

3.8 GEOLOGY, SOILS, AND MINERALS

3.8.1 INTRODUCTION

This section covers three closely related topics: geology (including geologic hazards such as earthquakes), soils, and mineral resources. For each of these topics, it describes existing conditions at and surrounding the project site, summarizes relevant regulations and policies, and analyzes the anticipated impacts of implementing the Proposed Action.

Sources of information used in this analysis include:

- Sierra Vista Specific Plan EIR prepared by the City of Roseville;
- Preliminary Geotechnical Engineering Report Sierra Vista Specific Plan, prepared by Wallace Kuhl & Associates;
- Maps and reports by the United States Geological Survey (USGS) and California Geological Survey (CGS); and
- Maps and reports by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).

3.8.2 AFFECTED ENVIRONMENT

3.8.2.1 Physiographic Setting

The project site is located in the Sacramento Valley, which forms the northern portion of California's Great Valley geomorphic province. Bounded by the Sierra Nevadas on the east and the Coast Ranges on the west, the Great Valley is only about 40 miles (64 kilometers) wide, but extends nearly 500 miles (805 kilometers) along the axis of the state, from the Klamath and Cascade Mountains in the north to the Tehachapi Mountains in the south. Much of the valley floor is near sea level (Norris and Webb 1990), with the conspicuous exception of the Sutter Buttes, 40 miles (64 kilometers) northwest of the project site, which rise to an elevation of about 2,100 feet (640 meters) above mean sea level (msl) (Norris and Webb 1990; City of Roseville 2010). The Sacramento Valley floor contains a thick sequence of sedimentary deposits that range in age from Jurassic through Quaternary that were derived from the weathering and erosion of the Sierra Nevada and the Coast Ranges, and carried by water and deposited on the valley floor (Norris and Webb 1990, Gutierrez et al. 2010).

3.8.2.2 Regional Seismicity and Fault Zones

The site is not located within or traversed by any earthquake fault zone defined by the State of California pursuant to the Alquist-Priolo Earthquake Fault Zoning Act (Bryant and Hart 2007). The closest State-zoned faults to the project site are portions of the Foothills fault zone, located approximately 18 miles (29 kilometers) east of the site. Farther to the west, a number of zoned faults are present in the Coast Ranges and San Francisco Bay Area, including the Ortigalita, Green Valley, Concord, Calaveras, Hayward, and San Andreas (**Figure 3.8-1**). Several faults not considered active are also present in the project area (City of Roseville 2010).

Because of its distance from major fault systems, Placer County is considered a low-severity earthquake zone. The maximum earthquake intensity anticipated would correspond to an intensity of VI or VII on the Modified Mercalli Scale (City of Roseville 2010).¹

3.8.2.3 Project Site - Topographic and Geologic Conditions

The project site is located on the eastern margin of the Sacramento Valley, about 10 miles (16 kilometers) from the westernmost foothills of the Sierra Nevada. The site is in a transitional zone between the flat, open terrain of the Sacramento Valley to the west and the foothills of the Sierra Nevada Mountains to the east. Topography on the site is flat to gently rolling, with elevations ranging from about 75 to 125 feet (23 to 38 meters) msl (Wallace Kuhl & Associates 2005). Principal features on the project site include the seasonal Curry Creek drainage, which flows southwest across the southeast corner of the project site, and a second drainage known as Federico Creek that flows west-southwest across the northern portion of the site (City of Roseville 2010).

