9. Geology, Soils, and Paleontological Resources

This chapter describes the geology and soils in the proposed project study area and evaluates the potential geology and soils impacts of Plan Concept 1 and Plan Concept 2 of the Renewable Placer: Waste Action Plan. This chapter also describes the paleontology of the proposed project study area and evaluates potential impacts from Plan Concepts 1 and 2 on paleontological resources.

9.1 Environmental Setting

The project site is located on gently rolling terrain at the base of the Sierra Nevada foothills. Pre-Western Regional Sanitary Landfill (WRSL) development elevations ranged from approximately 106 feet above mean sea level (AMSL) in the southwestern corner of the site to about 134 feet AMSL at the center of the site. Currently, the primary topographic feature on the site is the existing WRSL (Figure 9-1). Elevations within the WRSL footprint range from approximately 57 feet AMSL at the lowest point (excavated areas) to approximately 196 feet AMSL on filled areas (Golder 2017). The area surrounding the project site is characterized by open space and agricultural uses (irrigated land and grazing).

9.1.1 Methodology

Geology and Soils

The geology and soils evaluation is based on studies prepared by Golder Associates, Inc. (Golder), plans for the proposed project, other geologic and hydrogeologic investigations for the proposed project, compliance with applicable regulations, and other applicable information. The specific documents relied on to prepare this evaluation include the following:

- Final Environmental Impact Report, Sunset Area Plan/Placer Ranch Specific Plan. Prepared for Placer County (Ascent Environmental [Ascent] 2019).
- Geotechnical Exploration Report, Proposed Expansion of Western Regional Sanitary Landfill (Geotechnical Exploration Report; Golder 2018).
- Joint Technical Document, Western Regional Sanitary Landfill Placer County, California Volume I (Joint Technical Document [JTD]; Golder 2017).
- Countywide General Plan Policy Document, Adopted August 16, 1994; reflects amendments through May 21, 2013 (Placer County 2013).
- Western Placer Waste Management Authority (WPWMA) Waste Discharge Requirements (WDRs) Order No. R5-2007-0047 (WDR Order; CVRWQCB 2007).
- Placer County General Plan Update, Countywide General Plan Final Environmental Impact Report Volume I (Countywide General Plan EIR; Crawford Multari & Starr et al. 1994).

Paleontological Resources

No documented paleontological sites or studies have been conducted at or near the project site. The evaluation of paleontological resources is based primarily on the following documents, which describe the paleontology of the area north of Sacramento, California:

- Final Environmental Impact Report, Sunset Area Plan/Placer Ranch Specific Plan. Prepared for Placer County (Ascent 2019).

- Geology of Sacramento, California, United States of America, Geology of the Cities of the World Series (International Association for Engineering Geology [IAEG] 2018).
- Countywide General Plan Policy Document, adopted August 16, 1994; reflects amendments through May 21, 2013 (Placer County 2013).
- Clover Valley Large and Small Lot Tentative Subdivision Maps Recirculated Draft EIR (RMPI 2006).
- Placer County General Plan Update, Countywide General Plan Final EIR, Volume I (Crawford Multari & Starr et al. 1994).

9.1.2 Geologic Setting

The project site is located in the northeastern part of the Great Central Valley geomorphic province (Golder 2018). The Great Valley, also referred to as the Central Valley, is an alluvial plain about 50 miles wide and 400 miles long in the central part of California. The Great Valley is a trough in which sediments have been deposited since the Jurassic period (approximately 160 million years ago).

Basement rocks in the area consist of plutonic and metamorphic rocks of the Sierra Nevada Batholith and associated metamorphic complexes (Lawrence & Associates 1995; EDAW 2000, as referenced in Golder 2017). These basement rocks are exposed in the foothills approximately 5 miles east of the project site. Overlying the batholith in the valley is an eastward-thinning sequence of marine sedimentary rocks of the Upper Cretaceous age, unconformably overlain by Tertiary-age and Quaternary-age sedimentary deposits. Formations located near the project site include a Miocene-age through Holocene-age sequence of alluvial deposits derived from Tertiary-age volcanic rocks and the Sierra Nevada Batholith (EDAW 2000; Lawrence & Associates 1995; Helley and Harwood 1985, as referenced in Golder 2017). The Tertiary-age and Quaternary-age sedimentary units are exposed near the project site and underlie the project site. As described by Golder (2017), the local geology consists of Quaternary-age (up to 2.6 million years ago) alluvial deposits of terrestrial origin underlain by sandstone, shale, and gravel deposits of primarily Pleistocene- to Pliocene-age (0.01 to 5.3 million years ago), with some deposits as old as Miocene-age (up to 23 million years ago).

