4.7 GEOLOGY, SOILS, AND PALEONTOLOGICAL RESOURCES

4.7.1 INTRODUCTION

This chapter describes potential impacts related to geology, soils, and paleontological resources in the Planning Area associated with the proposed General Plan Update. To provide context for the impact analysis, this chapter begins with an environmental setting describing the existing soils, geologic, and seismic conditions in the Planning Area. Next, the regulatory framework is described, which informs the selection of the significance thresholds used in the impact analysis. The regulatory framework also includes existing General Plan policies related to the impact analysis of this chapter. The chapter concludes with the applicable significance thresholds, the impacts of the proposed changes to adopted General Plan policies, recommended mitigation measures, and the significance conclusion.

As part of the impact analysis, Notice of Preparation (NOP) comments were reviewed to help guide the analysis, and any comments were integrated into the analysis. No NOP comments related to geology, soils, or paleontological resources were received.

The City of Roseville does not overlie any known deposits of economically valuable mineral resources (Loyd 1995), and the City does not have a Surface Mining and Reclamation Act (SMARA) permit. No mining activities are currently underway nor does the City anticipate that any mining activities will take place in the future. Therefore, mineral resources are not evaluated in this EIR.

4.7.2 ENVIRONMENTAL SETTING

4.7.2.1 REGIONAL GEOLOGY

The Planning Area is located along the eastern margin of the Sacramento Valley and the western margin of the Sierra Nevada foothills. The Sacramento Valley, along with the San Joaquin Valley, comprise the Great Valley geomorphic province. The Great Valley is composed of thousands of feet of sedimentary deposits that have undergone periods of subsidence and uplift over millions of years. During the Jurassic (approximately 206 million years Before Present) and Cretaceous (approximately 144 million years Before Present) periods of the Mesozoic era, the Great Valley existed in the form of an ancient ocean. By the end of the Mesozoic era, the northern portion of the Great Valley began to fill with sediment as tectonic forces caused uplift of the basin. Geologic evidence suggests that the Sacramento Valley and San Joaquin Valley gradually separated into two separate water bodies as uplift and sedimentation continued. By the time of the Miocene epoch (approximately 24 million years Before Present), sediments deposited in the Sacramento Valley were mostly of terrestrial origin. In contrast, the San Joaquin Valley continued to be inundated with water for another 20 million years, as indicated by marine sediments dated to the late Pliocene epoch (approximately 5 million years Before Present). Most of the surface of the Great Valley is covered with Holocene (i.e., 11,700 years Before Present to present day) and Pleistocene (i.e., 2.6 million–11,700 years Before Present) alluvium. This alluvium is composed of sediments from the Sierra Nevada to the east and the Coast Range to the west that were carried by water and deposited on the valley floor.

The Sierra Nevada geomorphic province trends north-northwest from Bakersfield to Lassen Peak, and includes the Sierra Nevada mountain range and a broad belt of western foothills. The Sierra Nevada block is composed of northwest-trending belts of metamorphic, volcanic, and igneous rocks that have undergone intense deformation, faulting, and intrusion. Active faults that mark the eastern edge of the Sierra Nevada have resulted in upthrusting
and tilting of the entire Sierra Nevada block in the last 5 million years—steeply on the eastern edge (adjacent to the Mono Basin), and gently along the western edge (adjacent to the Great Valley). The gently rolling Sierra Nevada foothills are comprised of metamorphosed sedimentary rocks that have been intruded by igneous rocks. The rock formations that make up the western edge of the Sierra Nevada block likely originally formed as a volcanic arc that was later accreted (added) to the western margin of the continent during the Jurassic period.

### 4.7.2.2 PALEONTOLOGICAL RESOURCES

Exhibit 4.7-1 shows the surficial geologic formations that are exposed in the Planning Area. Recent, Holocene-age alluvium is present along the stream channel of Pleasant Grove Creek, as well as the channels of other smaller streams in the Planning Area. Most of the Planning Area is located within the Pleistocene-age Modesto, Riverbank, and Turlock Lake Formations. The eastern portion of the Planning Area, which is within the Sierra Nevada foothills, is composed primarily of the Mehrten Formation (Gutierrez 2011).

**Paleontological Sensitivity Assessment**

The potential paleontological sensitivity of a project area can be assessed by identifying the paleontological importance of rock units that are exposed there. A paleontologically sensitive rock formation is one that is rated high for potential paleontological productivity (i.e., the recorded abundance and types of fossil specimens, and the number of previously recorded fossil sites) and is known to have produced unique, scientifically important fossils. Exposures of a specific rock formation at any given project site are most likely to yield fossil remains representing particular species or quantities similar to those previously recorded from the rock formation in other locations. Therefore, the paleontological sensitivity determination of a rock formation is based primarily on the types and numbers of fossils that have been previously recorded from that rock unit.

An individual vertebrate fossil specimen may be considered unique or significant if it is identifiable and well preserved, and it meets one of the following criteria:

- a type specimen (i.e., the individual from which a species or subspecies has been described);
- a member of a rare species;
- a species that is part of a diverse assemblage (i.e., a site where more than one fossil has been discovered) wherein other species are also identifiable, and important information regarding life history of individuals can be drawn;
- a skeletal element different from, or a specimen more complete than, those now available for its species; or
- a complete specimen (i.e., all or substantially all of the entire skeleton is present).

The value or importance of different fossil groups varies depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions (such as for a research project). Marine invertebrates are generally common; the fossil record is well developed and well documented, and they would generally not be considered a unique paleontological resource. Identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare.
Exhibit 4.7-1
Paleontological Sensitivity Map

Source: Gutierrez 2011

Exhibit 4.7-1
Paleontological Sensitivity Map

Planning Area
Qha - Holocene alluvium
Qhb - Holocene basin deposits
Modesto Formation - Paleontologically Sensitive
Qmr - Undivided
Qmr1 - Upper member
Qmr2 - Lower member
Riverbank Formation - Paleontologically Sensitive
Qm - Undivided
Qm1 - Upper unit
Qm2 - Lower unit
Tullock Lake Formation - Paleontologically Sensitive
Mahwah Formation - Paleontologically Sensitive
MPm - Undivided
MPmc - Cobble conglomerate
MPmb - Mudflow breccia
Valley Springs Formation
Tom Formation - Paleontologically Sensitive
Rocklin Pluton

Source: Gutierrez 2011
In its standard guidelines for assessment and mitigation of adverse impacts on paleontological resources, the Society of Vertebrate Paleontology (SVP 2010) established four categories of sensitivity for paleontological resources: high, low, no, and undetermined. Areas where fossils have been previously found are considered to have a high sensitivity and a high potential to produce fossils. Areas that are not sedimentary in origin and that have not been known to produce fossils in the past typically are considered to have low sensitivity. Areas consisting of high-grade metamorphic rocks (e.g., gneisses and schists) and plutonic igneous rocks (e.g., granites and diorites) are considered to have no sensitivity. Areas that have not had any previous paleontological resource surveys or fossil finds are considered to be of undetermined sensitivity until surveys are performed. After reconnaissance surveys, a qualified paleontologist can determine whether the area of undetermined sensitivity should be categorized as having high, low, or no sensitivity. In keeping with the SVP significance criteria, all vertebrate fossils are generally categorized as being of potentially significant scientific value.

