5.5 Geology and Soils

This section analyzes the geology, soils, and seismicity of the Project Site, identifies the on-site soil conditions that have the potential to impact the Proposed Project and recommends mitigation measures to reduce the significance of such impacts to an acceptable level. This section summarizes the findings of the "Geotechnical Review of Conceptual Design Plans"(Geotechnical Review) prepared by American Geotechnical, Inc. dated August 2013 (Appendix G) and on the "Fault Hazard Assessment Report" (Fault Hazard Report) prepared by American Geotechnical, Inc. dated November 2012 (Appendix G) and approved by the County of Orange in March 2013, and the "Phase I Environmental Site Assessment Report" (Phase I ESA) prepared by American Geotechnical dated July 2012 (Appendix I).

The purpose of the geotechnical investigation was to determine the geologic setting of the site and the presence of any geologic hazards for analysis in the DEIR and to determine the geologic conditions in order to provide data for design of foundations, walls, slabs on grade, paving, and grading. The geotechnical investigation includes several recommendations that have been included herein as mitigation measures.

5.5.1 Existing Conditions

The Project Site is located in the unincorporated portion of Orange County in the Chino Hills and adjacent to the City of Yorba Linda (City). The site lies along the southeasterly flank of the Puente Hills at the northwesterly end of the Peninsular Ranges Geomorphic Province of California. The Puente Hills consist of complex, uplifted, and faulted anticlinal structures, with the south-dipping Chino Fault Zone on the northeast and the north-dipping Whittier Fault Zone on the southwest. These two fault zones merge with the northwest-trending Elsinore Fault Zone at the east end of the Puente uplift, in Santa Ana Canyon.

1. Geology

The Project Site is underlain by a series of thinly bedded marine sedimentary bedrock units assigned to the Soquel and Yorba members of the late Miocene age Puente Formation. Quaternary to recent age geologic units occur at the surface of the property, including deposits of alluvium, colluvium, older elevated stream terraces, and landslide debris. Bedrock units underlying the property are assigned to a series of deep-water marine sedimentary rocks of the Puente Formation. This upper Miocene age formation is

Acronyms used in this section:

AMSL	above mean sea level
AP Act	Alquist-Priolo Earthquake Fault Zoning Act
AP Zone	Alquist-Priolo Zone
CEQA	California Environmental Quality Act
DEIR	Draft Environmental Impact Report
EFZ	earthquake fault zone
SCE	Southern California Edison
SCG	Southern California Gas Co.

further divided into Soquel, Yorba, and Sycamore Canyon members that outcrop across the property from north to south.

The geologic structure underlying the site can be defined as a generally consistent pattern of alternating anticlinal (occurring at right angles to the surface) and synclinal (inclined down from opposite directions) folds with local areas of tight folding and high angle to overturned bedding. The structure tends to be closely related to the orientation, form and structure of major canyons and ridges. With increasing proximity to the Whittier Fault Zone, many axial folds are bent into a more northwesterly strike. Cross sections A-A and B-B depicting certain existing structural conditions are included herein as Exhibit 5-42 – Cross Sections A-A and B-B.

2. Topography

Site topography consists of a series of ridges and intervening canyons (or drainage areas). Elevations range from approximately 600 feet above mean sea level (AMSL) in Blue Mud Canyon near the southern margin of the property to approximately 1,540 feet at the northern perimeter of the northeastern-most area. Drainage flows within the canyons are generally from east to west. For purposes of this analysis, the canyons are referred to as Canyon A on the north, Canyon B, which crosses the western portion of the site, and Blue Mud Canyon, which lies along the southern boundary of the site. The topography is generally steep and the canyons are narrow, resulting in a moderate to significant landslide potential.

3. Regional Faulting and Seismicity

The two principal seismically induced hazards to property in the southern California region are damage to structures and foundations due to strong ground shaking and surface rupture of earth materials along fault traces. An earthquake occurs when the elastic strain energy that has accumulated in the bedrock adjacent to a fault is suddenly released. The energy released propagates in the form of seismic waves that radiate great distances in all directions from the earthquake epicenter. The strong ground motion or shaking produced by these seismic waves is the primary cause of earthquake damage. The amount of shaking at a given location depends on the earthquake size (magnitude), distance from the earthquake source (epicenter) and the local geologic conditions, which can either amplify or attenuate the earthquake waves.

The Project Site is located in a seismically active region of southern California dominated by the intersection of the northwest-trending San Andreas Fault system and the east-west trending Transverse Ranges Fault system. These fault systems accommodate the majority of the geological strain produced by the gradual, yet powerful, movement between the Pacific and the North American tectonic plates. As a result, numerous faults that have been mapped in the southern California region could produce significant ground shaking at the site.

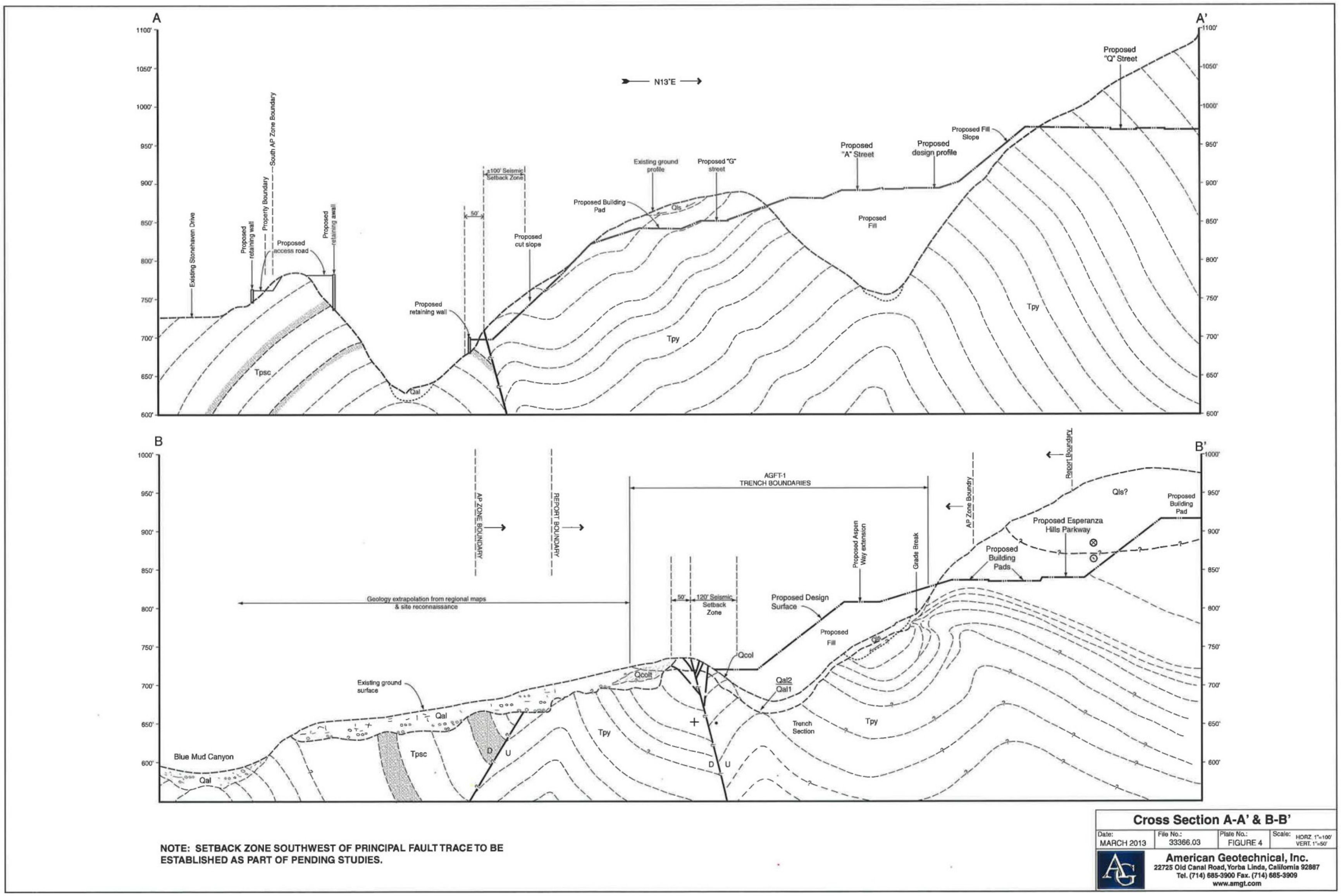


Exhibit 5-42 – Cross Sections A-A and B-B

The Chino Hills continue to be uplifted along active translational faults capable of generating moderate and larger earthquakes. The southwesterly margin of the hills is bounded by the Whittier Fault Zone. This fault zone is designated as an Alquist-Priolo Earthquake Fault Zone (A-P Zone) by the State of California. It is possible that active secondary faults, or splay faults, exist within the parcel area near the A-P Zone. Tectonic uplift, folding, jointing, and fracturing of the bedrock units has yielded structurally complex and weakened bedrock conditions.

The active Whittier Fault Zone transects directly through the southernmost area of the site along a well-defined and continuous west-northwesterly trend. This fault zone represents the northern 36 to 40 kilometers of the more regionally well-known Whittier-Elsinore Fault Zone that stretches from the Mexican border on the southeast to Whittier Narrows northwest of the Proposed Project. In addition to severe ground shaking, up to approximately four to seven feet of lateral (horizontal) surface rupture displacement is estimated in the event of a large earthquake along the Whittier Fault in this region. The Whittier Fault poses the most significant seismic threat to the Proposed Project. Active crude oil production and related facilities exist on the southerly portion of the site in close proximity to the Whittier Fault Zone.

The Fault Hazard Report provided an assessment for Option 1 and Option 2 of the Proposed Project regarding potential surface fault rupture and included findings and conclusions as well as recommendations pertaining to implementation of the conceptual design plan. The boundaries of the Fault Hazard Report are consistent with the southern margin of the Project Site and encompass the northern portion of the AP Zone. Fault trenching was conducted in the northern portion of the study site in areas generally coincident with proposed design grading improvements. Exhibit 5-43 – Hazard Assessment Boundaries, Option 1 and Exhibit 5-44 – Hazard Assessment Boundaries, Option depict the hazard assessment boundaries for Options 1 and 2. Detailed information related to the Fault Hazard Report is discussed below in Subsection 5.5.3,Project Impacts Prior to Mitigation below.

4. Ground Rupture

Primary ground rupture refers to fissuring and offset of the ground surface along a fault that breaks the ground during an earthquake. Primary ground rupture typically results in a relatively small percentage of the total damage in an earthquake, but being too close to a rupturing fault can cause severe damage to structures. Fault rupture is a significant potential impact on the Project Site due to the presence of the Whittier Fault trace along the southwest portion of the site.

In the Puente Hills, the Whittier Fault Zone comprises a series of short, discontinuous, northwest-trending, echelon faults, and a complex pattern of subordinate folds and faults. An active fault is defined as a fault that has had surface displacement within Holocene time (approximately the last 11,000 years). There is potential for primary fault rupture in the area where active strands of the Whittier Fault are present. Surface rupture due to a nearby earthquake on the Whittier Fault could potentially damage structures or facilities.

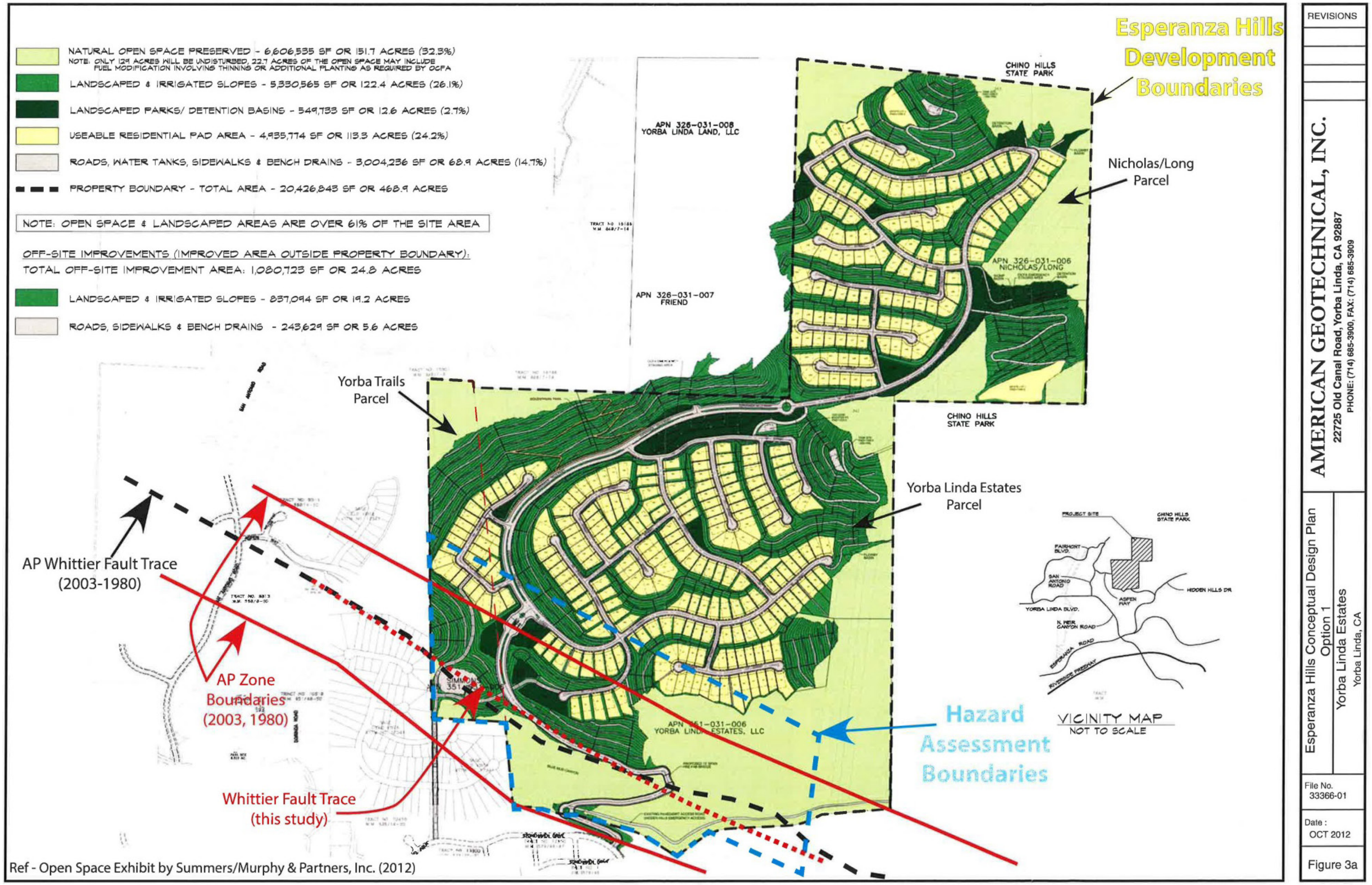


Exhibit 5-43 – Hazard Assessment Boundaries, Option 1

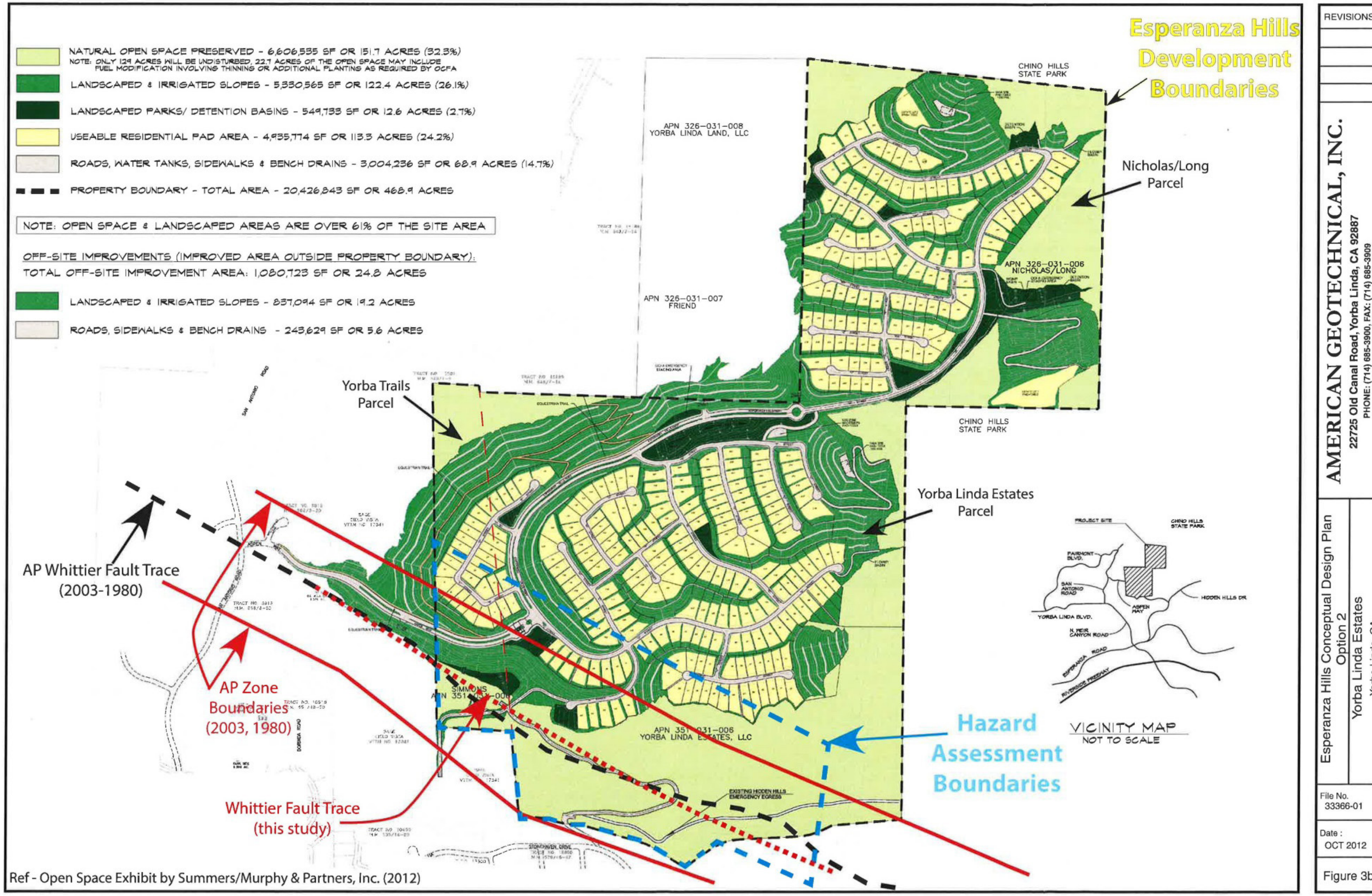


Exhibit 5-44 – Hazard Assessment Boundaries, Option 2

5. Geologic Setting

The geomorphic (surface configuration) character of the Puente/Chino hills and southeast Los Angeles basin in general is depicted on Exhibit 5-45 – Regional Geomorphology Map and Exhibit 5-46 – Regional Shaded Relief Map, respectively. Evidence exists suggesting that uplift of the Puente-Chino Hills block occurs along the relatively deep and gently northeasterly dipping Puente Hills Blind Thrust fault buried beneath approximately 3 km of alluvial sediments to the west. The uplift rate is approximately ±0.06 mm per year based on the age of drainage within the hills. Provided the Blind Thrust fault configuration is accurate, the Whittier Fault exists as an independent steeply northward-dipping fault within the hanging wall block of the thrust plate.

