3.5 - Geology, Soils, and Seismicity

3.5.1 - Introduction

This section describes the existing geology, soils, and seismicity setting and potential effects from implementation of the Specific Plan on the Specific Plan area and its surroundings. Descriptions and analysis in this section are based information included in the City of San Ramon General Plan 2030.

3.5.2 - Environmental Setting

Regional Setting

The Specific Plan area is located within the San Ramon Valley, a portion of the California Coast Range geomorphic province. In general, the geologic structure and topography of the San Ramon Valley are characteristic of the San Francisco Bay Area. The region is generally defined by northwest-trending ridges and valleys that are generally parallel to the surrounding geologic structures, including the major fault systems. San Ramon Valley fill includes quaternary-aged alluvium up to approximately 300 feet in thickness. The valley is drained by both North and South San Ramon creeks that are actively cutting into the alluvial surface soils.

The San Ramon Valley is surrounded by the East Bay Hills. The hills were formed from younger rocks, uplifted between the Hayward and Calaveras fault zones. The San Ramon area is underlain by Tertiary (approximately 2 million to 62 million years ago) marine and non-marine sedimentary rocks. Sandstone bedrock crops out locally on ridge crests and underlies upper hill slopes at shallow depths.

Seismicity

The term seismicity refers to the location, frequency, magnitude, and other characteristics of earthquakes. To understand the implications of seismic events, a discussion of faulting and seismic hazards is provided below.

Faulting

Faults form in rocks when stresses overcome the internal strength of the rock, resulting in a fracture. Large faults develop in response to large regional stresses operating over a long time, such as those stresses caused by the relative displacement between tectonic plates. According to the elastic rebound theory, these stresses build up in the earth's crust until enough stress has built up to exceed the strength along a fault and cause a brittle failure. The rapid slip between the two stuck plates or coherent blocks generates an earthquake. Following an earthquake, stress will build once again until the occurrence of another earthquake. The magnitude of slip is related to the maximum allowable stress that can be built up along a particular fault segment. The greatest buildup in stress due to the largest relative motion between tectonic plates or fault blocks over the longest period will generally produce the largest earthquakes. The distribution of these earthquakes is a study of much interest for both hazard prediction and the study of active deformation of the earth's crust. Deformation is a complex process and strain caused by tectonic forces is not only accommodated through faulting, but also by folding, uplift, and subsidence, which can be gradual or in direct response to earthquakes.

Faults are mapped to determine earthquake hazards, since they occur where earthquakes tend to recur. A historic plane of weakness is more likely to fail under stress than a previously unbroken block of crust. Faults are, therefore, a prime indicator of past seismic activity, and faults with recent activity are presumed to be the best candidates for future earthquakes. However, since slip is not always accommodated by faults that intersect the surface along traces, and since the orientation of stress and strain in the crust can shift, predicting the location of future earthquakes is complicated. Earthquakes sometimes occur in areas with previously undetected faults or along faults previously thought inactive.

Local Faulting

There are several active faults in the immediate and surrounding areas that could affect the San Ramon area, including the Specific Plan area. The major active fault nearest to the Specific Plan area is the Calaveras Fault, which lies parallel to and just west of San Ramon Valley Boulevard, less than 0.5 mile west of the plan's western boundary paralleling the west side of I-680. The Calaveras Fault is a strike-slip fault with an estimated maximum credible earthquake magnitude of 7.5. An Alquist-Priolo Fault Hazard Zone is designated along the main thrust of the Calaveras Fault. The General Plan 2020 indicates that a splay of the Calaveras Fault extends into the western edge of Specific Plan boundaries near the Crow Canyon Road interchange; however, this feature is not overlain with an Alquist-Priolo Fault Hazard Zone designation. Note that the General Plan 2030 no longer includes this fault splay on Figure 9-1, Geotechnical Hazards map.

