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 and the alternative site, summarizes relevant regulations and policies, and analyzes the anticipated impacts of implementing the Proposed Action or the alternatives.

Sources of information used in this analysis include:

- Sierra Vista Specific Plan EIR prepared by the City of Roseville (City of Roseville 2010a);
- Westbrook Specific Plan Amendment Initial Study, prepared by the City of Roseville (City of Roseville 2012);
- 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 Stated 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 2010a). 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 2010a).

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 2010a).[1]

3.8.2.3 Project Site - Topographic and Geologic Conditions

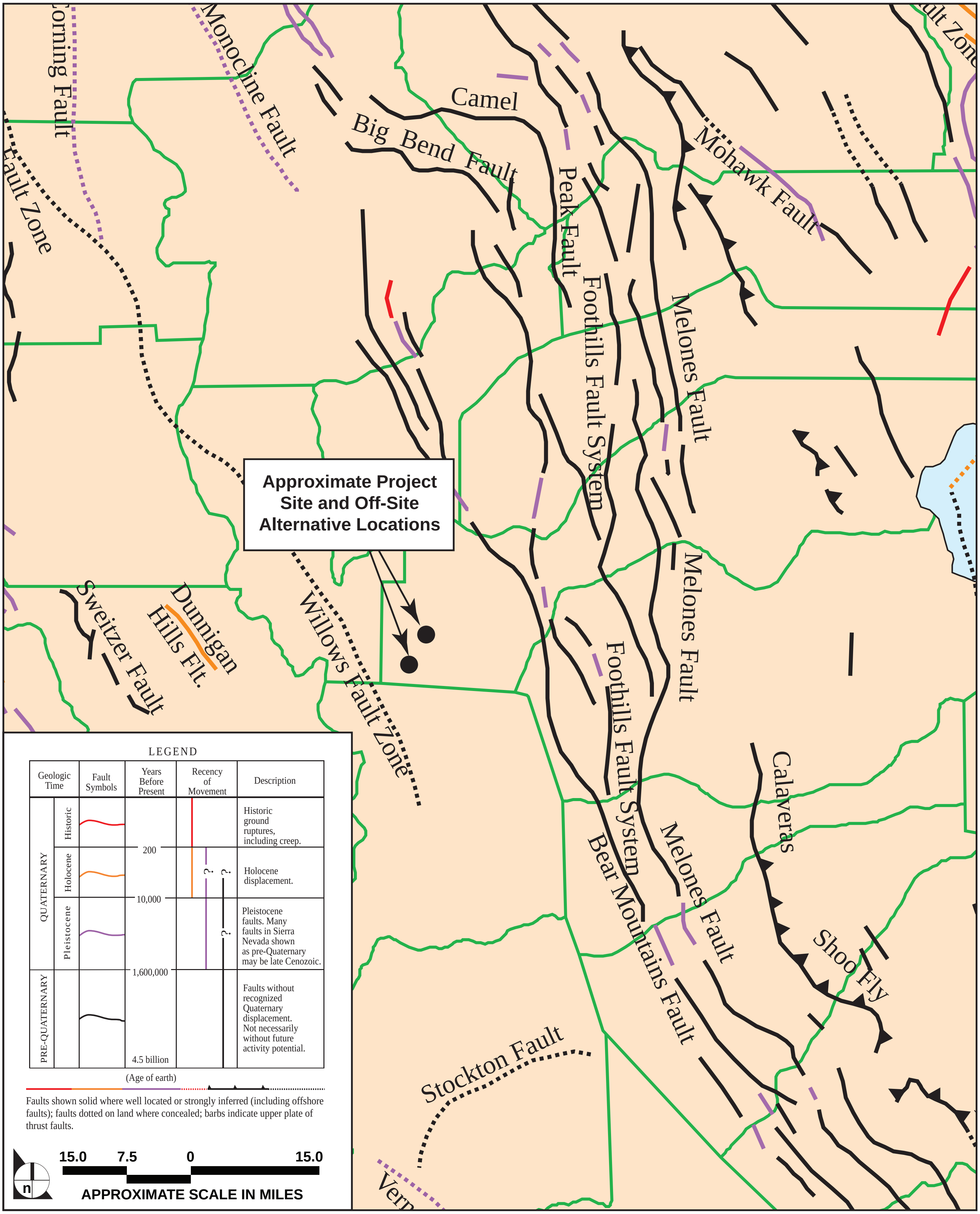
The project site is located on the eastern margin of the Sacramento Valley, about 10 miles (16 kilometers) from the westernmost foothills of the Sierra Nevada. The site is in a transitional zone between the flat, open terrain of the Sacramento Valley to the west and the foothills of the Sierra Nevada 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 (Google Earth 2012). The principal feature on the project site is the West Plan tributary to Curry Creek that traverses the northwest corner of the project site.