Geologic Units

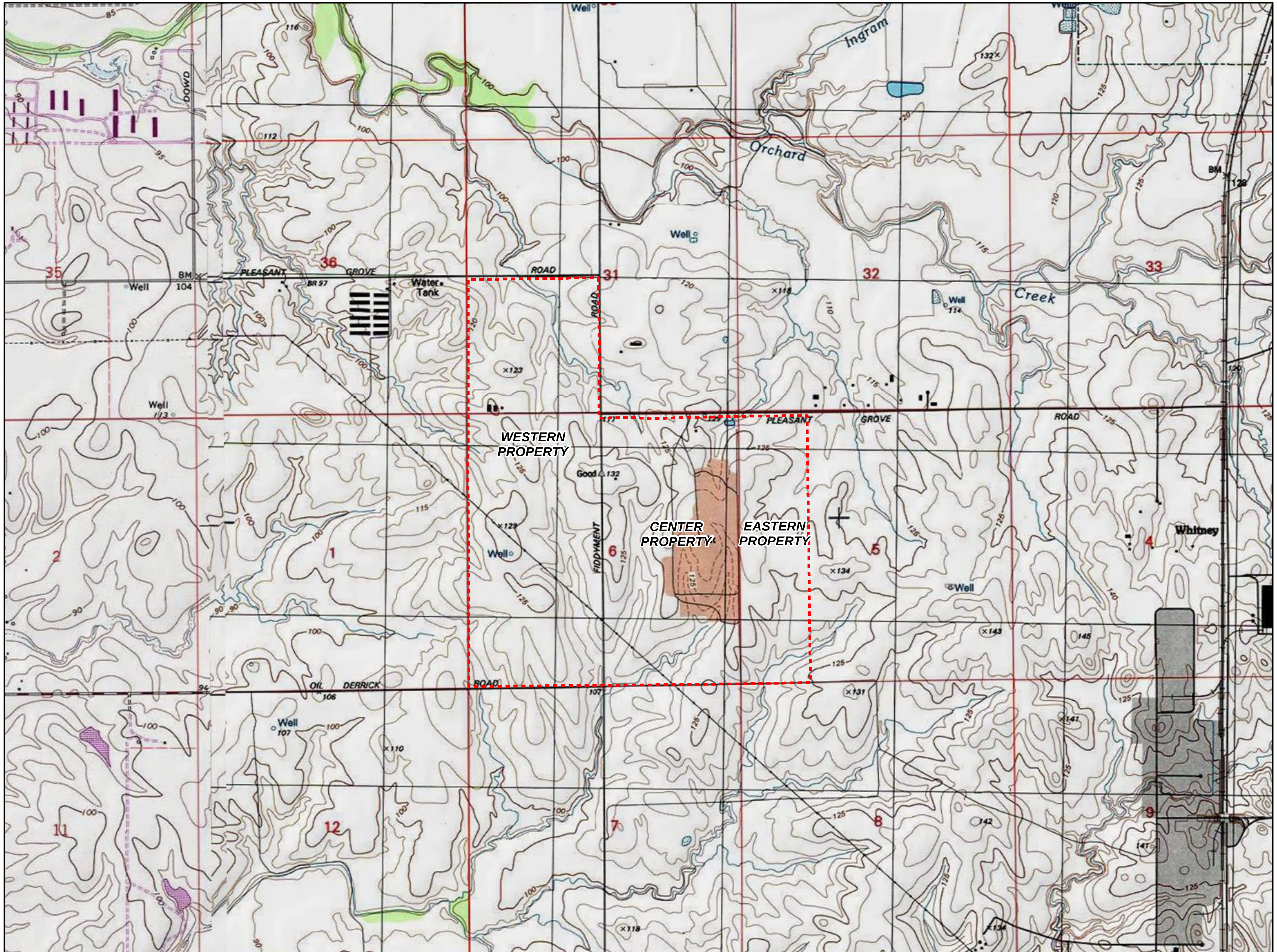
Geologic units in the immediate project site vicinity include the following from youngest to oldest:

- Holocene-age alluvium and basin deposits
- Pleistocene-age Riverbank Formation
- Pleistocene-age Turlock Lake Formation
- Pliocene-age Laguna Formation, and
- Miocene-Pliocene-age Mehrten Formation

These geologic units are relatively flat-lying alluvial sediments. The younger sedimentary units are often similar in lithology, and the subsurface contacts between the units are not well defined (Golder 2017). The distribution of these geologic units near the project site is shown on Figure 9-2. Descriptions of these units are presented from youngest to oldest in the following discussion.

Alluvium and Basin Deposits.

Holocene-age alluvial deposits occupy the present stream and river channels. These deposits are found in Pleasant Grove Creek and Orchard Creek to the south and north of the project site, respectively. The alluvium consists of unweathered gravel, sand, and silt. Holocene-age basin deposits are derived from the same sources as the alluvium but consist of fine-grained silt and clay.