The California Legislature has established an Alquist-Priolo Earthquake Fault Zone along the Calaveras Fault, requiring detailed studies of rupture hazards prior to construction. The seismic activity, along with the approximate distance and direction of all known mapped active faults with the potential to affect San Ramon, is summarized in Table 3.5-1.

Table 3.5-1: Fault Summary

Fault/Fault Zone	Distance from Planning Area (miles)	Relationship to Project Site	Slip Rate (inches/year)	Maximum Moment Magnitude
Calaveras	0	Southwest	0.24	6.8
Concord-Green Valley	8	North	0.24	6.9
Hayward	9	Southwest	0.35	7.1
Greenville	10	Northeast	0.08	6.9
Great Valley	16	Northeast	0.06	6.7
San Andreas	27	Southwest	0.94	7.9
Monte Vista – Shannon	28	Southwest	0.02	6.5
Rodgers Creek	30	Northwest	0.35	7.0

Table 3.5-1 (cont.): Fault Summary

Fault/Fault Zone	Distance from Planning Area (miles)	Relationship to Project Site	Slip Rate (inches/year)	Maximum Moment Magnitude
San Gregorio	33	Southwest	0.20	7.3
West Napa	41	Northwest	0.04	6.5
Sargent	44	South	0.12	6.8
Ortigalita	49	Southeast	0.04	6.9
Point Reyes	59	Northwest	0.01	6.8
Source: MACTEC Engineering and Consulting, Inc., 2007.				

Seismic Hazards

Seismic hazards pose a substantial danger to property and human safety and are present because of the risk of naturally occurring geologic events and processes affecting human development. Therefore, the hazard risk is equally influenced by the condition and location of human development as by the frequency and distribution of major geologic events. Seismic hazards present in California include ground rupture along faults, strong seismic shaking, liquefaction, ground failure, and slope failure.

Fault Rupture

Fault rupture is a seismic hazard that affects structures sited above an active fault. The hazard from fault rupture is the movement of the ground surface along a fault during an earthquake. Typically, this movement takes place during the short time of an earthquake, but can also occur slowly over many years in a process known as creep. Most structures and underground utilities cannot accommodate the surface displacements of several inches to several feet commonly associated with fault rupture or creep.

Ground Shaking

The severity of ground shaking depends on several variables such as earthquake magnitude, epicenter distance, local geology, thickness, and seismic wave-propagation properties of unconsolidated materials, groundwater conditions, and topographic setting. Ground shaking hazards are most pronounced in areas near faults or with unconsolidated alluvium.

The most common type of damage from ground shaking is structural damage to buildings, which can range from cosmetic cracks to total collapse. The overall level of structural damage from a nearby large earthquake would likely be moderate to heavy, depending on the characteristics of the earthquake, the type of ground, and the condition of the building. Besides damage to buildings, strong ground shaking can cause severe damage from falling objects or broken utility lines. Fire and explosions are also hazards associated with strong ground shaking.

While Richter magnitude provides a useful measure of comparison between earthquakes, the moment magnitude is more widely used for scientific comparison, since it accounts for the actual energy released by the earthquake. Actual damage is due to the propagation of seismic or ground waves as a result of the earthquake, and the intensity of shaking is related to earthquake magnitude and distance as well as to the condition of underlying materials. Loose and soft materials tend to amplify long period vibrations, while hard rock can quickly attenuate them, causing little damage to overlying structures. For this reason, the Modified Mercalli Intensity (MMI) Scale provides a useful qualitative assessment of ground shaking. The MMI Scale is a 12-point scale of earthquake intensity based on local effects experienced by people, structures, and earth materials. Each succeeding step on the scale describes a progressively greater amount of damage at a given point of observation. Figure 9-1 of the General Plan indicates that the Specific Plan area is subject to Modified Mercalli Intensity (MMI) scale shaking of VII, which is categorized as "very strong." MMI VIII shaking corresponds to collapse of poorly designed buildings and considerable damage to ordinary buildings.

The MMI Scale is shown in Table 3.5-2 along with relative ground velocity and acceleration.