**Paleontologically Sensitive Rock Formations in the Planning Area**

Table 4.7-1 presents the results of the paleontological sensitivity assessment for the Planning Area based on a review of geologic maps, a literature review, and a records search performed at the University of California, Berkeley Museum of Paleontology (UCMP) on October 21, 2019. As shown, the Planning Area includes several rock formations that are of high paleontological sensitivity:

- Modesto Formation (Qm2, Qm1)
- Riverbank Formation (Qr3, Qr2, Qr1)
- Turlock Lake Formation (Qtl)
- Mehrten Formation (MPm)
- Ione Formation (Ei)

**REGIONAL SEISMICITY AND FAULT ZONES**

**Measuring Earthquakes**

Earthquakes can be measured in several ways. Earthquakes create certain types of waves with different velocities, which can be recorded on instruments called seismometers. The Richter Scale measures earthquake magnitude by plotting the amplitude (length and width) of the seismic waves, taking into consideration the distance from the seismometer. The scale is logarithmic so that a recording of magnitude 7, for example, indicates a disturbance with ground motion 10 times as large as a recording of magnitude 6. The Moment Magnitude scale is used by geologists to measure the magnitude of an earthquake based on the physical size of the fault rupture and slip displacement, as well as the amount of energy released. The Modified Mercalli scale is used by the public as a subjective measure of earthquake intensity; it does not have a mathematical basis. It was developed as a way of relating the intensity of ground shaking at any particular location to the physical effects that people experience. This scale is composed of 12 increasing levels of intensity that range from imperceptible shaking (Scale I) to catastrophic destruction (Scale XII). Table 4.7-2 provides a description of the Modified Mercalli Intensity (MMI) scale.
### Table 4.7-1  Paleontological Sensitivity Assessment

<table>
<thead>
<tr>
<th>Formation Name and Map Unit Abbreviation</th>
<th>Description</th>
<th>Fossils</th>
<th>Paleontological Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holocene Alluvium (Qha)</td>
<td>Alluvium deposited on fans, terraces, or in basins. Sand, gravel, and silt that are poorly to moderately sorted (11,700 years Before Present to Present Day).</td>
<td>Holocene deposits contain only the remains of extant, modern taxa (if any resources are present), which are not considered “unique” paleontological resources.</td>
<td>None</td>
</tr>
<tr>
<td>Holocene Basin Deposits (Qhb)</td>
<td>Fine grained sediments with horizontal stratification deposited by standing or slow-moving water in topographic lows (11,700 years Before Present to Present Day).</td>
<td>Holocene deposits contain only the remains of extant, modern taxa (if any resources are present), which are not considered “unique” paleontological resources.</td>
<td>None</td>
</tr>
<tr>
<td>Modesto Formation (Qm2, Qm1)</td>
<td>Late Pleistocene tan and light-gray gravelly sand, silt, and clay forming alluvial terraces, alluvial fans, and abandoned channel ridges of major streams and rivers. Qm2 = Upper member; composed of unconsolidated, unweathered deposits of gravel, sand, silt, and clay. Terraces are topographically lower than Qm1. The age is estimated to be approximately 12,000 to 26,000 years Before Present. Qm1 = Lower member; composed of unconsolidated, slightly weathered deposits of gravel, sand, silt, and clay. Qm2 terraces are topographically higher than Qm1. The age is estimated to be approximately 29,000 to 42,000 years Before Present.</td>
<td>Fossil specimens from sediments referable to the Modesto Formation have been reported at a variety of locations throughout the Sacramento and San Joaquin Valleys, including Stockton, Tracy (along the Delta-Mendota Canal), Manteca, Modesto, and Merced. The Tranquility site in Fresno County (UCMP V-4401), has yielded more than 130 Rancholabrean-age fossils of fish, turtles, snakes, birds, moles, gophers, mice, wood rats, voles, jack rabbits, coyote, red fox, grey fox, badger, horse, camel, pronghorn antelope, elk, deer, and bison from sediments referable to the Modesto Formation.</td>
<td>High</td>
</tr>
<tr>
<td>Riverbank Formation (Qr3, Qr2, Qr1)</td>
<td>Pleistocene deposits of weathered reddish gravel, sand, and silt that form higher alluvial fans and terraces of major rivers. In the Sacramento Valley, this formation contains more mafic igneous rock fragments as compared to the San Joaquin Valley, where the Riverbank tends to contain more arkosic alluvium. Qr3 = Upper unit, Qr2 = Middle unit, Qr1 = Lower unit. The upper, middle and lower units of the Riverbank Fm. form terraces that increase in topographic position with age. The age of the Riverbank ranges from approximately 130,000 to 450,000 years Before Present.</td>
<td>Nine recorded vertebrate fossil localities in the Sacramento area, including a Teichert Gravel Pit approximately 6 miles southwest of the project site. Localities have yielded remains of Rancholabrean-age mammoth, bison, camel, coyote, horse, Harlan’s ground sloth, mammoth, antelope, deer, rabbit, woodrat, fish, mole, mice, squirrel, snake, and gophers, dire wolf, frog, Pacific pond turtle, and the family Anatidae (ducks, geese, and swans). There are numerous additional vertebrate fossil localities from the Riverbank Formation and from similar unnamed Rancholabrean-age alluvial sediments in Yolo, San Joaquin, Merced, Stanislaus, Fresno, and Madera Counties.</td>
<td>High</td>
</tr>
<tr>
<td>Turlock Lake Formation (Qtl)</td>
<td>Pleistocene arkosic alluvium that includes fine sand and silt at the base, grading upward into coarse sand and coarse pebbly sand or gravel. Sediments originated from the Sierra Nevada and have been divided into upper and lower members. The lower member includes gravel and coarse sand that overlies finer, well-sorted sand, silt, and clay of possible lacustrine (lake) origin. The upper unit is found topographically above the lower unit and includes gravel beds and silt and fine sand that may be lacustrine in origin (Marchand and Allwardt). The Fairmead Landfill site in Chowchilla contains Irvingtonian-age fossils that were originally discovered in 1993 during excavation activities for a new Madera County landfill. Since 1993, more than 15,000 fossil specimens from over 35 different species have been recovered from the Fairmead site, including mammoth, ground sloth, giant short-faced bear, saber tooth cat, wolf, deer, camel, horse, antelope, rodents, birds, reptiles, fish, and prehistoric vegetation. Furthermore, excavations for the California Department of Transportation’s Fresno SR 180 West Freeway project uncovered fossil.</td>
<td>The Fairmead Landfill site in Chowchilla contains Irvingtonian-age fossils that were originally discovered in 1993 during excavation activities for a new Madera County landfill. Since 1993, more than 15,000 fossil specimens from over 35 different species have been recovered from the Fairmead site, including mammoth, ground sloth, giant short-faced bear, saber tooth cat, wolf, deer, camel, horse, antelope, rodents, birds, reptiles, fish, and prehistoric vegetation. Furthermore, excavations for the California Department of Transportation’s Fresno SR 180 West Freeway project uncovered fossil</td>
<td>High</td>
</tr>
</tbody>
</table>
### Table 4.7-1 Palaeontological Sensitivity Assessment