EXISTING SITE TOPOGRAPHY

LEGEND

Project Boundary

Source: U.S. Geological Survey, 1:24,000 Topographic Map, Roseville, California, 1992.

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Feet

Figure 9-1. Site Vicinity and Regional Topography

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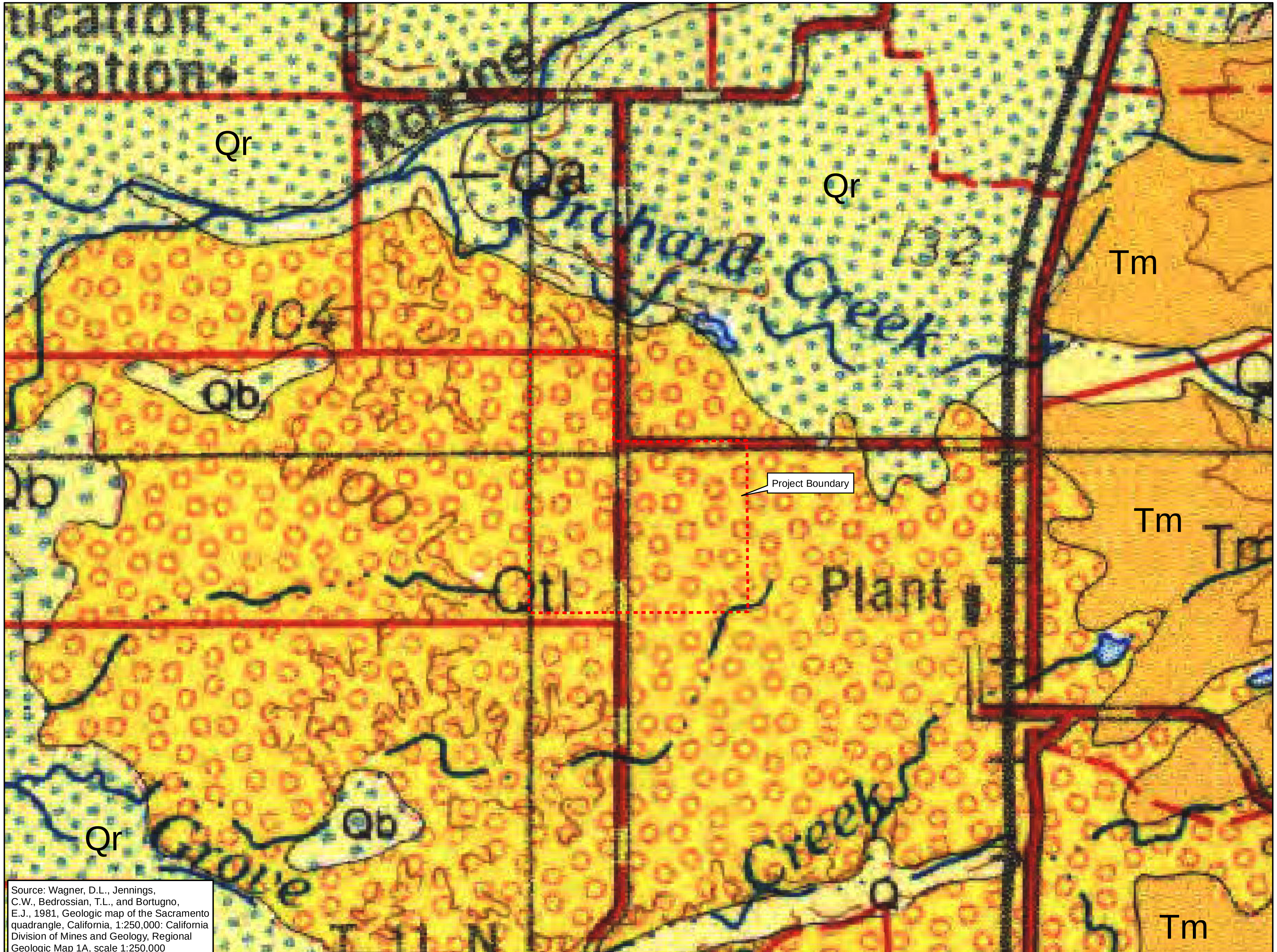

LEGEND

Project Boundary

Geology
Sedimentary and Metasedimentary Rocks
Cenozoic
Quarternary
Q Alluvium
Qa Levee and channel deposits
Qb Basin deposits (Alluvium)
Qr Riverbank Formation (Alluvium)
Qtl Turlock Lake Formation (Sand, silt, and gravel)
Tertiary
Tm Mehrten Formation (Andesitic conglomerate, sandstone, and breccia)

N

0 0.75 1.5
Miles

Figure 9-2. Regional Geologic Map
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Riverbank Formation.

