3.9 GEOLOGY, SOILS, AND MINERALS

3.9.1 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 within, and around, the project site; summarizes relevant regulations and policies; and analyzes anticipated effects to geology, soils, and minerals, under the Proposed Action and each alternative.

The Applicant has put forth a conceptual compensatory wetland mitigation plan that includes wetland restoration activities at three off-site mitigation properties. Since the mitigation plan is currently conceptual in nature, the specifics of grading activities associated with wetland restoration are not available. Therefore, temporary, short-term effects with respect to geology, soils, and minerals associated with wetland mitigation grading activities cannot be estimated. Furthermore, since no housing/commercial or other development would occur on any of the three mitigation properties, no long-term impacts with respect to geology, soils, and minerals would occur as a result of wetland restoration. Thus, the mitigation sites are not discussed further in this section.

Sources of information used in this analysis include:

- Amoruso Ranch Specific Plan (ARSP) EIR prepared by the City of Roseville (City of Roseville 2016a);
- City of Roseville General Plan 2035 (City of Roseville 2016b);
- 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).

3.9.2 AFFECTED ENVIRONMENT

3.9.2.1 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 Nevada Mountains to the east and the Coast Ranges to the west, the Great Valley is only about 50 miles wide, but extends nearly 500 miles 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, with the conspicuous exception of the Sutter Buttes, 42 miles north of the project site, which rise to an elevation of about 1,980 feet above mean sea level (msl). The Sacramento Valley floor contains a thick sequence of sedimentary deposits that were derived from the weathering and erosion of the Sierra Nevada and the Coast Ranges from the Mesozoic and Cenozoic eras. The sediment was then carried by water and deposited on the valley floor (City of Roseville 2016a).

3.9.2.2 Regional Seismicity and Fault Zones

The project site is located between the seismically active Coast Ranges and the inactive Foothills fault zone in the Sierra Nevada. To the west, a number of active and inactive zoned faults are present in the Coast Ranges and San Francisco Bay Area, including the Ortigalita, Green Valley, Concord, Calaveras, Hayward, and San Andreas. However, 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 and is not mapped as an area of having risk of surface fault rupture (CGS 2011). There are two inactive faults, the Bear Mountain fault zone and the Spencerville fault, located approximately 15 miles and 16 miles northeast of the project site, respectively (**Figure 3.9-1**). 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 IV or V on the Modified Mercalli Scale, meaning it would be felt by all but would only result in slight to moderate damage (City of Roseville 2016a).