Table 3.5-2: Modified Mercalli Intensity Scale

Richter Magnitude	Modified Mercalli Intensity	Effects	Average Peak Ground Velocity (centimeters/ seconds)	Average Peak Acceleration
0.1–0.9	I	Not felt. Marginal and long-period effects of large earthquakes	—	—
1.0–2.9	II	Felt by only a few persons at rest, especially on upper floors of building. Delicately suspended objects may swing.	—	—
3.0–3.9	III	Felt quite noticeably indoors, especially on upper floors of building, but many people do not recognize it as an earthquake. Standing cars may rock slightly. Vibration like passing a truck.	—	0.0035–0.007 g
4.0–4.5	IV	During the day, felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensations like heavy truck striking building. Standing cars rocked noticeably.	1–3	0.015–0.035 g
4.6–4.9	V	Felt by nearly everyone, many awakened. Some dishes, windows, broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.	3–7	0.035–0.07 g

Table 3.5-2 (cont.): Modified Mercalli Intensity Scale

Richter Magnitude	Modified Mercalli Intensity	Effects	Average Peak Ground Velocity (centimeters/ seconds)	Average Peak Acceleration
5.0–5.5	VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of falling plaster and damaged chimneys. Damage slight.	7–20	0.07–0.15 g
5.6–6.4	VII	Everyone runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well built, ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.	20–60	0.15–0.35 g
6.5–6.9	VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monument walls, and heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving in cars disturbed.	60–200	0.35–0.7 g
7.0–7.4	IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	200–500	0.7–1.2 g
7.5–7.9	X	Some well-built structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Railway lines bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks.	≥ 500	>1.2 g
8.0–8.4	XI	Few, if any masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	—	—
≥ 8.5	XII	Total damage. Waves seen on ground. Lines of sight and level distorted. Objects thrown into the air.	—	—

Source: United States Geologic Survey.

Ground Failure

Ground failure includes liquefaction and the liquefaction-induced phenomena of lateral spreading, and lurching.

Liquefaction is a process by which sediments below the water table temporarily lose strength during an earthquake and behave as a viscous liquid rather than a solid. Liquefaction is restricted to certain geologic and hydrologic environments, primarily recently deposited sand and silt in areas with high groundwater levels. The process of liquefaction involves seismic waves passing through saturated granular layers, distorting the granular structure, and causing the soil to densify.

Liquefaction can cause the soil beneath a structure to lose strength, which may result in the loss of foundation-bearing capacity and which could cause a structure to settle or tip. Liquefaction can also result in the settlement of large areas because of the densification of the liquefied deposit. Where structures are located within liquefied deposits, the liquefaction can result in the structure to rise as a result of buoyancy. The United States Geological Survey identifies the Specific Plan area as having a moderate potential for liquefaction susceptibility.

Lateral spreading is lateral ground movement, with some vertical component, as a result of liquefaction. In effect, the soil rides on top of the liquefied layer. Lateral spreading can occur on relatively flat sites with slopes less than 2 percent, under certain circumstances, and can cause ground cracking and settlement.

Lurching is the movement of the ground surface toward an open face when the soil liquefies. An open face could be a graded slope, stream bank, canal face, gully, or other similar feature.

Landslides and Slope Failure

Landslides and other forms of slope failure form in response to the long-term geologic cycle of uplift, mass wasting, and disturbance of slopes. Mass wasting refers to a variety of erosional processes from gradual downhill soil creep to mudslides, debris flows, landslides, and rock fall. These processes are commonly triggered by intense precipitation. Seismic activity can also trigger landslides and rockfalls.

Often, various forms of mass wasting are grouped together as landslides, which are generally used to describe the downhill movement of rock and soil. Geologists classify landslides into several different types that reflect differences in the type of material and type of movement. The four most common types of landslides are translational, rotational, earth flow, and rock fall. Debris flows and earth flows are another type of landslide that are characterized by soil and rock particles in suspension with water and which often move with considerable speed. Debris flows often refer to flows that contain coarser soil and rock materials while earth flows frequently refer to slides that are predominantly finer materials. Mudslide is a term that appears in non-technical literature to describe a variety of shallow, rapidly moving earth flows.

