SECTION 5.8
Geology, Soils, and Seismicity

5.8 GEOLOGY, SOILS, AND SEISMICITY

This section addresses impacts related to geologic hazards and conditions at the project site. The analysis presented in this section is based upon the *Revised Geotechnical Assessment Report – Proposed Tentative Tract No. 063022, Robinson Ranch Development* (November 2008), prepared by Leighton and Associates, Inc. The analysis summarized in the project's *Geotechnical Assessment* includes compilation and review of published geologic maps, site reconnaissance, and a review of comprehensive preliminary geotechnical reports previously prepared by Leighton and Associates between 1985 and 1990 that address geotechnical, geologic, and hydrogeologic conditions for the proposed development. The *Geotechnical Assessment* is included in its entirety as Appendix N.

5.8.1 REGULATORY SETTING

FEDERAL

SOIL PROTECTION ACT

The purpose of the Federal Soil Protection Act is to protect or restore the functions of the soil on a permanent sustainable basis. Protection and restoration activities include prevention of harmful soil changes, rehabilitation of the soil of contaminated sites and of water contaminated by such sites, and precautions against negative soil impacts. If impacts are made on the soil, disruptions of its natural functions as an archive of natural and cultural history should be avoided, as far as practicable. In addition, the requirements of the Federal Water Pollution Control Act (also referred to as the Clean Water Act [CWA]) through the National Pollution Discharge Elimination System (NPDES) permit provide guidance for protection of geologic and soil resources.

STATE OF CALIFORNIA

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This State law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards.

The Act requires the State Geologist to establish regulatory zones, known as "Earthquake Fault Zones," around the surface traces of active faults and to issue appropriate maps. Earthquake Fault Zones were called "Special Studies Zones" prior to January 1, 1994. Local agencies must regulate most development projects within these zones. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults. An evaluation and written report of a specific area must be prepared by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (typically 50-foot set backs are required).

Effective June 1, 1998, the Natural Hazards Disclosure Act requires that sellers of real property and their agents provide prospective buyers with a "Natural Hazard Disclosure Statement" when the property that is being sold lies within one or more State-mapped hazard areas, including Earthquake Fault Zones.

SEISMIC HAZARDS MAPPING ACT

The Seismic Hazards Mapping Act (S-H Act) of 1990 provides a statewide seismic hazard mapping and technical advisory program to assist cities and counties in fulfilling their responsibilities for protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other seismic hazards caused by earthquakes. Mapping and other information generated pursuant to the S-H Act is to be made available to local governments for planning and development purposes. The State requires (1) local governments to incorporate site-specific geotechnical hazard investigations and associated hazard mitigation, as part of the local construction permit approval process; and (2) the agent for a property seller or the seller if acting without an agent, must disclose to any prospective buyer if the property is located within a Seismic Hazard Zone. The State Geologist is responsible for compiling seismic hazard zone maps. The S-H Act specifies that the lead agency of a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

CALIFORNIA BUILDING STANDARDS CODE

California building standards are published in the *California Code of Regulations*, *Title 24*, known as the *California Building Standards Code* (*CBSC*). The *CBSC* applies to all applications for residential building permits. The *CBSC* consists of 11 parts that contain administrative regulations for the California Building Standards Commission and for all State agencies that implement or enforce building standards. Local agencies must ensure that development complies with the guidelines contained in the *CBSC*. Cities and counties have the ability to adopt additional building standards beyond the *CBSC*. *CBSC* Part 2, named the *California Building Code* is based upon the *2009 International Building Code*, and Part 11, named the *California Green Building Standards Cod*e, and is also called the CalGreen Code. California has adopted statewide, mandatory codes based upon the International Code Council's (ICC) Uniform codes. The 2010 California Building Standards Code will adopt the 2009 International codes (I-codes), and take effect January 1, 2011.

CITY OF SANTA CLARITA

BUILDING CODE

The "Building Code of the City of Santa Clarita" (*Building Code*) is codified in *Title 18 City Building Code*, of the City's *Municipal Code*. The *Building Code* adopted the *2007 CBC* (*California Code of Regulations*, *Title 24*, Part 2) based on the *2006 International Building Code*, including Appendix Chapter 1, Administration, and Appendix 1, Patio Covers, 2007 Edition, as published by the International Code Council. The purpose of the *Building Code* is to provide minimum standards to safeguard life or limb, health, property and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location and maintenance of all buildings and structures within the City of Santa Clarita.

CALIFORNIA 2010 GREEN BUILDING STANDARDS CODE – CALGREEN CALIFORNIA CODE OF REGULATIONS TITLE 24, PART 11

The purpose of the *California Green Building Standards Code* is to improve public health, safety and general welfare by enhancing the design and construction of buildings through the use of building concepts having a reduced negative impact or positive environmental impact and encouraging sustainable construction practices in the following categories:

1. Planning and design;
2. Energy efficiency;
3. Water efficiency and conservation;
4. Material conservation and resource efficiency; and
5. Environmental quality

GENERAL PLAN

The *General Plan Safety Element* addresses seismically-induced geologic hazards within the City's Planning Area. The *Safety Element* considered the following hazards: faults, seismically-induced ground shaking, ground surface ruptures, liquefaction, slope stability and landslides, tsunamis, and seiches. The Element specifically addresses the way in which the City will prepare and respond to fires, earthquakes, and floods. The *Safety Element* provides background information related to each issue and identifies hazard locations within the City, risk-reduction strategies, and hazard abatement measures that can ultimately be used by decision-makers in their review of projects.
Applicable goals, objectives, and policies from the *General Plan* Safety Element and *Conservation and Open Space Element* are listed below.