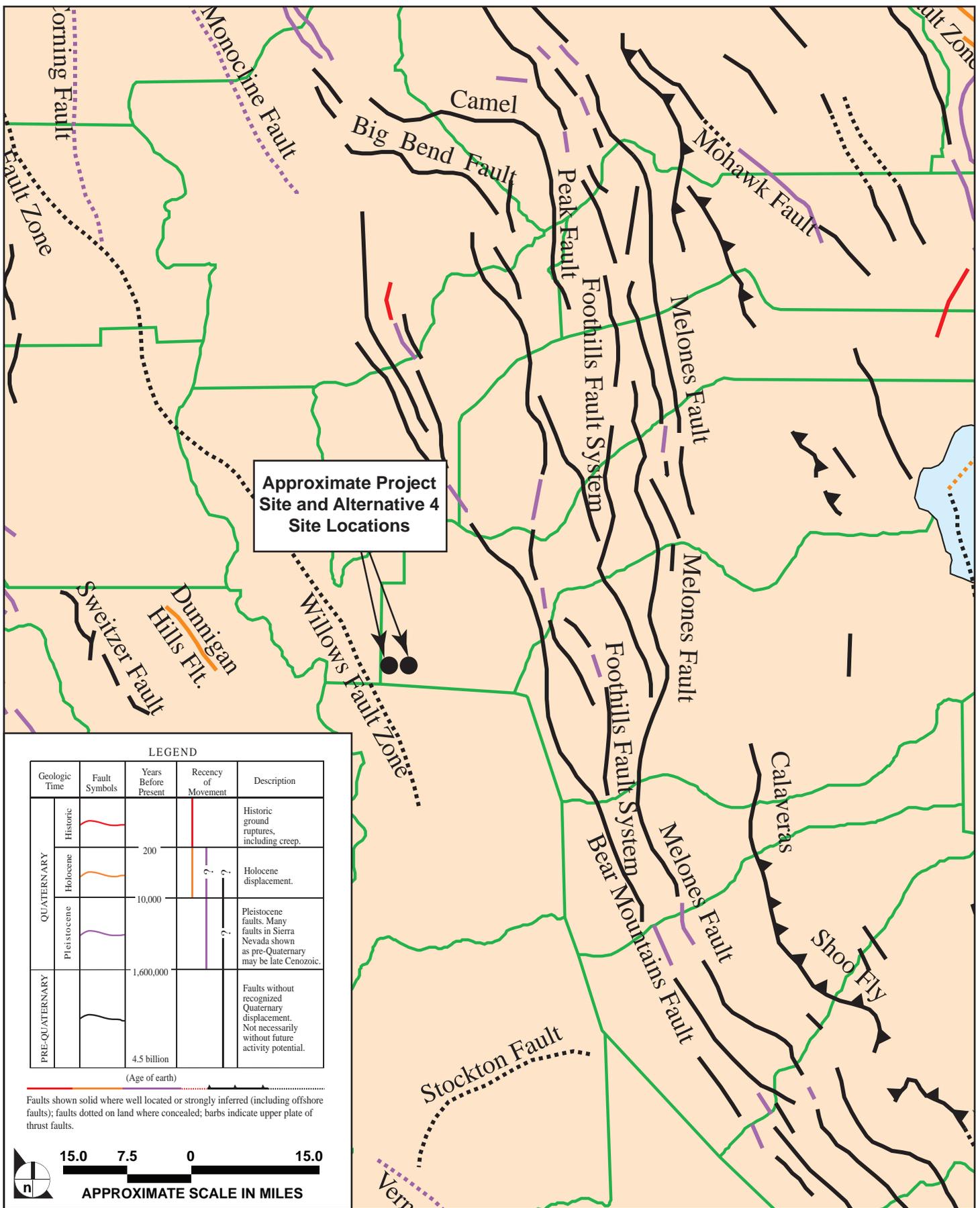
Figure 3.8-2 shows the geology of the project site and its immediate vicinity. The project site is underlain almost entirely by strata of the Riverbank Formation, with a small area in the site's southeast corner underlain by the Turlock Lake Formation. The Riverbank and Turlock Lake Formations are alluvial deposits consisting of material derived from erosion of the Sierra Nevada. The Riverbank Formation ranges in age from about 450,000 to about 130,000 years (Pleistocene). The lower member of the Riverbank Formation, which underlies the majority of the project site, is partially consolidated and consists of reddish gravel, sand, and silt. The upper member of the Riverbank Formation, which occurs only in a limited area in the southwestern corner of the project site, is darker in color and consists of unconsolidated gravel, sand, and silt with minor clay content. The Turlock Lake Formation, also of Pleistocene age but slightly older than the Riverbank Formation, is limited to the southeastern corner of the site and is dominated by feldspar-rich gravels but contains sand and silt along the east side of the Sacramento Valley (Helley and Harwood 1985).

Ground subsidence has occurred in some parts of the Great Valley geomorphic province as a result of groundwater overdraft. The Roseville area is not known to have experienced subsidence that would limit or constrain development (City of Roseville 2010).

3.8.2.4 Project Site – Liquefaction

Liquefaction is defined as the loss of soil strength due to seismic forces acting on water-saturated granular soils, which leads to quicksand conditions that generate various types of ground failure. The potential for liquefaction must take into account soil type, soil density, depth to the groundwater table and the duration and intensity of ground shaking. Liquefaction is most likely to occur in low-lying areas of poorly consolidated to unconsolidated water-saturated sediments or similar deposits. The City of Roseville's geographic location, soil characteristics, and topography combined minimize the risk of liquefaction. Based on the depth to groundwater and the project site soils, the project generally has a low to moderate potential for liquefaction.

¹ The Modified Mercalli Scale describes earthquake intensity based on observed effects. Mercalli intensity VI corresponds to the following observations: "Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight." Mercalli intensity VII is described as follows: "Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken." (U.S. Geological Survey 1989)



SOURCE: Compiled by Charles W. Jennings and George J. Saucedo – 1999 (Revised 2002, Tousson Topozada and David Branum)

FIGURE 3.8-1

Regional Fault Map

3.8.2.5 Project Site - Soils

Soils mapping by the Natural Resources Conservation Service shows seven soil units on the project site (**Figure 3.8-3**). **Table 3.8-1, Overview of Project Site Soils**, includes an overview of their characteristics, including limitations that represent potential constraints for project design and construction. Limitations may be evaluated as slight, moderate, high, or severe. **Table 3.8-1** is located at the end of this section. As described in **Table 3.8-1**, the soil mapping units within the project include: Alamo-Fiddymment complex 0 to 5 percent slopes; Cometa-Fiddymment Complex 1 to 5 percent slopes; Cometa-Ramona sandy loams, 1 to 5 percent slopes; Fiddymment loam 1 to 8 percent slopes; Fiddymment-Kaseberg loams 2 to 9 percent slopes; San Joaquin-Cometa sandy loams 1 to 5 percent slopes; and Xerofluvents hardpan substratum (NRCS Web Soil Survey 2010). All of these soils occur on low terraces, are shallow to moderately deep, and are underlain by hardpans except for Cometa which is underlain by a dense clay pan. The average depth to hardpan or clay pan in these soils ranges from 18 inches to 40 inches. As stated previously, virtually all of these soils have been disked and/or plowed in the past and are not now actively grazed. As a result, the soils typically are not compacted and are well aerated. The disking and/or plowing has eliminated much of the natural micro-topography in many areas but has not resulted in significantly truncated or buried soil profiles (Gibson & Skordal 2011).