3.9.2.3 Project Site - Topographic and Geologic Conditions

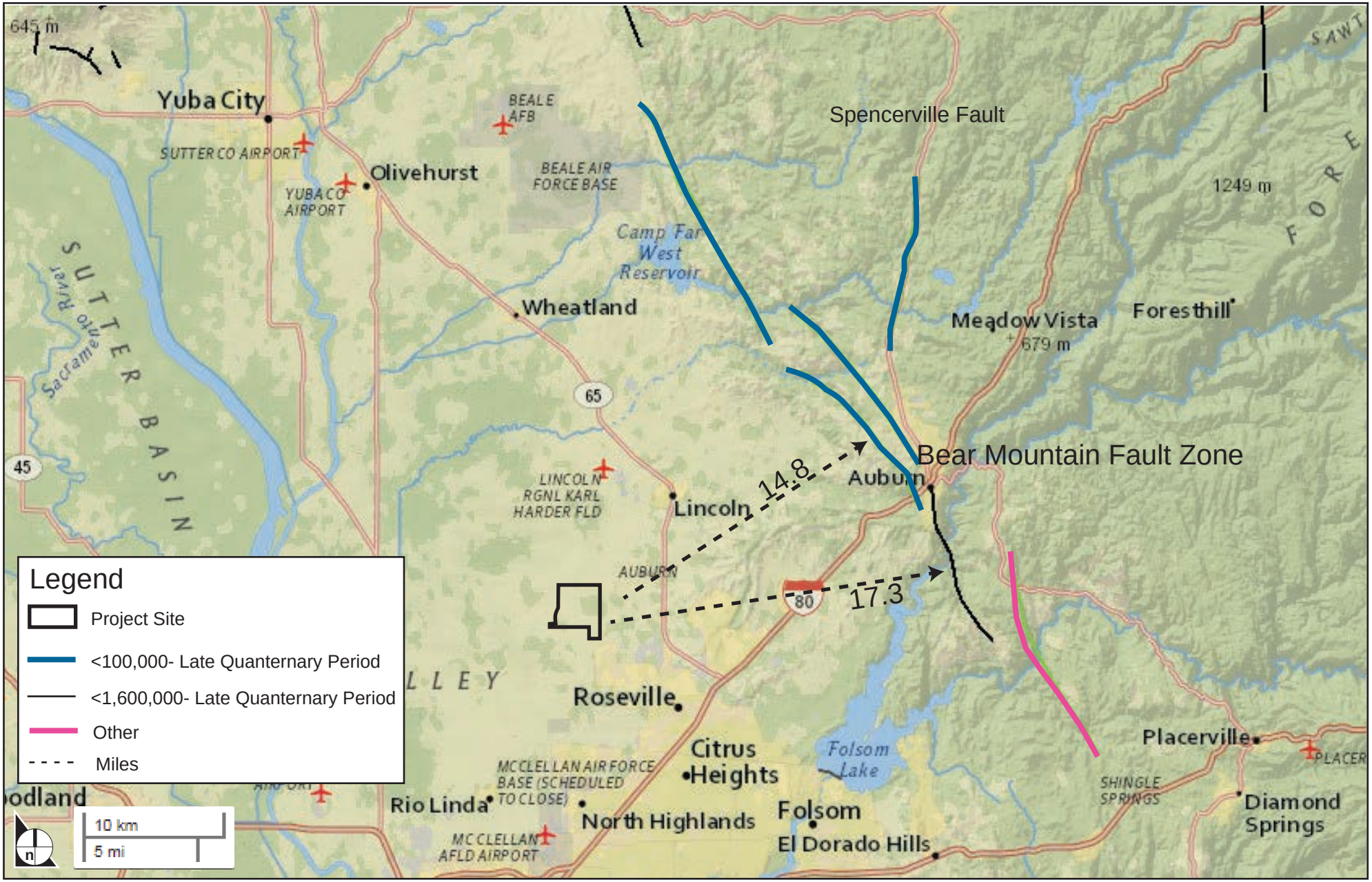
The project site is located on the eastern margin of the Sacramento Valley, about 12 miles from the westernmost foothills of the Sierra Nevada. The site is in a transitional zone between the flat, open terrain of the Sacramento Valley to the west and the foothills of the Sierra Nevada Mountains to the east. The topography of the site is fairly flat, with areas of gently rolling terrain and elevations ranging from 75 feet to 100 feet msl. The northeastern quadrant is slightly raised and causes minor drainages to flow away from that area. University Creek, an intermittent drainage and tributary to Pleasant Grove Creek, flows from east to west through the southwestern portion of the project site. It enters the site from the southeast, leaves the site along the southern boundary, then re-enters the project site in the southwestern corner.

In the vicinity of the site, sediments composing the coalesced American River-Pleasant Grove Creek alluvial fan have been divided into four stratigraphic units: the Laguna Formation, the Turlock Lake Formation, the Riverbank Formation, and the Modesto Formation. The project site is underlain by strata of the Riverbank Formation over Turlock Lake Formation (City of Roseville 2016a). Both deposits date back to the Pleistocene era and consist of material derived from erosion of the Sierra Nevada. However, the Riverbank Formation is largely made up of reddish gravel, sand, and silt, while the Turlock Lake Formation is dominated by feldspar-rich gravels (CGS 2002).

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 2016b).

3.9.2.4 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



SOURCE: Impact Sciences, Inc., 2017

FIGURE **3.9-1**

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Regional Fault Map

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geographic location, soil characteristics, and topography minimize the risk of liquefaction (City of Roseville 2016a). Based on the project site soils and the depth to groundwater, the project generally has a low to moderate potential for liquefaction.

3.9.2.5 Project Site – Soils

Soils mapping by the Natural Resources Conservation Service (NRCS) shows five soil units on the project site (**Figure 3.9-2**). **Table 3.9-1, 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. As described in **Table 3.9-1**, the soil mapping units within the project include: Alamo-Fiddyment Complex (0-5 percent slopes), Cometa-Fiddyment Complex (1 to 5 percent slopes), Fiddyment loam (1 to 8 percent slopes); Fiddyment-Kaseberg loams (2 to 9 percent slopes), and Xerofluvents hardpan substratum (NRCS 2016). Fiddyment loam and Fiddyment-Kaseberg loam are underlain by weathered bedrock, and Alamo-Fiddyment, Xerofluvents, and Cometa-Fiddyment are underlain by a dense clay pan. The average depth to bedrock or clay pan in these soils ranges from 16 inches to 40 inches.