As indicated by the San Ramon General Plan, the majority of the Specific Plan area is not susceptible to landslides with the exception of minor areas adjacent to Alcosta Boulevard in the northeastern portion of the plan area where landslide density and surficial deposits are designated as "few landslides."

Soils

The United States Department of Agriculture, Natural Resources Conservation Service indicates that the Specific Plan boundaries contain four soil types: Botella Clay Loam, Clear Lake Clay, Conejo Clay Loam, and Diablo Clay. Each soil is summarized in Table 3.5-3. Generally, all four soils exhibit shrink-swell characteristics consistent with expansive soils.

Table 3.5-3: Soil Properties Summary

Soil	Soil Surface Texture	Infiltration Rate	Percent of Clay
Botella Clay Loam	Clay Loam	Moderate	32.5
Clear Lake Clay	Clay	Very Slow	48.7
Conejo Clay Loam	Clay Loam	Slow	31.0
Diablo Clay	Clay	Moderately High	45.0

Note:
Data obtained from the online Web Soil Survey: http://websoilsurvey.nrcs.usda.gov.
Source: Natural Resources Conservation Service, 2009.

Subsurface Soil Conditions

Most of the properties within the Specific Plan boundaries are developed and, therefore, have been previously graded and soil engineered. Fill would be expected to be encountered at depths of less than 10 feet below ground surface within most properties.

3.5.3 - Regulatory Framework

State

California Building Standards Code

The California Building Standards Code establishes building requirements for construction and renovation. The most recent version of the California Building Standards Code was adopted in 2010 by the California Building Standards Commission and took effect January 1, 2011, and it is based on the International Code Council's Building and Fire Codes. Included in the California Building Standards Code are the Electrical Code, Mechanical Code, Plumbing Code, Energy Code, and Fire Code.

The State of California provides minimum standards for building design through the California Building Standards Code (California Code of Regulations, Title 24). Where no other building codes apply, Chapter 29 regulates excavation, foundations, and retaining walls. Finally, the 2010 California Building Standards Code regulates grading activities, including drainage and erosion control and construction on unstable soils, such as expansive soils and areas subject to liquefaction.

California Seismic Hazards Mapping Act

The California Seismic Hazards Mapping Act of 1990 (California Public Resources Code Section 1690-2699.6) addresses seismic hazards other than surface rupture, such as liquefaction and induced landslides. The Seismic Hazards Mapping Act specifies that the lead agency for 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.

Alquist-Priolo Earthquake Fault Zoning Act

In response to the severe fault rupture damage of structures by the 1971 San Fernando earthquake, the State of California enacted the Alquist-Priolo Earthquake Fault Zoning Act in 1972. This act required the State Geologist to delineate Earthquake Fault Zones along known active faults that have a relatively high potential for ground rupture. Faults that are zoned under the Alquist-Priolo Act must meet the strict definition of being "sufficiently active" and "well-defined" for inclusion as an Earthquake Fault Zones. The Earthquake Fault Zones are revised periodically, and they extend 200 to 500 feet on either side of identified fault traces. No structures for human occupancy may be built across an identified active fault trace. An area of 50 feet on either side of an active fault trace is assumed to be underlain by the fault, unless proven otherwise. Proposed construction in an Earthquake Fault Zone is permitted only following the completion of a fault location report prepared by a California Registered Geologist.