3.8.2.6 Project Site - Mineral Resources

The project site has been classified as mineral resource zone (MRZ) 4 by the State of California Division of Mines and Geology pursuant to the Surface Mining and Reclamation Act of 1975 (City of Roseville 2010). As discussed in more detail in **subsection 3.8.3**, below, this designation identifies areas where available information is inadequate to support assignment into any other MRZ category and “does not rule out either the presence or absence of significant mineral resources.” The current General Plan acknowledges the presence of limited sand and gravel resources in the City, but no extraction activities are currently taking place, and none are foreseen (City of Roseville 2010).

3.8.2.7 Alternative 4 Site - Topography, Geologic Conditions, and Mineral Resources

Alternative 4 site is located on the valley floor, about 2 miles (3.2 kilometers) to the west of the project site. Topography of the site is flat to gently rolling, with elevations ranging from about 75 to 125 feet (23 to 38 meters) msl. Principal features on the site include the seasonal Curry Creek drainage, which crosses the northeast corner of the project site and another seasonal creek and its tributary that traverses the central portion of the site in a general east to west direction. No mapped active faults are located on the site. Similar to the project site, the Alternative 4 site is also underlain almost entirely by strata of the Riverbank Formation. The Riverbank Formation is identified by weathered reddish gravel, sand, and silt forming clearly recognizable alluvial terraces and fans (Helley and Harwood 1985).

The soil mapping by the Natural Resources Conservation Service shows that the site is underlain by Alamo-Fiddymment Complex (0 to 5 percent slopes), Cometa-Fiddymment complex (1 to 5 percent slopes), Cometa-Fiddymment complex (1 to 5 percent slopes), San Joaquin-Cometa sandy loams (1 to 5 percent slopes), Xerofluvents (hardpan substratum), Cometa loam (0 to 2 percent slopes), San Joaquin sandy loam (0 to

2 percent slopes) and San Joaquin-Arents –Durochrepts complex (0 to 1 percent slopes). These are largely similar to soils on the project site and the physical properties and limitations for the majority of soils on Alternative 4 site are described in **Table 3.8-1**. The Alternative 4 site has been classified as MRZ-4 by the State of California Division of Mines and Geology.

3.8.3 REGULATORY FRAMEWORK – APPLICABLE LAWS, REGULATIONS, PLANS, AND POLICIES

3.8.3.1 Federal Regulations

Earthquake Hazards Reduction Act

The Earthquake Hazards Reduction Act—enacted in 1977 and amended several times, most recently in 2004—established the National Earthquake Hazards Reduction Program (NEHRP) as a means to address earthquake risks to life and property in the nation’s seismically active states, including but not limited to California. The Act charges NEHRP with the following specific activities.

- Developing effective measures for earthquake hazards reduction.
- Promoting the adoption of earthquake hazards reduction measures at federal, state, and local levels through a program of grants, contracts, cooperative agreements, and technical assistance; and through the development of standards, guidelines, and voluntary consensus codes for earthquake hazards reduction for buildings, structures, and lifelines.
- Developing and maintaining a repository of information on seismic risk and hazards reduction.
- Improving the understanding of earthquakes and their effects through interdisciplinary research that involves engineering; natural sciences; and social, economic, and decisions sciences; and
- Developing, operating, and maintaining an Advanced National Seismic Research and Monitoring System.

NEHRP is overseen by the Interagency Coordinating Committee on Earthquake Hazards Reduction, made of the directors of the Federal Emergency Management Agency (FEMA), the United States Geological Survey (USGS); the National Science Foundation; the Office of Science and Technology Policy; and the Office of Management and Budget.

3.8.3.2 State Regulations

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code Sec 2621 et seq.) charges the State of California with defining hazard corridors (Earthquake Fault Zones) along active faults, within which local jurisdictions must strictly regulate construction; in particular, the Act prohibits construction of structures intended for human occupancy (defined for purposes of the Act as more than 2,000 person-hours per year) across active faults. The Act establishes a legal definition for the term *active*, defines criteria for identifying active faults, and establishes a process for reviewing building proposals in and adjacent to defined Earthquake Fault Zones, to be implemented by the state’s local jurisdictions (cities and counties), who typically do so through the building permit review process.