<table>
<thead>
<tr>
<th>Formation Name and Map Unit Abbreviation</th>
<th>Description</th>
<th>Fossils</th>
<th>Paleontological Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981)</td>
<td>The maximum age is estimated to be approximately 780,000 years Before Present.</td>
<td>specimens from a Pleistocene-age camel in sediments of the Turlock Lake Formation in Fresno County. Other specimens of horses, camel, and mammoth from sediments in Fresno County have been interpreted as probably equivalent to the Turlock Lake Formation. Additional vertebrate fossils have also been reported from various locations in the Central Valley from sediments referable to the Turlock Lake Formation.</td>
<td>High</td>
</tr>
<tr>
<td>Mehrten Formation (MPm)</td>
<td>Consists predominantly of very hard, cemented, lehar (volcanic mudflow) deposits with occasional beds of volcanic ash derived from andesitic volcanoc sources in the Sierra Nevada. Contains lenticular deposits of weakly to strongly cemented, well rounded, andesitic boulders, cobbles, and gravels in a fine- to medium-grained andesitic sandstone matrix. This formation is Pliocene–Miocene age (approximately 9 million years Before Present).</td>
<td>Several specimens of plant fossils have been recovered from the Mehrten Formation in Granite Bay, Roseville, and Rocklin. Vertebrate mammal and plant fossils have been reported from the Mehrten Formation throughout the Sierra Nevada foothills and the eastern margin of the Central Valley. The closest recorded vertebrate fossil locality within the Mehrten Formation is near Camanche Reservoir, where a specimen of <em>Pliohippus</em> (horse) was recovered. Other vertebrate fossils have been recovered from the Mehrten Formation from over 40 locations in Calaveras, San Joaquin, Stanislaus, Tuolumne, and Merced Counties.</td>
<td>High</td>
</tr>
<tr>
<td>Valley Springs Formation (OMvs)</td>
<td>Consists of pumice, rhyolitic tuff, sandstone, and conglomerate from volcanic lava flows that occurred in the Sierra Nevada, were washed into streams, and transported downstream to form fluvial deposits. This formation is mid-Miocene age (approximately 24 million years Before Present).</td>
<td>A few isolated plant fossils have been recovered in El Dorado and Calaveras Counties. No vertebrate fossils have been recorded.</td>
<td>Low</td>
</tr>
<tr>
<td>Ione Formation (Ei)</td>
<td>Occurs as a 200-mile-long series of isolated exposures along the western foothills of the Sierra Nevada, from Oroville south to Friant in Fresno County. Consists of quartzose sandstone, conglomerate, and claystone that is generally soft and deeply eroded. Locally contains beds of kaolinite clay. Formed from fluvial, estuarine, and shallow marine deposits of Eocene age (approximately 35 to 55 million years Before Present).</td>
<td>Numerous large assemblages yielding hundreds of plant fossils have been recovered throughout the Sierra Nevada foothills, particularly from Ione, Iowa Hill, and Camanche Reservoir. Other vertebrate mammal and plant fossils have been recovered from the Ione Formation from over 300 locations in Nevada, Contra Costa, Placer, Amador, Butte, Alameda, Merced, Tuolumne, Sutter, Sierra, Plumas, Calaveras, Kern, and Stanislaus Counties.</td>
<td>High</td>
</tr>
<tr>
<td>Rocklin Pluton (Kr)</td>
<td>Light gray silicic quartz diorite of Lower Cretaceous age (approximately 145.5 to 99.6 million years Before Present).</td>
<td>Plutonic intrusive rocks were formed from magma that solidified at great depths below the earth’s surface; therefore, they do not contain fossils.</td>
<td>None</td>
</tr>
</tbody>
</table>

### Table 4.7-2 Modified Mercalli Index

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not felt. Marginal and long period effects of large earthquakes.</td>
</tr>
<tr>
<td>II</td>
<td>Felt by persons at rest, on upper floors, or favorably placed.</td>
</tr>
<tr>
<td>VII</td>
<td>Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.</td>
</tr>
<tr>
<td>VIII</td>
<td>Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.</td>
</tr>
<tr>
<td>IX</td>
<td>General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.</td>
</tr>
<tr>
<td>X</td>
<td>Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.</td>
</tr>
<tr>
<td>XI</td>
<td>Rails bent greatly. Underground pipelines completely out of service.</td>
</tr>
<tr>
<td>XII</td>
<td>Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.</td>
</tr>
</tbody>
</table>

Notes:
- Masonry A: Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.
- Masonry B: Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.
- Masonry C: Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners, but neither reinforced nor designed against horizontal forces.
- Masonry D: Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

Source: Wood and Neumann 1931

### Classifying and Identifying Faults

Geologists have determined that the greatest potential for surface fault rupture and strong seismic ground shaking is from active faults, that is, faults with evidence of activity during the Holocene epoch (the last 11,700 years). Faults classified as “potentially active” (where there is evidence that movement has occurred during the last 1.6 million years), have a lower potential for surface fault rupture and strong seismic ground shaking. Pre-Quaternary faults have exhibited evidence of movement more than 1.6 million years Before Present, and therefore are not considered active. Pre-Quaternary faults are generally not considered to represent a surface fault rupture or strong...
seismic ground shaking hazard (unless those faults are influenced by human-caused activity such as construction of a large water-storage reservoir directly over a fault zone).

Roseville is located within an area with relatively low seismic activity. As shown in Exhibit 4.7-2, there are no known fault traces within or adjacent to the Planning Area. The nearest active fault is a portion of the Dunnigan Hills Fault, approximately 30 miles to the west. Other active faults are located south of Lake Oroville, at Lake Tahoe, and in the Coast Ranges, approximately 45–60 miles away.

The Foothills Fault System is approximately 12 miles east of the Planning Area. This fault system includes a number of different faults, including the Bear Mountains Fault Zone. The northern portion of the Bear Mountains Fault Zone and the Maidu Fault (east of Folsom Lake), along with the northern portion of the Deadman Fault (north of Folsom Lake), have exhibited evidence of movement in the last 700,000 to 1.6 million years Before Present (Jennings and Bryant 2010). Therefore, these faults are considered potentially active.

There are several pre-Quaternary faults within 10 miles of the Planning Area (Jennings and Bryant 2010, City of Roseville 2010), which are not considered to be active:

- Willows Fault Zone, which diagonally transects the Sacramento Valley from northwest to southeast, from Red Bluff to south Sacramento.
- Volcano Hill Fault, located in Granite Bay and extending northwesterly from Volcano Hill for approximately 1 mile, terminating near Eureka Road.
- Linda Creek Fault, along a segment of Linda Creek from Roseville to Sacramento County, east of the Planning Area.
- An unnamed fault extending east–west between Folsom Lake and the city of Rocklin. Segments of this fault are concealed, and are therefore unmapped. However, this unnamed fault could connect to the Bear Mountains Fault Zone, branches of which are located beneath the eastern edge of Folsom Lake.

Potential seismic hazards resulting from an earthquake consist of surface fault rupture, ground shaking, liquefaction, and landslides, each of which are discussed below.

**Surface Fault Rupture**

Surface rupture is the actual cracking or breaking of the ground surface along a fault during an earthquake. Structures built over an active fault can be torn apart if the ground ruptures. However, surface ground rupture along a fault generally is limited to a linear zone that is only a few yards wide. The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) (see the “Regulatory Framework” section, below) was created to help reduce the loss of life and property from an earthquake by prohibiting the construction of structures designed for human occupancy across the traces of active faults. The Planning Area is not located within or adjacent to an Alquist-Priolo Earthquake Fault Zone (California Geological Survey [CGS] 2017). The nearest fault zoned under the Alquist-Priolo Act is a portion of the Dunnigan Hills Fault, approximately 30 miles to the west.
Seismic Ground Shaking

Ground shaking—motion that occurs as a result of energy released during faulting—could potentially result in the damage or collapse of buildings and other structures, depending on the magnitude of the earthquake, the location of the epicenter, and the character and duration of the ground motion. Other important factors to be considered are the characteristics of the underlying soil and rock and, where structures exist, the building materials used and the workmanship of the structures.

Ground motions from seismic activity can be estimated using a computer model. The CGS Probabilistic Seismic Hazards Assessment Model (CGS 2008) indicates that a minimum peak horizontal acceleration ranging from 0.14 to 0.16 g (where g is the percentage of gravity) could be expected. This means there is a 1-in-10 probability that an earthquake will occur within 50 years that would result in a peak horizontal ground acceleration exceeding 0.14 to 0.16 g in the Planning Area. This calculation indicates that a low level of seismic ground shaking could occur.