The Riverbank Formation consists of unconsolidated to semi-consolidated gravel, sand, and silt, with minor clay, and is red to dark brown in color. Riverbank Formation outcrops generally are topographically higher than the Holocene-age alluvial deposits. The formation is exposed along the sides of the present Orchard Creek drainage approximately 0.5-mile northeast of the project site.

Turlock Lake Formation.

The project site is situated on sediments mapped as the Turlock Lake Formation (Lawrence & Associates 1995, as referenced in Golder 2017). The Turlock Lake Formation in the southern and eastern parts of the Sacramento Valley consists of stream-laid alluvial deposits of arkosic gravel, sand, silt, and clay. The formation stands topographically higher than the Riverbank and modern alluvial plains and is highly dissected by stream erosion. The Turlock Lake Formation underlies most of the gently rolling hills near WPWMA and represents eroded alluvial fans derived from the Sierra Nevada.

Laguna Formation.

The Pliocene-age Laguna Formation consists of interbedded alluvial gravel, sands, and silts and generally is lithologically indistinguishable from the Turlock Lake Formation. Geologic maps from the early 1960s show much of the Turlock Lake Formation as Laguna Formation (Lawrence & Associates 1995, as referenced in Golder 2017). The distinction between the two formations is primarily based on soil development at the ground surface.

Generally, the coarser gravel and sand intervals in the alluvial deposits represent stream-channel deposits, and the finer silt and clay intervals represent floodplain and levee deposits around the stream channels. During deposition of these types of alluvial sediments, the gravel and sand deposits inter-finger with the fine-grained deposits as the stream channels meander across the alluvial fans.

Mehrten Formation.

Underlying the Pleistocene- and Pliocene-age alluvial deposits are the Pliocene- and Miocene-age volcanic deposits derived from the Sierra Nevada. The Mehrten Formation, exposed in the hills approximately 2 miles east of the project site, is composed of cemented boulder to cobble conglomerate, sandstone, siltstone, and tuff breccia of andesitic material. The tuff breccia is hard and forms ridge tops east of the site. The similar ages of the volcanic and alluvial deposits suggest that there may be some interfingering of the two deposits (Lawrence & Associates 1995, as referenced in Golder 2017).

9.1.3 Faults, Seismicity, and Related Hazards

The tectonic setting of the site region is dominated by the northwestern motion of the Pacific plate with respect to the North American plate (Golder 2017). Most of the movement is accommodated by right-slip displacement along the San Andreas fault system at about 50 millimeters per year (mm/yr). Earthquakes in the San Andreas system tend to be large and relatively frequent; for example, the 1906 moment magnitude (Mw) 7.8 San Francisco earthquake occurred on the San Andreas fault, which is located more than 93 miles southwest of the project site, as shown on Figure 9-3.

Some of the plate motion is taken up in convergence between the two plates. This compression is reflected in the uplifted mountains of the Coast Ranges that border the Central Valley to the west. The eastern margin of the Coast Ranges and western side of the subsiding Central Valley are marked by a zone of active anticlines that are the surface expression of the thrust and reverse fault system that extends from southwest of Bakersfield to at least Red Bluff (Idriss 2001, as referenced in Golder 2017). The faults in the system have moderate activity with slip rates of 1 to 3 mm/yr. The 1892 Vacaville-Winters earthquake (Mw 6.8) and the 1983 Coalinga (Mw 6.5) earthquakes are associated with fault segments in the zone. The Mysterious Ridge segment is also within this zone.

A relatively small part of the right shear between the Pacific and North American plates is transferred east of the Coast Ranges into the North American plate. Some strain is accommodated as right-slip or normal faulting on short faults within the relatively rigid Sierran block, a tectonic region that encompasses the Sierra Nevada and the Central Valley, including the project site. Typically, small fault segments along the ancient Foothills fault system (a zone of structural weakness within the block) have been reactivated but have very low slip rates of less than 0.1 mm/yr. The Foothills fault system is located approximately 15 miles northeast of the project site and includes the Spenceville fault, Wolf Creek fault, Deadman fault, and Maidu East Lineament of the Bear Mountains fault zone as shown on Figure 9-4. Faults with identified but uncertain time of most recent displacement include a question mark (?) after the age of the displacement on Figure 9-4. The Willows fault zone is approximately 16 miles southwest of the project site (Figure 9-4). The 1975 Oroville earthquake (Mw 5.6) occurred on a fault in the Foothills fault system. The Bear Mountain and Melones faults described in previous studies of the site (EDAW 2000, as referenced in Golder 2017) are within the Foothills fault system.

