street to 570 feet bgs at the USGS monitoring well located on Highland Springs Avenue adjacent to the western boundary of the Project site.[20] Field investigation by Geocon found no evidence of ground subsidence as a result of past groundwater withdrawal in the Project area or on the Project site. Accordingly, it is unlikely that the site would be affected by ground subsidence and no mitigation measures would be required.

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19 Geocon Inland Empire, Inc., *Geotechnical Investigation, Deutsch Property Highland Springs Avenue and Wilson Street, Banning, CA,* Sections 5.3 (*Liquefaction*) and 5.4 (*Seismic Densification*), June, 2005, pp 6-7.

20 Geoscience Support Services, Inc., *Preliminary Geohydrologic Evaluation of Artificial Recharge Potential – Proposed Butterfield Development, Banning, CA,* February 28, 2007, pp 8.

Impact 4.7-1d: Landslides

Threshold: *Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:*

iv) Landslides?

Determination: Less than Significant with Mitigation Incorporated

In the City of Banning, property damage resulting from landslides has occurred as development into hillside areas has increased. The potential for landslides to occur is increased during or following intense rainfall or seismic events resulting in ground shaking. Rock falls and rockslides may also occur, particularly along steep canyon walls and the natural slopes in the southern portion of the Banning Bench area.

The northernmost reaches of the proposed Project site extend into the foothills of the San Bernardino Mountains. Manufactured slopes of as much as thirty feet in height may be constructed as the more northerly portions of the site are developed. In addition, the Project site includes or abuts drainage courses that are capable of channeling debris flows generated by landslides occurring at higher elevations, particularly those that could be generated by seismic events. During the geotechnical investigation, debris flow deposits were identified within the fault trenches, and debris flows and landslides were observed during site reconnaissance along the south-facing slopes on-site. The hillside areas within the property may also support additional debris flow deposits; however, no evidence of deep-seated landslides was identified on the Project site. Nonetheless the potential for on-site landslides would exist within portions of PAs 73, 71, 69, 67, 61, and 60 in the natural condition. PA 73 would be left in its natural state following Project development and, therefore, lots located adjacent to its boundary in PAs 60 and 61 could be affected by landslides originating in PA 73; however, slopes in the balance of Planning Areas located within or in proximity to the foothill regions would be graded, protected from the effects of uncontrolled drainage through the construction of benches and down drains to channel flows, and stabilized with retaining walls and vegetation to reduce landslide potential. The proposed 30.4-acre north basin in PA 71 would be located at the base of the foothill area and would be designed to capture Smith Creek flows originating at higher elevations. The north basin could be subject to the effects of off-site landslides and resulting mudflows. The Specific Plan provides that prior to the development of upstream areas, the potential for the conveyance of debris from the off-site watershed would be accounted for in the design of on-site drainage facilities and the basin has been designed to divert such debris flows from the on-site drainage system without compromising the basin's capacity to detain storm flows.

As required by the City's Building Code and Grading Code, site-specific evaluation of geologic conditions prior to the grading design for each tract within the Specific Plan Project area be required and would provide the basis for the development of site-specific design criteria needed to ensure that grading and drainage plans for manufactured slopes minimize the potential effects of landslides. The City would ensure that Project grading and drainage plans were designed pursuant to these site-specific criteria through the City's plan check process prior to the issuance of grading permits. Compliance with permitted grading and drainage plans would be monitored through the construction phase by City inspectors and certification of the stability of building pads and slopes would be required prior to the issuance of building permits for any structures on lots with slope exposure. These measures, together with compliance with other applicable regulations contained in the City's Title 18 Grading Standards and Building Code and General Plan EIR Geotechnical Element Mitigation Measures, would ensure that adverse effects associated with on-site landslide potential would be reduced to a less than significant level.

The 2007 *Limited Geotechnical Observation* did not identify any specific geologic conditions in the off-site locations of Project-associated infrastructure that would make landslides a concern.

Mitigation Measures

The following mitigation measures would further reduce potentially significant impacts involving potential landslide hazards:

GEO-2: A detailed analysis of site geotechnical conditions, field investigation and slope stability analyses shall be conducted as 40-scale grading plans for mass- and fine-grading are prepared in the course of the phased development of the Project site. These studies shall be submitted to the City Building Department or Building Official, and their recommendations incorporated into Project design to the satisfaction of the City Engineer, prior to the issuance of any grading permits, including those for mass grading, in areas where slopes of 10 feet or more in height are anticipated and/or where evidence of debris flows or past landslides is found.

GEO-3 The Project site shall be constructed pursuant to the following mitigation measure contained in the City of Banning General Plan EIR, Geotechnical Element:

- During the site grading, all existing vegetation and debris shall be removed from areas that are to receive compacted fill. Any trees to be removed shall have a minimum of 95 percent of the root systems extracted. Man-made objects shall be over excavated and exported from the site. Removal of unsuitable materials may require excavation to depths ranging from 2 to 4 feet or more below the existing site grade.

- All fill soil, whether on site or imported, shall be approved by the individual Project soils engineer prior to placement as compaction fill. All fill soil shall be free from vegetation, organic material, cobbles and boulders greater than 6 inches in diameter, and other debris. Approved soil shall be placed in horizontal lifts or appropriate thickness as prescribed by the soils engineer and watered or aerated as necessary to obtain near-optimum moisture-content.

- Fill materials shall be completely and uniformly compacted to not less than 90 percent of the laboratory maximum density, as determined by American Society for Testing and Materials (ASTM) Test Method D-1557-78, or equivalent test method acceptable to the City Building Department. The project soils engineer shall observe the placement of fill and take sufficient tests to verify the moisture content, uniformity, and degree of compaction obtained. In-place soil density should be determined by the sand-cone method, in accordance with ASTM Test Method D1556-64 (74), or equivalent test method acceptable to the City Building Department.