Liquefaction

Soil liquefaction occurs when ground shaking from an earthquake causes a sediment layer saturated with groundwater to lose strength and become fluid, similar to quicksand. The liquefaction potential depends on the type of soil, the level and duration of seismic ground motions, and the depth to groundwater. The locations that are most susceptible to liquefaction-induced damage have loose, water-saturated, granular sediment that is within 40 feet of the ground surface. Liquefaction poses a hazard to engineered structures, such as buildings, bridges, and underground utility pipelines, because the loss of soil strength can result in bearing capacity insufficient to support foundation loads and increased lateral pressure on retaining walls. Groundwater elevations vary from 90 to 140 feet below the ground surface (bgs) throughout most of the Planning Area (California Department of Water Resources [DWR] 2019). Groundwater in the downtown area and inner neighborhoods (southwest of SR 65 and northwest of I-80) ranges from 50 to 90 feet bgs (DWR 2019). Furthermore, the Planning Area is composed of well consolidated to very hard, older Pleistocene- to Eocene-age deposits, and active seismic sources are at least 30 miles away. Therefore, it is unlikely that the Planning Area would be subject to liquefaction in the event of a large magnitude earthquake.

Landslides

Landslide susceptibility is based on various combinations of factors such as rainfall, rock and soil types, slope, vegetation, seismic conditions, and human construction activities. Generally, landslides are expected to occur most often on slopes steeper than 15 percent, in areas with a history of landslides, and in areas underlain by geologic units that are weakly cemented.

The Planning Area slopes upwards to the east, as part of the transition from the Sacramento Valley floor to the Sierra Nevada foothills. The northwestern edge of the Planning Area is at an elevation of approximately 70 feet above mean sea level (amsl), while the eastern portion of the Planning Area is approximately 230 feet amsl. The southeastern portion of the Planning Area, near Secret Ravine, is on a ridgeline that is approximately 400 feet amsl. Most of the new development in the Planning Area is planned for the nearly flat portion of the Sacramento Valley floor in the western and northwestern portions of the Planning Area, north of Baseline Road. The eastern and northeastern portions of the Planning Area, which are within the Sierra Nevada foothills, contain some areas
Exhibit 4.7-2

Regional Faults

Source: Jennings and Saucedo 2000

LEGEND
- Planning Area
- Fault Line Displacement
- Well Located
- Approximately Located or Inferred
- Concealed

Source: Jennings and Saucedo 2000
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where slopes exceed 15 percent. However, the Planning Area does not have a history of landslides, is composed of stable geologic units that are moderately to very strongly cemented, and active seismic sources are at least 30 miles away. Therefore, it is unlikely that landslides would pose a hazard in the Planning Area.

**Seismic Seiches**

Earthquakes may affect open bodies of water by creating seismic sea waves and seiches. Seismic sea waves (often called “tidal waves”) are caused by abrupt ground movements (usually vertical) on the ocean floor in connection with a major earthquake. Because of the Planning Area’s long distance from the Pacific Ocean, seismic sea waves do not represent a hazard. A seiche is a sloshing of water in an enclosed or restricted water body, such as a basin, river, or lake, which is caused by earthquake motion; the sloshing can occur for a few minutes or several hours. There are no large water bodies in the Planning Area where seiches would represent a hazard. Folsom Lake is approximately 3.25 miles east of the Planning Area, and as described above, the seismic hazards in the Sacramento Valley are very low, and therefore the risk of a seismic seiche that would overtop Folsom Lake and result in downstream flooding in the Planning Area is also considered very low.

**4.7.2.3 VOLCANIC ACTIVITY**

There are several regions of active volcanic activity in northern California. The Clear Lake volcanic field is located approximately 70 miles west of the Planning Area. The field contains lava domes and cinder cones that range in age from approximately 2 million to 10,000 years Before Present. Mount Konocti, with an elevation of 4,305 feet, is the largest volcanic feature. Steam in The Geysers vapor-dominated field, which is located on the southwest margin of the volcanic field, is harnessed by the Calpine Corporation for geothermal power production. The volcanic history of the Clear Lake field is episodic, i.e., long periods of no activity separated by shorter intervals of frequent eruptions. At present, geologists believe the field appears to be in a period of no activity following a volcanically active stretch between 60,000 and 10,000 years Before Present, which averaged 1 eruption every 1,800 years. Because of long pauses in the volcanic activity near Clear Lake, it is currently uncertain what stage of volcanism the region might be undergoing. Intermittent seismic activity and the presence of heat at depth indicate that the system is still active and eruptions may occur in the future. The U.S. Geological Survey (USGS), in cooperation with Calpine, maintains a real-time network of monitoring stations throughout the system that measure seismic activity, ground deformation, and volcanic gases (USGS 2016).

The Lassen Volcanic National Park area is located approximately 120 miles north of the Planning Area. Three episodes of volcanism have occurred in the vicinity of the Lassen volcanic center in the past 1,100 years. These eruptions occurred at Chaos Crags, Cinder Cone, and lastly at Lassen Peak in 1914–1917. An ash plume from the 1915 eruption rose more than 5.5 miles above the peak, and the prevailing winds scattered the ash across Nevada as far as 300 miles to the east (USGS 2001). The prevailing wind direction in that area is towards the east; thus, it is unlikely that the Planning Area would be affected by volcanic activity in the Lassen area.

**4.7.2.4 SOILS**

The U.S. National Resources Conservation Service (NRCS) provides soils surveys and reports for Placer County, which includes the city of Roseville. Exhibit 4.7-3 shows the soil types in the Planning Area (NRCS 2019).
Soil Properties

Soil properties influence the development of building sites, including the engineering design, construction techniques, and site maintenance. The NRCS soil database provides an indication of the limitations of soils for dwellings without basements, small commercial buildings, and local roads and streets. The rating system indicates the extent to which the soils are limited by the soil features that affect building site development. NRCS soil limitations are based on the soil properties that affect the capacity of the soil to support a load without movement, and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity consist of depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. The properties that affect the ease and amount of excavation consist of flooding, depth to a water table, ponding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

All of the soils in the Planning Area have some limitations with respect to dwellings, small commercial buildings, and local roads and streets. In general, these limitations are related to a shallow depth to bedrock, low soil bearing strength, and a moderate to high shrink-swell potential. Construction in the Mehrten Formation presents particularly difficult challenges during the excavation process due to its extreme hardness. Excavator-mounted rock hammers are required to break up larger areas for construction, while specialized trenching equipment equipped with saw blades can be used to cut foundation and utility trenches for smaller projects.

Most soils can be categorized into hydrologic soil groups (which apply only to surface soil layers) based on runoff-producing characteristics. Hydrologic soil groups are factored into calculations of erosion and stormwater runoff potential when drainage plans are prepared for new development. Soils are assigned to groups A, B, C, or D. Group D soils have a very slow water infiltration rate and therefore have a very high stormwater runoff potential. Most of the Planning Area soils are assigned to Hydrologic Group D (NRCS 2019) (see Exhibit 4.7-4). Water erosion hazards are particularly high in areas of steeper slopes along streambeds.

Expansive soils are composed largely of clays, which greatly increase in volume when saturated with water and shrink when dried. Because of this shrink-swell effect, structural foundations may rise during the rainy season and fall during the dry season. If this expansive movement varies beneath different parts of a structure, the foundation may crack and portions of the structure may become distorted. Retaining walls and underground utilities may be damaged for the same reasons. Some of the soils in the Planning Area are rated as moderately to highly expansive (NRCS 2019); these soils are located primarily along streambeds (see Exhibit 4.7-5). Proper foundation design and soil treatment can generally eliminate the problems caused by expansive soils.