<u>Geological Hazards</u>

Goals S 1: Protection of public safety and property from hazardous geological conditions, including seismic rupture and ground shaking, soil instability, and related hazards.

> **Objective S 1.2**: Regulate new development in areas subject to geological hazards to reduce risks to the public from seismic events or geological instability.
>
> > **Policy S 1.2.1**: Implement requirements of the Alquist-Priolo Earthquake Fault Zoning Act.
> >
> > **Policy S 1.2.2**: Restrict the land use type and intensity of development in areas subject to fault rupture, landslides, or liquefaction, in order to limit exposure of people to seismic hazards.
> >
> > **Policy S 1.2.3**: Require soils and geotechnical reports for new construction in areas with potential hazards from faulting, landslides, liquefaction, or subsidence,

and incorporate recommendations from these studies into the site design as appropriate.

Policy S 1.2.4: Enforce seismic design and building techniques in local building codes.

Objective S 1.3: Reduce risk of damage in developed areas from seismic activity.

Policy S 1.3.3: Provide informational materials to the public on how to make their homes and businesses earthquake safe.

Geological Resources

Goal CO 2: Conserve the Santa Clarita Valley's hillsides, canyons, ridgelines, soils, and minerals, which provide the physical setting for the natural and built environments.

Objective CO 2.1: Control soil erosion, waterway sedimentation, and airborne dust generation, and maintain the fertility of topsoil.

Policy CO 2.1.1: Review soil erosion and sedimentation control plans for development-related grading activities, where appropriate, to ensure mitigation of potential erosion by water and air.

Policy CO 2.1.2: Promote conservation of topsoil on development sites by stockpiling for later reuse, where feasible.

Policy CO 2.1.3: Promote soil enhancement and waste reduction through composting, where appropriate.

5.8.2 ENVIRONMENTAL SETTING

GEOLOGIC CONDITIONS

REGIONAL CONDITIONS

The project site is located within the western portion of the Transverse Ranges Geomorphic Province, and more specifically, within the central portion of the San Gabriel Mountains. The Transverse Ranges are a belt of east/west-trending folds and associated thrusts that formed in response to northeast to north-northeast crustal shortening that initiated in Pliocene time, approximately four to five million years ago. The area continues to undergo intense deformation by geological standards. This regional north-south compression causes the bedrock units to become progressively folded and faulted, forming valleys (such as the Santa Clara River Valley, Simi Valley, the Oxnard Plain, and the Ventura and Ojai Valleys), and uplands (including the San Gabriel Mountains, Oakridge-Santa Susanna Mountains, the Santa Monica Mountains, the Simi Hills, Big Mountain, South Mountain, and the Topatopa Mountains), that are generally bounded by reverse faults and/or thrust faults, which generally dip north along the southern range fronts and dip south along the northern range fronts.

Exhibit 5.8-1, *Regional Geology*, depicts the geologic conditions in the vicinity of site. The bedrock on-site exhibits relatively consistent dips to the west and slightly northwest with isolated southwest dips in the northeast portion of the site. Dip angles on site range from approximately 13 degrees to the west on the eastern portion of the site to 35 degrees on the northeastern portion of the site.

PROJECT SITE CONDITIONS

The project site is approximately 187.3 acres in size and is located on the south side of the Santa Clara River in the City of Santa Clarita; however approximately 14.7 acres in the southwestern portion of site have been identified as Not A Part, therefore only 172.6 acres would be affected by development. Site topography consists of a wide canyon bottom with gentle slope gradients trending downward from the southeast to the Santa Clara River on the northwest. Relatively steep-sided ridgelines border the site on the southwest, southeast, and east. Bordering ridges are inclined at gradients ranging from approximately 3:1 (horizontal to vertical) to approximately 1:1. Two bedrock outcrops of approximately 25 and 40 feet in height are located in the western and north-central portions of the property. Site elevations range from approximately 1,550 feet above mean sea level (AMSL) in the northwest portion of the site to approximately 1,730 feet above AMSL in the southeast portion of the site.

As stated within Section 3.0, Project Description, an active Metrolink railroad alignment traverses the northern portion of the site, while a natural gas pipeline easement and an elevated abandoned SPRC railroad alignment traverse the central portion of the site. Both railroad alignments and the pipeline easement are oriented in an east/west direction.