- Finish cut slopes generally shall not be inclined steeper than 2:1 (horizontal to vertical). Attempts to excavate near-vertical temporary cuts for retaining walls or utility installation in excess of 5 feet may result in gross failure of the cut and may possibly damage equipment and injure workers. All cut slopes must be inspected during grading to provide additional recommendations for safe construction.

- Finish fill slopes shall not be inclined steeper than 2:1 (horizontal to vertical). Fill slope surfaces shall be compacted to 90 percent of the laboratory maximum density by either overfilling and cutting back to expose a compacted core or by approved mechanical methods.

- Foundation systems that utilize continuous and spread footings are recommended for the support of one- and two-story structures. Foundations for higher structures must be evaluated based on structure design and on-site soil conditions.

- Retaining walls shall be constructed to adopted building code standards and inspected by the Building Inspector.

- Positive site drainage shall be established during finish grading. Finish lot grading shall include a minimum positive gradient of 2 percent away from structures for a minimum distance of 3 feet and a minimum gradient of 1 percent to the street or other approved drainage course.

- Utility trench excavations in slope areas or within the zone of influence of structures should be properly backfilled in accordance with the following:

  (a) Pipes shall be bedded with a minimum of 6 inches of pea gravel or approved granular soil. Similar material shall be used to provide a cover of at least 1 foot over the pipe. This backfill shall then be uniformly compacted by mechanical means or jetted to a firm and unyielding condition.

  (b) Remaining backfill may be fine-grained soils. It shall be placed in lifts not exceeding 6 inches in thickness or as determined appropriate, watered, or aerated to near optimum moisture content, and mechanically completed to a minimum of 90 percent of the laboratory maximum density.

  (c) Pipes in trenches within 5 feet of the top of slopes or on the face of slopes shall be bedded and backfilled with pea gravel or approved granular soils as described above. The remainder of the trench backfill shall comprise typical on-site fill soil mechanically completed as described in the previous paragraph.

Impact 4.7-2: Soil Erosion

Threshold: *Would the project result in substantial soil erosion or the loss of topsoil*?

Determination: Less than Significant

Soil is naturally eroded by the action of water or wind. In general, such erosion removes soil at roughly the same rate as soil is formed; however soil erosion can be accelerated by natural or human action that strips the soil of its natural cover, leaving land unprotected and vulnerable, and allowing erosive rainfall or wind to detach and transport soil from its original location at a much faster rate than soil creation can compensate for. The potential for erosion is influenced by area climate, topography, soils, and vegetation, as well as agricultural activities and land development patterns that may affect soil conditions. The Project site is located in an area that has been subject to soil erosion due to precipitation, wind, stormwater runoff, and sedimentation.

Loss of Topsoil

Topsoil comprises the top eight to ten inches of soil and provides approximately 80 percent of the nutrients plants need to grow and produce. This upper layer of soil, which contains organic matter, is most often removed during grading, and either discarded or moved, and mixed with nutrient-poor sub-soils and/or potentially, with imported soils that lack the characteristics of native soils, then compacted such that the post-graded surface is man-made. Compaction reduces the sites ability to absorb water, leading to increased imperviousness, especially in clay soils. The proposed development of the Project site, which includes grubbing and clearing of site vegetation in preparation for mass grading and tract-specific rough grading, has the potential to result in a substantial increase in soil erosion from the Project site, including the loss or degradation of topsoil.

The Project site has been heavily disturbed over the course of many decades through cattle grazing, plowing for farming, and weed abatement activity, etc. Importantly, much of the native topsoil has also been lost or moved due the scour effect of wind erosion over the sparsely vegetated property, a condition that is common in the Pass area. While high quality topsoil is an undoubted resource, the degraded condition of the site and type of proposed use would make the loss of any existing topsoil due to site grading a less than significant impact. Subsequent to site development, the then-existing soils would be amended through hydro-mulching and reseeding to support temporary re-vegetation of the site, and subsequently, to support ornamental landscape. Overall, the post-construction condition of on-site topsoil would be improved as compared to the current or immediate post-grading condition.

Wind and Water Erosion

The Smith Creek Channel and its adjacent flood plain have been profoundly impacted by water erosion. In addition, portions of the site are subject to inundation from precipitation induced surface flows. Wind scour is a serious problem for the site as well. Erosion during and subsequent to site grading could result in a substantial increase in the impacts of sedimentation affecting on-site and off-site drainage courses unless steps are taken to prevent or minimize the loss of soil.

Construction activities (including soil disturbing activities such as clearing, grading, excavating, and stockpiling) that disturb one or more acres, or smaller sites that are part of a larger common plan of development, are regulated under the EPA's National Pollutant Discharge Elimination System (NPDES) and by the fugitive dust regulations of the South Coast Air Quality Management District (SCAQMD). Analysis of wind-induced erosion and mitigation measures for the control of wind erosion are discussed in detail in Section 4.3, *Air Quality*, of this EIR and will not be further addressed in this section; however, efforts to control wind erosion would also be effective in controlling post-grading erosion due to precipitation and surface flows. Section 4.9, *Hydrology and Water Quality*, contains a detailed discussion of the NPDES program, the requirements for a SWPPP, and the provisions of the State's new General Permit requirements. Examples of BMPs that would directly reduce or avoid soil erosion include:

- The use of straw fiber rolls that can be laid across slope faces to shorten slope length, reduce runoff velocity and retain soil or along the perimeter of lots, to retain soil.