4.7.3 REGULATORY FRAMEWORK

4.7.3.1 FEDERAL

Earthquake Hazards Reduction Act, Public Law 95–124

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act to reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. To accomplish this goal, the act established the National Earthquake
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Exhibit 4.7-5. Shrink Swell Potential

Source: NRCS 2019
Hazards Reduction Program. This program was substantially amended in November 1990 by the National Earthquake Hazards Reduction Program Act, which refined the description of agency responsibilities, program goals, and objectives.

The mission of the National Earthquake Hazards Reduction Program includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and accelerated application of research results. The National Earthquake Hazards Reduction Program Act designates the Federal Emergency Management Agency as the lead agency of the program and assigns several planning, coordinating, and reporting responsibilities. Other National Earthquake Hazards Reduction Program Act agencies include the National Institute of Standards and Technology, National Science Foundation, and USGS.

4.7.3.2 STATE

Alquist-Priolo Earthquake Fault Zoning Act, California Public Resources Code Sections 2621–2630

The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) (California Public Resources Code Sections 2621–2630) was passed in 1972 to reduce the hazard of surface faulting on structures designed for human occupancy. The main purpose of the law is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. The Alquist-Priolo Act requires the State Geologist to establish regulatory zones known as Earthquake Fault Zones around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning efforts. Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

Seismic Hazards Mapping Act, California Public Resources Code Sections 2690–2699.6

The Seismic Hazards Mapping Act of 1990 (California Public Resources Code Sections 2690–2699.6) addresses earthquake hazards from non-surface fault rupture, including liquefaction and seismically induced landslides. The act established a mapping program for areas that have the potential for liquefaction, landslide, strong ground shaking, or other earthquake and geologic hazards. The act also specifies that the lead agency for a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

National Pollutant Discharge Elimination System

In California, the State Water Resources Control Board administers regulations promulgated by the U.S. Environmental Protection Agency (55 Code of Federal Regulations 47990) requiring the permitting of stormwater-generated pollution under the National Pollutant Discharge Elimination System (NPDES). In turn, the State Water Resources Control Board’s jurisdiction is administered through nine regional water quality control boards. Under these federal regulations, an operator must obtain a general permit through the NPDES Stormwater Program for all construction activities with ground disturbance of 1 acre or more. The State Water Resources Control Board’s statewide storm water general permit for construction activity (Order 2009-009-DWQ as amended by Order No. 2012-0006-DWQ) requires the implementation of best management practices (BMPs) to
reduce sedimentation into surface waters and to control erosion. One element of compliance with the NPDES permit is preparation of a storm water pollution prevention plan (SWPPP) that addresses control of water pollution, including sediment, in runoff during construction. (See Section 4.13 of this EIR, “Hydrology and Water Quality,” for more information about the NPDES permit program and SWPPPs.)

California Building Standards Code, California Code of Regulations Title 24

The California Building Standards Commission is responsible for coordinating, managing, adopting, and approving building codes in California. The State of California provides minimum standards for building design through the California Building Standards Code (CBC) (California Code of Regulations Title 24). Where no other building codes apply, Chapter 29 of the CBC regulates excavation, foundations, and retaining walls. The CBC applies to building design and construction in the state and is based on the Federal Uniform Building Code used widely throughout the country (generally adopted on a state-by-state or district-by-district basis). The CBC has been modified for California conditions with numerous more detailed or more stringent regulations.

The state earthquake protection law (California Health and Safety Code Section 19100 et seq.) requires that structures be designed to resist stresses produced by lateral forces caused by wind and earthquakes. The CBC requires an evaluation of seismic design that falls into Categories A–F (where F requires the most earthquake-resistant design) for structures designed for a project site. The CBC philosophy focuses on “collapse prevention,” meaning that structures are designed for prevention of collapse for the maximum level of ground shaking that could reasonably be expected to occur at a site. Chapter 16 of the CBC specifies exactly how each seismic design category is to be determined on a site-specific basis through the site-specific soil characteristics and proximity to potential seismic hazards.

Chapter 18 of the CBC regulates the excavation of foundations and retaining walls. This chapter regulates the preparation of a preliminary soil report, engineering geologic report, geotechnical report, and supplemental ground-response report. Chapter 18 also regulates analysis of expansive soils and the determination of the depth to groundwater table. For Seismic Design Category C, Chapter 18 requires analysis of slope instability, liquefaction, and surface rupture attributable to faulting or lateral spreading. For Seismic Design Categories D, E, and F, Chapter 18 requires these same analyses plus an evaluation of lateral pressures on basement and retaining walls, liquefaction and soil strength loss, and lateral movement or reduction in foundation soil-bearing capacity. It also requires mitigation measures to be considered in structural design. Mitigation measures may include ground stabilization, selection of appropriate foundation type and depths, selection of appropriate structural systems to accommodate anticipated displacements, or any combination of these measures. The potential for liquefaction and soil strength loss must be evaluated for site-specific peak ground acceleration magnitudes and source characteristics, consistent with the design earthquake ground motions. Peak ground acceleration must be determined from a site-specific study, the contents of which are specified in CBC Chapter 18.

Finally, Appendix Chapter J of the CBC regulates grading activities, including drainage and erosion control, and construction on unstable soils, such as expansive soils and areas subject to liquefaction.
4.7.3.3 REGIONAL AND LOCAL

Existing City of Roseville General Plan

The existing Roseville General Plan (City of Roseville 2016) includes the following goals and policies related to geology and soils. There are no existing General Plan policies related to paleontological resources.

Seismic and Geologic Hazards Goal 1: Minimize injury and property damage due to seismic activity and geologic hazards.

► Policy 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.
► Policy 2: Continue to mitigate the potential impacts of geologic hazards through building plan review.
► Policy 3: Minimize soil erosion and sedimentation by maintaining compatible land uses, suitable building designs, and appropriate construction techniques.
► Policy 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
► Policy 5: Create and adopt slope development standards prior to or as part of the planning process for any area identified as having significant slope.
► Policy 6: Require contour grading, where feasible, and re-vegetation to mitigate the appearance of engineered slopes and to control erosion.

Vegetation and Wildlife Policy 4: Require preservation of contiguous areas in excess of the City’s Regulatory Floodplain, as defined in the Safety Element, as merited by special resources or circumstances. Special circumstances may include, but are not limited to, sensitive wildlife or vegetation, wetland habitat, oak woodland areas, grassland connections in association with other habitat areas, slope or topographical considerations, recreation opportunities, and maintenance access requirements.

Groundwater Recharge and Water Quality Goal 1: Continue to improve surface water quality and accommodate water flow increases.

► Policy 2: Implement erosion control and topsoil conservation measures to limit sediments within watercourses.

City of Roseville Building Code, Roseville Municipal Code Chapter 16.04

City of Roseville Grading Ordinance, Roseville Municipal Code Chapter 16.20

The City’s Grading Ordinance (Roseville Municipal Code Chapter 16.20) establishes a process to regulate grading that is not otherwise permitted as part of a separate discretionary action. A grading permit is required for construction projects throughout the city. The permit application process includes submittal of grading plans, copies of any necessary state or federal permits, description and quantity of work (including mitigation measures to protect watercourses and wetlands), and dates when the work will be performed. The Grading Ordinance requires prompt re-vegetation of disturbed areas, avoidance of grading activities during wet weather, avoidance of disturbance within drainageways, and other erosion control measures.