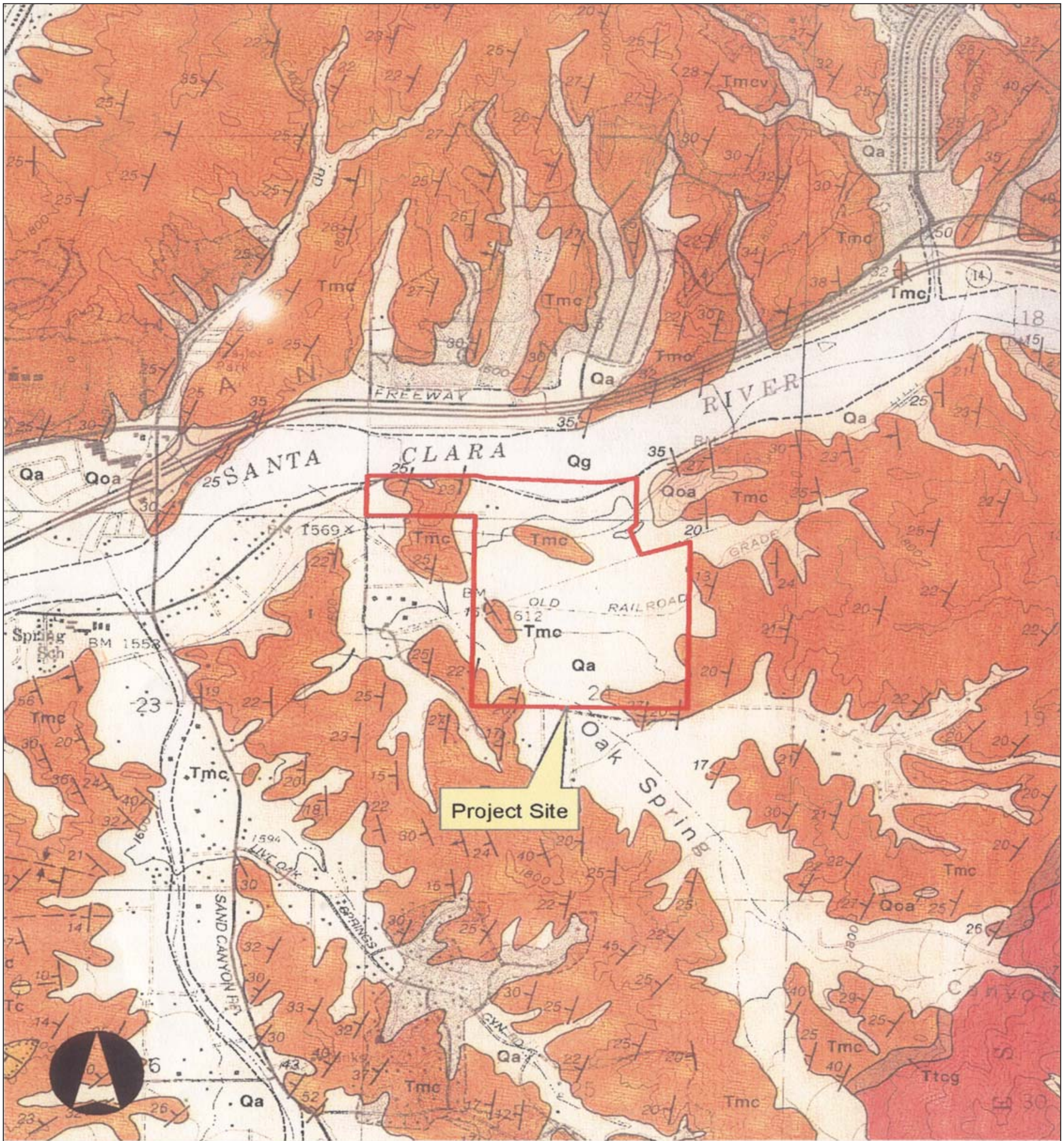
Geologic Materials

The earth materials underlying the site consist of artificial fill, surficial alluvial soils, terrace deposits, and recent landslide debris underlain by Tertiary sedimentary bedrock assigned to the Miocene age Mint Canyon Formation.

The majority of the subject site is underlain by Quaternary alluvium, Quaternary Older Alluvium, as well as by siltstones, sandstones, and conglomeratic bedrock of the Mint Canyon Formation. Quaternary Terrace deposits have been mapped at the site as capping units throughout the site. A description of each of the geologic units encountered at the site follows:

Artificial Fill - Uncertified (Afu)

Artificial fill soils have been mapped along the trend of the Metrolink railroad alignment, as well as the abandoned SPRC railroad grade. The Metrolink railroad alignment has an approximate maximum height of 27 feet and an approximate width of 205 feet. The abandoned SPRC railroad alignment is approximately 14 feet high at its highest point with a width of approximately 100 feet. Although not observed during Leighton's field investigation, it is likely that artificial fill is located along portions dirt roadways traversing the project site.



Ref: Dibblee, Thomas W., 1996, Geologic Map of the Mint Canyon Quadrangle, Los Angeles County, California, Dibblee Foundation Map #DF-57, dated March 1996.

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MANCARA AT ROBINSON RANCH
ENVIRONMENTAL IMPACT REPORT

Regional Geology

Exhibit 5.8-1

Quaternary Alluvium (Qol)

Alluvial materials consist of stream-channel deposits of silts, sands, and gravels that are transported by surface water, and are restricted to the bottoms of the main canyons and tributary channels. Alluvial deposits along the northern portions of the site in the vicinity of the Santa Clara River have been mapped as Quaternary Alluvium. Quaternary Alluvium encountered in Leighton's borings consists primarily of gray, brown, or slightly orangish brown silts and sands with varying amounts of clay and gravel.

Quaternary Older Alluvium (Qoal)

Alluvial materials encountered on the southern portion of the site have been mapped as Quaternary Older Alluvium. The Quaternary Older Alluvium consists of orange-brown to reddish-brown silts and sands with varying amounts of clay and gravel.

Terrace Deposits (Ot)

Terrace deposits were encountered as capping units overlying Mint Canyon bedrock on the outcrops located on the western and north-central portion of the property. Terrace deposits were also observed as remnants of older eroded surfaces along the northeastern portion of the site. The terrace deposits primarily consist of light brown silty sands with occasional sub-rounded gravelly layers.