- The use of straw mulching to reduce rainfall impact, conserve moisture and moderate temperature to encourage plant growth.

- The use of straw blankets which consist of straw fiber stitched to a single or double netting structure that are photodegradable and are frequently used on slopes and low-flow channels. Straw blankets also provide a growing medium that assists in revegetation.

- Hydroseeding which combines appropriate seed mixes with a binding medium such as hydro-straw which can be utilized to stabilize both slopes and pad areas, enhance revegetation, and collect sediments.

Title 18 of the City's Municipal Code details the City's grading, erosion, and sediment control requirements. In adopting Title 18 the City stated: "Growth and development have created permanent changes to the City's landscape and its natural resources. Open space and naturally vegetated areas have been permanently altered through clearing and grading activities associated with construction and land development. Loss of ground cover, coupled with grading, excavation, and compaction of land contributed to decreased groundwater infiltration, increased storm water flow, erosion and increased sediment runoff into washes, streams and other water bodies (Section 1).[21]

Title 18 implements the mitigation measures for erosion control and sedimentation contained in the City's Comprehensive General Plan EIR, as cited in the "Regulatory Setting" section of this analysis. Pursuant to Chapter 18.15, Article 6, *Erosion and Sediment Control*, projects are required to minimize exposure time of disturbed soil areas, temporarily stabilize and re-seed disturbed soil areas as rapidly as possible, permanently re-vegetate or landscape as early as feasible, and abide by all of the provision of the State's NPDES General Permit for construction activity.

The proposed Project would be required to conform to all of the provisions of the City's Title 18 Grading Standards, the Project's approved SWPPP, and the State's NPDES General Permit; refer to Section 4.9 (*Hydrology and Water Quality)* for a detailed discussion of these requirements, including the installation and maintenance of erosion control BMPs. While vegetation removal and disruption of soil cover by vehicle movement or excavation and grading activities may cause a temporary increase in the potential for soil erosion, implementation of approved BMPs and compliance with the above cited ordinances and permits would ensure that erosion from the site as a result of construction phase activities would be minimized to the MEP standard. As development of the site occurs over time, and structures and landscaping would

[21] City of Banning Grading Standards, Public Works Department, *Ordinance No. 1388 Grading Manual,* August 13, 2009, pp iii.

increasingly cover the soil, the overall rate of and potential for erosion would be expected to decrease. Grading would be designed to maintain existing drainage flows and slopes would be planted, drained, and maintained to reduce erosion potential.

Following construction, the amount of exposed soil would be significantly reduced by hydroseeding and landscape installation, the introduction of drainage features would control storm water run-off, and the installation and maintenance of site landscape, including slope landscape and implementation of other potential post-construction BMPs, would ensure that post-construction erosion would be less than significant.

The extension of water transmission lines from the Little San Gorgonio Creek Spreading Grounds, the construction of off-site sewer and recycled water facilities, drainage improvements, and construction of a lift station are not anticipated to result in a substantial loss of topsoil. Ground disturbing activities required for these improvements would be fairly localized and would not require extensive grading, exposure of earthen surfaces, or the potential loss of topsoil. All off-site infrastructure improvements would be subject to erosion control BMPs during construction to minimize the potential for erosion or sedimentation to occur. Following construction of the off-site infrastructure improvements, all affected roadway corridors would be restored to pre-construction conditions, and no exposed surfaces would remain.

Compliance with the requirements of Title 18 for construction phase and post-construction phase erosion and sedimentation control would be ensured by City through its pre-permit plan check process and through inspections during the construction and post construction phase conducted by City staff and, in response to complaints, by representatives of the RWQCB and AQMD. All of these agencies have the ability to enforce compliance through citation, fines, and job shutdowns. With the implementation of existing Municipal Code Title 18 requirements, State NPDES General Permit requirements, installation and maintenance of BMPs pursuant to an approved SWPPP, continuous construction phase inspections, and the post-construction installation of landscape and drainage improvements, as required by the City, Project impacts related to erosion and loss of topsoil would be reduced to a less than significant level and no additional mitigation measures are required.

Impact 4.7-3: Unstable Soils

Threshold: *Would the project be located on a geologic unit or soil that is unstable, or that would become unstable as the result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?*

Determination: Less than Significant with Mitigation Incorporated

Geologic hazards, such as landslides, lateral spreading, subsidence and liquefaction, are earth processes on the surface that have the potential to cause loss or harm to the community or the environment. The City of Banning and its surroundings are subject to such geologic hazards, due to the geophysical composition of the area. Impacts related to seismically induced landslides and debris flows, lateral spreading, subsidence, and liquefaction have been discussed in preceding impact analyses in this section. While the Project site is traversed by both Banning fault segments, compliance with requirements for building setbacks from the fault zones would ensure that no structures are constructed on unstable geological units. The Project is not located on soil that is unstable or could become unstable as the result of the Project.

The majority of soils materials identified on-site consist of silty sands that generally possess a very low potential for expansion and exhibit moderate shear strength characteristics. Soils that are identified as having very low to low expansion potential are suitable for use as fill, capping of building sites, and construction of fill slopes. Materials with expansion potential greater than low would remain at least three feet below the proposed finish grade elevation, if possible. Removal of soils that are unsuitable for loading is recommended and would be required pursuant to the 2010 CBC and the City's Title 14 grading standards.

When slopes are not properly engineered and constructed manufactured slopes may become unstable. The 2005 *Geotechnical Investigation and Fault Rupture Hazard Investigations* prepared by Geocon include measures and/or stabilization techniques to reduce the potential for damage caused by unstable soils and possible resulting on- or off-site landslide, or slope collapse, although additional study is recommended once 40-scale grading plans are available for the site. This requirement is incorporated into Mitigation Measure GEO-2.