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 northwest 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 Turlock Lake Formation, also of Pleistocene age but slightly older than the Riverbank Formation, is limited to the northwestern 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 2010a).

---

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)

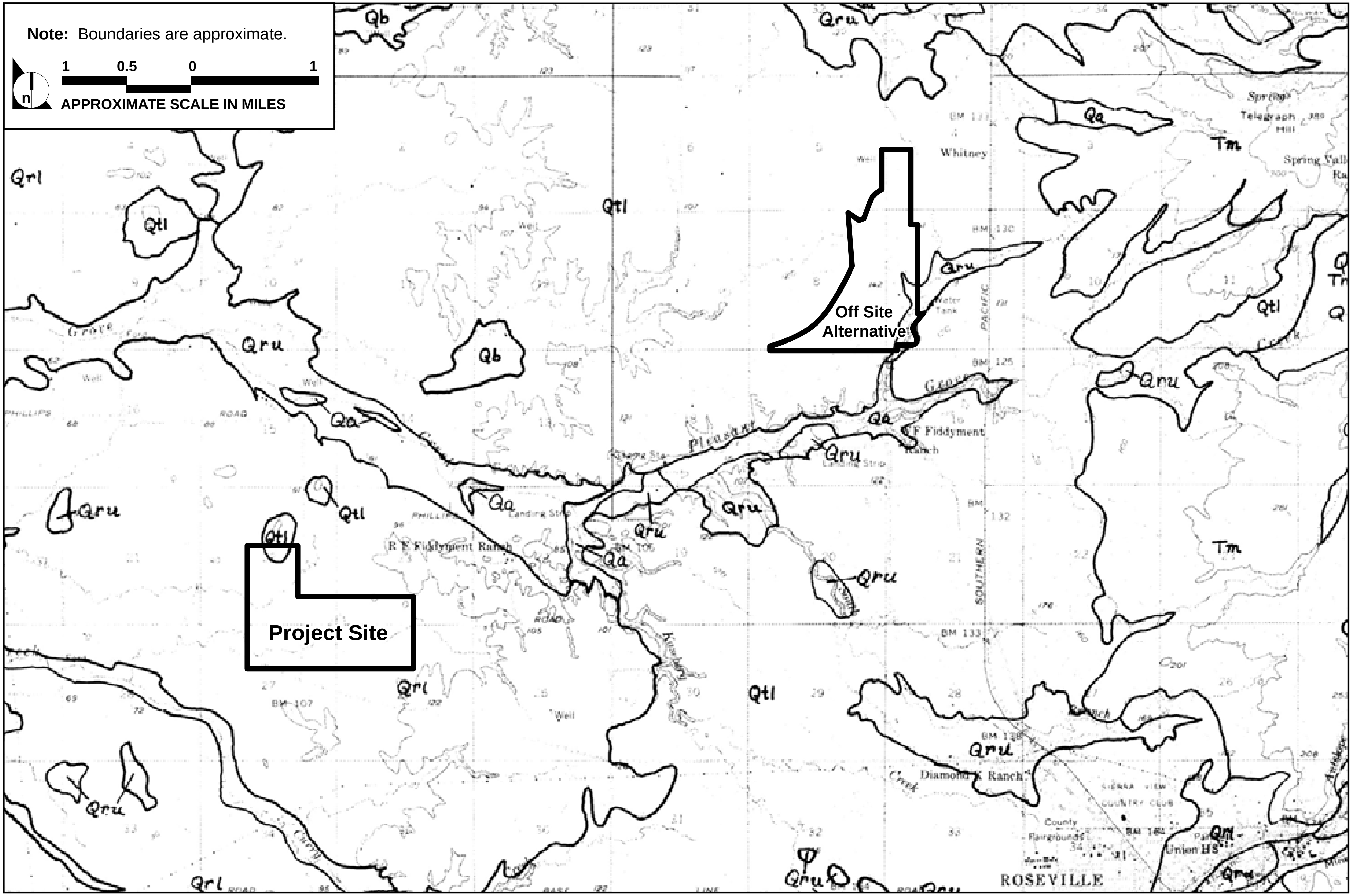


SOURCE: Compiled by Charles W. Jennings and George J. Saucedo – 1999 (Revised 2002, Tousson Toppozada and David Branum)

FIGURE **3.8-1**

Regional Fault Map

1122.001•08/12



SOURCE: Helly and Harwood – 1985

FIGURE 3.8-2

Project Site and Off-Site Alternative Geology

1122.001•04/13

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.

3.8.2.5 Project Site – Soils

Soils mapping by the Natural Resources Conservation Service shows five 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 the section. As described in **Table 3.8-1**, the soil mapping units within the project include: Cometa-Fiddyment Complex (1 to 5 percent slopes), Cometa-Ramona sandy loams (1 to 5 percent slopes), Fiddyment-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 2012). 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 these lands were grazed in the past. 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.

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 2010a). As discussed in more detail in **Subsection 3.8.3 Regulatory Framework**, 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 Roseville 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 2010a).

3.8.2.7 Alternative Site – Topography, Geologic Conditions, and Mineral Resources

The alternative site is located about 3 miles (4.8 kilometers) to the northeast of the project site. Topography of the alternative site is flat to gently rolling, with elevations ranging from about 110 to 140 feet (34 to 43 meters) msl. Pleasant Grove Creek crosses the southeast corner of the alternative site. No mapped active faults are located on the site. The alternative site is underlain almost entirely by strata of the Turlock Lake

Formation. The Turlock Lake Formation is dominated by feldspar-rich gravels but contains sand and silt along the east side of the Sacramento Valley (Helley and Harwood 1985). The southeast corner is underlain by the Riverbank Formation upper member. 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 NRCS shows that the site is underlain by Alamo-Fiddyment Complex (0 to 5 percent slopes), Cometa-Fiddyment complex (1 to 5 percent slopes), and Fiddyment-Kaseberg loams (2 to 9 percent slopes). These are largely similar to soils on the project site and the physical properties and limitations for the majority of soils on the alternative site are described in **Table 3.8-1.** The alternative site is 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