City of Roseville 2019 Design and Construction Standards

The City’s Design and Construction Standards (City of Roseville 2019) apply to transportation, storm drainage, sewer, wastewater pumping, water distribution, graywater distribution, underground pipelines, roadways, and other improvements, and are designed, in part, to avoid impacts related to geologic constraints and to control erosion and stormwater runoff.

City of Roseville Stormwater Quality BMP Guidance Manual for Construction

The *Stormwater Quality BMP Guidance Manual for Construction* (City of Roseville 2011a) was developed as part of the City’s program to implement the goals contained in the *City of Roseville Stormwater Management Program* (City of Roseville 2004), as required by the NPDES municipal stormwater permit from the State Water Resources Control Board. The BMP Guidance Manual provides the requirements for preparation and submittal of SWPPPs for construction activities, including City and State procedural requirements for SWPPP submittals and site inspections related to stormwater quality. The BMP Guidance Manual also identifies the various construction-related BMPs that can be used within the City to control construction site runoff. The manual addresses issues such as erosion control, sediment control, and good housekeeping practices.

Open Space Preserve Overarching Management Plan

The City’s General Plan focuses on the preservation and enhancement of a network of open space that not only provides habitat linkages, but also provides connections between neighborhoods and destinations. These connections are provided primarily via a network of open space corridors adjacent to streams throughout the Planning Area that typically also include pedestrian/bicycle trails. The General Plan recognizes that there is a balance between habitat protection and public access. Therefore, sensitive native communities, such as those that support endangered species have limited or supervised access, whereas other areas have regular access points, such as pedestrian/bicycle trails. Both habitat protection and public access must be considered for successful open space management. The City’s Open Space Preserve Overarching Management Plan provides a City-wide approach and specific goals, which serve as the implementing framework for open space management, maintenance, and monitoring for all open space within City limits (City of Roseville 2011b).

The Open Space Preserve Overarching Management Plan includes specific requirements and adopted mitigation measures for open space management, maintenance, and monitoring that are related to soils, erosion, and water quality, including the following:
Work Zone: Heavy equipment, vehicles, and maintenance work will be confined to existing or designated access roads, road shoulders, and disturbed or designated areas. Ground disturbance and vegetation removal will be confined to the minimum extent necessary to complete the work.

Erosion and Dust Control: The City will implement erosion, sediment, material stockpile, and dust control BMPs on-site to minimize the potential for fill or runoff to enter wetlands or waterways. A biological monitor will be retained as necessary to monitor and inspect the installation and removal of erosion/sediment control devices, if applicable.

Spill Prevention/Containment and Refueling Precautions: The City will maintain all maintenance equipment to prevent leaks of fuels, lubricants, or other fluids into waterways. Appropriate materials will be on-site to prevent and manage accidental spills. City will take appropriate precaution when handling and/or storing chemicals (e.g., fuel and hydraulic fluid) near waterways and wetlands, and any and all applicable laws and regulations will be followed. Service and refueling procedures will take place outside open space areas or at least 100 feet from waterways or in an upland area at least 100 feet from wetland boundaries to prevent spills from entering waterways or wetlands.

Trash Cleanup: The City will properly contain and remove all trash and waste items generated by maintenance activities.

Work Window: The City will only perform ground disturbing work within 250 feet of vernal pool habitat or work that will result in direct impacts authorized by the Biological Opinion during the dry season (generally May 15–October 15).

Adopted Specific Plans and Mitigation Measures

Currently, the City has adopted 14 Specific Plans. A Specific Plan is a comprehensive planning and zoning document that implements the General Plan by providing development and conservation standards for a defined geographic location within the Planning Area. Each Specific Plan contains guidelines for site, architectural, landscaping, lighting, roadway networks, pedestrian/bicycle paths, open space corridors, parks, and other aspects of design. Each adopted Specific Plan included an EIR, which evaluated potential impacts related to geology, soils, and paleontological resources. Where appropriate, mitigation measures were adopted to reduce the potential to impact paleontological resources, and these measures are required to be implemented in the respective Specific Plan Areas. Impacts related to geology and soils were found to be less than significant. The adopted mitigation measures include protection for unique paleontological resources, such as construction worker personnel training, monitoring during construction activities, and assessment and management recommendations in the event that fossil specimens are encountered.

4.7.4 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.7.4.1 METHODOLOGY

The analysis prepared for this EIR relies on published geologic literature and maps, NRCS soil survey data, and a records search performed at the University of California Museum of Paleontology (UCMP). The information obtained from these sources was reviewed and summarized to present the existing conditions and to identify potential environmental impacts, based on the thresholds of significance presented in this section. Impacts
associated with geology, soils, and paleontological resources that could result from construction and operational activities; expected construction practices; and the materials, locations, and duration of potential construction and related activities.

This proposed General Plan Update is compared to existing physical conditions which constitute the baseline for purposes of determining whether potential impacts are significant. This General Plan Update does not include any changes to land use designations, expansion to the City’s Planning Area, or other major physical changes to areas planned for development compared to the existing General Plan, but does include changes to goals, policies, and implementation measures, which are analyzed as a part of this EIR.

4.7.4.2 THRESHOLDS OF SIGNIFICANCE

Geology and Soils

The basis for determining the significance of impacts for this analysis is based on the environmental checklist in Appendix G of the State CEQA Guidelines. The proposed project would result in a significant impact related to geology and soils if it would do any of the following:

► directly or indirectly cause potential substantial adverse impacts, including the risk of loss, injury, or death involving:
  • rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
  • strong seismic ground shaking;
  • seismic-related ground failure, including liquefaction; or
  • landslides;
► result in substantial soil erosion or the loss of topsoil;
► be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
► be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property; or
► have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

Paleontological Resources

The proposed project would have a significant impact on paleontological resources if it would:

► directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.
Based on criteria developed by qualified professionals, a “unique paleontological resource or site” is one that is considered significant under the professional paleontological standards described below.

An individual vertebrate fossil specimen may be considered unique or significant if it is identifiable and well preserved, and it meets one of the following criteria:

- a type specimen (i.e., the individual from which a species or subspecies has been described);
- a member of a rare species;
- a species that is part of a diverse assemblage (i.e., a site where more than one fossil has been discovered) wherein other species are also identifiable, and important information regarding life history of individuals can be drawn;
- a skeletal element different from, or a specimen more complete than, those now available for its species; or
- a complete specimen (i.e., all or substantially all of the entire skeleton is present).

The value or importance of different fossil groups varies depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions (such as for a research project). Marine invertebrates are generally common; the fossil record is well developed and well documented, and they would generally not be considered a unique paleontological resource. Identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare.

### 4.7.4.3 Issues Not Discussed Further

**Surface Fault Rupture**—There are no fault traces either within or immediately adjacent to the Planning Area. Thus, surface fault rupture would not pose a hazard for the Planning Area, and this impact is not addressed further in this EIR.

**Liquefaction**—The depth to groundwater in the Planning Area ranges from 50 to 140 feet bgs; the Planning Area is underlain by stable, moderately cemented to very well cemented, older Pleistocene–Eocene age rock formations; and active seismic sources are at least 30 miles away. Thus, liquefaction would not pose a hazard for the Planning Area, and this impact is not addressed further in this EIR.

**Landslide Hazards**—Most land use change during General Plan buildout would occur in the nearly flat portions of the Sacramento Valley floor in the western and northwestern portions of the Planning Area. The eastern and northeastern portions of the Planning Area, which are within the Sierra Nevada foothills, have areas where slopes exceed 15 percent. However, the Planning Area does not have a history of landslides, is composed of stable geologic units that are moderately to very strongly cemented, and active seismic sources are at least 30 miles away. Therefore, it is unlikely that landslides would pose a hazard in the Planning Area, and this impact is not addressed further in this EIR.