In providing its analysis of slope stability, Geocon assumed that fill slopes would be constructed with on-site soils and are assumed to be stable to a height of 30 feet and a slope of 2:1. Slopes greater than 30 feet in height are currently possible, requiring additional evaluation and preparation of a detailed slope stability analysis once 40-scale grading plans are available. In addition, Geocon notes that if slopes that are steeper than 2:1 are constructed, these may be susceptible to slope instability unless disturbed surficial soils are removed to the extent possible, and irrigation systems and surface drains are properly maintained.

Mitigation Measures

With implementation of grading plans that are consistent with the requirements of the 2010 (or most current) CBC and the City's Title 18 Grading Standards and Title 15 Building Code, and Mitigation Measure GEO-2, the Project's development would not result in significant impacts due to unstable soils or geologic units.

Impact 4.7-4: Expansive Soils

Threshold: *Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property or on soils with an expansion index greater than 20 percent*?

Determination: Less than Significant

Expansive soil expands and contracts due to changes in the moisture content of the soil and can cause structural problems through the differential movement of the structure. Depending upon the supply of moisture in the ground, expansive soils can experience changes in volume of up to thirty percent or more. Foundation soils that are expansive will "heave" and can cause lifting of a building or other structure during periods of high moisture. Conversely, during periods of falling soil moisture, expansive soil will "collapse" and can result in building settlement. Expansive soil will also exert pressure on the vertical face of a foundation or retaining wall resulting in lateral movement. Expansive soils that have expanded due to high ground moisture experience a loss of soil strength or capacity, and the resulting instability can result in various forms of foundation damage and slope failure. Swelling and shrinkage cycles typically damage pavement, sidewalks, slab and spread foundations, as well as structures constructed on the ground.

The expansion potential of any particular expansive soil is determined by the percentage of clay and the type of clay in the soil. Soils engineers identify potentially expansive soils by measuring the percentage of fine particles in a soil sample. The American Society of Testing Materials (ASTM D 4829) has published a test method and an Expansion Index to quantify the results of soil testing for expansive potential. The Expansion Index range and potential expansion is 0-20 (Very Low); 21-50 (Low); 51-90 (Medium); 91-130 (High); over 130 (Very High).

In the Banning area, expansive soils are generally associated with areas underlain by older alluvial fan deposits containing argillic (clay-rich) soil profiles. These soils are considered to have moderate expansion potential. The low-lying areas within the City are underlain by alluvial fan sediments composed largely of granular soils. These soils are considered to have very low to moderately low expansion potential. As the majority of on-site materials consist of silty sands that generally possess a very low expansion potential, the Project is unlikely to be adversely affected by expansive soils; however, the soil profile for any particular location may be very unique and soil containing cobble, gravel, and sand may also be expansive depending upon the percentage and type of clay in the tested soil sample. Depending upon weathering patterns and other factors, near-surface soils could be highly expansive while soils at depth may be non-expansive.

Title 18 of the City's Municipal Code defines expansive soils as "any soil with an expansion index greater than twenty as determined by the Expansive Index Tests of the CBC. MC Section 3.11 requires submission of a site-specific geotechnical report prior to the issuance of a permit for any type of site grading. The geotechnical report is required to include identification and recommendations for the treatment of, or design criteria for, any expansive soils that may be present on a given site. Section 5.8 of the Code requires tests for expansive soils performed on soils within four feet of finish grade of any area intended or designed as a location for a building. The Code requires either removal of expansive soils to a minimum depth of four feet below finish grade and replacement with non-expansive soils, or a structural design solution must be provided prior to issuance of building permit.

The proposed Project would be required to conform to all of the pertinent provisions of the City's Title 18 grading standards, and all standards contained in Section 5.8 of the Municipal Code as cited above, including all requirements related to expansive soils. As tracts are developed within the Specific Plan area, site specific geotechnical studies, including those to identify expansive soils on building sites, would be prepared and expansive soils identified and designed for. The City would ensure design compliance through its plan check process prior to the issuance of grading permits and building permits, and would further ensure compliance with the approved grading plans and architectural structural engineering plans and foundation plans through inspections during the course of construction. Certification of compliance with all applicable approved plans by City inspectors would be required prior to the issuance of certificates of occupancy for any structure. With adherence to the provisions of the City's grading standards and building code, as enforced by the City, the potential for adverse impacts due to expansive soils would be less than significant.