Emergence of the hills is thought to have begun approximately 600 to 700 thousand years ago. Over time, motion along the fault has been transformed from mostly vertical reverse motion into what is currently almost purely dextral right-lateral strike-slip motion. The waning of vertical uplift has apparently allowed rates of erosion to outpace uplift, a condition interpreted from the nature pattern of surface erosion in the hills. Surface erosion is even more advanced southwest of the Whittier Fault where the juxtaposition of more youthful and erodible bedrock units exists.

6. Landslides

Bedrock landslides, as well as surficial soil slumps (coherent mass of loosely consolidated materials that has moved a short distance down a slope), slides, debris flows and soil creep, are relatively common occurrences in the Puente Hills. Natural slope stability is dependent on numerous factors, including soil and bedrock composition, slope steepness, slope height, seismic activity, human activities, groundwater, and structural features (e.g., faults, folds, and joints).

Thinly bedded silt and clay shales comprising the Yorba Member can be the source of moderate to large translational (a mass that slides downward and outward on top of an inclined planar surface) and rotational (downward and outward movement of a mass on top of a concave upward failure surface) landslides where bedding within hillside terrain is oriented adversely. Existing geologic maps indicate areas of the property may be underlain by larger landslides, mostly within areas of steeply sloping canyon walls. A stereoscopic review of historical air photo pairs, LIDAR imagery, fault trench exposures, geologic mapping, field reconnaissance, and subsurface exploration suggest that if many of the larger landslides exist, they have a significant degree of surface erosion and masking of morphologic landslide characteristics.

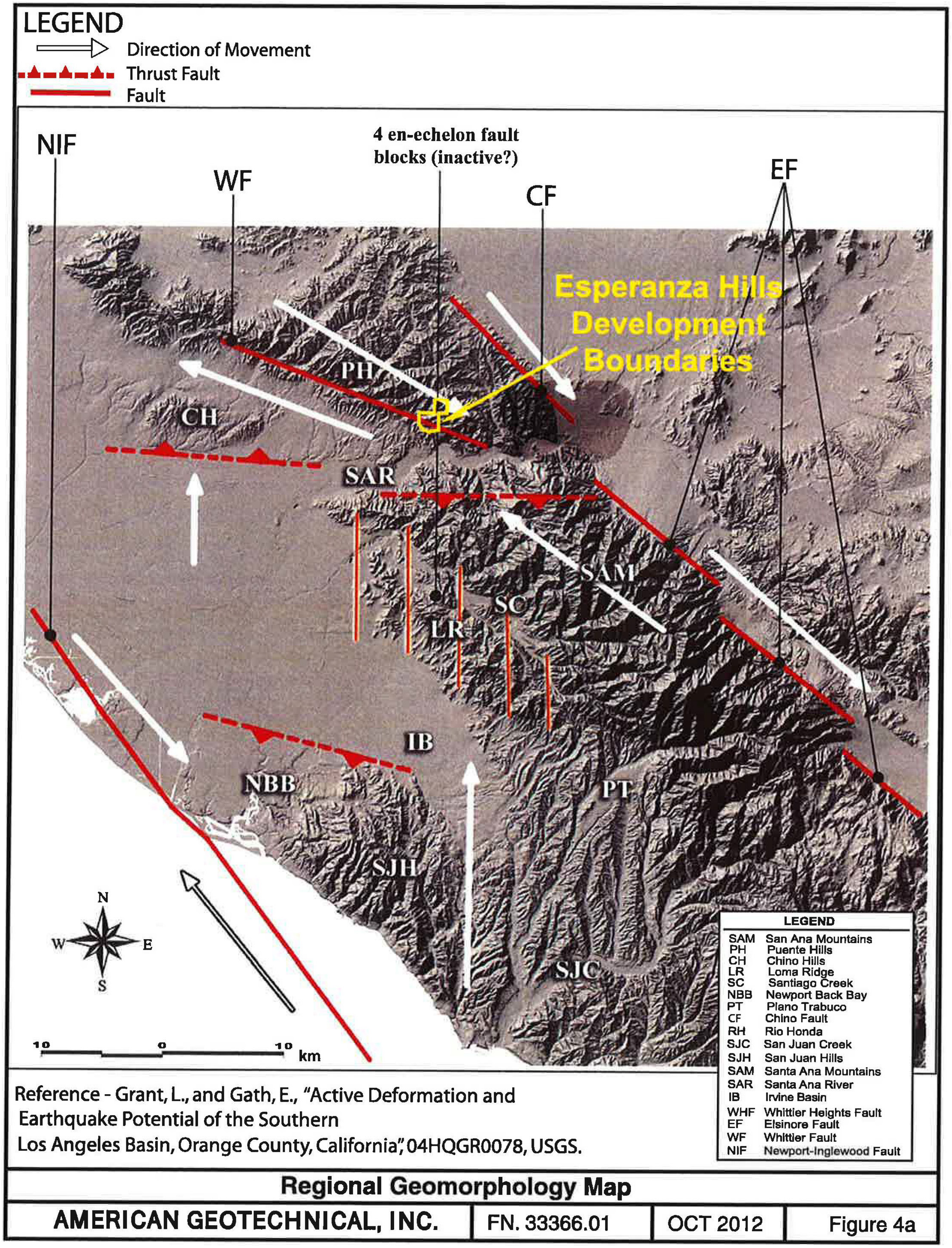
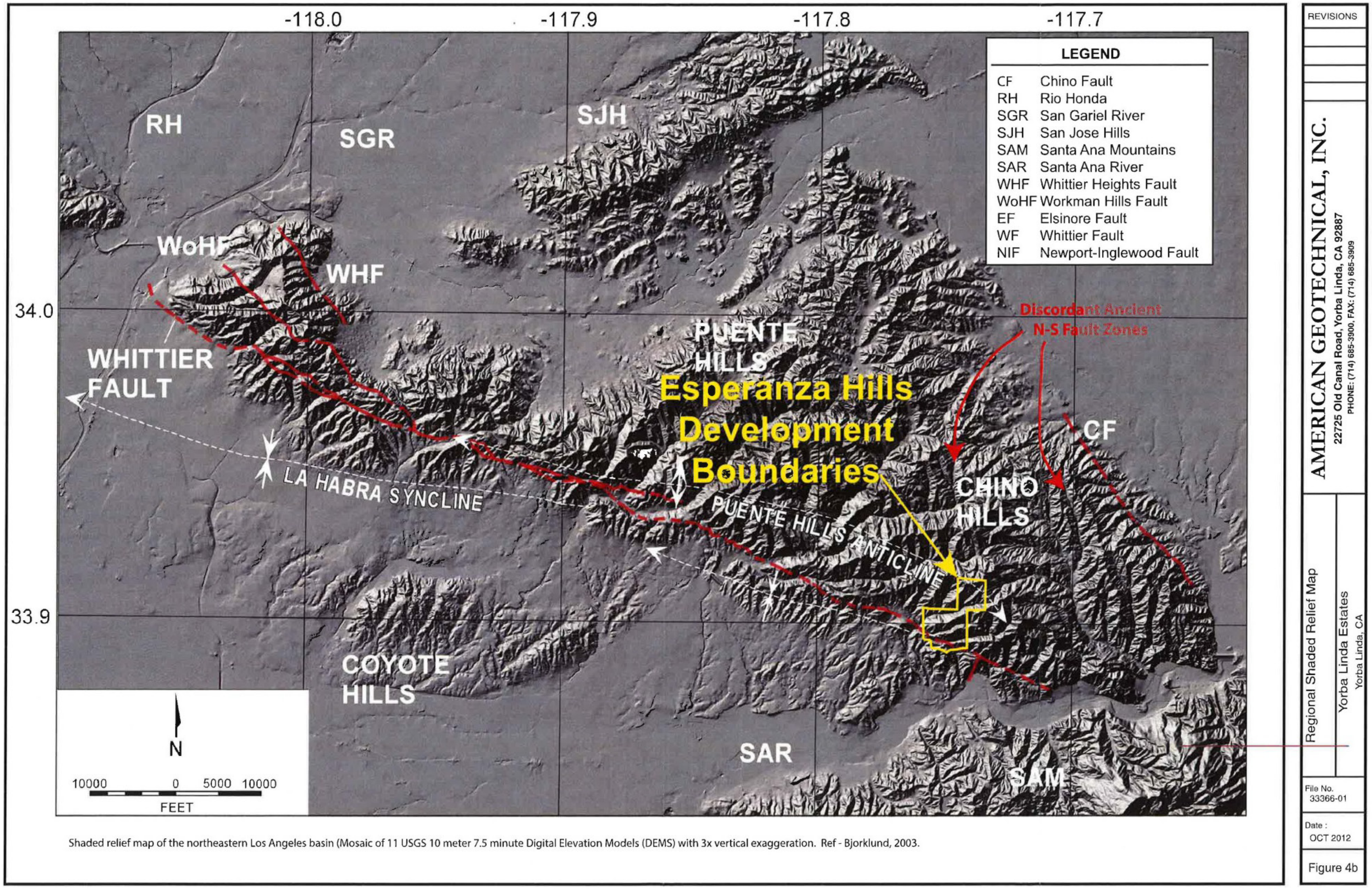


Exhibit 5-45 – Regional Geomorphology Map



Shaded relief map of the northeastern Los Angeles basin (Mosaic of 11 USGS 10 meter 7.5 minute Digital Elevation Models (DEMS) with 3x vertical exaggeration. Ref - Bjorklund, 2003.

Exhibit 5-46 – Regional Shaded Relief Map

7. Whittier-Elsinore Fault Zone

The Whittier-Elsinore Fault Zone is a major north-northwest trending structure that closely parallels the San Andreas Fault. The Whittier Fault represents the northernmost 36 to 40 kilometers of the greater Whittier-Elsinore Fault Zone. Based on its overall length, proximity to Orange and Los Angeles counties and recognition that earthquakes transfer seismic strain directly toward nearby metropolitan areas, the Whittier Fault Zone represents one of the most prominent actively seismic hazards within southern California. Its structural companion, the Chino fault, forms the northeasterly boundary of the Puente/Chino Hills. The Whittier and Chino faults extend northward from the Elsinore Fault in a horsetail-shaped array. The Whittier Fault is recognized as being the most active branch accommodating a majority of strain from the Elsinore fault.

The active Whittier Fault, which crosses the southerly portion of the Project Site, could subject the site to severe ground shaking resulting from a major earthquake along this segment of the fault. Peak ground accelerations could exceed 1.8 g., causing well-built structures to be destroyed, to collapse, or to be moderately to severely damaged or shifted off their foundations. Such shaking could also cause localized slope deformation and/or trigger slope failures in graded and natural slope areas, potentially leading to structural damage. Uplift of the ground surface and/or the continued propagation of existing folds could occur on a more regional scale, which could damage or alter the flow of buried utilities. The integrity of side-hill fills and retaining walls could also be impacted in the event of any related slope deformation. Impacts due to strong ground shaking could be significant.

8. Historical Seismicity and Earthquake History

The Fault Hazard Report included an evaluation of earthquake history within the southern California region. Significant and damaging earthquakes have been a common occurrence throughout the modern and geologic history of southern California. Exhibit 5-47 – Earthquake and Fault Plan depicts epicenters of regional quakes with magnitudes above 6.0 and traces of major fault lines which were obtained from the United States Geological Survey. Exhibit 5-48 – Site Earthquake and Fault Plan depicts a more local series of earthquakes exceeding magnitude 3.5 and were selected based on their proximity to the proposed Project. As shown, Exhibit 5-47 suggests that no earthquakes greater than 6.0 have occurred within the adjacent vicinity of the Project Site over the past 120 years. As shown on Exhibit 5-48 several quakes of lesser magnitude occurred during preparation of the Fault Hazard Report (June 14, 2012, August 8, 2012, and August 29, 2012).