Local

General Plan 2030

The General Plan 2030 sets forth the following guiding and implementing policies that are relevant to geology, soils, and seismicity:

- **Implementing Policy 8.3-I-10:** Promote maintenance and protection of waterways through the use of Geologic Hazard Abatement District(s), conservation easements, endowments, special assessments, or other appropriate mechanisms.
- **Implementing Policy 8.3-I-16:** Develop and adopt slope methodology standards to implement the resource management policies.
- **Implementing Policy 8.4-I-10:** Continue planning and managing ridgelines, agricultural lands, and open space acquired by the City or other Open Space areas through the Geologic Hazard Abatement District(s) and the Dougherty Valley Open Space Management Plan.
- **Implementing Policy 9.1-I-1:** Maintain and update the City's Emergency Operations Plan, as required by State and Federal laws, to minimize the risk to life and property of seismic and geologic hazards, hazardous materials and waste, and fire.
- **Guiding Policy 9.2-G-1:** Minimize risks of personal injury and property damage posed by geologic and seismic hazards.
- **Implementing Policy 9.2-I-1:** Review proposed development sites during the planning process to identify and mitigate any potential geologic or seismic hazards.

- **Implementing Policy 9.2-I-2:** Require the preparation of a fault investigation study to identify appropriate setbacks for any proposed structure intended for human occupancy within 50 feet of an active fault trace.
- **Implementing Policy 9.2-I-3:** Where appropriate, require an independent registered engineering geologist or geotechnical engineer to review geotechnical reports submitted by applicants on sites in seismically hazardous areas.
- **Implementing Policy 9.2-I-4:** Require comprehensive geologic and engineering studies of critical structures regardless of location.
- **Implementing Policy 9.2-I-5:** Require geotechnical field review during the construction phase of any new development as determined by the City Engineer.
- **Implementing Policy 9.2-I-6:** Require preparation of a soils report as part of the development review and/or building permit process.
- **Implementing Policy 9.2-I-7:** Limit cut-and-fill slopes to 3:1 (33 percent slope) except where an engineering geologist or geotechnical engineer can establish to the satisfaction of the City Engineer that a steeper slope would not pose undue risk to people and property.
- **Implementing Policy 9.2-I-8:** Blend cut-and-fill slopes with existing contours to avoid the appearance of artificial slopes.
- **Implementing Policy 9.2-I-9:** Provide information and establish incentives for property owners to rehabilitate existing buildings using construction techniques to protect against seismic hazards.
- **Implementing Policy 9.2-I-10:** Control erosion of graded areas with revegetation or other acceptable methods.
- **Implementing Policy 9.2-I-12:** Encourage continued investigation by State agencies of geologic conditions within the City's Planning Area to promote public awareness of potential geologic and seismic hazards.
- **Implementing Policy 9.2-I-13:** Review and update, as appropriate, City Code requirements for excavation, grading and filling to ensure that they conform to currently accepted standards.

San Ramon Municipal Code

The San Ramon Municipal Code Division C7 establishes requirements related to grading and erosion control. The division sets forth rules and regulations to control excavation, grading, and earthwork construction, including fills and embankments, and establishes administrative requirements for issuance of permits and approval of plans and inspection of grading construction in accordance with the requirements for grading and excavation. All projects within the City limits involving earthwork activities must obtain a grading permit and adhere to the requirements stipulated in the Municipal Code.

3.5.4 - Methodology

Michael Brandman Associates evaluated potential impacts on geology, soils, and seismicity through review of the City of San Ramon General Plan 2030, seismic hazard mapping, and the Natural Resources Conservation Service Web Soil Survey.

3.5.5 - Thresholds of Significance

According to Appendix G, Environmental Checklist, of the CEQA Guidelines, geology, soils, and seismicity impacts resulting from the implementation of the proposed project would be considered significant if the project 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- 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 wastewater disposal systems where sewers are not available for the disposal of wastewater? (Refer to Section 7, Effects Found Not To Be Significant.)

3.5.6 - Project Impacts and Mitigation Measures

This section discusses potential impacts associated with the development of the project and provides mitigation measures where appropriate.