4.7.5 CUMULATIVE IMPACTS

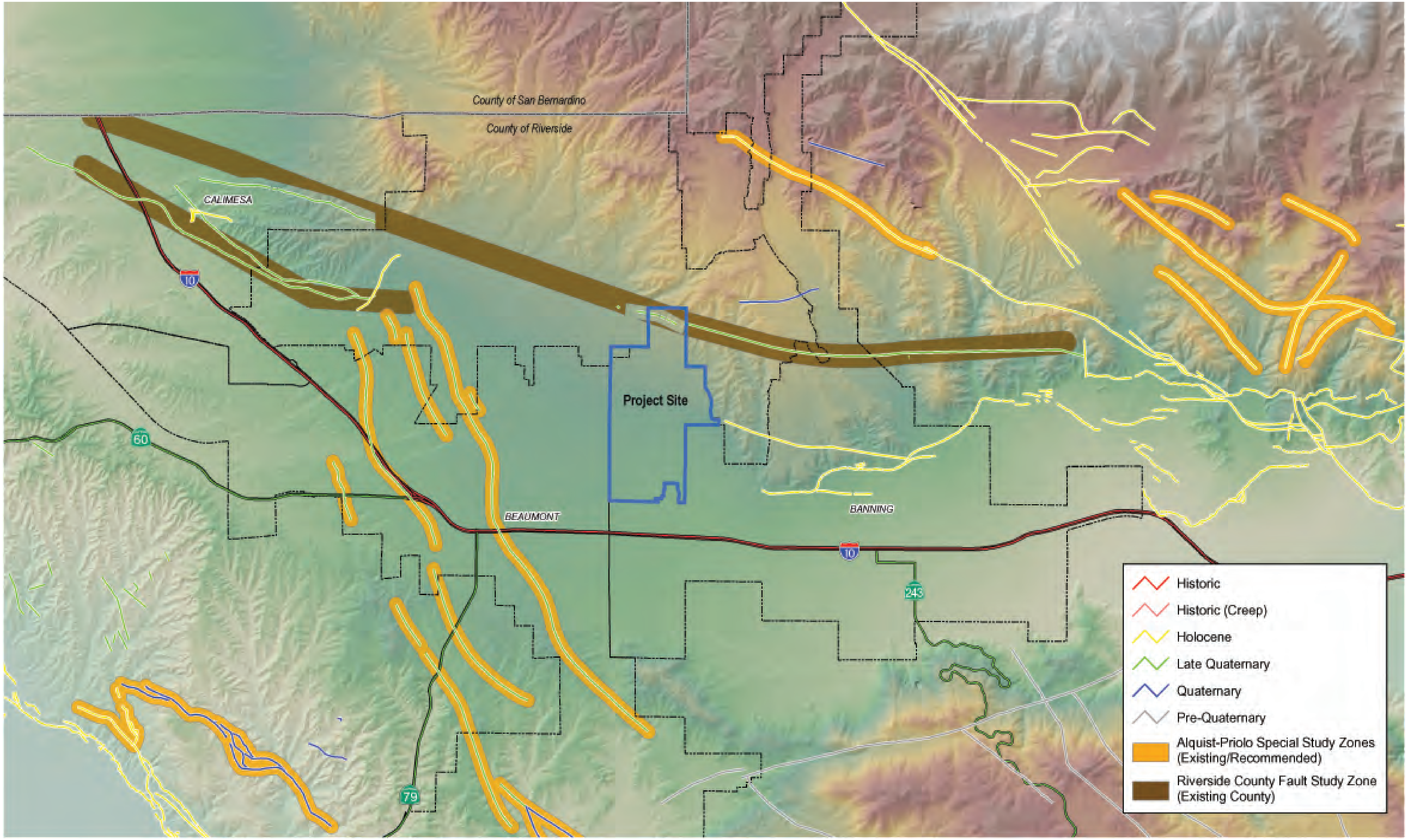
Determination: Less than Significant with Mitigation Incorporated.

The proposed Project is situated in a seismically active region. Implementation of the proposed Project would facilitate the continued urbanization of the region and could expose future residents and structures to geologic and seismic related hazards within the Project area. The General Plan EIR identified these potential hazards and provided mitigation measures which have since been incorporated into the City's Municipal Code, most notably in the newly adopted (2009) Title 18. The adoption and implementation of the provisions of Municipal Code Title 18 ensures that all development projects within the City will be designed and constructed in accordance with the policies, programs, and mitigation measures contained in the General Plan EIR and in conformance with the seismic requirements of the 2010 (or most current) California Residential Code and California Building Code, as well as in conformance with the findings and recommendations contained in the project-specific geotechnical reports (including fault hazard studies, slope analysis, and expansive soils testing) prepared for each individual project.

The General Plan EIR determined that, with the implementation of the above requirements, cumulative geotechnical and soils impacts of the General Plan build-out would be less-than-significant. Since the proposed Project is an amendment and restatement of a previously approved Specific Plan, its build out was considered as part of the General Plan EIR cumulative analysis. All of the requirements noted in the General Plan EIR and all of the requirements contained in Title 18 of the City's Municipal Code would be met by the proposed Project, in addition to Project-specific Mitigation Measures GEO-1 and GEO-3. Accordingly, the proposed Project would not contribute considerably to regional cumulative impacts related to geology and soils.

4.7.6 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Potentially significant impacts would be mitigated to a level considered less than significant with implementation of Mitigation Measures GEO-1 and GEO-3, and adherence to existing federal, State, and local codes, permits, regulations and ordinances.