3.9.2.6 Project Site – Mineral Resources

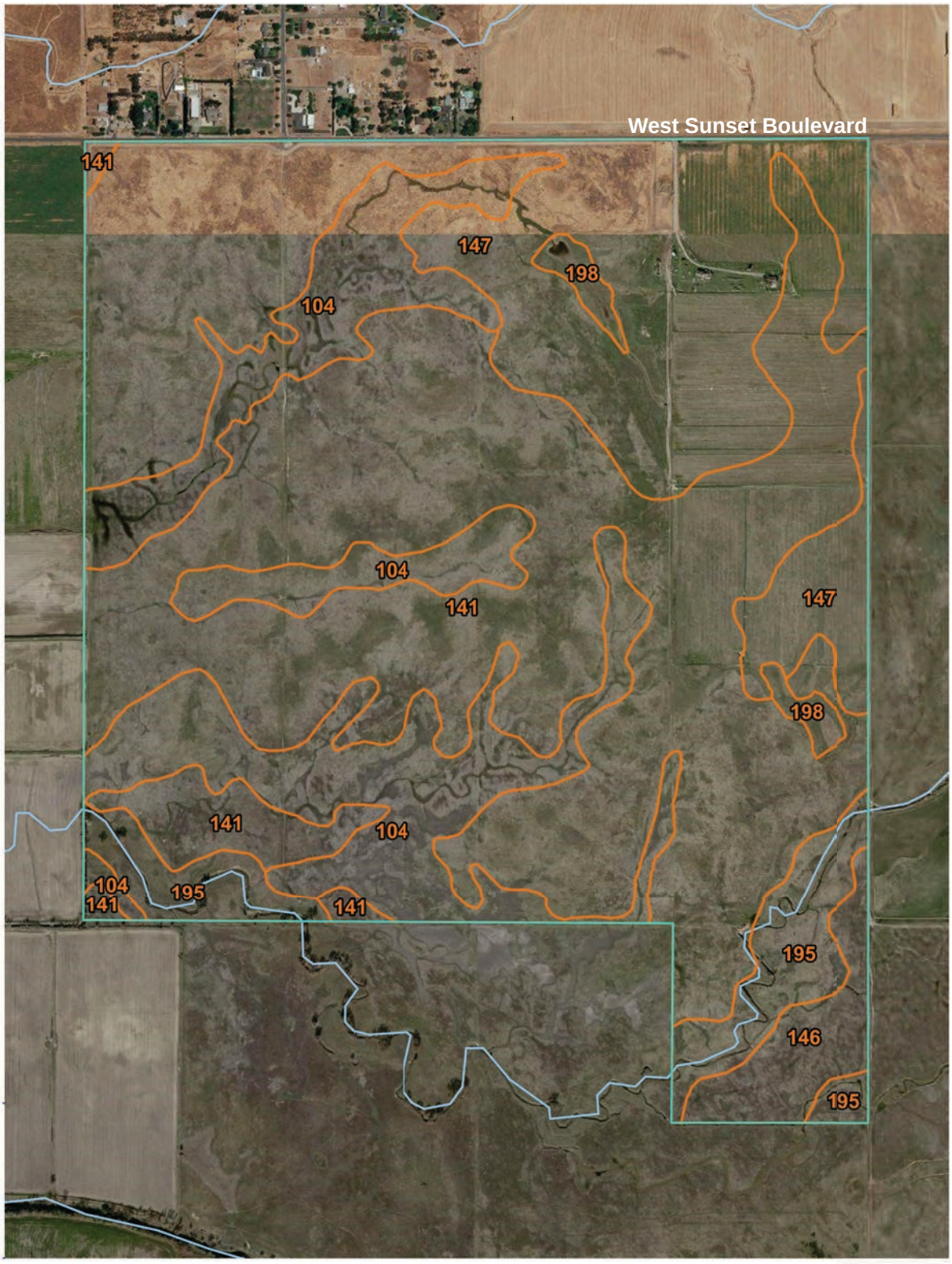
The project site has been classified as Mineral Resource Zone (MRZ) 4 by the State of California Division of Mines and Geology pursuant to the Surface Mining and Reclamation Act of 1975 (City of Roseville 2016b). As discussed in more detail in **Subsection 1.11, Regulatory Framework/Laws, Regulations, Plans, and Policies Applicable to the EIS**, 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 project site is not designated as an area of gold, aggregate, clay, or granite production, nor are there any mines as identified by the USGS Mineral Resources Data System (City of Roseville 2016a).