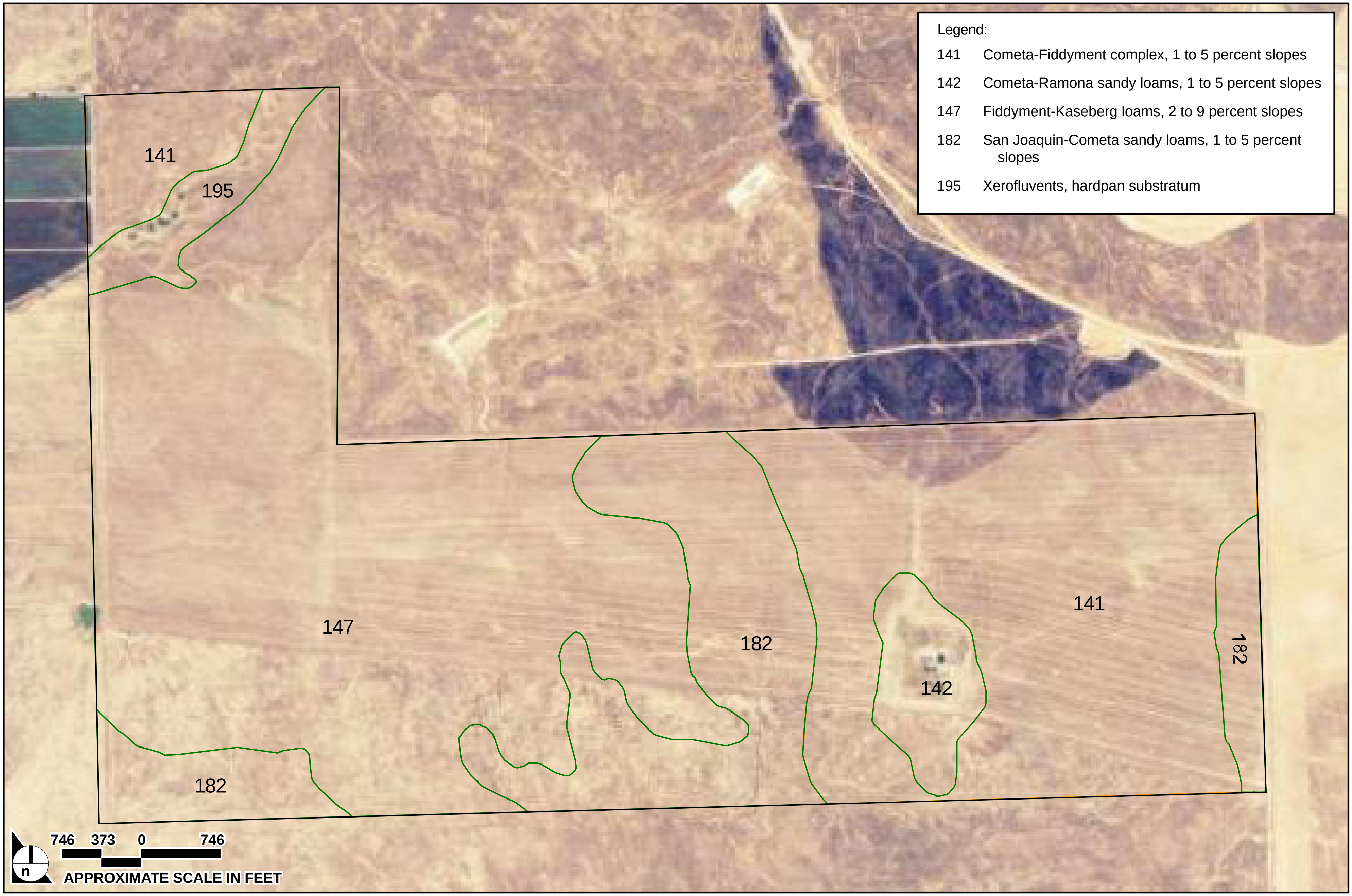
3.8.3.1 Federal Laws, Regulations, Plans, and Policies

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 USGS, the National Science Foundation, the Office of Science and Technology Policy, and the Office of Management and Budget.



SOURCE: City of Roseville, February 2011

FIGURE **3.8-3**

Project Site Soils Map

1122.001•08/12

3.8.3.2 State Laws, Regulations, Plans, and Policies

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.

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. 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 the

[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.

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.

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 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
City 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.	• California Division of Mines and Geology [California Geological Survey] studies • City Multi-Hazard Mitigation Plan
2 Continue to mitigate the potential impacts of geologic hazards through building plan review.	• California Building Code
3. Minimize soil erosion and sedimentation by maintaining compatible land uses, suitable building designs, and appropriate construction techniques.	• City development review process • City Grading and Erosion Control Ordinance • Specific Plans • 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.	• California Division of Mines and Geology [California Geological Survey] studies • 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.	• City development review process • Specific Plans
6. Require contour grading, where feasible, and revegetation to mitigate the appearance of engineered slopes and to control erosion.	• City development review process • Grading and Erosion Control Ordinance

Source: City of Roseville 2010b

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 U.S. Army Corps of Engineers (USACE) has determined that the Proposed Action or its alternatives would result in significant effects related to geology, soils, and minerals 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 risks related to strong seismic ground shaking, seismically induced ground failure, including liquefaction;
- expose people or structures to increased risk of landslides or other slope failure;
- 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; or
- impede extraction of mineral resources that are of regional importance.