SOURCE: Riverside County GIS Data

RBF CONSULTING

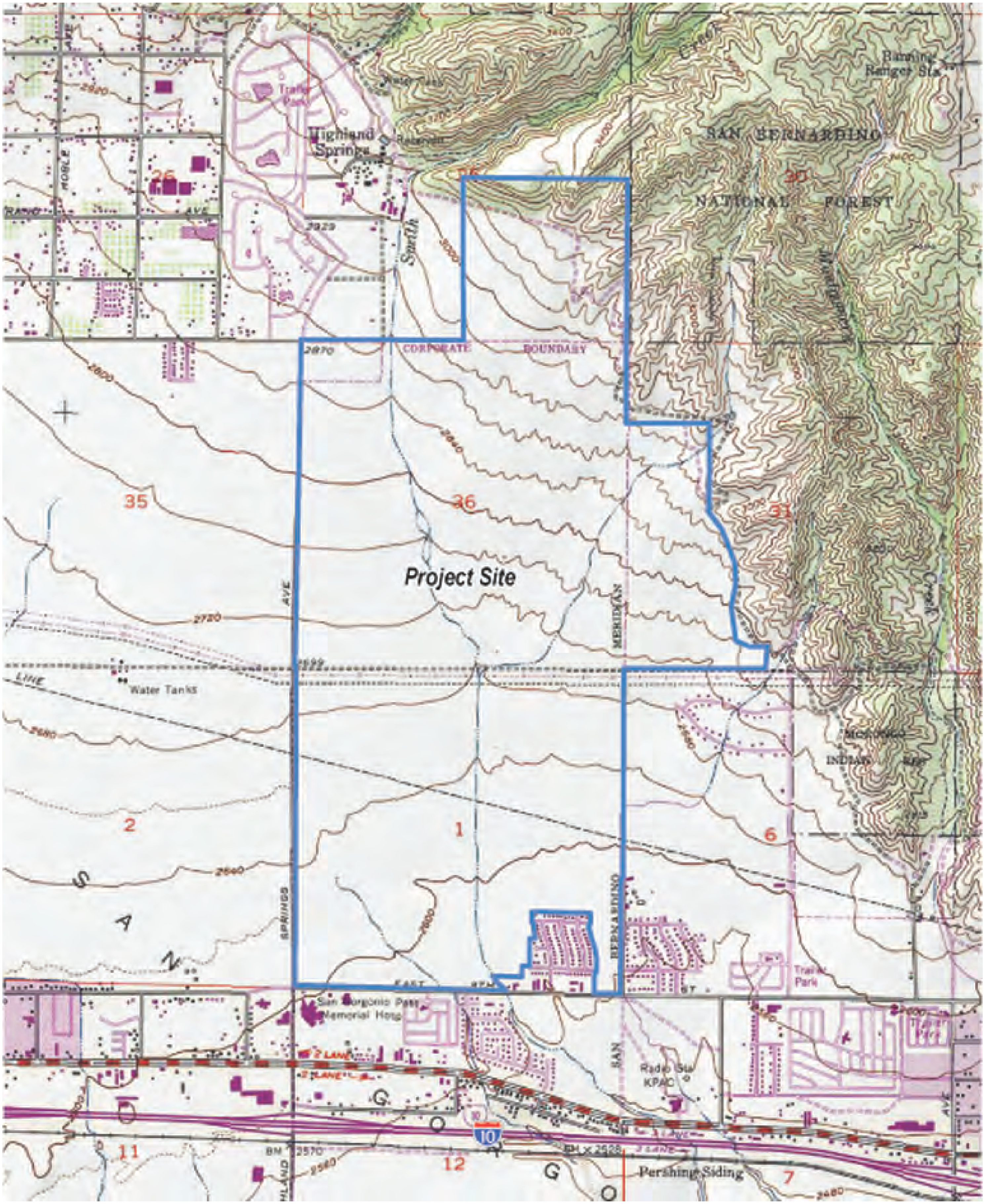
NOT TO SCALE

5/27/11 JN: 65-100290

PARDEE HOMES • BUTTERFIELD SPECIFIC PLAN EIR

Regional Fault Zones

EXHIBIT 4.7-1



SOURCE: RBF Consulting, Butterfield Specific Plan, May 25, 2011 (Exhibit 2.4)