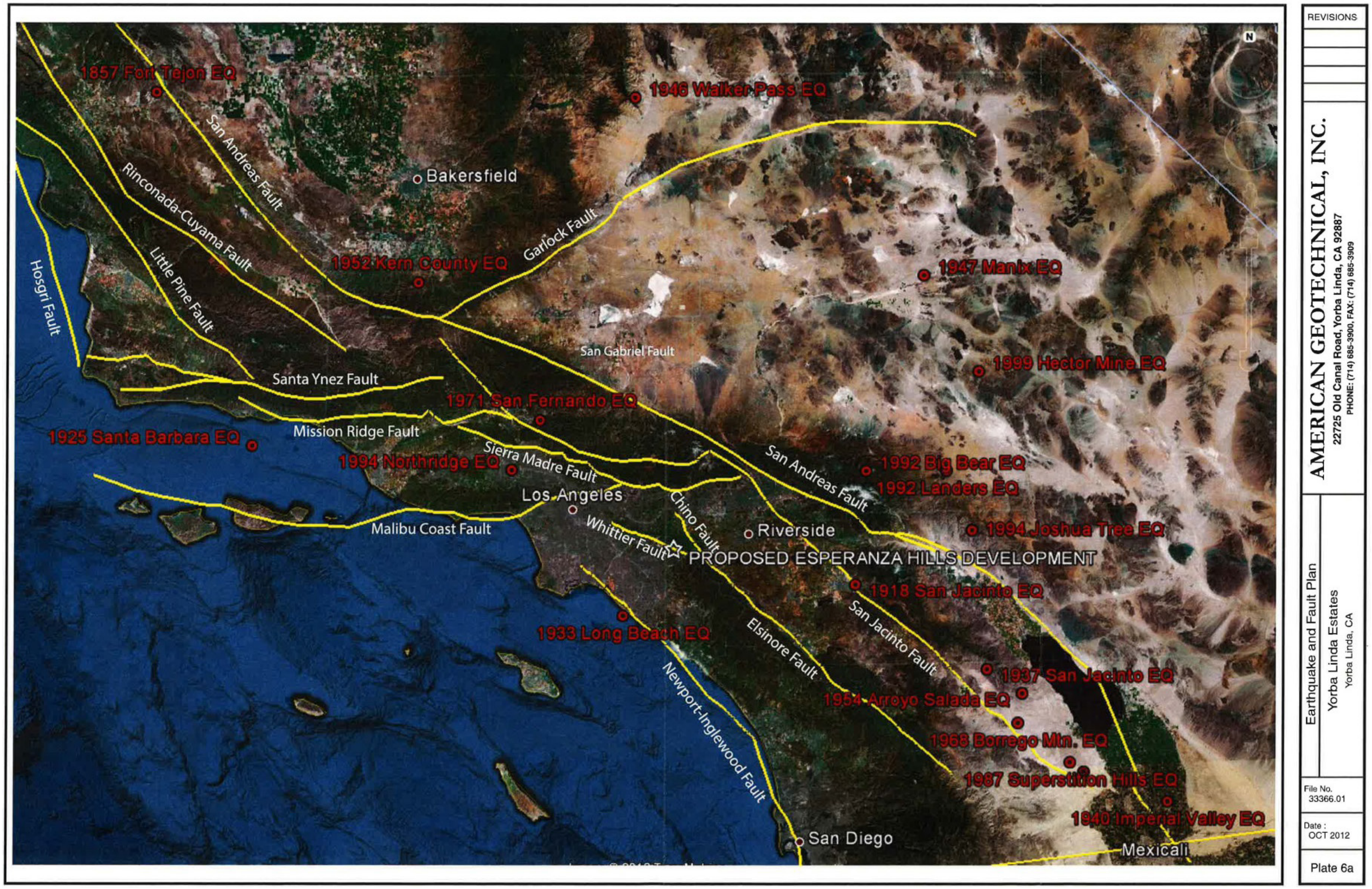


Exhibit 5-47 – Earthquake and Fault Plan

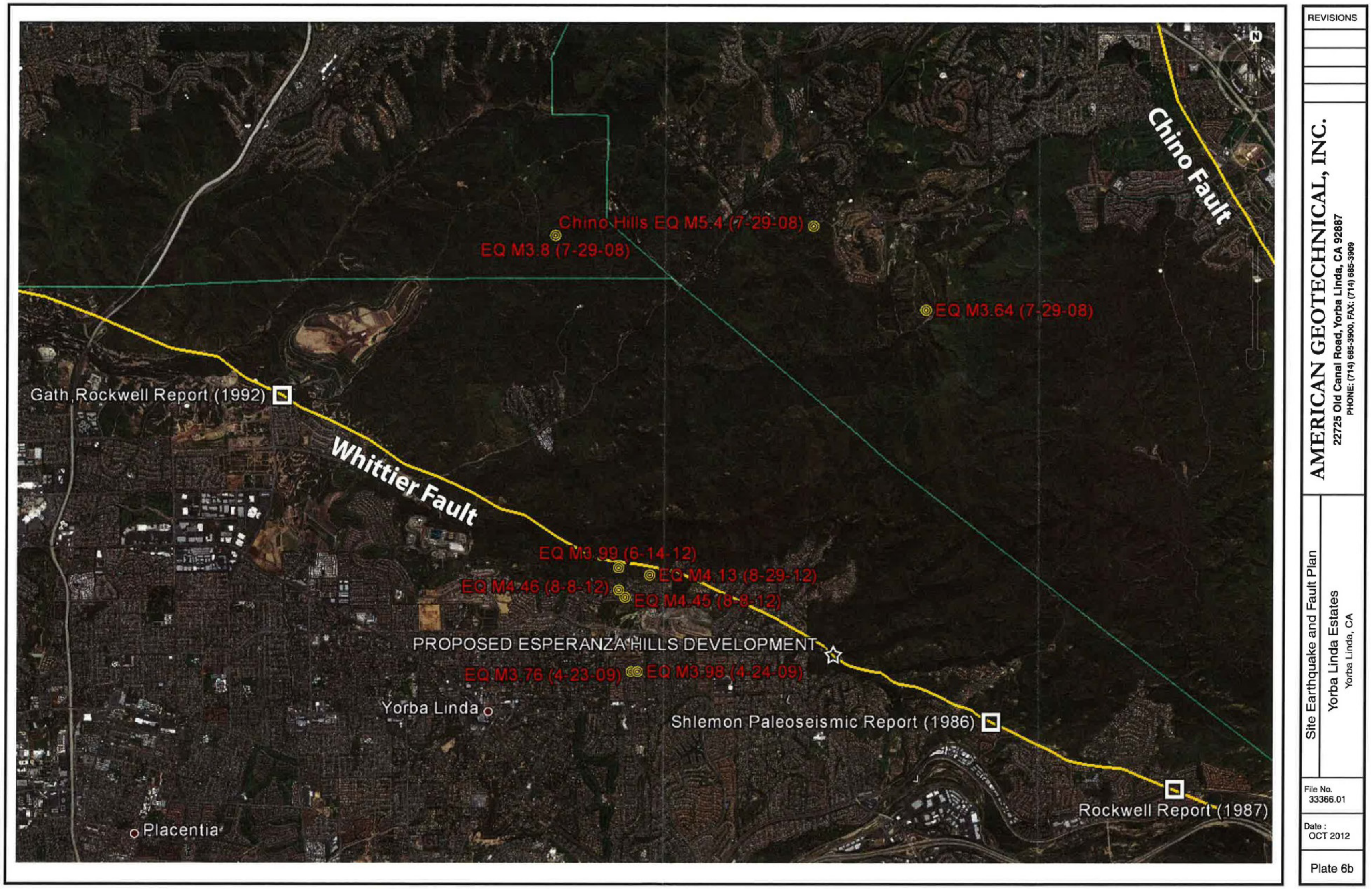


Exhibit 5-48 – Site Earthquake and Fault Plan

Results of the study conducted by Rockwell (1993) concluded the timing of the last large (resulting in surface rupture) earthquake along the Whittier Fault zone occurred between 1,400 and 2,200 years ago, with a minimum 1.9 meters of offset. The study also noted the minimum recurrence interval for probabilistic seismic hazard assessment was 760 years (±640) but that much longer recurrence intervals are suggested by the geologic data.

A historical list of earthquakes in the area is presented below:

Table 5-5-1 Historical Area Earthquakes

Magnitude	Earthquake Distance from Development	Latitude	Longitude	Depth (km)	Date (UTC) Time
5.39	6.27 km M	33.953	-117.761	14.7	07/29/08 18:42
3.8	7.46 km NW	33.952	-117.802	16.2	07/29/08 18:51
3.64	5.27 km NNE	33.942	-117.743	15.3	07/29/08 20:40
3.76	3.0 km W	33.894	-117.790	4.7	04/23/09 23:56
3.98	2.96 km W	33.894	-117.789	4.2	04/24/09 03:27
3.99	3.45 km WNW	33.908	-117.792	9.8	06/14/12 03:17
4.46	3.33 km WNW	33.905	-117.792	10.1	08/08/12 06:23
4.45	3.23 km WNW	33.904	-117.791	10.4	08/08/12 16:33
4.13	2.94 km WNW	33.907	-117.787	9.1	08/29/12 20:31

Current earthquake magnitude estimates are such that 6.7 quakes will occur every 700 years and 7.2 quakes every 1,000 to 1,500 years. Paleo-seismic studies in the area indicate that the last large earthquake had an offset of four to seven feet right-laterally and reportedly occurred more than 1,600 years ago.

9. Landslide Deposits/Debris Flows

Recent debris flow deposits mainly exist at the surface, are approximately three feet thick and overlie deposits of artificial fill, topsoil or bedrock. They are the result of downslope failure of moisture-laden surficial materials as an earthflow, mobilized in response to wetting and gravity during periods of heavy precipitation. Older slides are similar in nature but have a less significant weathering profile and more pronounced/ recognizable geomorphic surface expression.

Older debris flow deposits tend to underlie transition areas between canyon walls and main channel axes. Older and recent debris flows are similar in lithology and depositional environment but differ in age, thickness, stratigraphic location, and lithology depending on source area. Individual flow events are commonly a few feet thick, with local stacked flows representing multiple events. Of particular interest are local flows interpreted to be associated with ancient wildfires, represented by accumulations of deep reddish brown "baked" earth. The wildfire deposits exhibit a more welded texture, possibly due to the presence of oils, resins, and other byproducts of the fires.

Older Quaternary landslide deposits are generally similar in character to those of recent age but exhibit a more significant degree of weathering and less recognizable geomorphic expression or no expression at all. Slide material is derived from thinly bedded clayey to silty shale bedrock.

10. Compressible Soils

Compressible soils are deposits of recent alluvium within the boundaries of modern stream channels and accumulations of slope wash or colluvium near the base of natural slopes or within side-hill swales. Surficial soils are also categorized within this group but they are commonly thin on steeper natural slopes and would be removed during conventional grading operations. Impacts associated with compressible soils typically occur as a result of settlement and a loss of support in areas where structural fill has been placed against or above such deposits. Compressible soils will likely pose the most significant impact in development boundary areas where their removal will be necessary in order to achieve lateral support for proposed fill slopes or daylight cut lots.

11. Corrosive Soils

Corrosive soil types are categorized as being corrosive to metal, mainly steel and concrete elements. Where the chemistry of certain soils is corrosive to a degree that concrete and steel are weakened, the strength and integrity of foundations can be jeopardized.

12. Expansive Soils/Bedrock Heave

Expansive soil materials typically occur as part of engineered fill mixture derived from areas of bedrock cut. Impacts associated with expansive clay soil and heaving bedrock related to the adverse effects these materials can have on the structural integrity of foundations and other improvements.

13. Surficial Slope Stability

Surficial slope failures have occurred and may occur on natural slopes across the property in the future. Earth materials involved in these failures typically include loose accumulations of soil, vegetation and other debris mantling the slope surface or shallow fractured bedrock that is weakened by weathering.

Related impacts are more commonly associated with natural slopes but may also occur within engineered fill slopes that are buttressed or stabilized as part of a finished development. Of particular concern are areas where natural drainage swales exist above or below the development. Other impacts can include accumulations of mud and debris along the base of a slope or the destabilization of adjacent upslope areas where the scar of these failures encroach into existing building lots. Impacts from surficial slope failures are considered to be potentially significant.

14. Liquefaction

Liquefaction is defined as a failure of structure in loose, medium-grained soils in the presence of high groundwater due to an increase in pore pressure and resulting loss of shear strength induced by strong ground motion, typically resulting from a large earthquake. When liquefaction occurs, the sediments involved behave like a liquid or semi-viscous substance. Liquefaction can cause structural distress or failure due to ground settlement, a loss of bearing capacity in the foundation soils and the buoyant rise of buried structures.

15. Ground Water

The Geotechnical Review states that groundwater on the site is currently confined to permeable deposits of alluvium within the lower reaches of drainage canyons, tending to perch above bedrock in these areas. The height of the water table tends to fluctuate in response to seasonal rainfall.

16. Existing Infrastructure

Structures that currently exist within the influence of the conceptual design plans and may be adversely impacted by proposed grading and/or construction activities are considered problematic infrastructure. There are two existing large-diameter natural gas pipelines buried within a Southern California Gas (SCE) easement that extend along the western boundary of the adjacent proposed Cielo Vista project.

The second problematic infrastructure element is the regional SCE electrical transmission line system crossing the eastern boundaries of the Project Site.

17. Existing/Abandoned Oil Wells

The Fault Hazard Report identified a total of three active and four inactive (or previously abandoned) oil wells within the boundaries of the Project Site. The above-ground storage tanks and associated pipelines were also identified.

18. Previous Site Studies

Geologic studies associated with exploration for petroleum resources within the Puente Hills were conducted prior to 1998. Various generations of large scale regional geologic maps were published compassing the Project Site. The Esperanza Oil Field nearby provided a source of deep well log information. A 200-scale geotechnical constraints map was included in a 1998 report prepared by Earth Consultants International that related directly to potential residential development of the Proposed Project. The map outlined locations of possible landslides and faults on the property as well as estimated thicknesses of alluvium in canyon areas. A later site-specific study was performed in 2002 to evaluate geologic conditions for another conceptual design plan including excavation of in excess of 30 shallow exploratory trenches across the southern parcels to assess conditions of geologic structure and resolve some of the major landslide conditions.

American Geotechnical conducted an active fault study in 2013 within the limits of the southern site boundaries. The study included excavation and detailed logging of approximately 2,500 linear feet of exploratory trenches, mainly confined to the boundaries of the Alquist-Priolo Earthquake Study Zone established by the state of California for the Whittier Fault. The Fault Hazard Report was approved by the County of Orange in March 2013. Exhibit 5-49 depicts the previous trench study locations performed by Seward and the recent American Geotechnical trenching locations.

American Geotechnical also completed a recent Phase I ESA for the Project Site, which was submitted to the County of Orange for review. An ESA identifies potential or existing contamination. According to the findings of this report, there are a total of three active and four abandoned oil wells present within the boundaries of the development. The Phase I ESA findings and recommendations are discussed in detail in Section 5.7, Hazards and Hazardous Materials (beginning on page 5-275 in this DEIR).

5.5.2 Thresholds of Significance

The state encourages local agencies to adopt their own thresholds, but it is not required. For purposes of this DEIR, the thresholds of significance for evaluating project impacts are based upon suggested criteria from the CEQA Environmental Checklist (Appendix G of the CEQA Guidelines). According to the CEQA Guidelines, the Proposed Project would have a potentially significant impact with respect to geology and soils 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 fault, 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. Refer to Division of Mines and Geology Special Publication 42.
   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 a result of the project, and potentially result in on-site 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
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water

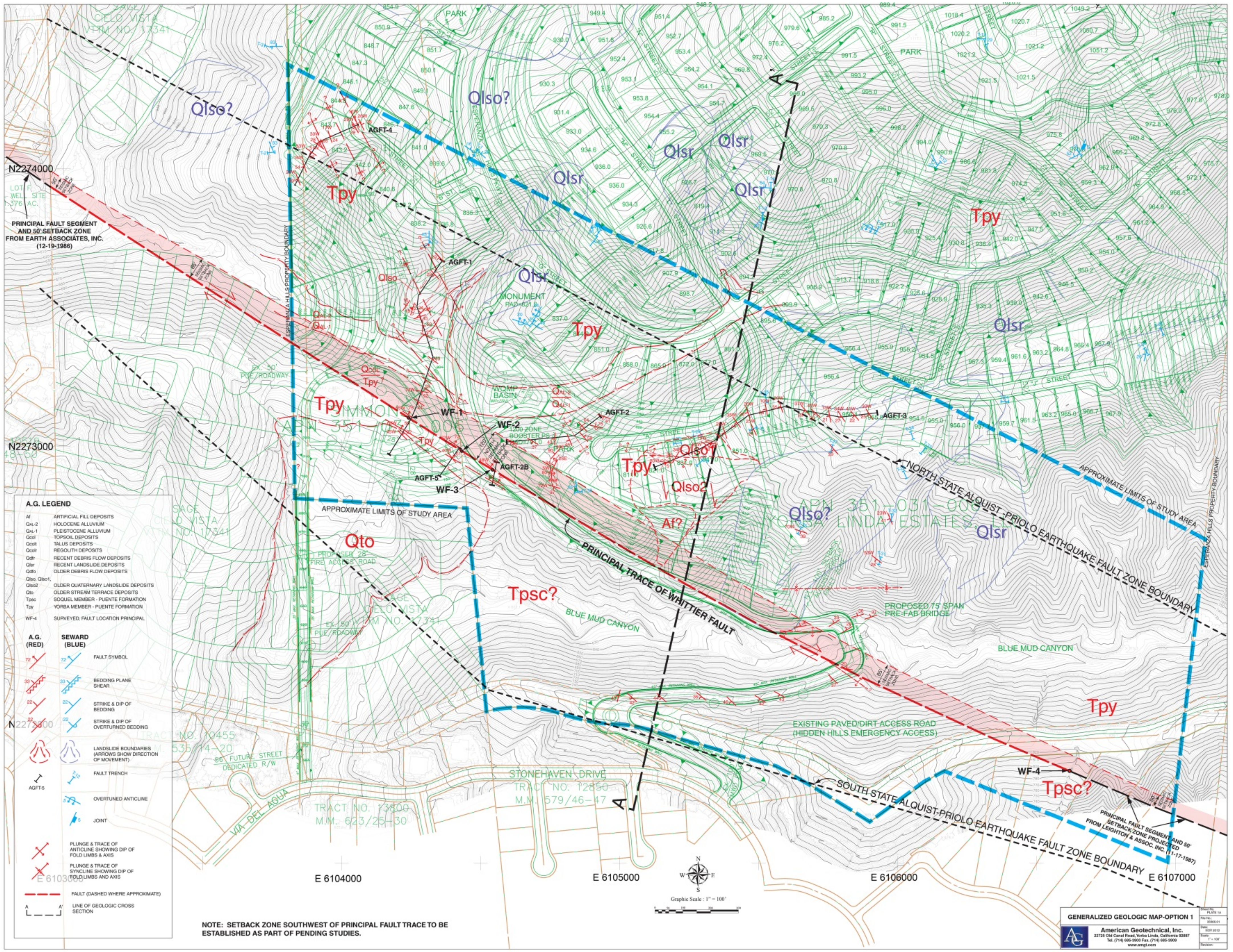


Exhibit 5-49 – Trench Study Locations

5.5.3 Project Impacts Prior to Mitigation

The Proposed Project includes conceptual design plans for access Options 1 and 2. Associated infrastructure will include internal roadways, parks, graded cut and fill slopes, bio-retention basins, underground water reservoirs, booster-pump pads, retaining walls, multi-use trails for hiking, biking, and equestrian uses. Grading volumes are currently estimated to range from approximately 15 to 16 million cubic yards of raw earthwork cut. Grading will be accomplished through conventional cut and fill methods including cuts and canyon fills exceeding 150 feet in some locations.

One prominent difference in design proposed under the Option 1 access plan is conversion of the existing access road within Blue Mud Canyon for use as Esperanza Hills Parkway and the main route of development access/egress. The 50-foot-wide road will closely follow the existing alignment. A prefabricated bridge or other structure will be constructed at the bottom of Blue Mud Canyon spanning the jurisdictional drainage area of the U.S. Army Corps of Engineers (ACOE) with graded earth-fill abutments and will be supported by retaining walls with variable heights along the north and south canyon walls. Grading within the canyon will be avoided where possible so natural slope areas below the walls remain as open space.

An emergency access road under Option 1 will extend from the southwesterly property line through the adjacent proposed Cielo Vista project. Road grades will be achieved by construction of retaining walls along roadway margins of varying heights. The roadway alignment will also serve as an easement for underground sewer and water utility lines.

Option 1 design depicts the abrupt termination of a fill slope along the western project boundary which will require a series of tiered retaining walls. Residential building pads are proposed at higher elevations upslope from the wall/slope to the east. A retaining wall or walls of varying heights are proposed across the axis of a tributary canyon that descends along the rear lots on southernmost parcel area.

The design for Option 2 will require fewer retaining walls to achieve design grades. The roadway will enter the western side of the project as an extension of Aspen Way, crossing two large diameter natural gas pipelines and the axis of Canyon B located on the proposed Cielo Vista project. The new 70-foot-wide roadway would be constructed by placement of fill within the canyon. A fill slope is to ascend out of the canyon to achieve roadway grades and beyond to a series of residential lots along "C" Street.

The unimproved roadway currently serving as access at the southerly area of the project would be improved for emergency fire access use under Option 2. The roadway crosses the trend of the active fault near the bottom of Blue Mud Canyon and parallels it along its northwestward ascent. No bridge or retaining walls are shown within Blue Mud Canyon for this Option. The roadway alignment will serve an easement for underground sewer and water utility lines.

Proposed cut/fill slopes, cut/fill depths, and construction of the tributary canyon retaining wall for support of lots along "J" Street are consistent with those identified for the Option 1 access plan.