Seismic Hazards

Impact GEO-1:	**Development and land use activities contemplated by the Specific Plan may expose people or structures to potential substantial adverse effects associated with seismic hazards.**

Impact Analysis

The Specific Plan area is located in an area of high seismicity, as is all of the San Francisco Bay Area. Potential seismic hazards include fault rupture, strong ground shaking, and seismic-related ground failure or liquefaction. Each is discussed separately.

Fault Rupture

The Specific Plan area does not contain an Alquist-Priolo Earthquake Fault Zone. However, an Alquist-Priolo Earthquake Fault Zone associated with the Calaveras Fault is present less than 0.5 mile to the west of the Specific Plan boundary. In addition, a splay of the Calaveras Fault may extend into the western edge of the Specific Plan boundaries near the Crow Canyon Road interchange; however, this feature is not assigned an Alquist-Priolo Fault Hazard Zone designation. Nonetheless, further investigation of fault rupture may be warranted for properties located near I-680. Mitigation GEO-1a is proposed that would require development within 500 feet of I-680 to prepare a fault investigation study to determine the location of the splay and, if warranted, identify appropriate setbacks pursuant to the Alquist-Priolo Earthquake Fault Zoning Act. This measure provides certainty that the development within the Specific Plan area would not be at risk from fault rupture.

Seismic Ground Shaking

A major seismic event on one of the faults listed in Table 3.5-1 may result in strong ground shaking within the Specific Plan area. To reduce the potential for exposure of persons and property to harm, development within the plan boundaries would be required to meet the applicable seismic design standards of the California Building Standards Code. These design standards are intended primarily to protect public safety and secondly to minimize property damage. Compliance with the seismic design standards of the California Building Standards Code and implementation of GEO-1b would ensure that potential impacts are less than significant.

Seismic-Related Ground Failure

The United States Geological Survey identifies the Specific Plan area as having a moderate potential for liquefaction susceptibility. However, development within the plan boundaries would comply with all applicable California Building Standards Code seismic design standards. In addition, implementation of Mitigation Measure GEO-1b would require a design-level geotechnical study, which would include analysis of the potential for ground failure. Compliance with standards and mitigations would ensure that the proposed structures would not expose persons to seismic-related ground failure hazards including liquefaction. Impacts would be less than significant.

Landslides and Slope Failure

The Specific Plan area and immediate vicinity is generally characterized by flat relief with slopes of less than 5 percent. Some areas of moderate slope occur, specifically near the northeastern portion of the plan area; however, the most of these slopes are minor and have been engineered to ensure stability. This condition precludes the possibility of earthquake-induced landsliding occurring onsite. Impacts would be less than significant.

Level of Significance Before Mitigation

Potentially significant impact.

Mitigation Measures

MM GEO-1a Prior to issuance of building permits for new construction on any property within 500 feet of I-680, the project applicant shall retain a qualified geologist or geotechnical engineer to prepare a fault investigation study for the splay of the Calaveras Fault that may extend into the western portion of the Specific Plan boundaries. The study shall identify the location of the splay in relation to the property in question and, if warranted, identify appropriate building setbacks pursuant to the Alquist-Priolo Earthquake Fault Zoning Act. Any necessary setbacks shall be shown on building plans submitted to the City of San Ramon. The approved plans shall be incorporated into the proposed project. The fault investigation study may be performed as part of a design-level geotechnical study prepared pursuant to Mitigation Measure GEO-1b.

MM GEO-1b Prior to issuance of building permits for new construction on any property within the Specific Plan, the project applicant shall submit a design-level geotechnical study and building plans to the City of San Ramon for review and approval. The building plans shall demonstrate that they incorporate all applicable recommendations of the design-level geotechnical study and comply with all applicable requirements of the most recent version of the California Building Standards Code. A licensed professional engineer shall prepare the plans, including those that pertain to soil engineering and structural foundations. The approved plans shall be incorporated into the proposed project. All onsite soil engineering activities shall be conducted under the supervision of a licensed Geotechnical Engineer or Certified Engineering Geologist.