Mint Canyon (Tmc)

The Mint Canyon Formation underlies the site and is exposed in the areas of higher topographic relief. This formation is Miocene in age and is believed to have been deposited in westward flowing streams and in a valley bottom fresh water lake. Mint Canyon Formation bedrock on-site consists of interbedded claystones, siltstones, sandstones, and conglomerates that are slightly to moderately friable and slightly to highly weathered.

Groundwater

The shallowest groundwater encountered in Leighton's borings was observed at a depth of 15 feet below ground surface (BGS), based on previous borings performed in October 1984. The historic high groundwater depths in the northern portion of the site (north of the Metrolink railroad alignment) are reported as 5 to 25 feet BGS, while areas south of the Metrolink railroad alignment have either historic depths of 25 feet BGS or have not been evaluated. The groundwater flow direction beneath the site is assumed to the northwest, generally following topography.

GEOLOGIC HAZARDS AND CONSTRAINTS

Primary Earthquake Hazards

According to the California Geological Survey (formerly the California Division of Mines and Geology), a fault is a fracture in the crust of the earth along which rocks on one side have moved relative to those on the other side. Most faults are the result of repeated displacements over a long period of time. An inactive fault is a fault that has not experienced earthquake activity within the past three million years. In comparison, an active fault is one that has experienced earthquake activity in the past 11,000 years. A fault that has moved within the past two to three million years, but not proven by direct evidence to have moved within the past 11,000 years, is considered potentially active.

The Modified Mercalli intensity scale was developed in 1931 and measures the intensity of an earthquake's effects in a given locality, and is perhaps much more meaningful to the layman because it is based on actual observations of earthquake effects at specific places. On the Modified Mercalli intensity scale, values range from "I" to "XII". The most commonly used adaptation covers the range of intensity from the conditions of "I: not felt except by very few, favorably situated," to "XII: damage total, lines of sight disturbed, objects thrown into the air." While an earthquake has only one magnitude, it can have many intensities, which decrease with distance from the epicenter.

The Alquist-Priolo Act of 1972 (now the Alquist-Priolo Earthquake Fault Zoning Act, Public Resources Code 2621-2624, Division 2, Chapter 7.5) regulates development near active faults so as to mitigate the hazard of surface fault rupture. Under the Act, the State Geologist is required to delineate Fault Rupture Hazard Zones along known active faults in California. The Act also requires that, prior to approval of a project, a geologic study be conducted to define and delineate any hazards from surface rupture. A geologist registered by the State of California, within or retained by the lead agency for the project, must prepare this geologic report. A 50-foot setback from any known trace of an active fault is required. According to the California Geological Survey, the project site is not located within an Alquist-Priolo Fault Rupture Hazard Zone.

Groundshaking

Ground motions, on the other hand, are often measured in percentage of gravity ("g", the acceleration due to gravity), where g is approximately 32 feet per second per second (9.8 meters per second per second) on the Earth. Groundshaking can be expected to be felt within the project site. However, the intensity of ground shaking would depend upon the magnitude of the earthquake, the distance to the epicenter, and the geology of the area between the epicenter and the project site.

A listing of active faults considered capable of producing strong ground motion at the project site, their closest distances to the property, and the maximum expected earthquake along each fault are presented in *Table 5.8-1*, *Summary of Faults and Generalized Earthquake Information – Project Site*. Also presented are generalized evaluations of maximum groundshaking on-site for the maximum earthquakes, and generalized predictions of the likelihood of such events occurring.

Table 5.8-1
Summary of Faults and Generalized Earthquake Information – Project Site

Fault Name	Miles (Direction from Site)	Maximum Credible Magnitude (M)	Expected Level of Ground Shaking	Earthquake Likelihood
Northridge (East Oak Ridge)	10.6 (southwest)	6.9	High	High
Santa Susana	11.1 (southwest)	6.6	High	High
Holser	8.6 (west)	6.5	High	Moderate
San Gabriel	5.1 (southwest)	7.0	High	Moderate
Sierra Madre	1.2 (southwest)	6.7	High	High
Santa Rosa	21 (southwest)	6.7	Moderate	Moderate
San Andreas (Mojave)	14.9 (northeast)	7.1	Moderate	High
Newport–Inglewood	27 (southeast)	6.9	Low	Moderate
Garlock (west)	28 (northeast)	7.1	Low	Moderate

Project Site Faulting and Seismicity

There are several unnamed local faults mapped within project site boundaries. These faults do not exhibit signs of recent activity and probably originate under similar post-depositional conditions as the Sulphur Springs Fault to the west of the project site. The unnamed local faults are well exposed within the cut slopes associated with the two railroad alignments traversing the site (the active Metrolink alignment and abandoned SPRC alignment). These faults offset the Mint Canyon Formation but do not disturb the overlying Pleistocene terrace deposits.

No active faults have been mapped at, or are known to project towards, the project site. As previously discussed, the site does not lie within an Alquist-Priolo Earthquake Fault Zone.

For the purposes of providing seismic design for planned construction, active faults in California have been designed as seismic sources and classified designed as Type A, B, or C faults. Type A faults are those that are capable of producing a Maximum Moment Magnitude Earthquake of Magnitude (M) greater than 7.0 and have a slip rate of greater than 5 millimeters per year. Type C faults are those that are only capable of producing an Earthquake with a Maximum Moment Magnitude of less than 6.5 and have a slip rate of less than two millimeters per year. Type B faults are those that have a Moment Magnitude and slip rate characteristics in between those of Type A and Type C faults. Seismic source Type Cs have not been designated in California because they have been judged not to have a significant impact on seismic design.