1. Primary Impacts

Geotechnical and engineering geologic hazards posing the most significant impact to conceptual design plan implementation are categorized as "Primary" impacts herein. They are considered more significant as they are likely to require use of supplemental engineering structures to achieve adequate factors of safety in excess of conventional costs and practices commonly associated with remedial grading operations. These impacts relate to the stability of proposed slopes including graded fill and/or cut slopes, slopes steeper than 2:1 (horizontal:vertical) and slopes to remain natural following grading. The grade (or slope) of a physical feature or landform refers to the inclination of that surface to the horizontal. Slope stability is of particular concern where daylight cut and fill lots are proposed above or below natural slopes. Additional impacts include the stability of retaining walls to be constructed on sloped areas. Other primary impacts relate to surface rupture associated with a major earthquake along the Whittier Fault. Elements of the conceptual plan could be damaged by right-lateral strike-slip and/or vertical offset anticipated within the 50- to 120-foot-wide seismic setback zone established in the Fault Hazard Report. Individual impacts are discussed below.

a. Gross Slope Stability

Gross slope stability refers to deep-seated failures which can occur on natural or man-made slopes. The potential for slope failure is dependent on many factors and their inter-relationships. Some of the most important factors include slope height, slope steepness, shear strength (a material's ability to resist forces that can cause the internal structure to slide against itself), and orientation of weak layers in the underlying geologic units. Joints and shears, which weaken the rock fabric, allow penetration of water leading to deeper weathering of rock along with increasing pore pressures, increasing the plasticity of weak clays, and increasing the weight of the land mass. For engineering of earth materials, these factors are combined in calculations to determine if a slope meets a minimum safety standard.

A slope is considered to be in equilibrium where it is determined to possess a factor-of-safety of 1.0. Slopes calculated as having safety factors less than 1.0 are considered to be either failing or on the precipice of failure. In order to satisfy regulatory code requirements, a minimum 1.5 factor-of-safety must be achieved either through remedial grading methods or installation of supplemental engineering structures.

Large graded cut, fill or cut/fill combination slopes will be constructed as part of the Proposed Project. Most are designed at gradients of 2:1. Some are designed at steeper gradients up to 1.5:1.

Other slopes of significant concern are natural slopes which will remain along project margins in descending or ascending configurations. Natural slope impacts relate to their overall height, gradient, unstable nature and requirements that they remain undisturbed by remedial grading. Where proposed building lots will daylight above or below natural slopes, gross stability will have a direct impact on the integrity of adjacent lots and associated improvements. Many of these slopes may not meet safety factors in their present configuration.

Graded slopes and natural slopes may be underlain by thinly bedded and tectonically folded sedimentary bedrock structure with adversely oriented bedding plans of low shear strength. Depending upon these and other factors, there is a potential for the occurrence of translational (bedding plane) or rotational type landslide failures. Such failures pose a significant "Primary" impact to the development. Exhibit 5-50 – Typical Translational Landslide and Exhibit 5-51 – Typical Rotational Landslide depict examples of translational and rotational landslides.

Design cut, fill and fill-over-cut slopes, and slopes to remain natural following grading, may not meet minimum 1.5 factors of safety standards, and pose a hazard to planned improvements and areas beyond the boundaries of the development from a gross slope stability standpoint. Design slopes steeper than 2:1 will not satisfy minimum grading code requirements and are likely to possess an even greater slope stability hazard. Such slopes may require more difficult grading measures and/or use of engineering structures to achieve minimum factor-of-safety requirements. Therefore, mitigation measures have been included herein to ensure gross slope stability.

b. Ground Rupture

Current earthquake magnitude estimates are such that magnitude 6.7 quakes could occur every 700 years and magnitude 7.2 quakes every 1,000 to 1,500 years along the Whittier Fault. Paleoseismic studies in the nearby area indicate the last large earthquake along this fault segment resulted in approximately four to seven feet of right-lateral offset and occurred more than 1,600 years ago.

The Fault Hazard Report addressed proposed Option 1 and Option 2 conceptual design plans for Esperanza Hills. The Fault Hazard Report was based in part on guidelines published by the California Geological survey[9]. Current Alquist-Priolo Earthquake Fault Zone Maps were used as the base map in the Fault Hazard Report.

[9] (2002, Note 49 entitled "Guidelines for Evaluating the Hazard of Surface Fault Rupture")

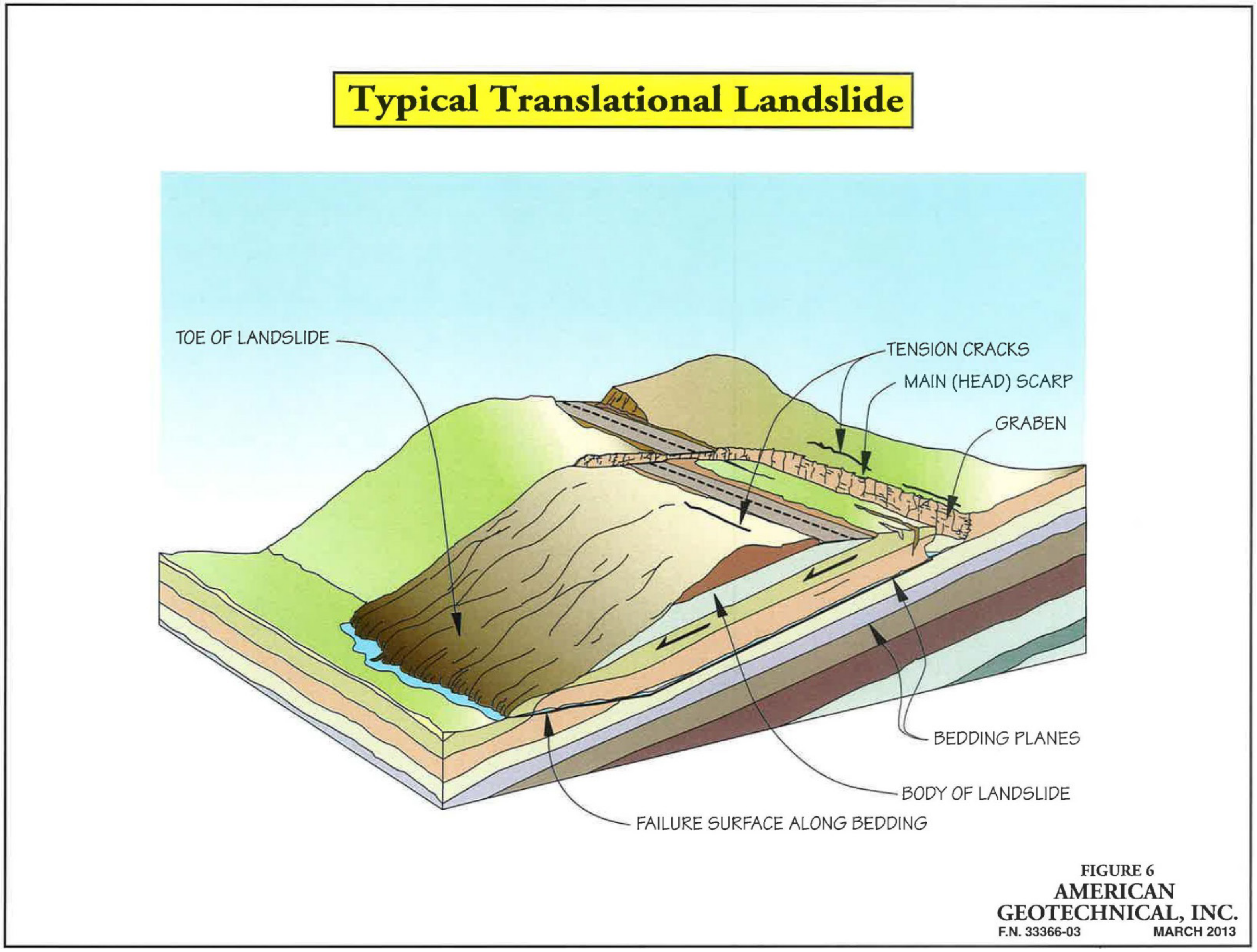


Exhibit 5-50 – Typical Translational Landslide

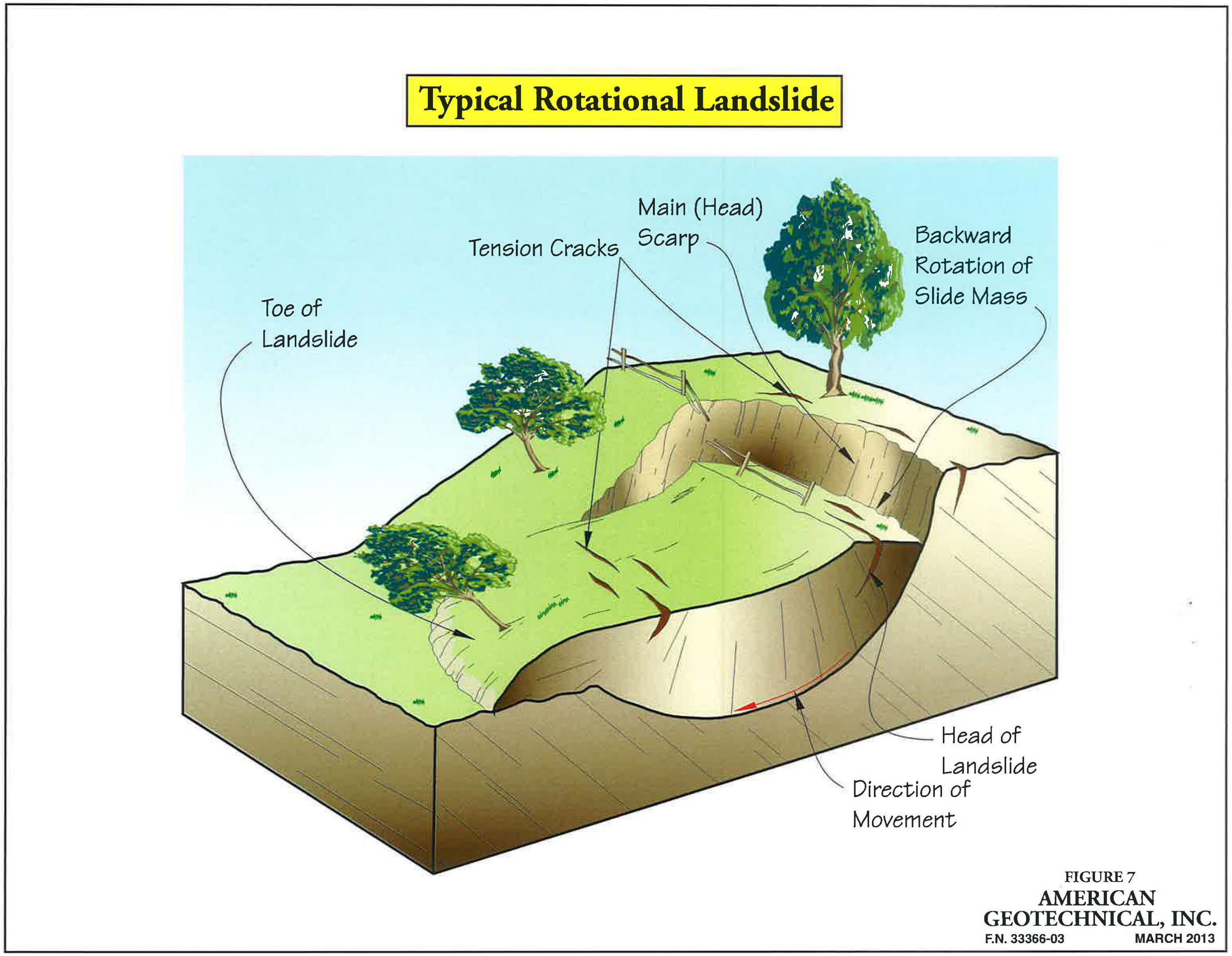


Exhibit 5-51 – Typical Rotational Landslide

The boundaries of the assessment zone for the Fault Hazard Report were located in the southern portion of the Project Site designated by the State of California Geological Service as the Alquist-Priolo Zone (AP Zone). The north boundary of the assessment area extends beyond the northern AP Zone boundary, to determine whether north-trending fault traces were present. The southern limits of the proposed conceptual design plan occur within the boundaries of the AP Zone. Fault trenching was conducted in the northern portion of the assessment area in areas generally coincident with proposed design grading improvements. Exhibit 5-52 – Orthophoto Map depicts the boundaries of the Fault Hazard Report analysis (Exhibit 5-43 (page 5-207) and Exhibit 5-44 (page 5-209)). The following information is based on and taken from the Fault Hazard Report.

1) Option 1 Access

Option 1 access closely follows that of the existing unimproved access road connecting with Stonehaven Drive on the south. From Stonehaven Drive, the road descends the south wall of Blue Mud canyon. A retaining wall system is proposed along the downslope side of the roadway with a pre-fabricated bridge allowing the roadway across the bottom axis of the canyon. From the bridge to the development area, the road generally follows the principal trace of the Whittier Fault.

Option 1 also includes construction of an emergency access road along the westerly property boundary of the Yorba Trails LLC property, extending south through the proposed Cielo Vista property along the western border of the Virginia Richards Trust property and then extending south to Via del Agua. A retaining wall is proposed along each side of the road.

2) Option 2 Access

Option 2 access is provided by an extension of Aspen Way eastward across a north-south trending canyon. The proposed roadway includes earthwork grading (placement of fill) to bridge the axis of the canyon. A fill slope would ascend from the canyon bottom to road grades and residential lots beyond. The unimproved road currently serving as the main access to the property from Stonehaven Drive would be improved for emergency fire access.

Option 2 also includes construction of an emergency access road that closely follows that of the existing unimproved access road connecting with Stonehaven Drive on the south. From Stonehaven Drive, the road descends the south wall of Blue Mud Canyon. A retaining wall system is proposed along the downslope side of the roadway with a pre-fabricated bridge allowing the roadway across the bottom axis of Blue Mud Canyon, which will span the jurisdictional drainage area for the ACOE. From the bridge up the hill to the development area, the road generally follows the principal trace of the Whittier Fault.

Exhibit 5-43 (page 5-207) and Exhibit 5-44 (page 5-209) depict the Option 1 and Option 2 access relative to the Fault Hazard Report boundaries.

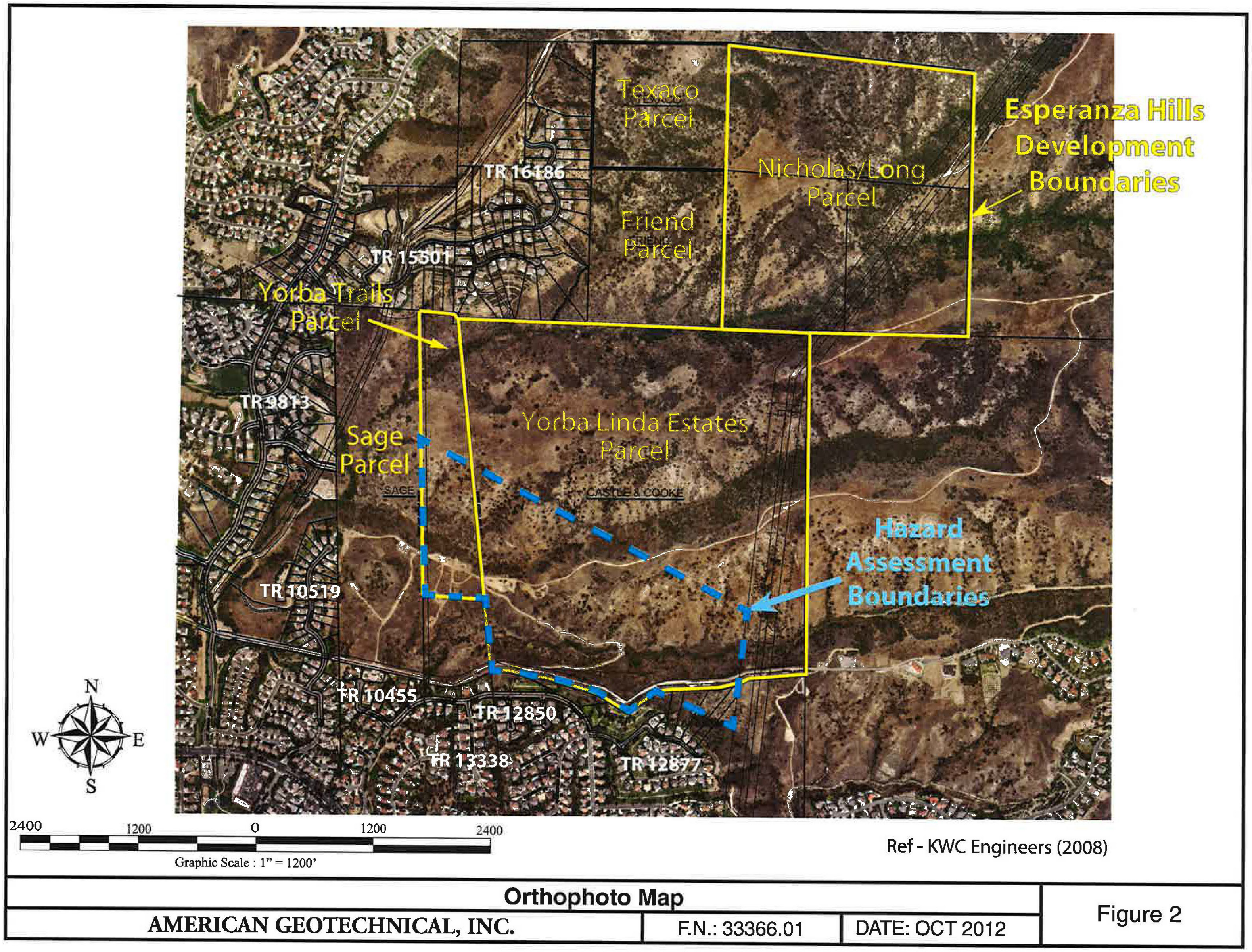


Exhibit 5-52 – Orthophoto Map

3) Alquist-Priolo Act

The Alquist-Priolo Earthquake Fault Zoning Act (AP Act) requires the State of California to delineate appropriately wide earthquake fault zones to encompass all potentially and recently active traces of faults or segments determined to be sufficiently active and well-defined as to constitute a potential hazard to structures from surface faulting or fault creep. The earthquake fault zones (EFZs) and locations of faults are published as Official Earthquake Fault Zone Maps on 7.5 Minute Quadrangle based maps.