Table 3.9-1
Overview of Project Site Soils

Soil Unit	Description	Physical Properties	Limitations
Alamo- Fiddyment sandy loams, 0 to 5 percent slopes	Deep soils formed in alluvium derived primarily from sedimentary sources. Approximately 50 percent Alamo and similar soils and 30 percent Fiddyment soil with the remaining 20 percent made up of San Joaquin and Cometa sandy loam and Kaselburg loam. Alamo soil consists of clay to a depth of ~37 inches where it becomes indurated. Fiddyment soil consists of loam and clay loam overlying hardpan at a depth of about 28 inches.	Very slow permeability; slow runoff rate, slight erosion hazard; high expansion potential	The Alamo portion of the complex has a high shrink-swell potential, while the Fiddyment portion of the complex has a low to moderate shrink-swell potential. Slight risk of erosion hazard, a low risk of corrosion to concrete, and a high risk of corrosion to steel

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 hardpan at a depth of about 28 inches.	Very slow permeability, potentially slow runoff, slight erosion hazard; expansion potential ranges from low to high	Ranges from low to high shrink-swell potential, has a moderate risk of corrosion of concrete, and has a moderate risk of corrosion to stee
Fiddyment loam, 1 to 8 percent slopes	Moderately deep soil formed in alluvium derived from siltstone. Fiddyment loam consists of 80 percent Fiddyment soil and 15 percent of minor components like Cometa, Kaseburg, San Joaquin, and Alamo soils. Fiddyment has a profile of loam above clay loam and duripan, overlying bedrock at a depth of 35 inches.	Very slow permeability, very high runoff rate, slight to moderate erosion hazard; expansion potential ranges from low to high	The upper 12 inches of soil have a low shrink-swell potential, while the lower horizons (12 to 28 inches) have a high shrink-swell potential. Slight risk of erosion, a moderate risk of corrosion of concrete, and a low risk of corrosion to steel.
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	Slight risk of erosion, a moderate risk of erosion of concrete, and a low risk of corrosion to steel
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	Low risk of corrosion of concrete and a high risk of corrosion of steel

Source: NRCS Web Soil Survey 2016



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Map Unit Legend

104 - Alamo-Fiddyment complex 0 to 5 percent slopes
141 - Cometa-Fiddyment complex 1 to 5 percent slopes
146 - Fiddyment loam, 1 to 8 percent slopes
147 - Fiddyment-Kaseberg loams, 2 to 9 percent slopes
195 - Xerofluvents, hardpan substratum
198 - Water

SOURCE: USDA, Natural Resources Conservation Service, 2018

FIGURE **3.9-2**

Soil Types

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3.9.3 SIGNIFICANCE THRESHOLDS AND ANALYSIS METHODOLOGY

3.9.3.1 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 Corps has determined that the Proposed Action, or an alternative, would result in significant effects related to geology, soils, and minerals if it 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.

3.9.3.2 Analysis Methodology

Impacts related to geology, soils, and mineral resources under the Proposed Action, and associated alternatives, were evaluated qualitatively, based on professional judgment in consideration of the prevailing geologic and geotechnical engineering standard of care. Analysis relied on existing information available from published literature; thus, no new fieldwork was determined to be necessary, nor conducted, for this Draft EIS. As discussed in **Subsection 3.9.2, Affected Environment** above, the project site is not 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 un-zoned, faults within the site. Based on this information, neither the Proposed Action or any of the alternatives (No Action alternative or Alternatives 1, 2, or 3) are expected to result in significant effects related to the exposure of structures and their occupants to a surface fault rupture hazard; therefore, the analysis below focuses solely on effects related to seismic ground shaking, liquefaction, slope failure, and expansive soils.