LEGEND

- 104 ALAMO-FIDDYMENT COMPLEX, 0 TO 5 PERCENT SLOPES
- 141 COMETA-FIDDYMENT COMPLEX, 1 TO 5 PERCENT SLOPES
- 142 COMETA-RAMONA SANDY LOAMS, 1 TO 5 PERCENT SLOPES
- 146 FIDDYMENT LOAM, 1 TO 8 PERCENT SLOPES
- 147 FIDDYMENT-KASEBURG LOAMS, 2 TO 9 PERCENT SLOPES
- 182 SAN JOAQUIN-COMETA SANDY LOAMS, 1 TO 5 PERCENT SLOPES
- 195 XEROFLUVENTS, HARDPAN SUBSTRATUM



1000 500 0 1000

APPROXIMATE SCALE IN FEET

SOURCE: City of Roseville, February 2011

FIGURE 3.8-3

Project Site Soils Map

Under the Alquist-Priolo Act, a fault is considered active if one or more of its segments or strands shows evidence of surface displacement during Holocene time.² Because of the Alquist-Priolo Act's statewide purview, the Earthquake Fault Zone maps are a key tool for assessing surface fault rupture risks to projects of all types, even though the Act regulates only construction for human occupancy.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 (California Public Resources Code Sections 2690–2699.6) addresses secondary earthquake-related hazards, including liquefaction and seismically induced landslides. Like the Alquist-Priolo Act, the Seismic Hazards Mapping Act charges the state with mapping areas subject to hazards, and makes cities and counties responsible for regulating development for human occupancy within mapped Seismic Hazard Zones. In practice, as with the Alquist-Priolo Act, local jurisdiction building permit review serves as the primary mechanism for controlling public exposure to seismic risks, since cities and counties are prohibited from issuing development permits for sites within Seismic Hazard Zones until or unless appropriate site-specific geologic/geotechnical investigations have been carried out and measures to avoid or reduce damage have been incorporated into the development proposal.³ Like the Alquist-Priolo Earthquake Fault Zone Maps, the maps produced by the Seismic Hazards Mapping Program are useful as a first-order risk assessment tool for liquefaction and seismically induced landslide risks to projects of all types, although the Seismic Hazards Mapping Act, like the Alquist-Priolo Act, regulates only construction for human occupancy.

California Building Standards Code

The State of California's minimum standards for structural design and construction are given in the California Building Standards Commission (CBSC) (CCR Title 24). The California Building Code (CBC) is based on the International Code Council's International Building Code, which is used widely throughout United States (generally adopted on a state-by-state or district-by-district basis) and has been modified for California conditions with numerous, more detailed or more stringent regulations. The CBSC provides standards for various aspects of construction, including but not limited to:

- excavation, grading, and earthwork construction;
- fills and embankments;
- expansive soils, foundation investigations, and liquefaction potential; and
- soil strength loss.

² Under the Alquist-Priolo Act, Holocene time is conservatively defined as referring to approximately the last 11,000 years, although it is more commonly understood as including only the last 10,000 years.

³ For University of California projects (which are not subject to local jurisdiction permit review) the University is responsible for enforcing these provisions.

Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act (SMARA) of 1975 is the state's primary mineral resources law. The stated purpose of the act is to provide a comprehensive surface mining and reclamation policy that will encourage the production and conservation of mineral resources while ensuring that adverse environmental effects of mining are prevented or minimized, that mined lands are reclaimed, and residual hazards to public health and safety are eliminated. SMARA requires the State Geologist to classify mineral resources in order to help identify and protect mineral resources in areas within the state subject to urban expansion. The State Geologist is charged with evaluating mineral resource potential and assigning one of three MRZ designations that reflect the known or inferred presence and significance of a given mineral resource:

- MRZ-1: areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence;
- MRZ-2: areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists; or
- MRZ-3: areas containing mineral deposits, the significance of which cannot be evaluated from available data.

In practice, an additional category, MRZ-4, is used to designate areas for which available information is inadequate for assignment into any other MRZ. In addition, at least once every 10 years (following the completion of each decennial census) SMARA requires the state's Office of Planning and Research to identify areas that are already urbanized, subject to urban expansion, or under other irreversible land uses that preclude mineral extraction. Under SMARA, permitting, oversight, and enforcement responsibility for mining operations (including mine reclamation) is assigned to the local jurisdiction level.

3.8.3.3 Local Plans, Policies, and Ordinances

City of Roseville Building Code

Building codes are adopted at the local jurisdiction level and enforced through the local jurisdiction building permit process. The City of Roseville's adopted building code is the current CBC. The City of Roseville considers administrative variances to allow deviations from its ordinances. Among other requirements, the application for a variance must demonstrate that special physical circumstances applicable to the property, including size, shape, topography, location or surroundings; and that approval of the variance would not be materially detrimental to the public health, safety, or welfare, or injurious to the property or improvements in the project vicinity.

City of Roseville Grading Ordinance

The City's Grading Ordinance (Roseville Municipal Code Chapter 16.20) requires a grading permit (Grading plan approval) for all grading except very minor operations that result in excavations and fills less than 2 feet deep and involve a total volume of less than 50 cubic yards, and those specifically exempted by the building code (trenching for utilities installation, well excavations, cemetery graves, etc.) For many types of grading, a grading plan must be submitted and approved before grading may proceed.

City of Roseville General Plan

Table 3.8-2 summarizes the current City General Plan goal, policies, and implementation measures relevant to geology, soils, and geologic hazards.

No mineral extraction operations are currently take place within the City, and none are planned during the lifespan of the current planning documents. Consequently, the City's 2025 General Plan contains no policies relevant to mineral resources, but it does identify that if the City expands in the future, such policies may need to be added (City of Roseville 2010b).