Qualified professional geologists must critically investigate the presence of faults when structures for human occupancy are proposed inside the limits of an EFZ and demonstrate that no critical structures will be impacted by surface rupture, mainly by their construction across active traces. The AP Act states:

- An active fault is defined as having had surface displacement during the Holocene time (last 11,000 years)
- Unless proven otherwise, the area within 50 feet of an active fault is presumed to be underlain by active branches of the fault
- Geologic reports are required, directed at the problem of potential surface faulting for all projects defined by the Act
- Cities and counties are required to review geologic reports for adequacy, and
- Geologic reports shall be submitted to the State Geologists for open-file

In keeping with the guidelines of the AP Act, the purpose of the Fault Hazard Report was to identify the presence of all faults within the EFZ (active and inactive) and to establish a "seismic setback zone" encompassing all recognized active faults within which structures proposed for human occupancy are to be avoided.

Field exploration for preparation of the Fault Hazard Report included:

- Excavation of six fault trenches over 2,500 feet in total length
- Graphic fault trench logging at a scale of 1 inch equals 5 feet
- Photo-documentation of fault trenches using a digital camera
- Subcontracted consulting paleoseisomologist for review and comment on certain outcrops (no written report commissioned)
- Collected samples of organic material for radiometric age date testing
- Organized fieldtrips for peer review

The trenching took place between June 12 and August 1, 2012. The total combined measured length of trenching as established by civil engineering survey was 2,535 linear feet. Excavations were accomplished using a three-foot wide bucket attachment. Trench depths ranged between approximately 10 feet and a maximum of 20 feet below existing grades. Hand tools were used to remove the effects of bucket-smudging from log walls and reveal underlying geology. Final trench logs are included in the Fault Hazard Assessment, which can be found in Appendix G of this DEIR.

c. Faulting

Findings of the Fault Hazard Report, reached after surface mapping, LIDAR imagery review, and review and study of more than 2,500 feet of continuous fault trenching provided conclusive documentation of fault locations on the Project Site. Several bedrock faults were observed in the trenches, having varying degrees of offset, age, and style. Three fault trenches encountered what is considered to be the principal active strand of the Whittier Fault. This structure consists of a narrow well-defined zone approximately two feet wide, bounded by near vertical to steeply northeasterly dipping fault strands and additional internal high angle shears.

Bedrock directly south of the principal fault extends upward nearly to the surface of the oil/gas cut pad on the Darco oil well located on the western portion of the Yorba Linda Estates, LLC property, covered by only a few inches of residual topsoil. To the north, across what is interpreted to be a buried fault scarp (step slope), bedrock is covered by a four-foot-thick wedge-shaped graben deposit (a depressed block of land bordered by parallel faults), infilled with organic-rich topsoil material that is heavily disturbed by plants and animals (bioturbated). The principal fault extends upward to the base of the topsoil but does not offset this contact.

Several branch faults were observed to the north and south of the principal fault trace. None of these fault traces were found to extend upward into overlying surficial deposits or break the contact between capping soil and underlying bedrock. Although the branch faults are subsidiary to the principal fault, they likely accommodate only a fraction of sympathetic movement on the order of millimeters to inches and are laterally discontinuous. The Hazard Fault Report states that branch faults should be considered active and included within the boundaries of a seismic setback zone, barring mitigation through special grading or construction measures.

No geomorphic evidence of recent faulting was noted in LIDAR imagery or on aerial photographs as being associated with these faults, nor is any evidence of their presence depicted on as-graded geotechnical maps prepared for nearby tracts on file with the City. Observations of the faults in the field by peers confirm the absence of active fault features.

Field exposures of faulting and general geology were observed within several trenches by professional geologists from the County of Orange, the California Geological Survey, and consulting geologists with Seward Engineering Geology, Inc. There was near universal agreement among all parties with the geologic interpretations of the Fault Hazard Report, including identification of principal and branch faults and absence of evidence for active faulting beyond the established 120-foot-wide seismic setback zone to the north. No change in the state-mandated 50-foot-wide seismic setback zone to the south was recommended, as there are no habitable structures designed to occur south of the main trace of the Whittier Fault.

d. Geologic Setting

Regarding the Project Site, deep and sharply-incised canyons and narrow ridges cross the property in a general east-northeasterly trend. The east-west canyon and ridge topography is locally interrupted off-site to the east by one or more distinct north-trending canyons and ridges which are likely the expressions of an ancient fault zone associated with the uplift of the Puente-Chino Hills structural block. Significant active strike-slip motion associated with the Whittier Fault zone is evident as consistently offset and beheaded drainage channels, enclosed basins and a northward bending of major topographic features in closer proximity to the Whittier Fault. Exhibit 5-53 – Regional Geologic Map (Tan, et al.) depicts the geological characteristics of the Project Area.

Site specific characteristics identified in the Fault Hazard Report include:

- A sequence of deep water marine sedimentary bedrock of the late Miocene age occurs extensively at/near the surface and depths of approximately 2,000 feet. The bedrock consists of well bedded shale and sandstone unit considered to be contemporaneous in deposition with the Monterey Formation, a regionally extensive unit found throughout the Los Angeles basin and elsewhere along western coastal North America.
- The overall geologic structure of the Puente-Chino Hills is that of a northwest trending anticline elevated above surrounding alluvial basins by as much as 1,000 feet. Geologic structure across the Project Site exhibits several tightly spaced parallel fold axes trending in a general east-northeasterly direction. Exhibit 5-54 – Regional Geologic Map (Dibblee) indicates that no faults cross the Hazard Assessment areas analyzed in the Fault Hazard Report. Fault trenching performed by American Geotechnical allowed the principal Whittier Fault trace to be mapped across the length of the Hazard Assessment area.

The maps are included as Plates 1A/1B in the Fault Hazard Report. The mapping confirms that of published data, which indicates that interbedded sandstones and shale of the Yorba Member of the Puente Formation are more prominent at the surface to the north and northeast of the Whittier Fault Zone. Interpretations of faulting from well data in the Esperanza Oil Field suggest that deformation of underlying Puente Formation has been accommodated mainly by flexural slip and not by faulting.

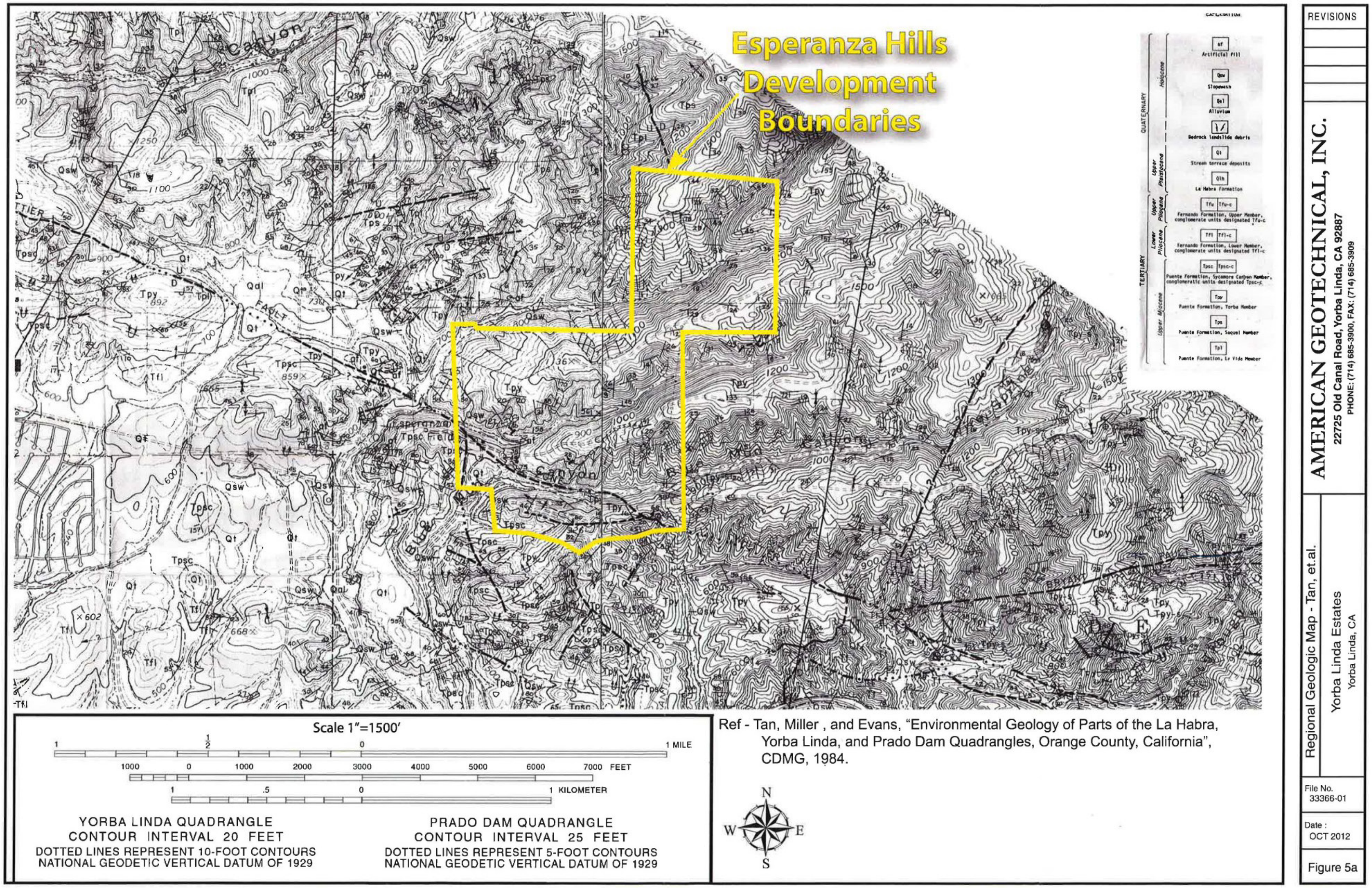


Exhibit 5-53 – Regional Geologic Map (Tan, et al.)

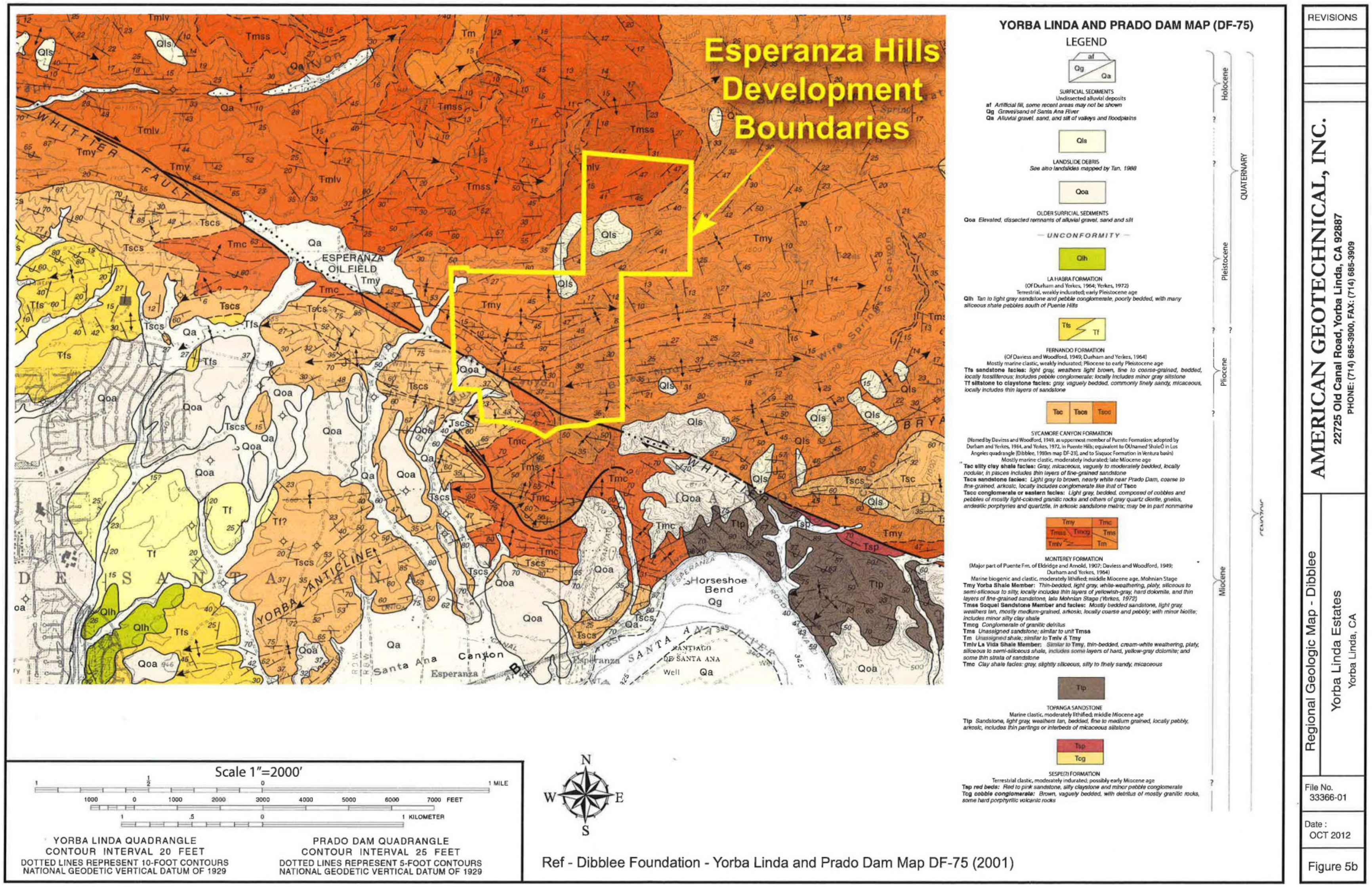


Exhibit 5-54 – Regional Geologic Map (Dibblee)

e. Landslide Deposition/Debris Flows

No such landslide deposits were encountered in any fault trenches performed by American Geotechnical.

The thickest older debris flow deposit, approximately 12 feet, occurred along the margins of the southerly canyon wall in Canyon B. The occurrence of these deposits is comparatively limited along the north canyon margin where only a single slope failure event is interpreted, measured to approximately seven feet thick and likely originating within the nearby tributary canyon to the north.

No geomorphic surface expression of older landslide deposits was recognizable in light detection and ranging (LIDAR) imagery and historical stereo aerial photographs. Along with the relatively significant degree of weathering exhibited by the deposits, the Fault Hazard analysis estimated the slides to be at least 15,000 years in age.

f. Local Geomorphic Landforms

Local geomorphic landform conditions are clearly recognizable on LIDAR imagery and aerial photographs as shown on Exhibit 5-55 – LIDAR Image – Oblique Southwesterly View and Exhibit 5-56 – LIDAR Image – Oblique Northeasterly View. LIDAR shows a major right-lateral deflected stream channel (Blue Mud Canyon), triangular slope faceting along canyon margins, side-hill benches and a major “scissor-ridge” in the area of the oil/gas operations. These features are depicted and identified on Exhibit 5-56.

g. Ground Water Conditions

A small amount of groundwater was encountered within the lower portion of trench AGFT-1, where it crosses the bottom of the main drainage canyon. The water occurs within the lower portion of the Pleistocene Alluvium Deposits, perched above bedrock. The elevation of the water table existed at approximately 673 AMSL at the time of the excavation. No discharge of groundwater occurred during testing.