3.9.4 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

Impact GEO-1 Hazard associated with Seismic Ground-Shaking

No Action Alt. The No Action alternative would construct a large-scale, mixed-use community on the project site comprising about 1,679 dwelling units and about 29 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 IV or V on the Modified Mercalli Scale (City of Roseville 2016b). 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. 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. Therefore, **no direct** or **indirect** effects associated with seismic ground shaking under the No Action alternative were identified.

Proposed Action, Alts. 1, 2, 3

The Proposed Action, as well as Alternatives 1, 2, and 3, would construct a large-scale, mixed-use community on the project site with about 2,308 to 2,826 residential units and 51 acres to 58 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 would be minimized by compliance with CBC seismic design requirements, and monitored by the City. Based on the significance criteria listed above, and as discussed under the No Action alternative above**, no direct** or **indirect** effects associated with seismic ground shaking under the Proposed Action, as well as Alternatives 1, 2, and 3,were identified.

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 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 2016b). The Applicant must comply with the City's building permit process and complete a geotechnical investigation as part of the project to ensure that areas susceptible to liquefaction are identified before any construction is undertaken on the site and that 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, risks associated with liquefaction and other types of seismically induced ground failure will be managed consistent with the prevailing engineering standard of care. Thus, **no direct** or **indirect** effects associated with liquefaction under the No Action alternative were identified.

Proposed Action, Alts. 1, 2, 3

The Proposed Action, as well as Alternatives 1, 2, and 3, would construct large-scale, mixed-use developments on the project site that would be similar in the type of development, but larger, than the No Action alternative in terms of the number of dwelling units and the amount of commercial development. 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 and the alternatives, including the CBC design requirements. Based on the significance criteria listed above, and as discussed under the No Action alternative; **no direct** or **indirect** effects associated with liquefaction under the Proposed Action, as well as Alternatives 1, 2, and 3, were identified.

Impact GEO-3 Hazard associated with Slope Failure

No Action Alt.

Development of the site is not expected to result in slope failure, related to natural slopes, due to the project site's gentle topography. This includes both seismically induced and non-seismic landslides and slope failures. Additionally, development is unlikely to be affected by landslide run-out (distance of travel), due to the distance between the project site and the Sierra Nevada and Coast Range foothills.

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 used 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 cut and fill slopes would be reduced consistent with prevailing engineering practices. Thus, **no direct** or **indirect** effects associated with slope failure under the No Action alternative were identified.

Proposed Action, Alts. 1, 2, 3

The Proposed Action, as well as Alternatives 1, 2, and 3, would construct large-scale, mixed-use developments 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 as discussed under the No Action alternative, **no direct** or **indirect** effects associated with slope failure under

the Proposed Action, as well as Alternatives 1, 2, and 3, were identified.

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 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 over excavation and replacement of native soils with non-expansive fills, soil 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. Thus, **no direct** or **indirect** effects to structures due to expansive soils under the No Action alternative were identified.

Proposed Action, Alts. 1, 2, 3 The Proposed Action, as well as Alternatives 1, 2, and 3, would construct large-scale, mixed-use developments 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, which will identify appropriate foundation design recommendations consistent with the CBC and current geotechnical engineering practices. Based on the significance criteria listed above, and as discussed under the No Action alternative**, no direct or indirect** effects associated with expansive soils under the Proposed Action, as well as Alternatives 1, 2, or 3, were identified.

Impact GEO-5 Effect on Mineral Resources

No Action Alt. As discussed in Subsection 3.9.2 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 2016b), 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 most of the site, the mineral resources on the site are not of regional or statewide importance. Moreover, the use of the site for land development is consistent with the City's long-term land use planning vision; whereas, mineral resources extraction is not. Thus, **no direct** or **indirect** effects to mineral resources under the No Action alternative were identified.

Proposed Action, Alts. 1, 2, 3

The Proposed Action, as well as Alternatives 1, 2, and 3, would construct large-scale, mixed-use developments on the project site, similar to the No Action alternative; thus, the effect on mineral resources would be similar. Based on the significance criteria listed above, and as discussed under the No Action alternative, **no direct** or **indirect** effects to mineral resources under the Proposed Action, as well as Alternatives 1, 2, and 3, were identified.

3.9.5 REFERENCES

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