**Soil Suitability for Alternative Wastewater Treatment Systems**—All new and infill development in the Planning Area is required to install utility connections for wastewater treatment at the Pleasant Grove or Dry Creek Wastewater Treatment Plants (depending on the location of the development). Therefore, alternative
wastewater treatment systems (such as septic systems) would not be used, and this impact is not addressed further in this EIR.

### 4.7.4.4 IMPACT ANALYSIS

**IMPACT 4.7-1** Substantial Adverse Impacts Related to Strong Seismic Ground Shaking. Development occurring through buildout of the General Plan and utilities and public facilities required to serve such development could subject people and structures to hazards associated with seismic ground shaking. Implementation of the policies in the proposed General Plan Update, and compliance with relevant laws and ordinances, would reduce the potential for loss or damage from seismic hazards. This impact is less than significant.

If buildings and other improvements are constructed in areas with potential seismic activity, this could expose people and property to damage related to ground shaking. Damage from strong seismic ground shaking is most likely to occur in areas where older buildings that consist of unreinforced masonry are located. However, Roseville is in an area with relatively low seismic activity, and there are no fault traces either within or immediately adjacent to the Planning Area. The nearest active seismic source is 30 miles to the west. Other active seismic sources are 45–60 miles to the north, east, and southwest near Lake Oroville, Lake Tahoe, and in the Coast Ranges, respectively. However, the estimated probabilistic ground motions are very low (0.14–0.16) indicating that strong seismic ground shaking is unlikely to occur.

The State earthquake protection law (Health and Safety Code Section 19100 et seq.) requires that structures be designed to resist stresses produced by lateral forces caused by wind and earthquakes. The CBC, which has been adopted by the City, requires a site-specific analysis of seismic hazards by a licensed engineer, and incorporation of a variety of design features (such as metal bars designed to tie the structural elements of a building together) based on the results of the site-specific assessment, which are intended to prevent structural damage and collapse, and thereby protect human life, to the maximum extent practicable.

There are no existing General Plan goals or policies related to risks from seismic ground shaking that are proposed for revision as part of the proposed General Plan Update.

**Conclusion**

Development occurring as a part of buildout of the General Plan could lead to an increase in the number of people and structures exposed to hazards associated with seismic ground shaking from regional faults; however, as discussed in the foregoing analysis, strong seismic ground shaking is unlikely. Furthermore, implementation of existing General Plan Seismic and Geologic Hazards Goal 1 and Policies 1, 2, and 4 (listed previously in the Regulatory Framework section, and which have been renumbered for the proposed General Plan Update), in combination with compliance with the geologic and seismic requirements in the CBC (which the City has adopted), and the City’s site-specific Design Review process (as set forth in the City’s Design Standards Section 2, General Requirements), would reduce the potential for adverse impacts to people or structures related to seismic shaking. Building plans would be reviewed by City engineers to ensure that structures are consistent with standard engineering practices and requirements contained in the CBC, which are specifically designed to prevent the collapse of structures during seismic ground shaking. This is impact is less than significant.
Mitigation Measures

No mitigation is required.

**IMPACT 4.7-2**

**Substantial Adverse Impacts Related to Soil Erosion.** Development occurring through buildout of the General Plan and utilities and public facilities required to serve such development would result in substantial grading, excavation, and movement of earth associated with site preparation activities. These activities would increase the potential for soil erosion from wind and water, and the potential for siltation of local drainages. Implementation of the policies in the proposed General Plan Update, combined with relevant laws and ordinances, would reduce the potential for soil erosion. This impact is less than significant.

Land use change occurring as a part of buildout of the General Plan, along with construction of public infrastructure and facilities required to support this land use change, would involve grading, excavation, and earth-moving activities. NRCS (2019) soil survey data indicate that most of the Planning Area is composed of Group D soils, which have a very slow water infiltration rate and therefore have a very high stormwater runoff potential. Construction would result in the temporary disturbance of soil and would expose disturbed areas to winter storm events. Rain of sufficient intensity could dislodge soil particles from the soil surface. If the storm is large enough to generate runoff, localized erosion could occur. In addition, soil disturbance during the summer as a result of construction activities could result in soil loss because of wind erosion.

Chapter 16.20 of the City of Roseville Municipal Code addresses erosion and sediment control under the City’s Grading Ordinance. Project applicants must obtain a grading permit that includes evidence of environmental documentation under CEQA, a list of measures to be implemented that would provide erosion control, and a soils engineering report and an engineering geology report as required by Appendix Chapter 33 of the CBC, Section 3309. Erosion and sediment control are also regulated for both private and public projects through the City’s Design and Construction Standards (Sections 10, 11, 101, and 111).

The City addresses the potential for stormwater runoff from construction sites with requirements for development projects in the *City of Roseville Stormwater Management Program* (City of Roseville 2004) (described in detail in Section 4.13, “Hydrology and Water Quality”).

Projects that disturb more than 1 acre of land must comply with the requirements in the State Water Resources Control Board General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Order 2009-0009-DWQ, as amended). The State Water Resources Control Board general permit contains a numeric, two-part, risk-based analysis process. It also identifies the need to address hydromodification (stream channel modification and alterations in the natural hydrology of a watershed that result from changes in land cover/land use), and requires low impact development (LID) controls to more closely mimic the pre-developed hydrologic condition. The SWPPP must include a site map and a description of construction activities, and must identify the BMPs that will be employed to prevent soil erosion and discharge of other construction-related pollutants.

In the City of Roseville, project applicants are required to comply with the *Stormwater Quality BMP Guidance Manual for Construction* (City of Roseville 2011a), which includes the City’s BMPs for erosion and sediment control relating to construction activities and stormwater runoff (such as mulch, re-seeding, straw wattles, check
dams, sediment traps, silt fencing, sediment basins, placement of rip rap under drain outfalls, and stabilizing construction entrances and exits).

The following policy related to soil erosion and associated degradation of water quality would be revised as a part of the proposed General Plan Update, with additions shown in **bold, underlined** text and deletions shown in **strikethrough** text:

► **Policy SAFE1.3:** Minimize soil erosion and sedimentation **through** by maintaining compatible land uses, suitable building placement, **maximum lot coverage standards**, context-sensitive designs, and appropriate construction techniques.

The proposed General Plan Update policy change listed above is intended to clarify that the compatibility of adjacent land uses does not relate to soil erosion. This change would not result in any adverse environmental impacts.

**Conclusion**

Existing General Plan Seismic and Geologic Hazards Goal 1 and Policies 3, 5, and 6, Vegetation and Wildlife Policy 4, and Groundwater Recharge and Water Quality Goal 1 and Policy 2 (listed previously in the Regulatory Framework section, and which have been renumbered for the proposed General Plan Update), as well as revised proposed General Plan Update Policy SAFE1.3 listed above, would reduce soil erosion by requiring consideration of appropriate land uses on slopes, use of the appropriate construction techniques to stabilize slopes, and the use of contour grading.

Development occurring as part of buildout of the General Plan, and the utilities and public facilities required to serve such development, have the potential to cause an increase in construction-related soil erosion due to increased grading, excavation, movement of construction vehicles, and other construction activities. Eroded soil can be transported into local waterways, resulting in a degradation of water quality. However, compliance with existing stormwater, grading, and erosion control regulations and implementation of policies in the existing General Plan and proposed General Plan Update would reduce the soil erosion impact by requiring applicants to implement BMPs based on the City’s *Stormwater Quality BMP Guidance Manual for Construction*, develop and implement a SWPPP, comply with the City’s Grading Ordinance, comply with the City’s Design and Construction Standards, and comply with the avoidance and minimization measures contained in the Open Space Preserve Overarching Management Plan, all of which are specifically designed to minimize construction-related soil erosion and degradation of water quality to the maximum extent feasible. This impact is **less than significant**.