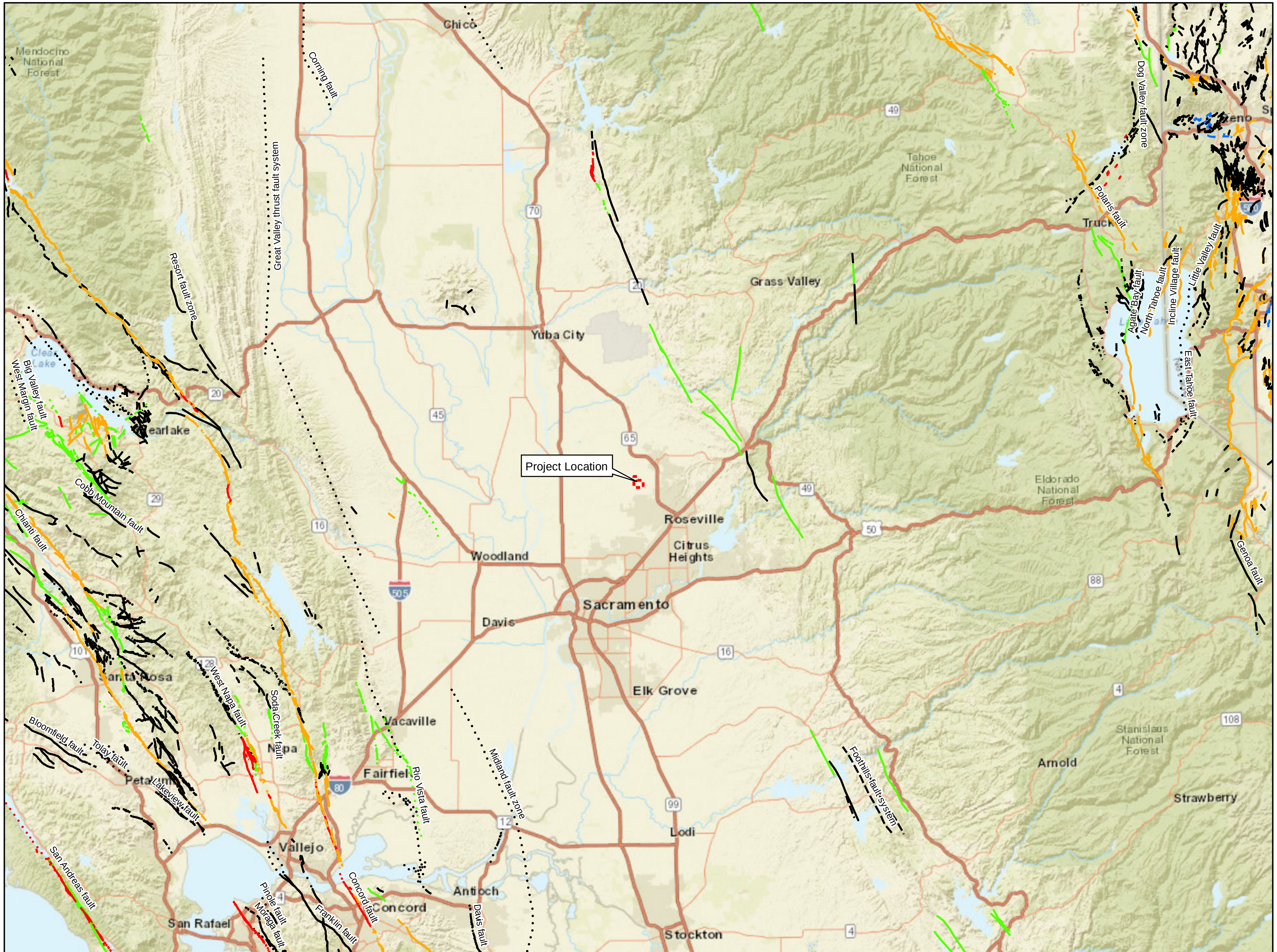
There are no known active faults within the project site. Idriss (2001, as referenced in Golder 2017) reported that the Spenceville fault and Mysterious Ridge segment (includes the Rumsey Hills and Dunnigan Hills thrust faults) are the closest active faults to the site, 13 miles east and 27 miles west, respectively. The San Andreas fault system, the major seismic source in California, is approximately 93 miles southwest of the site.

Title 27 of the *California Code of Regulations* (CCR), commonly referred to as Title 27, require that the foundation, final slopes, and containment structures of a Class II landfill must be designed to withstand ground motions and resulting movement from a maximum credible earthquake (MCE). Title 40, Part 258 of the *Code of Federal Regulations* (CFR), "Solid Waste Disposal Facility Criteria," commonly referred to as Subtitle D, requires landfills to be designed to withstand a ground acceleration resulting from an earthquake with a 10 percent chance of exceedance of the MCE in a 250-year period.