The nearest Seismic Source Type A Fault to the site is the San Andreas Fault, at a distance of approximately 4.3 miles southwest of the site. The nearest Seismic Source Type B Fault is the Sierra Madre Fault, situated approximately 1.2 miles southwest of the project site.

Probabilistic Seismic Hazard Assessment

A probabilistic seismic hazard assessment (PSHA) was performed for the site in accordance with the requirements of the 2002 edition of the *Los Angeles County Building Code* (*LACBC*). The *LACBC* states that the design-basis earthquake is the ground motion that has a 10 percent probability of exceedance in a 50-year time period (i.e., a ground motion with an average 475-year return period). In order to estimate this ground motion, the PSHA considered various magnitudes of earthquakes that major active or potentially active faults within a 100-kilometer radius of the site could produce along their respective fault lengths.

Table 5.8-2, Probabilistic Hazard Summary, summarizes the design earthquake peak horizontal ground acceleration (PHGA) values for the project site, for both non-magnitude-weighted and magnitude-weighted with a magnitude of 7.5.

Table 5.8-2
Probablistic Hazard Summary

Attenuation Relationship	PHGA *(Not Magnitude-Weighted)*	PHGA *(Mw = 7.5)*
Score et al., (1997), 250 meters per second (m/s)	0.74g	0.54g
Campbell (1997, 2002), alluvium	0.57g	0.44g
Sadigh, et al., (1997), deep soil	0.57g	0.41g
Average Estimated PHGA	0.63g	0.46g
Source: *Revised Geotechnical Assessment Report – Proposed Tentative Tract No. 063022, Robinson Ranch Development*, Leighton and Associates, Inc., November 2008.		

Secondary Earthquake Hazards

Liquefaction Potential and Dry Sand Settlement

Liquefaction may occur when saturated, loose to medium dense, cohesionless soils are densified by ground vibrations. The densification results in increased pore water pressures if the soils are not sufficiently permeable to dissipate these pressures during and immediately following an earthquake. When the pore water pressure is equal to or exceeds the overburden pressure, liquefaction of the affected soil layers occurs. For liquefaction to occur, three conditions are required:

1. Ground shaking of sufficient magnitude and duration.
2. A high ground water level at or above the level of the susceptible soils during the ground shaking.
3. Soils that are susceptible to liquefaction.

Liquefaction of the underlying soil layers may result in settlement of the soils as well as surface manifestation such as sand boils, mud-spouts, surface water seepage, or quicksand like conditions. According to the *Geotechnical Assessment*, the ground surface at a site will not experience damage due to liquefaction if a sufficient thickness of the non-liquefiable soils overlies the liquefiable soils.

Based on the *Geotechnical Assessment*, it appears that some of the subsurface alluvial layers located at approximately 25 feet BGS north of the abandoned SPRC railroad alignment may be subject to liquefaction. This liquefaction could occur if underground water rises to the historic high levels and the design basis earthquake occurs simultaneously in the area. The *Geotechnical Assessment* indicates that the liquefaction-induced settlement in the aforementioned area is estimated to range from one to three inches. Areas with liquefaction-induced settlements larger than two inches may be susceptible to the aforementioned surface manifestations of liquefaction (i.e., sand boils, mud-spouts, etc.).

Soils above the historic high groundwater elevation may also be susceptible to dynamic settlement due to relatively strong ground shaking. The *Geotechnical Assessment* indicates that soils above the groundwater level could be susceptible to less than one inch of settlement for the area south of the abandoned SPRC railroad alignment, less than one inch in the area north of the Metrolink railroad alignment, and less than two inches between the two railroad alignments.

<u>Tsunamis</u>

A tsunami is a seismic sea wave caused by sea bottom deformations that are associated with earthquakes or large landslides on the ocean floor. The hazard from tsunamis is nil, given the 30 miles that separate the project site from the Pacific Ocean.

<u>Seiching</u>

Seiching is the oscillation of an enclosed body of water due to groundshaking, usually following an earthquake. Lakes and water reservoirs are typical bodies of water affected by seiching. Given the large distance to the ocean (and associated bays, harbors, or estuaries) and the fact that there are no large open bodies of water or reservoirs upgradient of the project site, the potential for seiching is considered nil.

<u>Expansive Soils</u>

The effects of expansive soils on foundation systems can cause significant cracking, differential heave, and other adverse impacts. Generally speaking, the existing on-site soils are classified as predominantly granular, which generally have a very low expansion potential. The degree of expansivity of the few existing on-site cohesive soils is not expected to be more than moderate. According to the *Geotechnical Assessment*, the potential for structural damage resulting from expansive soils on-site is considered unlikely.

<u>Soil Erosion</u>

On-site soils are considered susceptible to erosion from both wind and stormwater. Other forms of soil erosion are debris flows, which typically form as a result of significant saturation from rainfall or concentrated surface water runoff within steeper, first-order hillside drainages underlain by any combination of soil, colluvium, and/or highly weathered bedrock. These types of flows can involve slow movement of a highly viscous soil-like mass to rapid down-slope movement of a fluid-like flow.