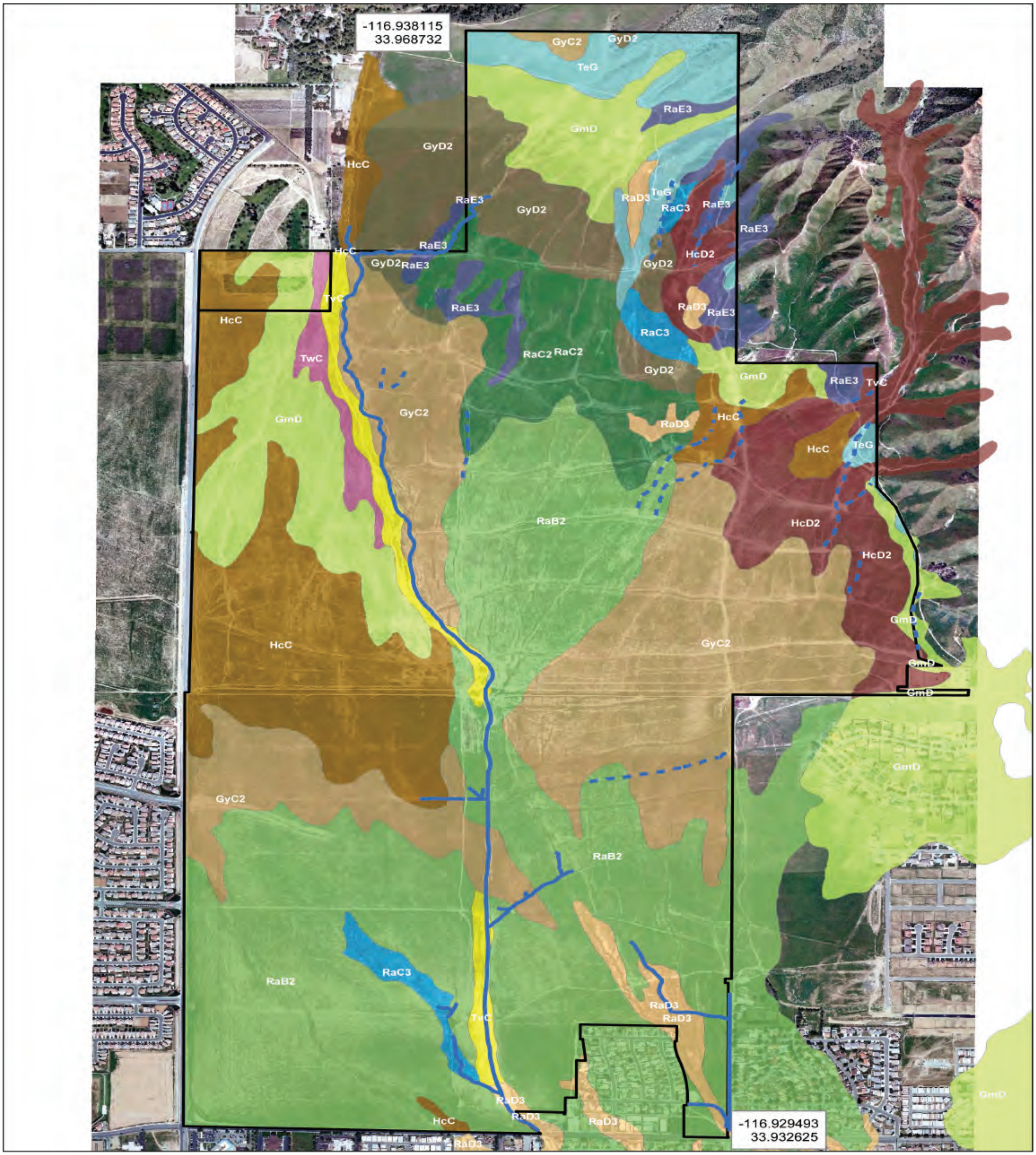
NOT TO SCALE

5/27/11 JN: 65-100290

PARDEE HOMES • BUTTERFIELD SPECIFIC PLAN EIR

Topographic Map

EXHIBIT 4.7-2



Legend

- Project Boundary
- GmD - Gorgonio gravelly loamy fine sand, 2 to 15 percent slopes
- GyC2 - Greenfield sandy loam, 2 to 8 percent slopes, eroded
- GyD2 - Greenfield sandy loam, 8 to 15 percent slopes, eroded
- HcC - Hanford coarse sandy loam, 2 to 8 percent slopes
- HcD2 - Hanford coarse sandy loam, 8 to 15 percent slopes, eroded
- RaB2 - Ramona sandy loam, 2 to 5 percent slopes, eroded
- RaC2 - Ramona sandy loam, 5 to 8 percent slopes, eroded
- RaC3 - Ramona sandy loam, 5 to 8 percent slopes, severely eroded
- RaD3 - Ramona sandy loam, 8 to 15 percent slopes, severely eroded
- RaE3 - Ramona sandy loam, 15 to 25 percent slopes, severely eroded
- TeG - Terrace escarpments
- TvC - Tujunga loamy sand, channeled, 0 to 8 percent slopes
- TwC - Tujunga gravelly loamy sand, 0 to 8 percent slopes

SOURCE: Glenn Lukos Associates, Jurisdictional Delineation August 31, 2010
(refer to Appendix C-2, Exhibit 5)