A seismic hazards assessment was performed for the WRSL, as discussed in Idriss (2001, as referenced in Golder 2017). The assessment estimated the MCE for the regional faults and associated peak horizontal ground acceleration (PHGA). The MCEs determined for the Spenceville fault and Mysterious Ridge segment have Mw of 6.5 and 6.75, respectively. The estimated PHGA that could be expected at the project site from a Mw 6.5 seismic event on the Spenceville fault, about 13 miles east of the project site, is 0.15 times the standard acceleration of Earth's gravity (0.15g), corresponding to strong perceived shaking and light potential damage. A Mw 6.75 seismic event on the Mysterious Ridge segment located almost 27 miles west of the project site, produces a site PHGA in bedrock of 0.10g, also corresponding to strong perceived shaking and light potential damage. A major seismic event on either of these faults is not expected to result in significant ground motion (less than 0.15g, corresponding to strong perceived shaking and light potential damage) based on the site-specific analysis performed in Idriss (2001, as referenced in Golder 2017).

9.1.4 Soils

Native surface soils underlying the project site consist of the following soil types and associated slopes, water erosion potential, and linear extensibility (shrink-swell potential) (U.S. Department of Agriculture 1980, as referenced in Ascent 2019), as shown on Figure 9-5.



LEGEND

Project Boundary

Quaternary Faults

Based on time of most recent surface deformation

- Historical (<150 years), well constrained location
- Historical (<150 years), moderately constrained location
- Historical (<150 years), inferred location
- Latest Quaternary (<15,000 years), well constrained location
- Latest Quaternary (<15,000 years), moderately constrained location
- Latest Quaternary (<15,000 years), inferred location
- Late Quaternary (<130,000 years), well constrained location
- Late Quaternary (<130,000 years), moderately constrained location
- Late Quaternary (<130,000 years), inferred location
- Middle and late Quaternary (<750,000 years), well constrained location
- Middle and late quaternary (<750,000 years), moderately constrained location
- Undifferentiated Quaternary(<1.6 million years), well constrained location
- Undifferentiated Quaternary(<1.6 million years), moderately constrained location
- Undifferentiated Quaternary(<1.6 million years), inferred location

Source: U.S. Geological Survey and California Geological Survey, Quaternary fault and fold database for the United States, accessed December 2020.

N

0 15 30

Miles

Figure 9-3. Regional Fault Map

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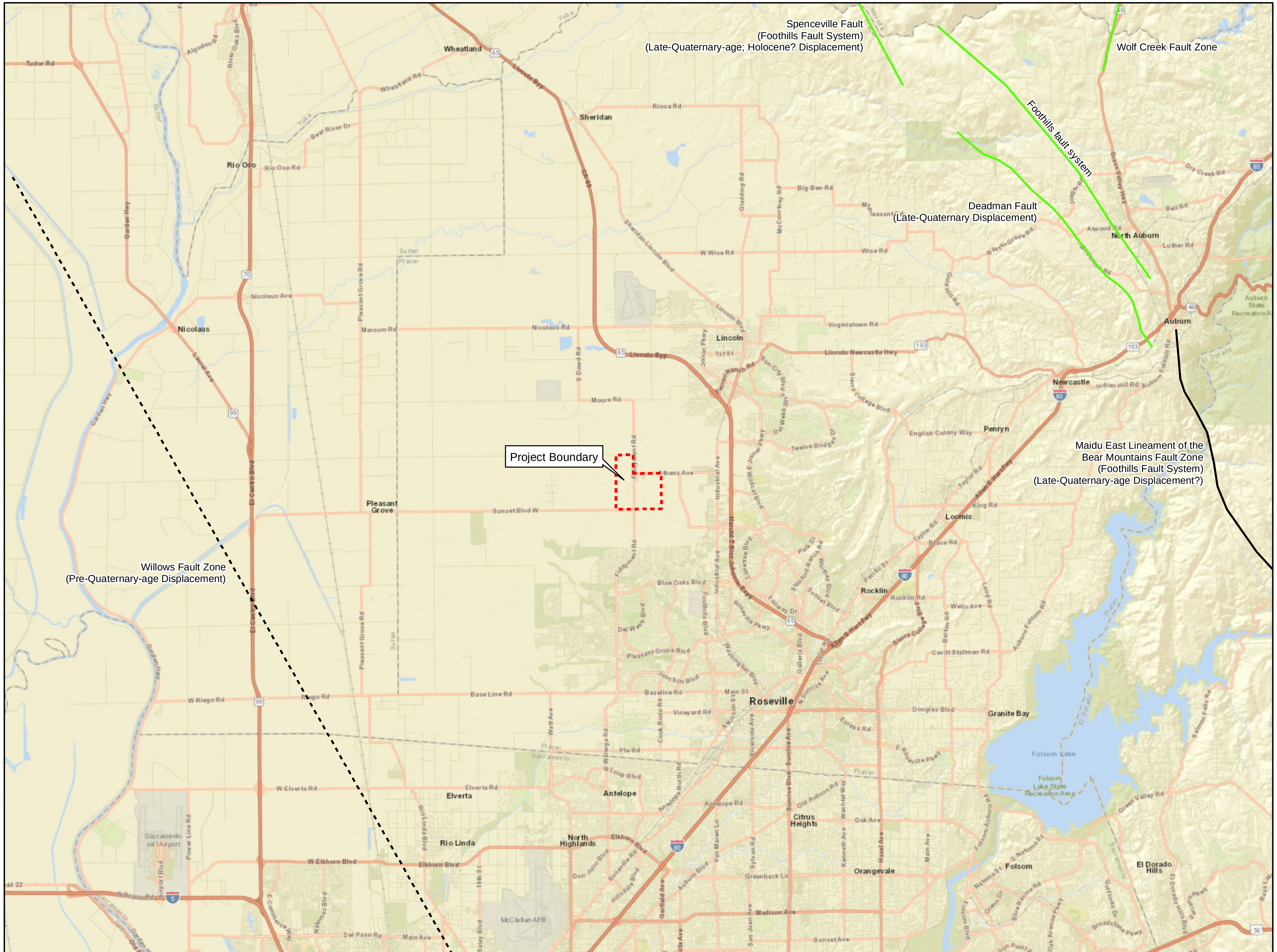