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** section above, neither the project site nor the Off-Site Alternative 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 (No Action Alternative, Alternatives 1 through 5, and the Off-Site 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 ground shaking, liquefaction, slope failure, and expansive soils.

3.8.5 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

Impact GEO-1 Hazard associated with Seismic Ground-Shaking

No Action Alt. The No Action Alternative would construct a moderate scale, mixed-use community on the project site comprising about 1,500 dwelling units and about 30 acres of commercial development. Because of its distance from major faults, Placer County is considered a comparatively low-severity earthquake zone. The maximum anticipated earthquake intensity on the project site would correspond to an intensity of VI or VII on the Modified Mercalli Scale (City of Roseville 2010a). 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. Even though risks associated with seismic ground shaking cannot be entirely avoided in a seismically active area, implementation of the seismic design requirements of the CBC would manage these unavoidable risks consistent with the prevailing engineering standard of care and, therefore, the **indirect** effects associated with seismic ground shaking would be **less than significant**. Mitigation is not required. **No direct** effects would occur.

Proposed Action The Proposed Action would construct a somewhat larger mixed-use community on the project site with about 2,000 dwelling units and about 43 acres of commercial development. The risk from seismic ground shaking to the residents and employees on the project site would be similar to that described above for the No Action Alternative and minimized by compliance with CBC seismic design requirements, which would be monitored by the City. Based on the significance criteria listed above and for the same reasons presented above for the No Action Alternative, the **indirect** effects associated with seismic ground shaking would be **less than significant** under the Proposed Action. Mitigation is not required. **No direct** effects would occur.

Alts. 1 through 5 All of the on-site alternatives would construct a mixed-use development on the project site. Alternatives with reduced footprints and increased densities (Alternatives 1, 4, and 5) could require construction of slightly taller buildings. To the extent that the buildings are taller under an alternative, they may be more susceptible to damage from seismic ground shaking. However, the risk from seismic ground shaking for all five 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 No Action Alternative, the **indirect** effects associated with seismic ground shaking would be **less than significant** under all of the on-site alternatives. Mitigation is not required. **No direct** effects would occur.

Off-Site Alt. The Off-Site Alternative would construct a project broadly similar to the Proposed Action on the alternative site which is located approximately 3 miles (4.8 kilometers) to the northeast of the project site. In addition, the Off-Site Alternative 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 for the Off-Site Alternative would be similar to that described above for the No Action 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 No Action Alternative, the **indirect** effects associated with seismic ground shaking would be **less than significant** under the Off-Site Alternative. Mitigation is not required. **No direct** effects would occur.

Impact GEO-2 Hazard associated with Liquefaction

No Action Alt. 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, as part of its building permit process, the City requires a site-specific geotechnical investigation for the development of the project site and the implementation of the recommendations of the geotechnical investigation during the design and construction of the proposed project (City of Roseville 2010a). The Applicant will comply with the City's building permit process and complete a geotechnical investigation as part of the project which will ensure that areas susceptible to liquefaction are identified before any construction is undertaken on the site and facilities are appropriately designed and constructed to avoid damage due to liquefaction. 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 as part of the No Action Alternative, risks associated with liquefaction and other types of seismically induced ground failure will be managed consistent with the prevailing engineering standard of care. This **indirect** effect is considered **less than significant**. Mitigation is not required. **No direct** effects would occur.

Proposed Action, Alts. 1 through 5 The Proposed Action and all of the on-site alternatives would construct a mixed-use development on the project site that would be similar in scale or larger than the No Action Alternative. The risk from liquefaction would be similar to that described above for the No Action Alternative and minimized by compliance with the City's requirements, which are part of the Proposed Action, including the CBC design requirements. Based on the significance criteria listed above and for the same reasons presented above for the No Action Alternative, the **indirect** effects associated with liquefaction would be **less than significant** under the Proposed Action and all of the on-site alternatives. Mitigation is not required. **No direct** effects would occur.