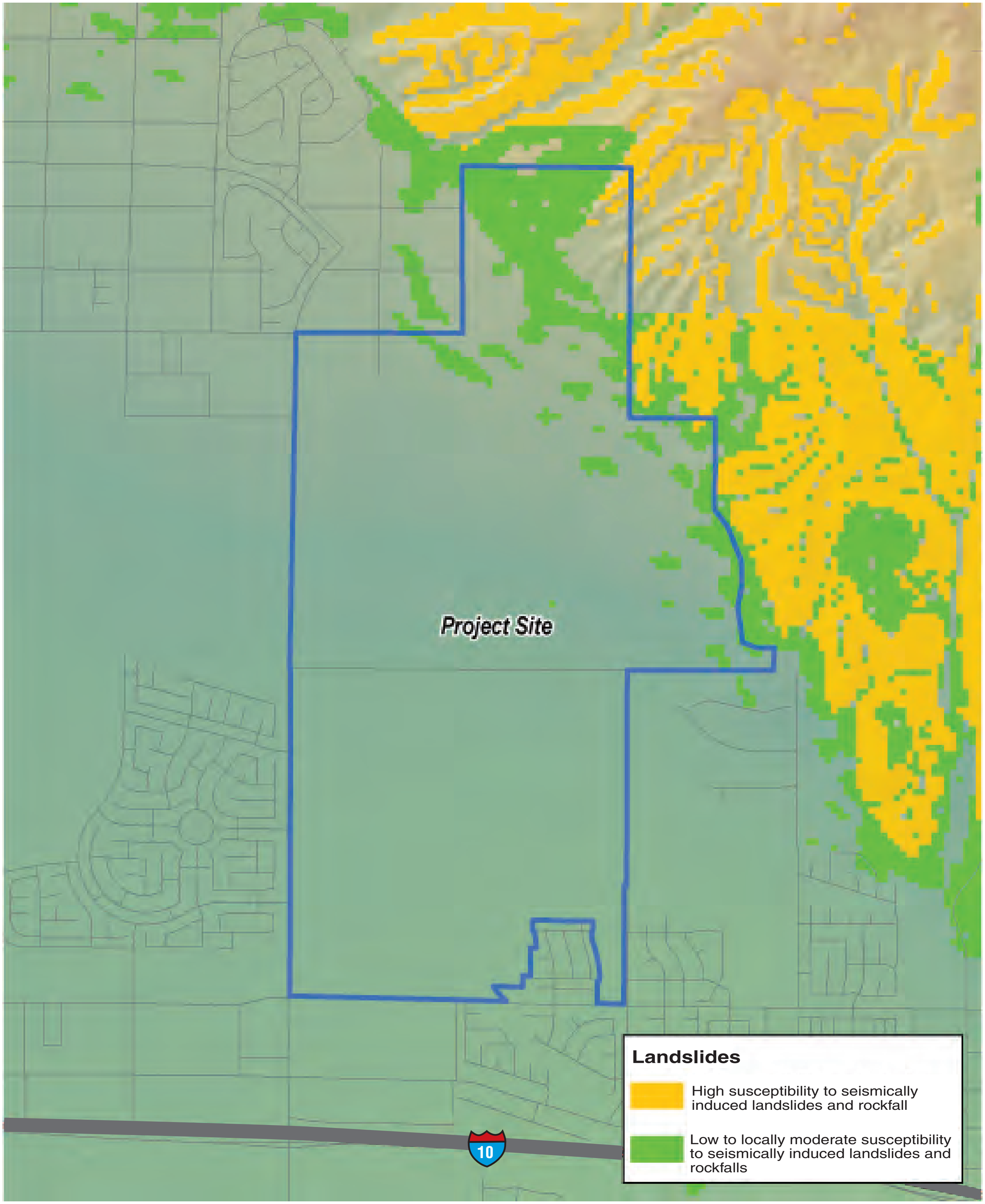
NOT TO SCALE

PARDEE HOMES • BUTTERFIELD SPECIFIC PLAN EIR

Soils Map

RBF CONSULTING 5/27/11 JN: 65-100290

EXHIBIT 4.7-3



SOURCE: Riverside County GIS Data

PARDEE HOMES • BUTTERFIELD SPECIFIC PLAN EIR

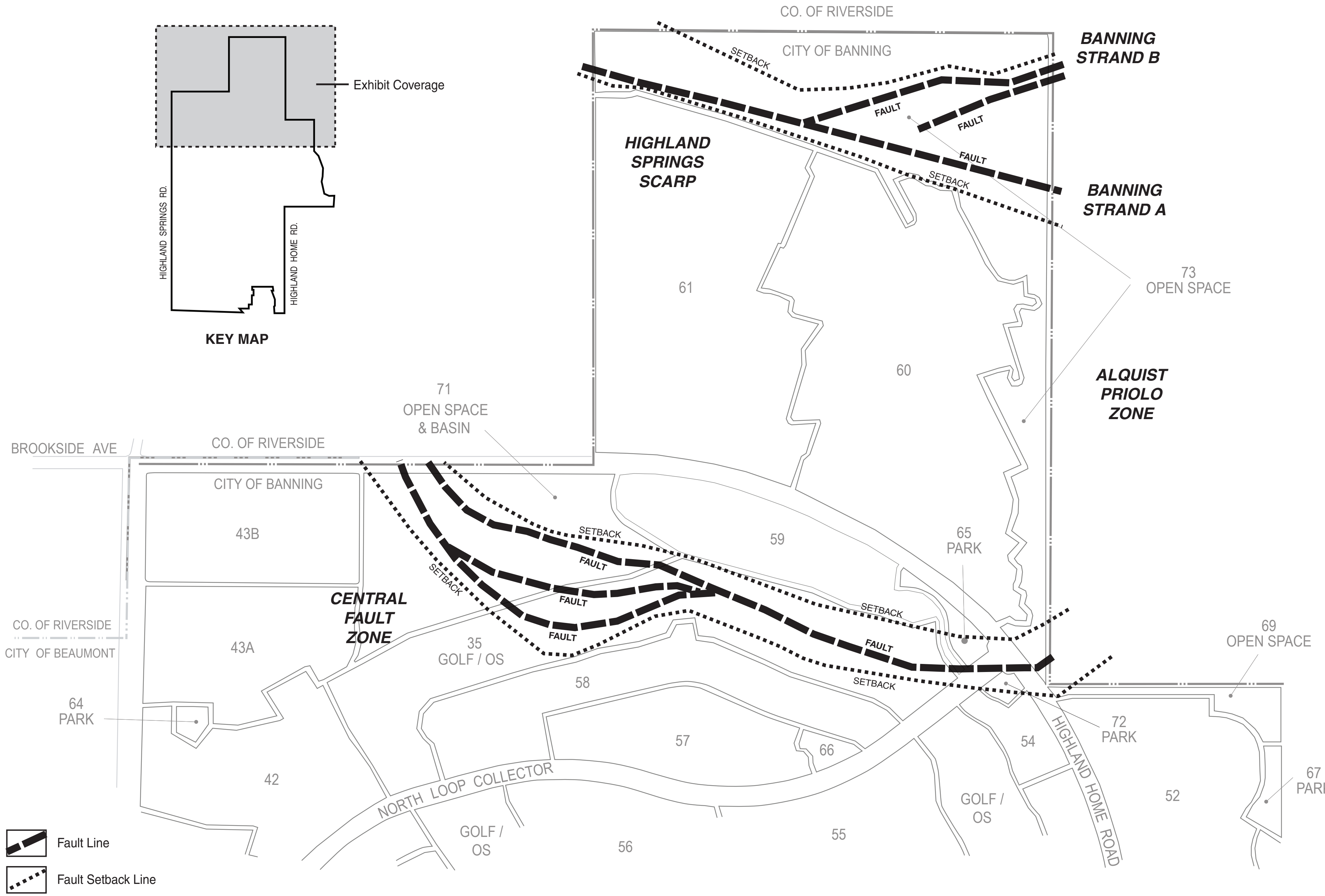
Slope Stability Map

RBF CONSULTING

NOT TO SCALE

5/27/11 JN: 65-100290

EXHIBIT 4.7-4



SOURCE: Douglas Bender and Associates,
Draft TTM No. 35947, Draft TTM No. 35944, 5/19/08

RBF CONSULTING

NOT TO SCALE

5/27/11 JN: 65-100290

PARDEE HOMES • BUTTERFIELD SPECIFIC PLAN EIR

Fault Setback Zones

EXHIBIT 4.7-5