LEGEND

Project Boundary

Quaternary Faults

Based on time of most recent surface deformation

Late Quaternary (<130,000 years), well constrained location

Undifferentiated Quaternary(<1.6 million years), well constrained location

Note:
1. No liquefaction zones delineated for this area.

Sources:
1. U.S. Geological Survey and California Geological Survey, Quaternary fault and fold database for the United States, accessed December 2020.
2. California Geological Survey, 2010. 150th Anniversary Fault Activity Map of California and An Explanatory Text to Accompany the Fault Activity Map of California. https://www.conservation.ca.gov/cgs/publications/fault-activity-map-of-california
3. California Department of Conservation, Seismic Hazard Zone Maps for Liquefaction, 2017. https://maps.conservation.ca.gov/cgs/metadata/SHP_Liquefaction_Zones.html

N

0 3 6

Miles

Figure 9-4. Local Faults and Liquefaction

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LEGEND

Project Boundary

Soils

104: Alamo-Fiddyment complex, 0 to 5 percent slopes

141: Cometa-Fiddyment complex, 1 to 5 percent slopes

142: Cometa-Ramona sandy loams, 1 to 5 percent slopes

146: Fiddyment loam, 1 to 8 percent slopes

147: Fiddyment-Kaseberg loams, 2 to 9 percent slopes

Source: Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey, accessed December 2020.

N

0 1,000 2,000

Feet

Figure 9-5. Soils

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- 104 Alamo-Fiddyment Complex, with 0 to 5 percent slopes, moderate water erosion potential, and high linear extensibility. The Alamo-Fiddyment complex supports little construction and is primarily used for farmsteads. Major limitations to construction for the Alamo soil include wetness, slow permeability of subsurface soils, high shrink-swell potential, and the limited ability of the soil to support a load. Fiddyment soil has engineering characteristics similar to those of Alamo soil, with the addition of a shallow depth to hardpan.
- 141 Cometa-Fiddyment complex, with 1 to 5 percent slopes, severe water erosion potential, and low linear extensibility. Cometa soil is composed of a deep, well-drained claypan soil that formed on alluvium, primarily from granitic sources. Surface soils are typically brown sandy loam and are approximately 18 inches thick. The subsoil is brown clay and extends to a depth of about 29 inches, where it grades into a compacted, very pale brown sandy loam. Permeability of the Cometa soil is very slow, and surface runoff is slow. Major construction limitations of the Cometa are the very slow permeability of the subsoil, high shrink-swell potential, and limited ability of the soil to support a load. Fiddyment soil has engineering characteristics similar to those of Cometa soil, with the addition of a moderate depth to hardpan.
- 146 Fiddyment loam, with 1 to 8 percent slopes, severe water erosion potential, and low linear extensibility. This is a moderately deep, well-drained soil found on low terraces overlying siltstone at elevations of 75 to 135 feet. Fiddyment loam is mainly composed of Fiddyment soil and about 15 percent of a combination of Kaseberg loam, Cometa sand, San Joaquin sandy loam, and Alamo clay, which occurs in some drainageways and basins. The major limitations of the unit include slow permeability of the subsoil, the moderate depth to the hardpan, and the limited ability of the soil to support a load.
- 147 Fiddyment-Kaseberg loams, with 2 to 9 percent slopes, moderate water erosion potential, and low linear extensibility. This unit is undulating to gently rolling and overlies terraces with elevations of 75 to 135 feet. The unit is composed of 50 percent Fiddyment soil and 30 percent Kaseberg soil. The remaining percentages include Alamo clay, which can be found in areas with swales and drainageways. The Kaseberg soil is a well-drained soil that is shallow and overlying a hardpan. These soils typically formed in old valley fill overlying siltstone. The surface layer is light brownish gray loam with yellowish brown mottles and is about 8 inches thick. The subsoil consists of light gray silt loam, which, at a depth of approximately 16 inches, overlies a silica-indurated hardpan.