**Table 3.8-2
General Plan Guidance for Geologic Hazards**

Goal 1 Minimize injury and property damage due to seismic activity and geologic hazards.	
Policy	Implementation Measures
1. Continue to monitor seismic activity in the region and take appropriate action if significant seismic hazards, including potentially active faults, are discovered in the planning area.	1. California Division of Mines and Geology [California Geological Survey] studies 2. City Multi-Hazard Mitigation Plan
2. Continue to mitigate the potential impacts of geologic hazards through building plan review.	3. California Building Code
3. Minimize soil erosion and sedimentation by maintaining compatible land uses, suitable building designs, and appropriate construction techniques.	4. City development review process 5. City Grading and Erosion Control Ordinance 6. Specific Plans 7. Land use designations
4. Comply with state seismic and building standards in the design and siting of critical facilities including police and fire stations, school facilities, hospitals, hazardous material manufacture and storage facilities, bridges, and large public assembly halls.	8. California Division of Mines and Geology [California Geological Survey] studies 9. California Building Code
5. Create and adopt slope development standards prior to or as part of the planning process for any area identified as having significant slope.	10.City development review process 11.Specific Plans
6. Require contour grading, where feasible, and revegetation to mitigate the appearance of engineered slopes and to control erosion.	12.City development review process 13.Grading and Erosion Control Ordinance

Source: City of Roseville 2010b

Placer County Building Code

Building codes are adopted at the local jurisdiction level and enforced through the local jurisdiction building permit process. Placer County uses several model codes, including the current CBC and some model building codes from the International Code Council (ICC).

Grading, Erosion and Sediment Control Ordinance

The County's Grading, Erosion and Sediment Control (Placer County Code Chapter 15.48) requires a grading permit (Grading plan approval) for fill or excavation greater than 250 cubic yards, cuts or fills exceeding 4 feet in depth, soil disturbances exceeding 10,000 square feet, grading within or adjacent to a drainage course or wetland, and grading within a floodplain. For many types of grading, a grading plan must be submitted and approved before grading may proceed. In addition, a soil or geologic investigation report is required if grading includes cut or fill exceeding 10 feet in depth, when highly expansive soils are present, and in areas of known or suspected geological hazards.

Placer County General Plan

Placer County General Plan goal, policies, and implementation measures relevant to geology, soils, and geologic hazards include the following:

- Goal:** To minimize the loss of life, injury, and property damage caused by seismic and geological hazards.
- Policy 8.A.1:** The County shall require the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to geological or seismic hazards (i.e., groundshaking, landslides, liquefaction, critically expansive soils, and avalanche).
- Policy 8.A.2:** The County shall require submission of a preliminary soils report, prepared by a registered civil engineer and based upon adequate test borings, for every major subdivision and for each individual lot where critically expansive soils have been identified or are expected to exist.
- Policy 8.A.3:** The County shall prohibit the placement of habitable structures or individual sewage disposal systems on or in critically expansive soils unless suitable mitigation measures are incorporated to prevent the potential risk or these conditions.
- Policy 8.A.8:** The County shall continue to support scientific geologic investigations which refine, enlarge, and improve the body of knowledge on active faults zones, unstable areas, severe ground shaking, avalanche potential, and other hazardous conditions in Placer County.
- Policy 8.A.9:** The County shall require that the location and/or design of any new buildings, facilities, or other development in areas subject to earthquake activity minimize exposure to danger from fault rupture or creep.
- Policy 8.A.10:** The County shall require that new structures permitted in areas of high liquefaction potential be sited, designed, and constructed to minimize the dangers from damage due to earthquake-induced liquefaction.
- Implementation Program 8.1:** The County shall continue to enforce provisions of the Uniform Building Code which address seismic concerns, including masonry building design requirements.

Implementation Program 8.2: The County shall assess the need for an ordinance requiring evaluation of unreinforced masonry structures and the repair or replacement of identified hazardous structures.

3.8.4 SIGNIFICANCE THRESHOLDS AND ANALYSIS METHODOLOGY

3.8.4.1 Significance Thresholds

Council on Environmental Quality (CEQ) regulations require an evaluation of the degree to which the Proposed Action could affect public health or safety as well as an evaluation of the effects of the Proposed Action on natural resources. The US Army Corps of Engineers (USACE) has determined that the Proposed Action or its alternatives would result in significant effects related to geology and soils if the Proposed Action or an alternative would:

- expose people or structures to increased risk from rupture of a known earthquake fault;
- expose people or structures to increased risk related to strong seismic ground shaking;
- expose people or structures to increased risk related to seismically induced ground failure, including liquefaction;
- expose people or structures to increased risk of landslides, other slope failure;
- result in substantial soil erosion or the loss of topsoil; or
- be located on a geologic unit or soil (including expansive soils) that is unstable or that would become unstable as a result of the project and potentially result in an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

3.8.4.2 Analysis Methodology

Impacts of the Proposed Action and alternatives related to geology, geologic hazards, and mineral resources were evaluated qualitatively, based on professional judgment in consideration of the prevailing engineering geologic and geotechnical engineering standard of care. Analysis relied on information available from the published literature; no new fieldwork was determined to be necessary and was not conducted for this EIS. As discussed in the **Affected Environment** subsection above, neither the project site nor Alternative 4 site is within or traversed by any earthquake fault zone defined by the State of California pursuant to the Alquist-Priolo Earthquake Fault Zoning Act, and there is no evidence suggesting the presence of other active but currently unzoned faults within the sites. Therefore, neither the Proposed Action nor any of the alternatives (Alternatives 1, 2, 3, 4, and the No Action Alternative) is expected to result in significant effects related to the exposure of structures and their occupants to surface fault rupture hazard. This issue is not analyzed further below, and the analysis is focused on effects related to seismic groundshaking, liquefaction, slope failure, and expansive soils. Note that impacts related to soil erosion are addressed in **Section 3.10, Hydrology and Water Quality**.