Slope Stability

According to the *General Plan Safety Element*, the project site is not located within an "Earthquake-Induced Landslide Hazard Zone". In addition, the *Geotechnical Assessment* includes an analysis of slope stability on the project site for proposed conditions. Three representative cross sections ("LS 1" through "LS 3") were drawn across the project site and were analyzed for stability. The results of the *Geotechnical Assessment* in regards to slope stability are discussed below in Section 5.8.4.

5.8.3 SIGNIFICANCE THRESHOLD CRITERIA

The *City of Santa Clarita Local CEQA Guidelines* (Resolution 05-38) adopted on April 26, 2005 and the Initial Study Environmental Checklist form in *CEQA Guidelines* Appendix G serve as the thresholds for determining the significance of impacts relating to geology, soils, and seismicity. As such, a project would be considered to have a significant environmental impact if it would result in the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
    - 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 Section 9.0, Effects Found Not To Be Significant).
    - Strong seismic ground shaking.
    - Seismic-related ground failure, including liquefaction.
    - Landslides.
- Result in substantial wind or water soil erosion or the loss of topsoil, either on or off site (refer to Section 5.7, Hydrology and Water Quality).
- 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- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1997), creating substantial risks to life or property.

- 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 9.0, Effects Found Not To Be Significant).

- Change in topography or ground surface relief features.

- Earth movement (cut and/or fill) of 10,000 cubic yards or more.

- Development and/or grading on a slope greater than 10% natural grade.

- The destruction, covering, or modification of any unique geologic or physical feature.

All of the thresholds listed above are addressed in the following analysis, with the exception of the first, second, and fifth major bullet points above, because no known active faults traverse the project site, erosion is addressed in Section 5.7, Hydrology and Water Quality, and the proposed project does not include the use of septic tanks or alternative wastewater disposal systems.

Based on these standards, the effects of the proposed project have been categorized as either a "less than significant impact" or a "potentially significant impact." Mitigation measures are recommended for potentially significant impacts. If a potentially significant impact cannot be reduced to a less than significant level through the application of mitigation, it is categorized as a significant unavoidable impact.

5.8.4 PROJECT IMPACTS AND MITIGATION MEASURES

The level of geotechnical and landform information contained in the proposed project's *Geotechnical Assessment* is adequate to analyze the potential project effects on earth resources and landforms, and to determine appropriate mitigation measures for the proposed development. There are a number of short- and long-term impacts related to the current physical and geological setting that can be generally expected from grading and development activities associated with the proposed development.

SEISMIC GROUNDSHAKING

- ***DEVELOPMENT OF THE PROPOSED PROJECT COULD EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS FROM SEISMIC GROUNDSHAKING.***

Level of Significance Before Analysis and Mitigation: Less Than Significant Impact.

Impact Analysis: Groundshaking accompanying earthquakes on nearby faults is anticipated to be felt within the project site. However, the intensity of groundshaking would depend upon the magnitude of the earthquake, the distance to the epicenter, and the geology of the area between the epicenter and the project site. The greatest amount of groundshaking at the project site would be expected to accompany large earthquakes on the Northridge/East Oak Ridge, Santa Susana, Holser, and San Gabriel faults. Earthquake magnitudes in the range of up to M7.5 could produce average peak horizontal ground acceleration on the order of 0.46g.

Despite the fact that the project site would experience groundshaking as a result of an earthquake along any of the active or potentially active faults in the region, as is the case in all of southern California, proposed structures would be required to be designed, engineered, and constructed to meet all applicable local and State seismic safety requirements, including those of the *California Building Standards Code*. Given compliance with applicable seismic safety requirements and implementation of the applicable *General Plan* goals and policies, impacts on the proposed development from seismic groundshaking would be less than significant.

Mitigation Measures: No mitigation measures are required.

Level of Significance After Analysis and Mitigation: Less Than Significant Impact.

GROUND FAILURE

- ***DEVELOPMENT OF THE PROPOSED PROJECT COULD EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS FROM GROUND FAILURE, INCLUDING SETTLEMENT, COLLAPSE, GROUND LURCHING, LIQUEFACTION, OR LATERAL SPREADING.***

Level of Significance Before Analysis and Mitigation: Potentially Significant Impact.

Impact Analysis: Liquefaction along with seismically induced settlements of up to five inches, surface manifestations such as sand boils, and lateral spreading could occur to varying degrees across the project site and affect future on-site development. However, the potential for structural damage from seismically-induced settlement, liquefaction, or lateral spreading can be reduced, by implementing the applicable recommendations contained in Section 7 of the *Geotechnical Assessment*. These recommendations include additional explorations to more accurately delineate areas of potential liquefaction, removal and recompaction of affected soils, and/or proper foundation design.

Recommendations related to foundation design can only mitigate the effects of differential settlement on structures, and would not affect area total settlements or surface manifestations of liquefaction. Recommendations for site mitigation for total settlements and surface manifestations would consist of improving the upper soils to provide a sufficient thickness of non-liquefiable soils to reduce total settlements and suppress surface expressions of liquefaction. This could consist of overexcavation of the upper soils to locally as deep as 30 feet and replacing them with compacted fill. Other means of improving the upper soils can include stone columns or compaction grouting. Details of the particular methods employed, if any, would be decided following subsequent investigations of the site.

Despite the localized potential for liquefaction, seismically-induced ground settlement, and lateral spreading, implementation of the applicable *General Plan* goals and policies and applicable recommendations in the Geotechnical Assessment as noted in Mitigation Measure GEO-1 would reduce associated risks to an acceptable level, and as such, impacts would be less than significant.