Level of Significance After Mitigation

Less than significant impact.

Erosion or Topsoil Loss

Impact GEO-2:	**Development and land use activities contemplated by the Specific Plan have the potential to result in soil erosion or the loss of topsoil.**

Impact Analysis

The development of land uses as envisioned in the Specific Plan would require grading and excavation. During these activities, there would be the potential for surface water to carry sediment from onsite erosion into the stormwater system and local waterways. Soil erosion may occur during construction in areas where temporary soil storage is required.

Construction activities associated with the development of land uses would involve vegetation removal, grading, and excavation activities that could expose barren soils to sources of wind or water, resulting in erosion and sedimentation on and off the project site. National Pollutant Discharge Elimination System (NPDES) Phase II stormwater permitting programs regulate stormwater quality from construction sites, which includes erosion and sedimentation. Under the NPDES permitting program, the preparation and implementation of Stormwater Pollution Prevention Programs (SWPPPs) are required for construction activities more than 1 acre in size. The SWPPP must identify potential sources of erosion or sedimentation that may be reasonably expected to affect the quality of stormwater discharges as well as identify and implement BMPs that ensure the reduction of these pollutants during stormwater discharges. Typical BMPs intended to control erosion include sand bags, detention basin, silt fencing, landscaping, hydroseeding, storm drain inlet protection, street sweeping, and monitoring of water bodies.

Prior to construction grading, the applicant must file a Notice of Intent to comply with the General NPDES Permit issued to the RWQCB and prepare the SWPPP, which addresses the measures that would be included in the project to minimize and control construction and post-construction runoff to the "maximum extent practicable." In addition, development within the Specific Plan area would be required to comply with the City Code requirements pertaining to grading and excavation.

Once completed, development projects within the Specific Plan area would be required to implement long-term pollution prevention measures.

The implementation of the above requirements (including the preparation and implementation of an SWPPP and compliance with City Code requirements) would reduce potential construction-related erosion impacts to a level of less than significant.

Level of Significance Before Mitigation

Potentially significant impact.

Mitigation Measures

Implement Mitigation Measures HYD-1a and HYD-1b in Section 3.7, Hydrology and Water Quality.

Level of Significance After Mitigation

Less than significant impact.

Unstable Geologic Units or Soils

Impact GEO-3:	**Development and land use activities contemplated by the Specific Plan may expose persons or property to hazards associated with unstable geologic units or soils.**

Impact Analysis

As previously discussed, the Specific Plan area contains areas potentially susceptible to liquefaction and minor areas susceptible to landsliding as a result of underlying geologic conditions. Existing development within the Specific Plan area mitigated the potential for adverse impacts from unstable geologic units and soils through compliance with building code requirements, retaining walls, and landscaping.

Future development as envisioned in the Specific Plan would also be required to comply with building code requirements to mitigate and minimize liquefaction and landslide hazards. Furthermore, implementation of Mitigation Measure GEO-1b would require a geotechnical study to be completed, which would include preventative measures for liquefaction and landsliding. As such, impacts related to unstable geologic units or soils would be less than significant.

Level of Significance Before Mitigation

Potentially significant impact.

Mitigation Measures

Implement Mitigation Measure GEO-1b.

Level of Significance After Mitigation

Less than significant impact.

Expansive Soils

Impact GEO-4:	**Development and land use activities contemplated by the Specific Plan may result in unacceptable risks associated with expansive soils.**

Impact Analysis

Expansive soils, also known as shrink-swell soils, refer to the potential of soil to expand when wet and contract when dry. The Specific Plan area contains four soil types, all of which exhibit shrink-swell characteristics consistent with expansive soils. Implementation of Mitigation Measure GEO-1b would determine the presence of expansive soils and indicate where further grading, excavation, and soil engineering should be performed. Implementation of mitigation would ensure impacts related to expansive soils would be less than significant.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

Implement Mitigation Measure GEO-1b.

Level of Significance After Mitigation

Less than significant impact.