Off-Site Alt. The Off-Site Alternative would construct a project broadly similar to the Proposed Action on the alternative site. In addition, the Off-Site Alternative 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 to that described above for the No Action Alternative and minimized by compliance with the City's requirements, which are part of the project, including the CBC design requirements. Off-Site improvements which would be located in unincorporated Placer County would be subject to the Placer County building permit process which also requires compliance with the CBC. Based on the significance criteria listed above and for the same reasons presented above for the No Action Alternative, the **indirect** effects associated with liquefaction would be **less than significant** under the Off-Site Alternative. Mitigation is not required. **No direct** effects would occur.

Impact GEO-3 Hazard associated with Slope Failure

No Action Alt. 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 and slope failures. Because of the site's distance from the Sierra Nevada and Coast Range foothills, development is also unlikely to be affected by landslide runout.

The No Action Alternative 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, via its building permit process, 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 also requires the preparation of a site-specific geotechnical investigation, which may identify recommendations with respect to cut and fill slopes that would become binding on the project. 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, and this **indirect** effect would be **less than significant**. Mitigation is not required. **No direct** effects would occur.

Proposed Action The Proposed Action would construct a moderate scale, mixed-use development on the project site. The risk of slope failure would be similar to that described above for the No Action Alternative and would be minimized by compliance with the City's requirements, including the CBC design requirements and implementation of the recommendations of the site-specific geotechnical investigation as part of the project. Based on the significance criteria listed above and for the same reasons presented above for the No Action Alternative, the **indirect** effects associated with slope failure would be **less than significant** under the Proposed Action. Mitigation is not required. **No direct** effects would occur.

Alts. 1 through 5 All of the on-site alternatives would construct a moderate scale, mixed-use development on the project site. The risk of slope failure would be similar to that described above for the No Action Alternative and minimized by compliance with the City's requirements, including the CBC design requirements and implementation of the recommendations of the site-specific geotechnical investigation as part of the project. Based on the significance criteria listed above and for the same reasons presented above for the No Action Alternative, the **indirect** effects associated with slope failure would be **less than significant** under all of the on-site alternatives. Mitigation is not required. **No direct** effects would occur.

Off-Site Alt. The Off-Site Alternative would construct a project broadly similar to the No Action Alternative on the alternative site, which like the project site is also generally flat and not susceptible to landslides and slope failure. The risk of slope failure would be similar to that described above for the No Action Alternative and minimized by compliance with the City's requirements, including the CBC design requirements and implementation of the recommendations of the site-specific geotechnical investigation as part of the project. Based on the significance criteria listed above and for the same reasons presented above for the No Action Alternative, the **indirect** effects associated with slope failure would be **less than significant** under the Off-Site Alternative. Mitigation is not required. **No direct** effects would occur.

Impact GEO-4 Potential Structural Damage due to Expansive Soils

No Action Alt. 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 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. As is standard City practice, the City will require the preparation of a site-specific geotechnical investigation as part of the project, which will identify appropriate foundation design recommendations consistent with the CBC and current geotechnical engineering practices. This **indirect** effect is considered **less than significant**. Mitigation is not required. **No direct** effects would occur.

Proposed Action The Proposed Action would construct a moderate scale, mixed-use development on the project site. The risk from expansive soils would be similar to that described above for the No Action Alternative and minimized by compliance with the City's requirements, including the CBC design requirements which are part of the project. The City will also 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. Based on the significance criteria listed above and for the same reasons presented above for the No Action Alternative, the **indirect** effects associated with expansive soils would be **less than significant** under the Proposed Action. Mitigation is not required. **No direct** effects would occur.

Alts. 1 through 5 All of the on-site alternatives would construct a mixed-use development on the project site. The risk of expansive soils would be similar to that described above for the No Action Alternative 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 No Action Alternative, the **indirect** effects associated with expansive soils would be **less than significant** under all of the on-site alternatives. Mitigation is not required. **No direct** effects would occur.

Off-Site Alt. The Off-Site Alternative would construct a project broadly similar to the No Action Alternative on the alternative site. In addition, the Off-Site Alternative 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 to that described above for the No Action Alternative 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 No Action Alternative, the **indirect** effects associated with expansive soils would be **less than significant** under the Off-Site Alternative. Mitigation is not required. **No direct** effects would occur.