Mitigation Measures:

GEO-1 The proposed development shall incorporate all applicable recommendations contained in Sections 7.2, 7.3, 7.4, 7.5, and 7.7 of the *Geotechnical Assessment* related to liquefaction, seismically induced ground settlement, and lateral spreading. Such recommendations shall include subsequent investigation to more accurately delineate areas of potential ground failure, remediation of affected soils, and proper foundation design. Any recommendations in the *Geotechnical Assessment* shall be implemented during site grading and construction.

Level of Significance After Analysis and Mitigation: Less Than Significant Impact.

LANDSLIDES AND SLOPE STABILITY

- ***DEVELOPMENT OF THE PROPOSED PROJECT COULD EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS FROM LANDSLIDES OR OTHER SLOPE FAILURES.***

Level of Significance Before Analysis and Mitigation: Potentially Significant Impact.

Impact Analysis: Global slope stability analyses performed as part of the *Geotechnical Assessment* utilized shear strength parameters presented in the California Geological Survey's seismic hazard zone report for the Mint Canyon Quadrangle for a similar type of bedrock. Geologic cross-sections of proposed slopes were analyzed for the proposed project, and are labeled as cross-sections LS1 through LS3 in *Exhibit 5.8-2*, *Project Site Geologic Map*.

Section LS1 was constructed to depict the most critical cut slope proposed as a portion of the proposed tentative tract map. The location of LS1 was selected based on the height of the proposed cut slope as well as the adverse geologic structure. The results of the slope stability analyses for this section indicated that the planned slope meets the minimum factor of safety requirements of the *Los Angeles County Building Code* (*LACBC*).

Section LS2 was constructed through the natural slopes descending to the tallest proposed cut slope at the margin of the project site. The results of the slope stability analyses for the LS2 section indicated that the planned slope does not meet the minimum factor of safety requirements by the *LACBC*. Additional analyses were performed and indicated that flattening the proposed slope to at 2-1/2:1 or flatter would meet the minimum factor of safety requirements of *LACBC*.

Section LS3 was constructed through the natural slopes descending from off-site to the northeastern portion of the project site, and then extending through the proposed detention/desilting basin east of Lot 14. Slope stability analyses as well as rapid drawdown analyses were performed. The result of the slope stability analyses for this section indicated that the planned slope meets the minimum factor of safety required by the *LACBC*.

As relates to surficial slope stability, shear strength parameters were conservatively utilized from those presented in the California Geological Survey's seismic hazard zone report, for a similar type of bedrock, the Mint Canyon Quadrangle. It would be necessary to obtain undisturbed ring samples during grading from the exterior faces of fill slopes, to perform the relevant direct shear tests, and to verify the surficial stability. Additional field subsurface explorations should be performed to obtain undisturbed bedrock samples in order to perform direct shear tests to develop site-specific shear strength parameters. Additional slope stability analyses, together with additional recommendations, may be required if the new shear strength parameters are significantly different than those assumed in the *Geotechnical Assessment*.

With implementation of the applicable *General Plan* goals and policies and applicable recommendations contained in the *Geotechnical Assessment* as noted in Mitigation Measure GEO-2, impacts related to slope stability would be less than significant.

Mitigation Measures:

GEO-2 The proposed project shall incorporate all applicable recommendations contained in Section 7.3 of the *Geotechnical Assessment* regarding slope stability, including those related to cut and fill slope design and subsequent subsurface explorations and shear tests. Any subsequent recommendations resulting from additional investigations and analysis shall then be incorporated into the design of the proposed project.

Level of Significance After Analysis and Mitigation: Less Than Significant Impact.

EXPANSIVE SOILS

- ***ON-SITE EXPANSIVE SOILS COULD POSE A RISK TO PEOPLE AND STRUCTURES ASSOCIATED WITH PROPOSED PROJECT.***

Level of Significance Before Analysis and Mitigation: Less Than Significant Impact.

Impact Analysis: The on-site soils are predominantly granular, with little to no expansion potential, while the few on-site cohesive soils are expected to have low to moderate expansion potential. These soils are not expected to cause significant cracking, differential heave, and other adverse impacts on structure foundations. Therefore, the potential of structural damage resulting from expansion of the existing on-site soils is considered remote, and impacts would be less than significant in this regard.

Mitigation Measures: No mitigation measures are required.

Level of Significance After Analysis and Mitigation: Less Than Significant Impact.

NOT TO SCALE

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MANCARA AT ROBINSON RANCH
ENVIRONMENTAL IMPACT REPORT

Project Site Geologic Map

Exhibit 5.8-2

GRADING

- ***DEVELOPMENT OF THE PROPOSED PROJECT COULD RESULT IN A CHANGE IN TOPOGRAPHY OR GROUND SURFACE RELIEF FEATURES, EARTH MOVEMENT OF 10,000 CUBIC YARDS OR MORE.***

Level of Significance Before Analysis and Mitigation: Potentially Significant Impact.

Impact Analysis: The proposed project includes the development of 99 single-family graded residential lots and open space areas within 105 lots on approximately 187.3 gross acres of land, of which 172.6 acres would be affected by development with Lots 1 through 99 for single-family homes and Lots 100-105 for open space and equestrian lots. The residential units would comprise one to two-story single family detached wood structures, together with the associated streets and flatwork. Subterranean structures do not appear to be planned at this point; however, it is anticipated that the proposed development would include earth retaining structures. In addition, three detention basins are proposed throughout the project site.