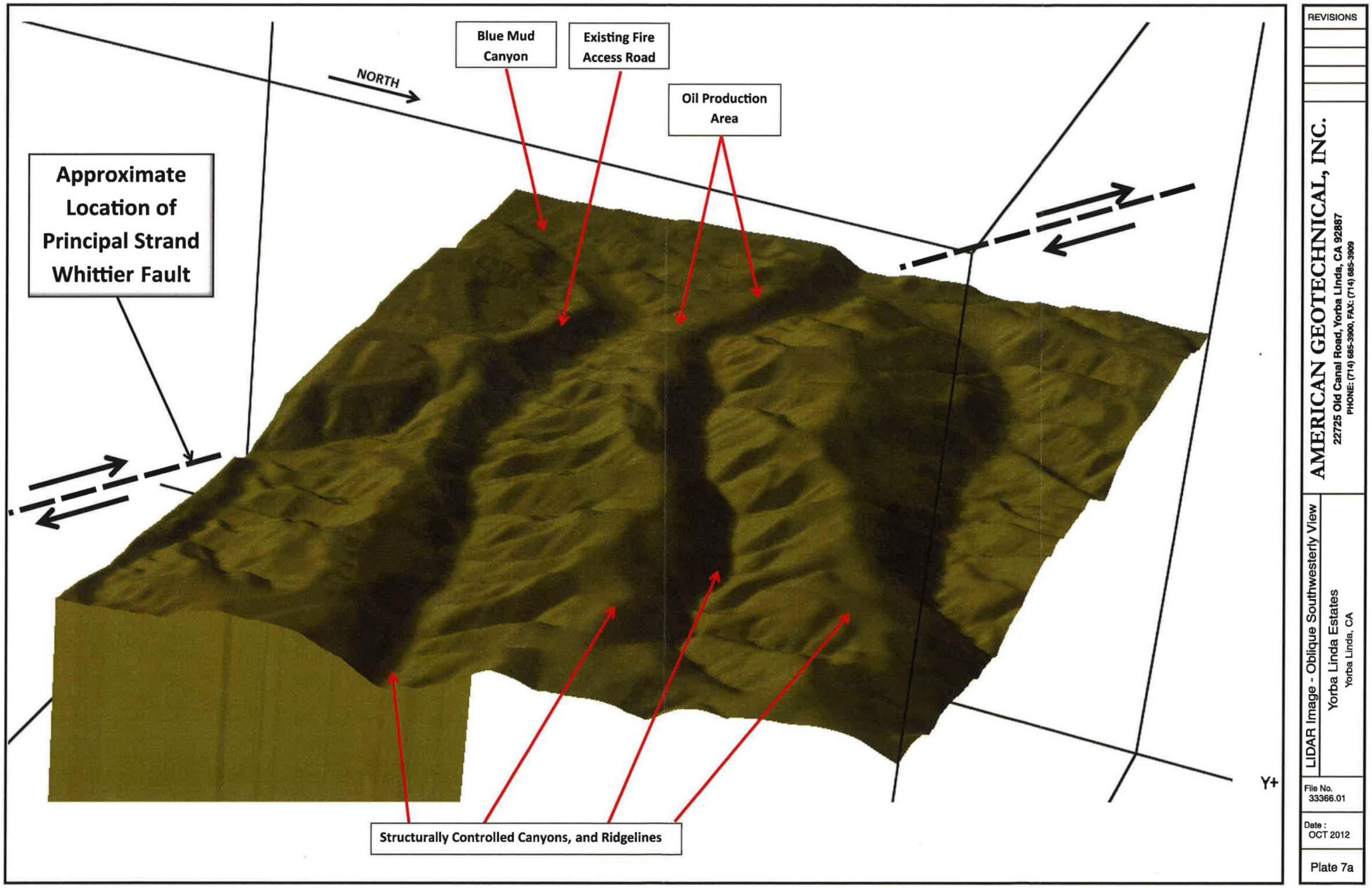


Exhibit 5-55 – LIDAR Image – Oblique Southwesterly View

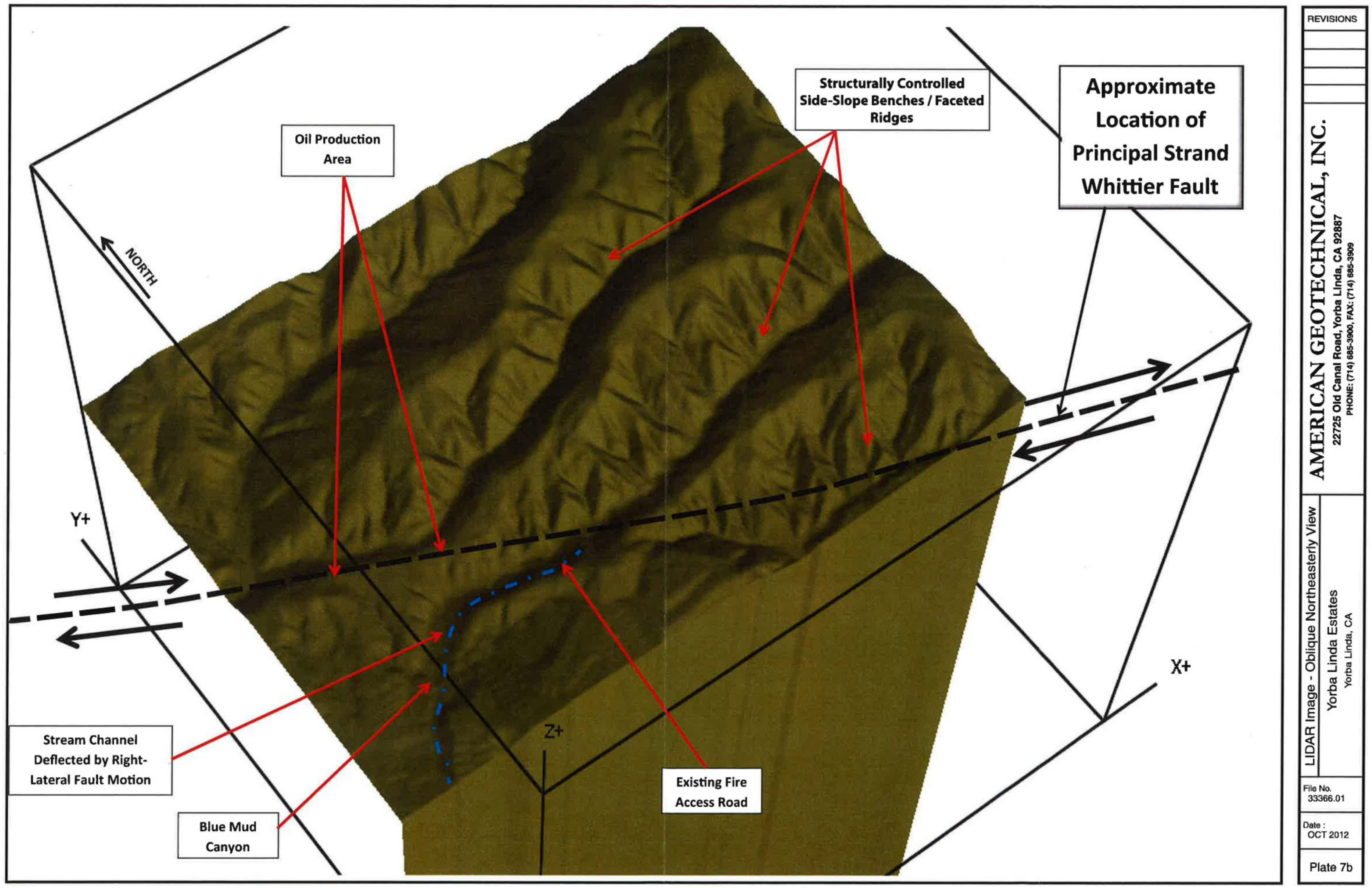


Exhibit 5-56 – LIDAR Image – Oblique Northeasterly View

h. Retaining Wall Stability

Conceptual design plans indicate use of retaining walls of varying height, or alternatively, a series of retaining walls set back from each other, as part of the development. The purpose of the more significant walls is to support access roads within Blue Mud Canyon or accommodate changes in grade along the western parcel boundary. The walls will primarily be constructed across the face of significantly high natural slopes with ratios steeper than 2:1. Some walls will span side-hill swales. Some walls with significant combined wall/slope heights to be constructed across steep and unstable natural slopes may not meet minimum factors-of-safety for gross stability without proper design. Some may also be underlain by landslides where gross stability is not possible without additional grading. These impacts would be considered significant. Therefore, mitigation measures are included herein to reduce potential significant impacts.

i. Fault Hazard Report Recommendations

The principal "active" trace of the Whittier Fault was found to consist of a single fault strand or narrow zone of multiple strands bounding a zone of gouge. The main fault orientation was found to dip northward between 75 and 80 degrees. Significant changes in the dip of bedding and stratigraphic section were observed across the fault. A significant right-lateral deflection of Blue Mud Canyon on the property is supporting evidence for motion in a right-lateral sense.

Several secondary faults north and south of the principal trace of the Whittier Fault are bedrock faults classified as normal, thrust and bedding-plane styles. Geomorphic evidence of recent movement along these faults ranged from subtle to non-existent. The branch faults diminish in frequency, magnitude and dip angle with increasing distance from the principal fault strand and are likely discontinuous and anastomosing laterally. Trenching revealed these faults to be steeply dipping between 61 and 85 degrees in a direction consistently toward the principal fault strand. The amount of future offset along these faults is expected to be variable and significantly less than that of the principal fault, likely on the order of only a few inches. The location and orientation of secondary faults was used to define the existing margins/widths of the existing seismic setback zone, as documented within the Fault Hazard Report.

A few inactive faults were noted within the elevated/uplifted area of the Puente Hills block. None of these faults were noted as breaking deposits of overlying topsoil or colluvium, nor are they associated with any geomorphic landforms indicative of active faulting.

A seismic setback zone has been established based on the mapped locations of principal and secondary branch faults. Widths vary from a maximum of 120 feet to the north of the main fault trace in the area of specific trenches to 50-feet where established by others outside the subject property to the northwest and southeast. No setback zone has been established to the south of the principal fault trace other than the state-mandated 50-foot seismic zone as the results of ongoing studies by others related to the adjacent proposed Cielo Vista project are pending. There are no habitable structures designed south of the main trace of the Whittier Fault on the Proposed Project Site. Mitigation has been included herein to ensure compliance with identified seismic setback zones.

The right-lateral style and magnitude of anticipated surface rupture should be incorporated into future design plans for any improvements within the seismic setback zone where possible. Construction of utilities across the fault zone should incorporate flexible connections capable of sustaining their integrity following an abrupt lateral offset associated with a surface rupture event. Mitigation has been included herein related to structures and utilities within the seismic setback zone.

Conceptual design level geotechnical studies should be conducted in close coordination with County of Orange staff in order to ensure satisfactory compliance with all residential development requirements for this level of design. Depending on which access option is selected, the studies will address development of proposed roadways, building lots, cut and fill slopes, bridges, retaining walls detention basins and other improvements at a scale of 1-inch equals 100 feet. Mitigation has been included herein to ensure coordination with County of Orange staff for compliance with development regulations.

A finalized version of the Fault Hazard Report should be forwarded to the California Geological Survey for inclusion in their open-file library of Alquist-Priolo Earthquake Fault Study reports.

The Fault Hazard Report concludes that the fault trenches and review by professional geologists suggest that the location of the principal Whittier Fault trace and secondary fault strands have been accurately mapped. The study confirmed that there was no evidence of active faulting beyond the limits of the established seismic setback zone. Therefore, the risk of surface rupture hazards to proposed habitable structures will be low, because active faults do not extend into areas designated for habitable structures. The risk to improvements proposed within the seismic setback zone as a result of future surface rupture is considered significant. Improvements within the seismic setback zone will be limited to non-habitable structures. In addition, no houses are permitted within the seismic setback zone.

The Geotechnical Review included discussion regarding ground rupture impacts and states that, in accordance with California law, construction of habitable residential structures will be prohibited across the trace of the active Whittier Fault or within the limits of the seismic setback zone. Other elements of the conceptual design plan will be constructed across or astride the fault within the setback zone. If not designed and constructed properly, structures could be damaged, destroyed, or rendered inoperable where affected by ground rupture.

The location and orientation of faults are currently based on detailed trench logging conducted as part of the fault study. The width of the seismic setback zone was conservatively established to accommodate the style of observed active faulting. It remains possible that local adjustments (increases/decreases) in the width of the existing seismic setback zone could be warranted after more widespread geologic exposures of these conditions are observed during rough grading. A modification of zone width would depend upon the configuration of the design earthwork (slope face orientation and fill thickness) and orientation of secondary faults used to define the margin of the zone. Increases in zone width typically result where a relatively thicker fill body is constructed above a controlling fault that possesses a shallow dip angle. The greater the increase in surface elevation and the flatter the dip of a fault, the greater the potential change in setback width. Zone width changes will be established by projecting the plane of a causative fault through the body of an overlying fill to its intersection with design ground surface. Vertical faults would not be expected to result in any change in zone width, regardless of fill thickness or slope face orientation.

Earthwork required within the influence of the seismic setback zone will mainly include fill slope and access road construction where fill thickness will range from approximately 20 to 80 feet. In most cases design slopes ascend away from current setback margins at angles shallower than that of controlling faults and, thus, modification to the existing seismic setback zone margins, if any, would be insignificant.

California's building regulations and standards are contained within Title 24 of the *California Code of Regulations* published by the California Building Standards Commission. These are regulations passed by California agencies charged with enforcing the state's various laws and requirements for builders and property owners. Title 24 includes all regulations for how buildings are designed and constructed, and are intended to ensure the maximum structural integrity and safety of private and public buildings.

Other hazards were identified as possible settlement in areas underlain by different earth materials or minor co-seismic (places simultaneously affected by an earthquake shock) slip along bedding planes. In addition, the anticipated effects of ground rupture could destroy or severely damage improvements and infrastructure and are thus considered to be significant. Therefore, mitigation measures have been included herein to reduce such impacts:

2. Secondary Impacts

Secondary impacts are those which can be mitigated by more conventional construction grading practices and costs. These impacts relate to surficial slope stability, strong ground shaking associated with earthquakes, deep fill settlement in canyon areas, and differential settlement across steep cut/fill transitions and compressible soils in areas of proposed fill. Additional secondary impacts could include effects of potential liquefaction, problematic soils, the control of groundwater (either from natural and/or expected future irrigation sources), rippability (the measure of ability to excavate with conventional methods) of harder sandstone bedding and disposal of oversize materials, the effects of expansive soil and differential bedrock heave, corrosivity of soils to metal and concrete elements and problematic existing infrastructure. Individual secondary impacts are discussed below.

a. Surficial Slope Stability

Surficial slope failures have occurred on the Project Site. Failures are typically local in scale and on the order of a few feet thick. Exhibit 5-57 – Typical Surficial Slump and Repair and Exhibit 5-58 – Typical Mud-Debris Flow depict examples of typical surficial slump and mud-debris flow failures.

The occurrence of slope creep or rock creep can be categorized as a type of surficial failure as the slow movement of rock or soil down-slope in response to gravity can progressively affect improvements such as property-line or screen walls, swimming pools, and hardscaping or flatwork located within its sphere of influence. Exhibit 5-59 – Typical Environmental Slope Creep Process (Expansive Soil) depicts the occurrence of environmental slope creep.

Surficial slope failures can occur within natural slopes abutting the development or within finished graded slopes. While the failures have the potential to undermine improvements constructed along the rear of lots that daylight above natural slopes, the same types of failures could also impact graded areas where natural slopes ascend away from the development. In order to reduce the potential for slope failure, the following mitigation measures are incorporated herein.

b. Strong Ground Shaking

There is no feasible way to avoid earth shaking from seismic events. However, the seismic shaking expected to occur at the Project Site is not significantly greater than the surrounding areas or other hillside areas in southern California. Strong earthquake-induced ground shaking could be triggered by seismic activity from the Whittier Fault and could result in damage as set forth above. For residential development, structures should be constructed to be able to:

- Resist minor earthquakes with no damage, such as the three recent earthquakes;
- Resist moderate earthquakes with some non-structural damage;
- Resist major earthquakes with some structural damage, but with a low likelihood of collapse.