Impact GEO-5 Effect on Mineral Resources

No Action Alt. As discussed in the **Affected Environment** section 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 2010a), 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 under the No Action Alternative would effectively preclude future mineral extraction activities on the site, the mineral resources on the site are not of regional or statewide importance. Moreover, development of the site is consistent with the City's long-term land use planning vision whereas mineral resources extraction is not. This **direct** effect is considered **less than significant**. Mitigation is not required. **No indirect** effects would occur.

Proposed Action, Alts. 1 through 5 The Proposed Action and 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 No Action Alternative, the **direct** effect related to the reduced availability of mineral resources of regional importance would be **less than significant** under the Proposed Action and all of the on-site alternatives. Mitigation is not required. **No indirect** effects would occur.

Off-Site Alt. The Off-Site Alternative would construct a project broadly similar to the No Action Alternative on the alternative site. In addition, the Off-Site Alternative 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 No Action Alternative, the **direct** effect related to the reduced availability of mineral resources of regional importance would be **less than significant** under the Off-Site Alternative. Mitigation is not required. **No indirect** effects would occur.

3.8.6 RESIDUAL SIGNIFICANT IMPACTS

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

3.8.7 CUMULATIVE IMPACTS

All of the effects discussed above are site-specific and would not cumulate. Therefore, there would be no cumulative effects related to geology, soils, and minerals under the Proposed Action and all alternatives.

3.8.8 REFERENCES

Bryant, W. A., and E. W. Hart. 2007. "Fault-rupture hazard zones in California—Alquist-Priolo Earthquake Fault Zoning Act with index to Earthquake Fault Zones maps." (Special Publication 42, Interim Revision 2007). ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sp/Sp42.pdf.

City of Roseville. 2010a. Sierra Vista Specific Plan Final Environmental Impact Report.

City of Roseville. 2010b. City of Roseville General Plan 2025. Adopted May 5, 2010.

City of Roseville. 2012. Westbrook Specific Plan Amendment Initial Study.

Google Earth. 2012. Elevations of Proposed Project Site.

Gutierrez, C., Bryant, W. Saucedo, G., and Wills, C. 2010. "California Geological Survey 150th anniversary geologic map of California, scale 1:750,000, 2010." Sacramento, California: California Geological Survey. Original compilation by Charles W. Jennings, 1977.

Helley, E. J., and D. S. Harwood. 1985. "Geologic Map of the late Cenozoic deposits of the Sacramento Valley and northern Sierran Foothills, California." (U.S. Geological Survey Miscellaneous Field Investigations series, MF0-1790). http://pubs.usgs.gov/mf/1985/1790/.

USDA Natural Resources Conservation Service (NRCS). 2012. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/

Norris, R. M., and Webb, R. W. 1990. *Geology of California* (2nd edition). New York, NY: John Wiley & Sons, Inc.

United States Geological Survey (USGS). 1989. "The modified Mercalli intensity scale" (abridged from *The Severity of an Earthquake, a US Geological Survey General Interest Publication*). http://earthquake.usgs.gov/learn/topics/mercalli.php.

Wallace, Kuhl & Associates, Inc. 2005. *Preliminary Geotechnical Engineering Report Sierra Vista Specific Plan*.

Table 3.8-1
Overview of Project Site Soils

Soil Unit	Description	Physical Properties	Limitations
Cometa-Fiddyment complex, 1 to 5 percent slopes	Shallow to moderately deep soils formed in alluvium derived from granite (Cometa) or sedimentary rock (Fiddyment). Approximately 35 percent Cometa soil and 35 percent Fiddyment 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. Fiddyment 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 to 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, Fiddyment 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
Fiddyment-Kaseberg loams, 2 to 9 percent slopes	Shallow soil formed in alluvium derived from sedimentary rock. Approximately 50 percent Fiddyment soil and 30 percent Kaseberg soil. Fiddyment 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

Soil Unit	Description	Physical Properties	Limitations
San Joaquin-Cometa sandy loams 1 to 5 percent slopes	Shallow to deep soil formed in alluvium derived from granitic sources. Approximately 40% San Joaquin soil, 30 percent Cometa soil, and 10 percent Fiddyment 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
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 2012