3.8.5 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

Impact GEO-1 Hazard associated with Seismic Ground-shaking

- Proposed Action** Because of its distance from major faults, Placer County is considered a comparatively low-severity earthquake zone. The maximum anticipated earthquake intensity would correspond to an intensity of VI or VII on the Modified Mercalli Scale (City of Roseville 2010). Such an event would be sufficient to cause substantial damage in poorly designed or constructed structures, with a corresponding risk to personal life and safety. As discussed in **Local Plans, Policies, and Ordinances** above, the City requires new construction to comply with the current CBC. Risks associated with seismic ground shaking cannot be entirely avoided in a seismically active area, but implementation of the seismic design requirements of the CBC would manage these unavoidable risks consistent with the prevailing engineering standard of care. This effect is considered **less than significant**. Mitigation is not required.
- No Action Alt.** The No Action Alternative would construct a smaller mixed-use development on the project site. The risk from seismic ground shaking would be similar and minimized by compliance with CBC seismic design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with seismic groundshaking would be **less than significant** under the No Action Alternative. Mitigation is not required.
- Alts. 1, 2, 3 (On Site)** All of the on-site alternatives would construct a mixed-use development on the project site. Alternative 1 (reduced footprint and increased density alternative) could require construction of slightly taller buildings. To the extent that the buildings are taller under this alternative, they may be more susceptible to damage from ground shaking. However, the risk from seismic ground shaking for all three alternatives would be minimized by compliance with CBC seismic design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with seismic groundshaking would be **less than significant** under all of the on-site alternatives. Mitigation is not required.
- Alt. 4 (Off Site)** Alternative 4 would construct a project broadly similar to the Proposed Action on the alternative site. In addition, Alternative 4 would require the installation of off-site infrastructure consisting of water, recycled water and sewer lines and roadway improvements. The risk from seismic ground shaking would be similar for this alternative and minimized by compliance with CBC seismic design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with seismic groundshaking would be **less than significant** under the off-site alternative. Mitigation is not required.

Impact GEO-2 Hazard associated with Liquefaction

- Proposed Action** Liquefaction typically occurs in well-sorted, saturated sandy materials, at depths of less than 50 feet (15 meters) below ground surface. Because of the project site's geologic setting, there may be some potential for liquefaction in some portions of the site. However, the City will require a site-specific geotechnical investigation for the Sierra Vista project as part of the building permit process (City of Roseville 2010), ensuring that areas susceptible to liquefaction are identified before any construction is undertaken on the site. Moreover, as discussed above, the City routinely requires compliance with the CBC, which includes provisions for foundation design in areas with liquefiable soils, as well as any additional recommendations identified by the site-specific geotechnical investigation. With building code compliance and adherence to recommendations of a site-specific geotechnical investigation prepared by licensed personnel, risks associated with liquefaction and other types of seismically induced ground failure will be managed consistent with the prevailing engineering standard of care. This effect is considered **less than significant**. Mitigation is not required.
- No Action Alt.** The No Action Alternative would construct a smaller mixed-use development on the project site. The risk from liquefaction would be similar and minimized by compliance with the City's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with liquefaction would be **less than significant** under the No Action Alternative. Mitigation is not required.
- Alts. 1, 2, 3 (On Site)** All of the on-site alternatives would construct a mixed-use development on the project site. The risk from liquefaction would be similar and minimized by compliance with the City's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with liquefaction would not be **less than significant** under all of the on-site alternatives. Mitigation is not required.
- Alt. 4 (Off Site)** Alternative 4 would construct a project broadly similar to the Proposed Action on the alternative site. In addition, Alternative 4 would require the installation of off-site infrastructure consisting of water, recycled water and sewer lines and roadway improvements. The risk from liquefaction would be similar and minimized by compliance with the County's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with liquefaction would be **less than significant** under the off-site alternative. Mitigation is not required.

Impact GEO-3 Hazard associated with Slope Failure

Proposed Action	<p>Because of the project site's gentle topography, development on the site is not expected to be subject to slope failure related to natural slopes. This includes both seismically induced and non-seismic landslides. Because of the site's distance from the Sierra Nevada and Coast Range foothills, development is also unlikely to be affected by landslide runoff.</p> <p>The project will involve substantial grading activities, including the construction of cut slopes and fill embankments. Cut and fill slopes can become unstable if they are improperly designed or constructed. However, as identified above, the City routinely requires compliance with the CBC, which includes provisions for the design and construction of cuts and fills, including limitations on the materials suitable for use as fill, specifications for fill compaction, and requirements for slope drainage. The City will also require the preparation of a site-specific geotechnical investigation for the Proposed Action, which may identify additional recommendations that would become binding conditions for project approval. With building code compliance and adherence to recommendations of a site-specific geotechnical investigation prepared by licensed personnel, the potential for slope instability or failure of cuts and fills would be reduced consistent with prevailing engineering practices. This effect is considered less than significant. Mitigation is not required.</p>
No Action Alt.	<p>The No Action Alternative would construct a smaller mixed-use development on the project site. The risk of slope failure would be similar and minimized by compliance with the City's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with slope failure would be less than significant under the No Action Alternative. Mitigation is not required.</p>
Alts. 1, 2, 3 (On Site)	<p>All of the on-site alternatives would construct a mixed-use development on the project site. The risk of slope failure would be similar and minimized by compliance with the City's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with slope failure would be less than significant under all of the on-site alternatives. Mitigation is not required.</p>
Alt. 4 (Off Site)	<p>Alternative 4 would construct a project broadly similar to the Proposed Action on the alternative site. In addition, Alternative 4 would require the installation of off-site infrastructure consisting of water, recycled water and sewer lines and roadway improvements. The risk of slope failure would be similar and minimized by compliance with the County's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with slope failure would be less than significant under the off-site alternative. Mitigation is not required.</p>