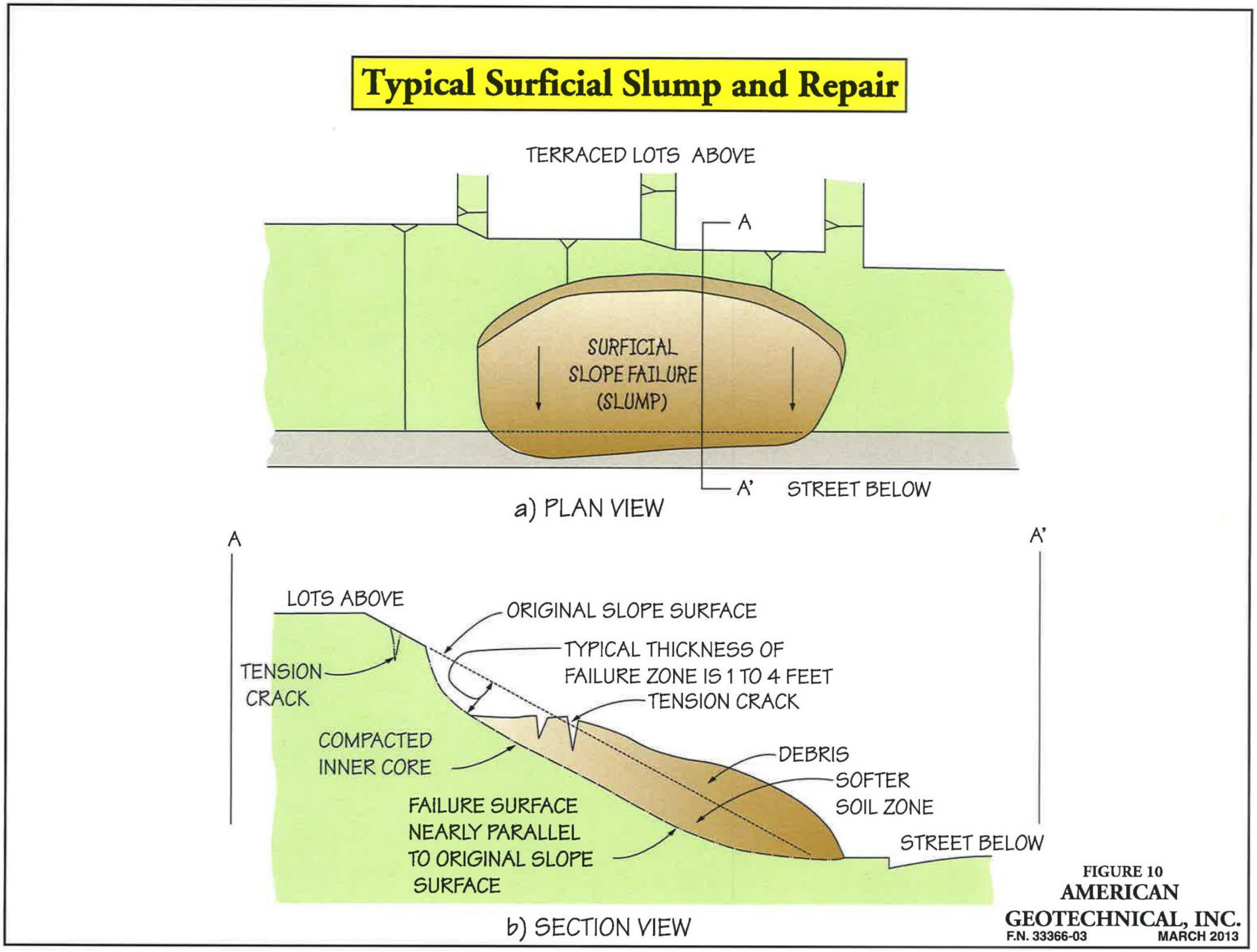


Exhibit 5-57 – Typical Surficial Slump and Repair

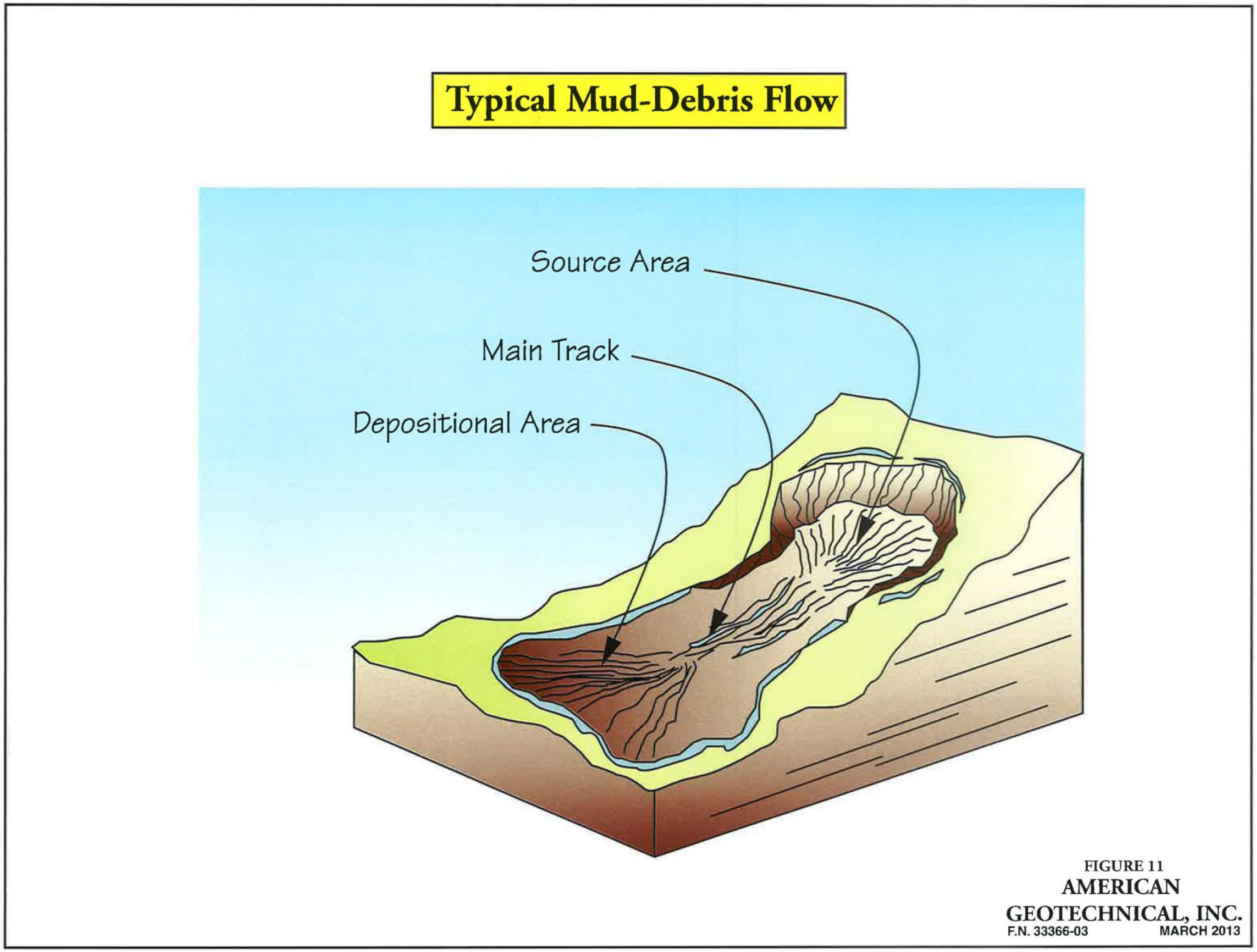


Exhibit 5-58 – Typical Mud-Debris Flow

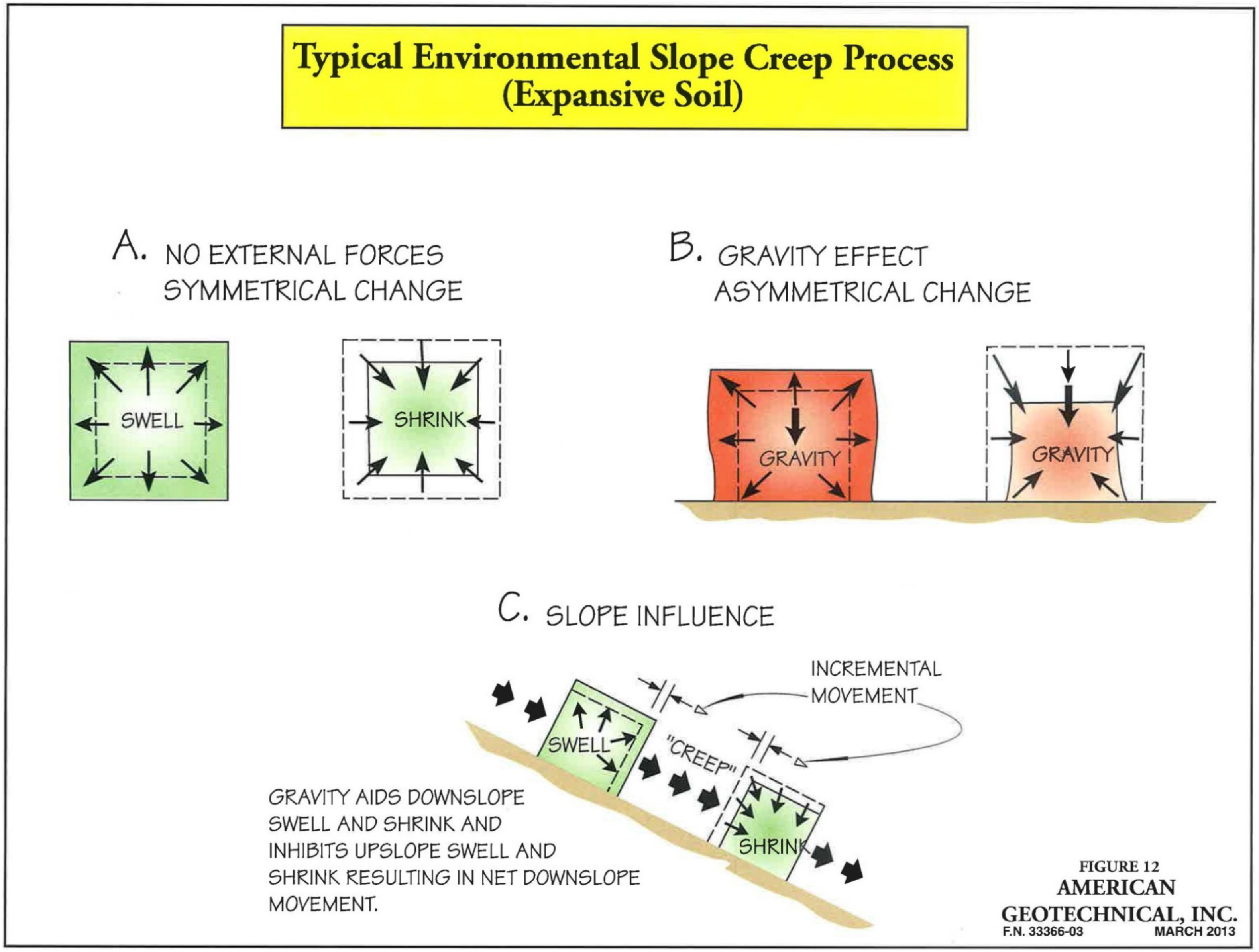


Exhibit 5-59 – Typical Environmental Slope Creep Process (Expansive Soil)

Design of structures in accordance with the current Uniform Building Code will promote safety and reduce the damaging effect of seismic shaking.

The Geotechnical Review proposed mitigation based on the Fault Hazard Report results from the exploratory trenching to identify active fault traces. Therefore, in addition to the above, mitigation has been incorporated herein.

Adherence to the current Uniform Building Code and Mitigation Measure Geo-11 will result in earthquake resistance as stated above, and will reduce impacts from ground shaking to the maximum extent practicable.

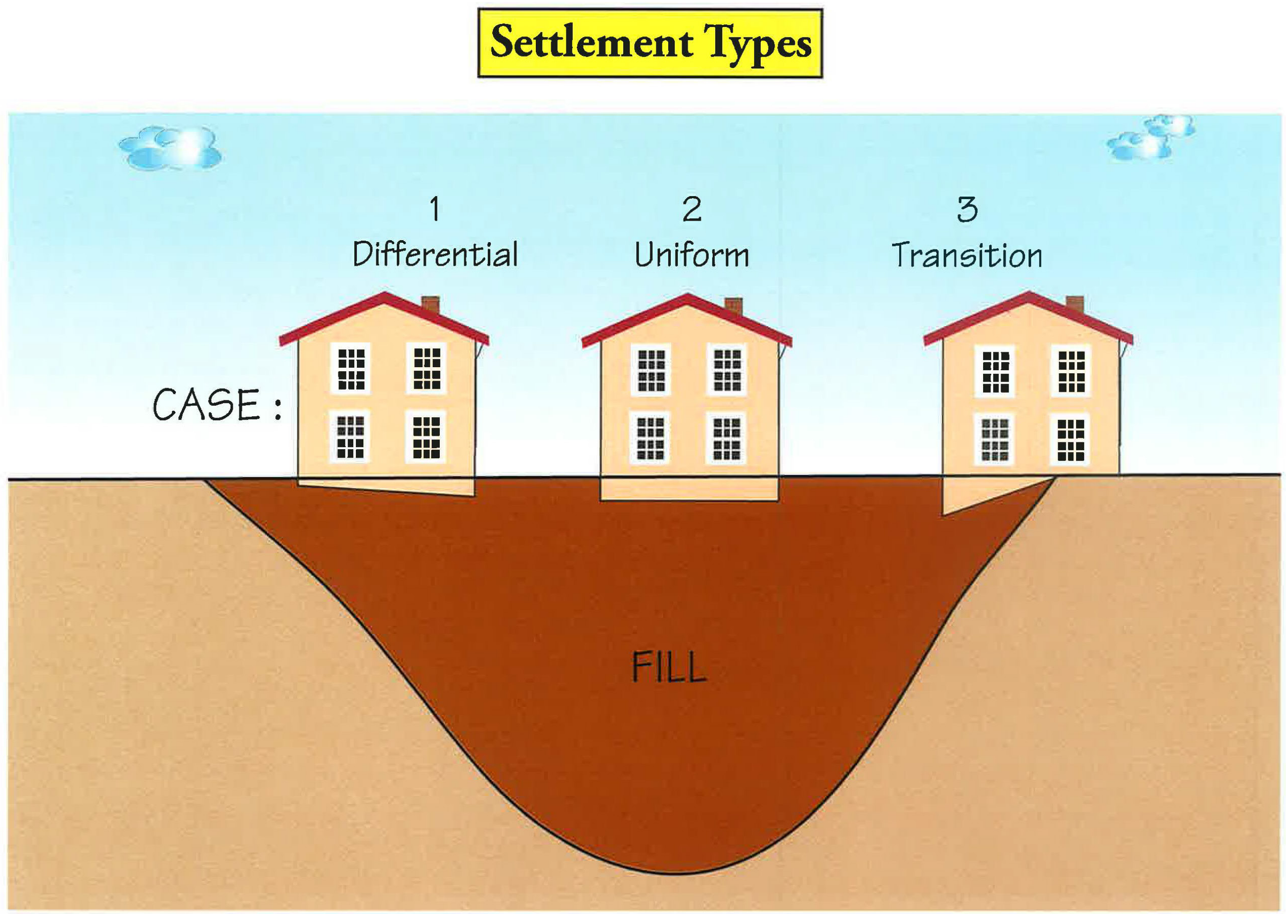
c. Deep Fill Settlement

Fill greater than approximately 40 feet in thickness can be expected to settle under its own weight. The rate of settlement depends upon fill composition and overall thickness, the ability of the fill to displace pore waters during settlement and other geotechnical criteria associated with its placement including degree of mechanical compaction. Exhibit 5-60 – Settlement Types depicts general types of deep canyon fill settlement and related damage risks. Generally, sandier fill will settle at a greater rate than a clayey fill. Design fills greater than 40 feet are planned for Canyon A and Canyon B where the thicknesses will be approximately 180 feet and 150 feet, respectively.

Impacts from fill settlement are considered significant due to the potential damage to elements of the conceptual design plan as well as the lengthy overall time required for primary settlement to occur. This could take up to several years depending upon fill composition and methods of emplacement. Therefore, mitigation has been included herein to minimize potential impacts from deep fill settlement.

d. Steep Cut/Fill Transitions

Excessive differential fill settlement can occur where removal contacts between new fill soil and bedrock removals are greater than approximately 1.5:1. This condition is anticipated to be emphasized most where cut/fill boundaries exist between steep natural canyon removals and areas of mass cut. The magnitude of this settlement could be on the order of several inches. Duration of settlement is different compared to deep vertical fills due to the long term dynamic interaction between fill, bedrock, and groundwater along the contact and component of creep. Potential damage could occur to conceptual design elements due to such settlement in areas above steep daylight fill/cut contacts. This impact is considered significant. Exhibit 5-61 – Potential Transition Lot Impacts depicts generalized cut/fill transition impacts to building lots. Therefore, to minimize this potential impact, mitigation has been included herein.



Category	Comparative Risk of Damage
1	Intermediate
2	Lowest
3	Highest

FIGURE 14A
AMERICAN GEOTECHNICAL, INC.
F.N. 33366-03 MARCH 2013

Exhibit 5-60 – Settlement Types

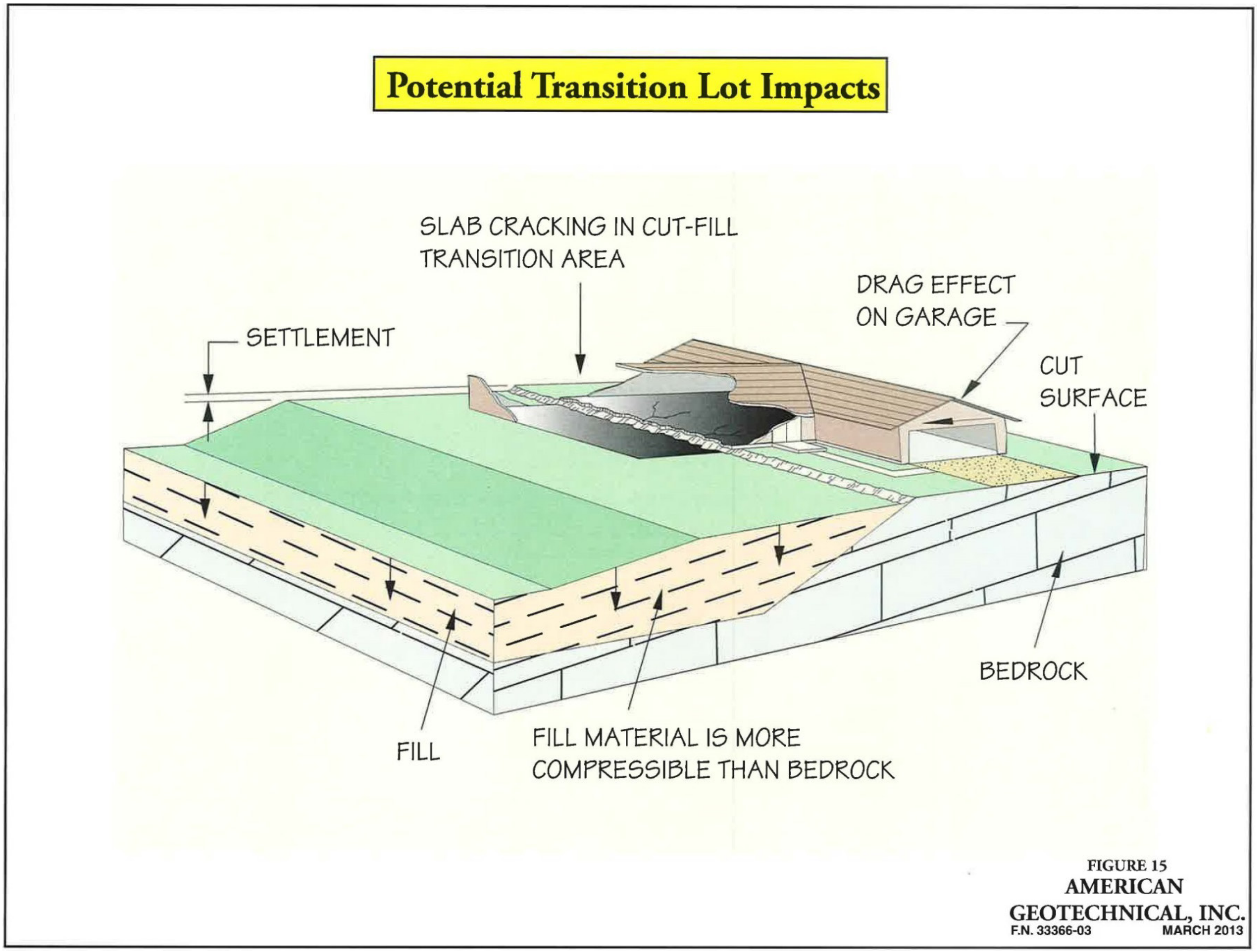


Exhibit 5-61 – Potential Transition Lot Impacts

e. Soils (Compressible/Corrosive/Expansive)

1) Compressible Soils

The removal of compressible soils to establish structural fill prisms becomes significant where the toe of descending fill slopes is designed mid-height along a natural slope, above sloped areas that otherwise remain natural. This will occur along Blue Mud Canyon in association with the proposed main road and retaining walls designed under access Option 1 or the emergency road under Option 2. A second area where this occurs is along Canyon A where the toe of the proposed fill slope occurs in a deposit of thicker alluvium and adjacent active stream channel. Where restrictions to off-site grading occur, it is likely that structural support will need to be achieved through other supplemental methods such as pin piles. From a cost standpoint, use of any such support structures would be a significant impact due to additional grading and use of supplemental engineering methods to achieve stability. Therefore, mitigation has been included to reduce potential impacts.