Access to the project site is proposed to occur via three vehicular gate-controlled points. The first would occur along a proposed easterly extension of Lost Canyon Road (at the northwestern corner of the site), immediately south of the Metrolink railroad alignment. The second vehicular gate would occur at the southern boundary of the site, further south along the Lost Canyon Road extension just north of Oak Springs Canyon Road and the third would occur to the south of Oak Springs Canyon Road on the adjacent property on the proposed Mancara Road bridge with a span of approximately 275 feet is planned for Lost Canyon Road, and a second bridge with a span of approximately 160 feet is planned for a future street near its intersection.

Cut slopes up to 40 feet in height and a gradient of 2:1 (horizontal: vertical) are planned to descend to Lost Canyon Road at the northwest site margin. A cut slope up to 50 feet in height is planned in the southeastern portion of the site, behind Lots 15 through 17. Off-site and to the east of the project site, two cut slopes are planed: one up to 30 feet in height and descending to Lots 1 through 4, and a second almost 100 feet in height descending to Lots 10 through 13 in the southeastern portion of the site.

A fill slope up to approximately 25 feet in height is planned from the northern margin of Lots 66 through 68.

The project site is located on the south side of the Santa Clara River. Site topography consists of a wide canyon bottom with gentle slope gradients trending downward from the southeast to the Santa Clara River on the northwest. Relatively steep-sided ridge lines border the site on the southwest, southeast, and east. Bordering ridges are inclined at gradients ranging from approximately 3:1 (horizontal to vertical) to approximately 1:1. Two bedrock outcrops of approximately 25 and 40 feet in height are located in the western and north-central portions of the property. Site elevations range from approximately 1,550 feet above mean sea level (msl) in the northwest portion of the site to approximately 1,730 feet (msl) in the southeast portion of the site. Grading would occur within these areas, including areas with slopes in excess of 10 percent. The ridge lines and bedrock outcrops are not considered significant landforms or unique geologic or physical features, and do not constitute ridgelines, as designated by the City of Santa Clarita. Therefore, construction of the proposed project would not alter any significant landforms, or destroy, cover or modify any unique geologic or physical feature, and impacts would be less than significant in this regard.

The proposed project would be graded in one phase, and would require a total earthwork volume (excluding any remedial grading) of approximately 624,,000 cubic yards. However, all earthwork would be balanced on-site, with no need for import or export of soil. Grading activities associated with the residential development and where grading of pads, slopes and interior roads are planned would create moderate to significant changes to the current topography. The greatest changes to existing topography would occur from construction of the residential lots and roadways within the eastern portion of the site.

While both the cut and fill volumes exceed the threshold of 10,000 cubic yards, implementation of the applicable *General Plan* goals and policies and applicable recommendations contained in the *Geotechnical Assessment* as noted in Mitigation Measure GEO-3 would reduce impacts due to earth movement to a less than significant level.

Mitigation Measures:

GEO-3 The proposed development shall incorporate all applicable recommendations contained in Sections 7.2 and 7.3 of the *Geotechnical Assessment* related to grading and slopes. Any recommendations in the *Geotechnical Assessment* shall be implemented during site grading and construction.

Level of Significance After Analysis and Mitigation: Less Than Significant Impact.

5.8.5 CUMULATIVE IMPACTS AND MITIGATION MEASURES

- ***DEVELOPMENT ASSOCIATED WITH THE PROPOSED PROJECT AND OTHER RELATED CUMULATIVE PROJECTS COULD CONTRIBUTE TO CUMULATIVELY CONSIDERABLE GEOLOGY, SOILS, AND SEISMICITY IMPACTS.***

Level of Significance Before Analysis and Mitigation: Less Than Significant Impact.

Impact Analysis: The proposed project would not result in significant unavoidable impacts related to geology, soils, and seismicity, with implementation of applicable mitigation measures. Furthermore, geology, soils, and seismicity impacts are site-specific and each development site is subject to, at minimum, uniform site development and construction standards relative to seismic and other geologic conditions that are prevalent within the locality and/or region. Because the development of each cumulative project site would have to be consistent with City of Santa Clarita requirements for projects in the City, the requirements of the Los Angeles County Department of Public Works for project sites in unincorporated Los Angeles County, as each pertains to protection against known geologic hazards, and given the known geologic conditions, impacts of cumulative development would be less than significant.

Mitigation Measures: No mitigation measures are required.

Level of Significance After Analysis and Mitigation: Less Than Significant Impact.

5.8.6 SIGNIFICANT UNAVOIDABLE IMPACTS

All potentially significant impacts related to geology, soils, and seismicity are at less than significant levels or can be reduced to a level less than significant with implementation of applicable mitigation measures. As such, implementation of the proposed project would not result in any significant unavoidable geology, soils, and seismicity impacts.

5.8.7 SOURCES CITED

Santa Clarita General Plan, adopted June 15, 2011.

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California 2010 Fault Activity Map, found online at http://quake.ca.gov/gmaps/FAM/faultactivitymap.html, accessed October 2010.

California Geological Survey Website and Landslide Maps, found on line at http://www.conservation.ca.gov/cgs/rghm/landslides/Pages/ls_index.aspx, accessed October 2010.

Official United States Department of Agriculture Soils Maps, found online at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, accessed October 2010.

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