Impact GEO-4 Potential Structural Damage due to Expansive Soils

Proposed Action	Collapsible soils have not been identified on the project site, but, as shown in Table 3.8-1 , some of the site soils are highly expansive. Expansive soils, which shrink and swell cyclically as they are wetted and dried by seasonal rains or irrigation, can result in substantial damage to improperly designed or constructed structures over time. However, as discussed above, the City routinely requires compliance with the CBC, which includes provisions for the foundation design and construction in areas with expansive soils. Depending on site conditions and the nature of a project, a variety of approaches are possible, including overexcavation and replacement of native soils with non-expansive fills, amendment and on-site use of native soils, and implementation of specialized foundation designs. The City will require the preparation of a site-specific geotechnical investigation for the Proposed Action, which will identify appropriate foundation design recommendations consistent with the CBC and current geotechnical engineering practices. This effect is considered less than significant . Mitigation is not required.
No Action Alt.	The No Action Alternative would construct a smaller mixed-use development on the project site. The risk from expansive soils would be similar and minimized by compliance with the City's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with expansive soils would be less than significant under the No Action Alternative. Mitigation is not required.
Alts. 1, 2, 3 (On Site)	All of the on-site alternatives would construct a mixed-use development on the project site. The risk of expansive soils would be similar and minimized by compliance with the City's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with expansive soils would be less than significant under all of the on-site alternatives. Mitigation is not required.
Alt. 4 (Off Site)	Alternative 4 would construct a project broadly similar to the Proposed Action on the alternative site. In addition, Alternative 4 would require the installation of off-site infrastructure consisting of water, recycled water and sewer lines and roadway improvements. The risk of expansive soils would be similar and minimized by compliance with the County's requirements, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effects associated with expansive soils would be less than significant under the off-site alternative. Mitigation is not required.

Impact GEO-5 Effect on Mineral Resources

Proposed Action	As discussed in the Affected Environment subsection above, the project vicinity has been designated MRZ-4 by the State of California, meaning that available information is inadequate to demonstrate either the presence or the absence of significant mineral resources. The City identifies the presence of limited sand and gravel resources within the City's Sphere of Influence but does not foresee extraction activities during the lifespan of the current General Plan (City of Roseville 2010), and the area has not been identified as having either regional or statewide importance for mineral resources pursuant to SMARA. Consequently, although development of the site would effectively preclude future mineral extraction activities on the site, the loss of mineral resources availability, if any, is not expected to be extensive. Moreover, development of the site is consistent with the City's long-term land use planning vision whereas mineral resources extraction is not. This effect is considered less than significant . Mitigation is not required.
No Action Alt.	The No Action Alternative would construct a smaller mixed-use development on the project site. The effect on mineral resources would be similar. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effect related to the reduced availability of important mineral resources would be less than significant under the No Action Alternative. Mitigation is not required.
Alts. 1, 2, 3 (On Site)	All of the on-site alternatives would construct a mixed-use development on the project site. The effect on mineral resources would be similar. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effect related to the reduced availability of important mineral resources would be less than significant under all of the on-site alternatives. Mitigation is not required.
Alt. 4 (Off Site)	Alternative 4 would construct a project broadly similar to the Proposed Action on the alternative site. In addition, Alternative 4 would require the installation of off-site infrastructure consisting of water, recycled water and sewer lines and roadway improvements. The effect on mineral resources would be similar. Based on the significance criteria listed above and for the same reasons presented above for the Proposed Action, the effect related to the reduced availability of important mineral resources would be less than significant under the off-site alternative. Mitigation is not required.

3.8.6 RESIDUAL SIGNIFICANT IMPACTS

All of the effects would be **less than significant**. No residual significant effects were identified for the Proposed Action and any of the alternatives.