**Mitigation Measure**

No mitigation is required.
IMPACT 4.7-3

Geologic Hazards Related to Unstable and Expansive Soils. Development occurring as a part of General Plan buildout would result in the construction of buildings and infrastructure in areas of unstable soils and soils with a moderate to high shrink-swell potential. Implementation of the policies in the proposed General Plan Update, combined with relevant laws and ordinances, would reduce the potential for hazards from unstable and expansive soils. This impact is less than significant.

Land use change occurring as a part of buildout of the General Plan would place buildings and infrastructure in areas of unstable soils, and soils with high a shrink-swell potential. A review of NRCS (2019) soil data indicates that Planning Area soils have been rated with moderate limitations for construction of buildings and roads because of a shallow depth to bedrock, low soil bearing strength, and a moderate to high shrink-swell potential. Construction in unstable soils could result in structural damage to buildings, roads, and bridges.

Expansive soils shrink and swell as a result of moisture change. These volume changes can result in damage to building foundations, underground utilities, and other subsurface facilities and infrastructure if they are not designed and constructed appropriately to resist the damage associated with changing soil conditions. Based on a review of NRCS (2019) soil survey data, some of the soil types in the Planning Area have a moderate to high shrink-swell potential, indicating that the soils are expansive.

The City has adopted the CBC. The CBC includes engineering practices that require special design and construction methods to reduce or eliminate hazards from construction in unstable and expansive soil. Compliance with the CBC ensures appropriate design and construction of building foundations to resist soil movement. In addition, the CBC also contains drainage-related requirements to reduce seasonal fluctuations in soil moisture content. Construction in soils of low strength is also addressed in the CBC through implementation of soil engineering tests and amending and compacting soils.

No goals or policies related to risks from construction in unstable or expansive soils that are proposed for revision as part of the proposed General Plan Update.

Conclusion

Development occurring as a part of General Plan buildout has the potential to expose buildings and structures to unstable and expansive soils. However, implementation of existing General Plan Seismic and Geologic Hazards Goal 1 and Policies 2, 5, and 6 (listed previously in the Regulatory Framework section, and which have been renumbered for the proposed General Plan Update), and compliance with existing laws and regulations, including Section 111 (Grading) of the City’s Design and Construction Standards related to soil testing for earthwork and backfill, would address issues related to unstable and expansive soils by requiring new construction to prepare site-specific geotechnical reports to identify areas of unstable soil and shrink-swell potential, and to follow design specifications contained in the CBC and standard engineering practices to prevent adverse impacts associated with these limitations. This impact is less than significant.

Mitigation Measure

No mitigation is required.
**IMPACT**

4.7-4 Damage or Destruction of Unique Paleontological Resources, Sites, or Unique Geologic Features during Earthmoving Activities. The Planning Area contains paleontologically sensitive rock formations, and therefore construction activities associated with new and/or infill development under buildout of the General Plan and public infrastructure required to serve such development could result in accidental damage to, or destruction of, unknown subsurface paleontological resources. This impact is considered potentially significant.

As shown on Exhibit 4.7-1, there are a variety of geologic formations in the Planning Area. As discussed in Table 4.7-1, Holocene-age alluvial and basin deposits (which are primarily located along stream channels in the Planning Area) contain only the remains of extant, modern taxa (if any resources are present), which are not considered “unique” paleontological resources. As also discussed in Table 4.7-1, the Valley Springs Formation located in the far southeastern corner of the Planning Area (see Exhibit 4.7-1) contains no known vertebrate fossils or plant fossil assemblages; therefore, its paleontological sensitivity is low. The Rocklin Pluton, also located in the far southeastern corner of the Planning area (see Exhibit 4.7-1), is a type of intrusive rock that formed from magma solidified at great depths below the earth’s surface; thus, it does not contain fossils. Therefore, construction-related earthmoving activities in the alluvial and basin deposits, Valley Springs Formation, and Rocklin Pluton would not affect unique paleontological resources.

The Modesto, Riverbank, Turlock Lake, Mehrten, and Ione Formations all outcrop at the surface in various locations in the Planning Area (see Exhibit 4.7-1). Pleistocene-age sediments of the Modesto, Riverbank, and Turlock Lake Formations have yielded thousands of vertebrate fossils at localities throughout the Central Valley. The Pliocene-age Mehrten Formation, although primarily volcanic in nature, contains lenses of alluvial deposits that have yielded vertebrate fossils from several localities along the eastern margin of the Central Valley. Finally, the Eocene-age Ione Formation has yielded hundreds of plant fossils from large assemblages in the western Sierra Nevada foothills. Therefore, these formations are considered paleontologically sensitive.

The following proposed General Plan Update goals and policies are proposed for revision:

**Goal OS4.1:** Strengthen Roseville's unique identify through the protection of its archaeological, historic, paleontological, and tribal cultural resources.

► **Policy OS4.11:** Provide guidance to construction personnel for recognizing paleontological resources and when items of paleontological significance are discovered within the City, a qualified paleontologist shall be called to evaluate the find and to recommend proper action.

The proposed General Plan Update changes listed above are intended to clarify that the City intends to protect paleontological resources, and therefore these changes would result in an environmental benefit. The proposed changes would not result in any adverse environmental impacts.

**Conclusion**

The existing General Plan does not contain goals or policies that would protect unique paleontological resources. With the revision to Goal OS4.1, the City’s intent to protect unique paleontological resources is identified, and with the new Policy OS4.11, the City has established the approach to protecting resources during future construction activities. This would help to reduce potential impacts during construction-related earthmoving activities associated with projects envisioned under the proposed General Plan Update that occur in the Modesto,
Riverbank, Turlock Lake, Mehrten, and Ione Formations could damage or destroy unique paleontological resources. While this policy would reduce potential impacts, additional, more specific guidance will be helpful, and this impact is conservatively determined to be potentially significant.

**Mitigation Measures**

**Mitigation Measure 4.7-4 – The proposed General Plan Update should be amended as follows:**

**Implementation Measure**

**Paleontological Resources**

Where there is potential for a significant impact to paleontological resources:

1. Consult the Paleontological Sensitivity Map.

2. For projects located in geologic units that are not identified as paleontologically sensitive and which do not involve ground disturbance to a depth greater than 5 feet below the ground surface, no further actions related to paleontological resources shall be required.

3. For projects that would be located in paleontologically sensitive geologic units, or those that would be located in non-paleontologically sensitive surficial units but would involve ground disturbance to a depth greater than 5 feet, provide a site-specific analysis of the project’s potential to damage or destroy unique paleontological resources, and measures designed to protect unique paleontological resources, as needed and appropriate. Such measures may include, but are not limited to, construction worker personnel training, periodic monitoring during construction activities, stopping work within 50 feet of any fossil that is discovered, evaluation of the fossil by a qualified paleontologist, and proper recordation and curation of the specimen.

**Significance after Mitigation**

Implementing Mitigation Measure 4.7-4 would reduce impacts to unique paleontological resources to a less-than-significant level because guidance would be provided to construction personnel for projects that could affect unique paleontological resources, and in the event fossil specimens are encountered during construction activities, a paleontologist would be retained to evaluate the fossil and recommend appropriate actions, which may include, but are not limited to, full or part-time construction monitoring, along with appropriate measures for documenting, recording, and curating the specimens.