2) Corrosive Soils

If corrosive soils are detected on the Project site, the strength and integrity of foundations can be jeopardized. This is considered a significant impact. Therefore, mitigation has been included requiring testing of soils to determine their potential corrosive effects.

3) Expansive Soils/Bedrock Heave

Expansive soils due to engineered fill mixtures could result in impacts to the structural integrity of foundations.

Exhibit 5-62 – Potential Expansive Soil Impacts depicts impacts of this condition to improvements. Expansive materials can also exist as relatively thin sedimentary bedding within in-situ bedrock, exposed in areas of cut. When subjected to moisture, these materials tend to swell and can transfer significant upward forces into overlying earth materials and/or buildings. The occurrence of this phenomenon would be considered a significant impact. Therefore, mitigation is included herein to reduce impacts due to expansive soils.

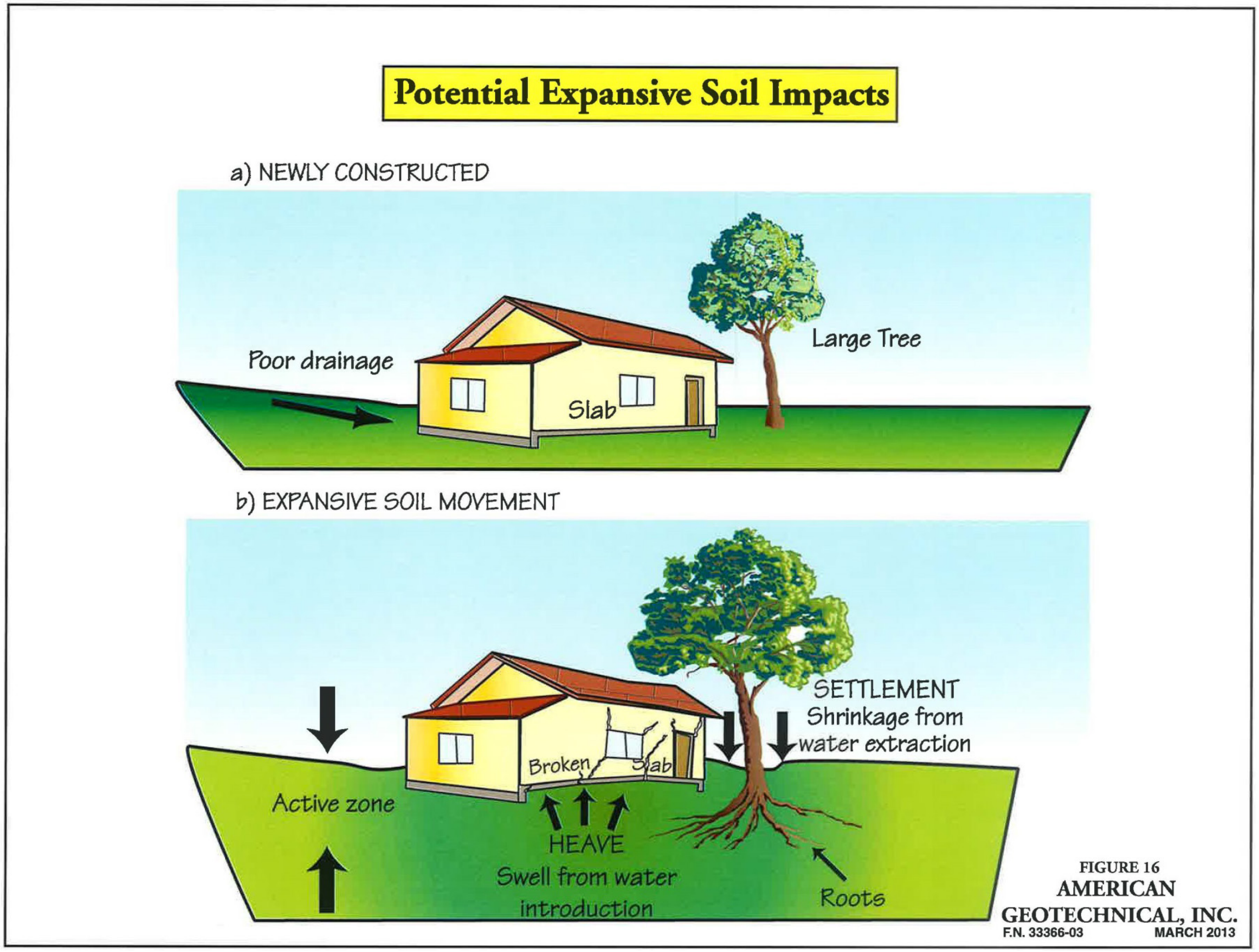


Exhibit 5-62 – Potential Expansive Soil Impacts

f. Liquefaction

The potential for liquefaction is limited to deposits of recent alluvium occurring within modern drainage channels. The most significant areas of liquefaction concern are within Canyon A and Canyon B where grading of roadway fill is proposed to support the main routes of access for Option 2. Another area of concern exists along the alignment for an emergency fire access road where it crosses Blue Mud Canyon south to Via del Agua across the adjacent proposed Cielo Vista project. The potential for liquefaction on the Project Site is considered a significant impact; therefore, mitigation has been included herein to reduce impacts.

g. Ground Water

It is anticipated that implementation of the conceptual design will dramatically increase the amount of subsurface groundwater, specifically related to residential landscape irrigation activities occurring within the development area. This potentially significant impact will be reduced to a less than significant level through utilization of common methods of subsurface groundwater control such as subdrain networks will reduce potential impacts. Therefore, mitigation has been included herein to reduce potential impacts due to groundwater.

h. Existing Infrastructure

Structures that currently exist within the influence of the conceptual design plans and may be adversely impacted by proposed grading and/or construction activities are considered problematic infrastructure. There are two existing large-diameter natural gas pipelines buried within a Southern California Gas (SCG) easement that extend along the western boundary of the adjacent proposed Cielo Vista project. Minor cuts and fills are proposed in order to construct the road to Aspen Way across this easement as part of the primary access for the Option 2 plan. Use of special supplemental engineering structures and/or grading methodology may be required to establish a stable roadway and/or to maintain or protect the integrity of the pipelines during grading.

The second problematic infrastructure element is the regional SCE electrical transmission line system crossing the eastern boundaries of the Project Site. Two significant cut slopes are proposed near the hills on which the transmission towers are located. The integrity of the transmission towers must be maintained during and after rough grading. Final grading plans will be submitted for review by SCE and SCG. Any impacts to the stability of the gas line or the electrical transmissions lines would result in catastrophic failure or disruption in infrastructure service. Therefore, mitigation has been included herein to reduce potential impacts.

i. Existing/Abandoned Oil Wells

Three active wells and four inactive (or previously abandoned) oil wells are located within the boundaries of the Project Site. The above-ground storage tanks and associated pipelines were identified as potential obstructions and sources of accidental or unauthorized releases of oil or hydrocarbon product if disturbed during project development. A more detailed analysis of impacts due to active and inactive oil wells is presented in this DEIR in 5.7, Hazards and Hazardous Materials (beginning on page 5-275).

5.5.4 Mitigation Measures

The following mitigation measures have been incorporated herein related to Geology and Soils impacts. This is a restatement of the Mitigation Measures identified above in the appropriate sections where the mitigation was described.

Geo-1 Prior to issuance of building permits, the Project Applicant and the County hall ensure that geologic conditions underlying design slopes and those to remain natural in areas adjacent to the development perimeter shall be investigated and analyzed for gross stability in accordance with current geotechnical engineering practice. Investigation shall include areas where larger landslides are suspected to exist, mainly in natural slope areas bordering the development, including analysis of distribution and dimension regarding conditions of gross stability.

Geo-2 During grading, the Project Applicant and the County shall ensure that unstable areas be avoided or that design slopes determined to be grossly unstable be stabilized by construction of buttresses or stabilization fills, flattening gradients, lowering overall heights, improving stability through use of tie-back/grade-beam systems, use of geogrid, use of cement-treated-soil or similar supplemental stabilization measures or combinations of these methods.

Geo-3 During grading, the Project Applicant shall ensure that zones of weathered bedrock be removed from back cuts and/or areas upon which new fill is to be placed.

Geo-4 Prior to issuance of building permits, the Project Applicant shall ensure that construction across the trace of active faults and/or outside the limits of the setback zone will be avoided to the maximum extent practicable, and no residential lots are designed within the setback zone established for the Whittier Fault. Where access roads, retaining walls, bridge structures or structural fills are planned within the setback zone, the direction and magnitude of anticipated fault offset and severity of anticipated ground shaking shall be incorporated into the design.

Geo-5 Prior to issuance of building permits, the Project Applicant shall ensure that the design for improvements that cross the Whittier Fault should be minimal, and the trend in which crossings are made should be oriented as nearly perpendicular (20 degrees east of north) to the trend of the fault as possible. The prefabricated bridge structure spanning Blue Mud Canyon under Option 1 shall be positioned and designed to accommodate expected fault offset. The Project Applicant shall consider use of alternative geotechnical engineering technologies to minimize impacts to structures constructed above active fault strands. These may include the incorporation of geo-fabric materials into fill bodies to add to fill strength and/or select placement of gravel blankets within subgrade areas to diffuse shear forces relating to ground rupture.

Geo-6 Prior to issuance of building permits, the Project Applicant shall ensure that utility lines located in or near the Whittier Fault incorporate flexible joints into their design, to accommodate anticipated ground rupture in a right-lateral strike-slip sense.

Geo-7 Prior to issuance of building permits, the Project Applicant shall verify that the existing seismic setback zone margins are appropriate for encountered geologic conditions and, where changes are warranted, evaluate any impacts to design plan elements and assure any revisions to the margins are depicted on final plan sets.

Geo-8 Prior to issuance of building permits, the County shall ensure that the Project Applicant has provided geotechnical investigations and engineering analyses to evaluate retaining wall design and stability, establish foundation design recommendations and determine conditions of gross and surficial stability of overall wall/slope combinations. In surficially unstable slopes where no remedial grading is permitted, wall foundations shall be strengthened to accommodate a potential loss of lateral support. Where natural slopes are grossly unstable, possibly due to the presence of a larger landslide, the slope shall be stabilized or buttressed through grading methods. Where grading is not permitted, structural stabilization shall be accomplished through the design of retaining walls and/or soldier pile walls, tie backs, or some combination of both.

Geo-9 Prior to issuance of building permits, the Project Applicant shall ensure that natural slope areas adjacent to development are analyzed for stability and estimated volumes of failure material determined. Setback zones or design of a bench in the upper slopes shall be employed to reduce the potential for failures to migrate into graded areas. Areas of rock creep influence shall require use of tie-backs and structural sheets to prevent this occurrence.

Geo-10 Prior to issuance of building and grading permits, the Project Applicant shall ensure that the following methods are incorporated into the design to prevent slope failure:

- Where daylight fill lots lie adjacent to ascending natural slopes, building pad elevations shall be raised, and toe-of-slope catchment troughs have been designed into which the failure materials can accumulate. These areas should be designated as “common areas” and maintained by homeowners associations.
- In areas where a more significant volume of debris is expected, such as an area situated within the path of adjacent natural drainage swales, impact or deflection walls shall be installed.
- Use of design stabilization fills, which are typically the width of standard grading equipment, shall be used for surficially unstable cut or fill slopes.

Geo-11 During the conceptual design phase, the Project Applicant and the County shall ensure that no lots are designed with habitable structures within the fault hazard setback zone as determined in the Fault Study, and no building permits shall be applied for or granted for any habitable structures within the hazard fault setback zone in the future. Asymmetrical floor plans shall be avoided, because these kinds of buildings tend to twist in addition to shaking laterally.

Geo-12 Prior to issuance of building permits, the Project Applicant shall demonstrate to the County that deep fills have undergone a cycle of "primary" settlement sufficient to allow safe construction. The Project Applicant may opt to employ supplemental geotechnical measures to minimize anticipated settlement time. Such measures could include vertical wick-drain installation, use of higher fill compaction standards, use of granular fill zones prone to less settlement, and/or placement of surcharge fills.

Geo-13 During construction, Project Applicant and the County shall ensure that appropriate conventional engineering measures are implemented to reduce impacts of excessive differential settlement in cut/fill transition areas as determined by the County building official. These measures can include a flattening of removal profiles to 2:1 or shallower, deepening over-excavation of building pads within zones of expected impacts, use of higher compaction standards, limiting construction of certain improvements within structural setback zones or construction of stiffened foundation systems including post-tension foundations caisson walls or mat slabs as determined feasible and appropriate.

Geo-14 During grading, the Project Applicant and the County shall ensure that removal and re-compaction of compressible native soils shall be performed in areas of proposed structural fills to minimize settlement of new fill and/or prevent loss of lateral support. The limits of removals shall extend beyond conceptual plan boundaries and potentially beyond the limits of grading into areas to remain natural. Where no removals are permitted beyond the boundaries of design, engineered structures shall be installed such as pin piles to achieve proper slope stability.

Geo-15 Prior to issuance of building permits, the County shall verify that testing has been conducted to evaluate the chemical character of fill soils. Results of such testing shall be used to formulate appropriate foundation design criteria to reduce the adverse effects of corrosive soils.

Geo-16 Prior to issuance of building permits, the County shall ensure that the Project Applicant has provided geotechnical studies to evaluate the occurrence and character of expansive clay soil on the Project Site. Based on the results of the studies, criteria for foundation design shall be formulated to reduce adverse effects such as selective grading methods including placement of adverse clay soils in deeper fill areas, or non-structural fill areas, and/or increasing the vertical distance between in-situ clayey bedrock and design structures through building pad over-excavation. Post grading studies and testing shall be conducted on finished building pads to verify the adequacy of foundation design.

Geo-17 Prior to grading, the County shall ensure that the Project Applicant has conducted geotechnical investigations of recent alluvium deposits to evaluate the potential for liquefaction. Findings of such investigations shall be incorporated into the design of structures proposed in areas where there is a potential for liquefaction to occur.

Geo-18 Prior to construction, the Project Applicant shall ensure that a network of subdrains and back-drains shall be installed in areas of expected groundwater or active seepage.

Geo-19 Prior to issuance of building permits, the County shall ensure that the Project Applicant has conducted geotechnical investigations and engineering analyses in areas where proposed roadways cross existing natural gas pipelines or transmission towers exist adjacent to proposed cut slopes and designed roadway crossings to avoid or minimize damage to these facilities.

5.5.5 Level of Significance after Mitigation

The Geotechnical Review and the Fault Hazard Report identify impacts to gross and surficial slope stability, ground rupture, retaining wall stability, strong ground shaking, fill settlement, compressible soils, liquefaction, groundwater, and expansive soils that may be encountered during grading or construction.

Development of the Proposed Project will place housing in an area that is subject to earthquakes and seismic ground shaking. Strong seismic ground shaking is endemic in southern California, and future residents of Esperanza Hills will not be exempt from this risk, if it occurs. All feasible mitigation measures identified herein, along with adherence to state and local building and construction standards, will reduce potential impacts to the extent feasible.

Grading and construction activities could result in erosion or the loss of topsoil. Mitigation measures have been incorporated to minimize potential impacts related to erosion. Mitigation has also been identified to reduce risks from expansive soils, landslides, lateral spreading, subsidence, liquefaction, or collapse. The use of septic tanks is not proposed. Provision has been made for wastewater disposal through the development of infrastructure for water and sewer service.

Mitigation Measures Geo-1 through Geo-19 have been designed to reduce impacts in the area of Geology and Soils to below a level of significance.

5.5.6 Cumulative Impacts

Cumulative impacts associated with geological conditions resulting from the Proposed Project development in the vicinity and surrounding uses include short-term impacts as a result of potential increases in erosion due to grading activities. Mitigation Measures AQ-1, AQ-2, and AQ-3, and Condition of Approval COA-5 will ensure that erosion from Esperanza Hills is reduced to a level of insignificance. However, the Proposed Project and the proposed Cielo Vista project, when taken together, may result in a cumulatively considerable impact in the area of erosion. While erosion control measures will be in place that will reduce impacts to air quality and water quality, and these measures are considerably more effective than they were in the past, erosion from blowing wind may carry soil to off-site areas in the form of dust. If grading operations for the two projects overlap, as is anticipated at the time of this writing, it will be difficult to identify the source of such dust. Therefore, a potential cumulative impact in the area of erosion is identified. No other cumulative impacts will occur in the area of Geology and Soils, because none of the grading or construction activities planned for Esperanza Hills will significantly impact regional or cumulative geologic conditions off-site.

5.5.7 Unavoidable Adverse Impacts

Implementation of the recommended mitigation measures specified above will reduce all potentially significant geological impacts to a less than significant level.