3.8.7 REFERENCES

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**Table 3.8-1
Overview of Project Site Soils**

Soil Unit	Description	Physical Properties	Limitations
Alamo-Fiddymment complex, 0 – 5 percent slopes	Shallow soils formed in alluvium. Principal components are Approximately 50 percent Alamo soil and 30 percent Fiddymment soils, with remaining 20 percent made up of San Joaquin sandy loam, Comenta sandy loam, and Kaseberg loam. Alamo soil consists of clay overlying duripan at a depth of about 37 inches. Fiddymment soil consists of loam and clay loam overlying duripan at a depth of about 28 inches.	Very slow permeability, slow runoff, slight erosion hazard; high expansion potential	Shallow excavations: moderate to severe (wetness, shallow depth to bedrock, claypan) Residences, small commercial buildings: severe (wetness, shrink-swell) Local roads and streets: severe (wetness, shrink-swell, low strength) Grassed waterways (erosion control): slow percolation/wetness, claypan, shallow depth to rock
Cometa-Fiddymment complex, 1 – 5 percent slopes	Shallow to moderately deep soils formed in alluvium derived from granite (Cometa) or sedimentary rock (Fiddymment). Approximately 35 percent Cometa soil and 35 percent Fiddymment soil with the remaining 30 percent made up of San Joaquin sandy loam, Kaseberg loam, Ramona sandy loam, and Alamo clay. Cometa soil consists of sandy loam to a depth of 18 inches, with clay from 18 to 29 inches, and sandy loam to a depth of 60 inches. Fiddymment soil consists of loam and clay loam overlying duripan at a depth of about 28 inches.	Very slow permeability, potentially slow runoff, slight erosion hazard; expansion potential ranges from low to high	Shallow excavations: moderate to severe (clay content, shrink-swell, shallow depth to bedrock) Residences, small commercial buildings: severe (low strength, shrink-swell) Local roads and streets: severe (low strength, shrink-swell) Grassed waterways (erosion control): slow percolation, shallow depth to rock
Cometa-Ramona sandy loams, 1 – 5 percent slopes	Deep soils formed in alluvium derived primarily from granitic sources. Approximately 50 percent Cometa soil and 30 percent Ramona soil with the remaining 20 percent made up of San Joaquin sandy loam, Fiddymment loam, and Alamo clay. Cometa soil consists of sandy loam to a depth of 18 inches, with clay from 18 to 29 inches, and sandy loam to a depth of 60 inches. Ramona soil consists of sandy loam, loam, sandy clay loam and gravelly sandy loam to a depth of 73 inches.	Very slow to moderate permeability; potentially slow to medium runoff rate, slight erosion hazard; expansion potential ranges from low to high	Shallow excavations: severe (clay content) Residences, small commercial buildings: severe (low strength, shrink-swell) Local roads and streets: severe (low strength, shrink-swell) Grassed waterways (erosion control): slow percolation

Soil Unit	Description	Physical Properties	Limitations
Fiddymment loam, 1 – 8 percent slopes	Moderately deep soil formed in alluvium derived from sedimentary rock. Consists of silt and clay loam overlying hardpan at an approximate depth of 28 inches.	Very slow permeability, potentially slow to medium runoff rate, slight to moderate erosion hazard; expansion potential ranges from low to high	Shallow excavations: moderate (shallow depth to bedrock, claypan) Residences, small commercial buildings: severe (shrink-swell) Local roads and streets: severe (shrink-swell) Grassed waterways (erosion control): shallow depth to bedrock
Fiddymment-Kaseberg loams, 2 – 9% slopes	Shallow soil formed in alluvium derived from sedimentary rock. Approximately 50 percent Fiddymment soil and 30 percent Kaseberg soil. Fiddymment soil consists of loam and clay loam overlying hardpan at an approximate depth of 28 inches. Kaseberg soil consists of loam overlying claypan at a depth of 16–17 inches.	Very slow to moderate permeability, potentially slow to medium runoff rate, slight to moderate erosion hazard; expansion potential ranges from low to high	Shallow excavations: moderate to severe (shallow depth to bedrock, claypan) Residences, small commercial buildings: severe (shrink-swell, shallow depth to bedrock) Local roads and streets: severe (shrink-swell, low strength, claypan, shallow depth to bedrock) Grassed waterways (erosion control): shallow depth to bedrock
San Joaquin-Cometa sandy loams 1 – 5% slopes	Shallow to deep soil formed in alluvium derived from granitic sources. Approximately 40% San Joaquin soil, 30 percent Cometa soil, and 10 percent Fiddymment loam, with the remaining 20 percent made up of Kaseberg loam, Ramona sandy loam, Alamo clay, and Kilaga loam. San Joaquin soil consists of sandy loam and clay loam overlying claypan at a depth of 35 inches, which in turn overlies stratified loamy soils at a depth of 50 inches. Depth to rock is about 60 inches. Cometa soil consists of sandy loam overlying clay at a depth of 18 inches, which in turn overlies sandy loam at a depth of 29 inches. Depth to rock is about 60 inches.	Very slow permeability, potentially slow runoff, slight erosion hazard; expansion potential ranges from low to high	Shallow excavations: severe (clay content, hardpan) Residences, small commercial buildings: severe (shrink-swell, low strength) Local roads and streets: severe (shrink-swell, low strength) Grassed waterways (erosion control): slow percolation, hardpan

Soil Unit	Description	Physical Properties	Limitations
Xerofluvents, hardpan substratum	Stratified loam and clay loam overlying hardpan at a depth of 40 inches. Associated with principal drainage courses.	Moderately slow permeability, slow runoff, slight erosion hazard	Shallow excavations: severe (flooding, wetness) Residences, small commercial buildings: severe (flooding, wetness) Local roads and streets: moderate (flooding, wetness) Grassed waterways (erosion control): hardpan

Source: City of Roseville 2009, NRCS Web Soil Survey 2010