As described by Golder (2017), the surface and subsurface soils at the WRSL have been characterized in several exploration programs by Geomechanics, Inc. (1977), Emcon Associates (1979), Lawrence & Associates (1995 and 1996), Holdrege & Kull Consulting (1997), and Golder (2001).

In general, the surface soils are predominantly fine-grained silts and clays, and the subsurface soils vary over the WRSL, resulting in a wide variety of sand, silt, and clay mixtures typical of the historical gently graded riverbed system. Orange and dark-gray staining indicates wet and dry cycles typical of seasonal high and low water levels. Typically, the first 5 to 10 feet of materials encountered were compacted sandy gravel or silty sand with gravel artificial fill associated with road construction. Below the compacted fill, a hard sandy silt/clay was evident in most borings. This hard fine-grained soil layer was intermixed with poorly graded sand lenses ranging from a thickness of less than 1 inch to about 20 feet. Some borings encountered low-plasticity clay layers that averaged about 5 feet thick. Soils at the site are generally moderately to highly expansive, with areas of low-expansive soils (EDAW 2000, as referenced in Golder 2017). Near-surface soils in the area of the blower and flare station were characterized as slightly to moderately expansive (Lawrence & Associates 1995, as referenced in Golder 2017).

Based on the testing described in Golder (2017), the soil materials at the WRSL are generally hard to dense and provide an excellent foundation for the sanitary landfill.

The Geotechnical Exploration Report (Golder 2018) further details the soil at the eastern property. According to the report, the first 5 feet of material encountered was a sandy clay of low plasticity. In general, the materials encountered after the first 5 feet consisted of sand, silt, and clay mixtures. Most of the soil encountered after 50 feet was fine-grained and consisted of clayey sand and sandy clay. No bedrock was encountered in any of the borings advanced as part of the Geotechnical Exploration Report.

Liquefaction Potential

Mass wasting (for example, landslides) is uncommon to the project area because of the relatively flat topography and gently undulating terrain (Ascent 2019). The U.S. Geological Survey (USGS), which monitors historical and current subsidence, does not identify subsidence in the project area (USGS 2017, as referenced in Ascent 2019).

The potential occurrence of liquefaction during an earthquake event is considered negligible, based on site conditions at the WRSL (Golder 2017). Liquefaction is a condition that occurs when a saturated soil deposit experiences a temporary reduction in shear strength in response to dynamic loading, such as an earthquake. Liquefaction potential is highest in areas subject to strong ground motions, and by sites underlain by shallow groundwater and clean, loose, fine sands. Liquefaction potential decreases with the following factors:

- Increasing fines content
- Increasing depth (confining stress)
- Increasing soil density
- Decreasing ground accelerations

Geotechnical laboratory testing of the clay content and geotechnical data from the project site was performed to determine the critical water contents of the soil, including shrinkage limit, plastic limit, and liquid limit, to establish the moisture contents at which fine-grained clay and silt soils transition between solid, semi-solid, plastic, and liquid states. Based on the results of the geotechnical laboratory testing, the sandy clay and silty sand deposits at the project site are generally classified as non-liquefiable. Geotechnical testing of the sand deposits at the project site also indicated that liquefaction potential is negligible (Golder 2017). As shown on Figure 9-4, no areas indicating liquefaction potential have been delineated at the project site.

9.1.5 Soil Stability

Slope stability was evaluated at the existing WRSL and was discussed in Golder (2017) in relation to the following conditions at the site:

- Soil stockpile stability
- Interim refuse fill stability
- Cut slope stability
- Final cover stability

As described by Golder (2017), unvegetated slopes steeper than 3 percent (ratio of 33 feet horizontal to 1 foot vertical (33H:1V) will have relatively high erosion potential. Temporary soil stockpiles accumulated during current construction and operational activities at the site, which have much higher slopes on the order of 3H:1V or higher, are managed according to the requirements of the approved construction grading plans and applicable Stormwater Pollution Prevention Plan (SWPPP) requirements (Michael Baker International 2015).

As described by Golder (2017), during the WRSL development, interim refuse fill slopes are developed according to a monthly fill plan. These monthly fill plans are completed as interim steps to filling phases of the master filling plan, which is typically one phase per landfill module. Prior to the construction of a base liner, an engineering design report is prepared and submitted to the regulatory agencies for review and approval. The engineering design report presents a maximum final refuse fill plan with supporting slope stability calculations that consider static and dynamic loading conditions.

Golder evaluated the stability of excavated (that is, cut) slopes required to achieve proposed base grades for the WRSL (Golder 2017). An idealized cut slope inclined at 2H:1V into the onsite soils was analyzed, using Spencer's method and the computer program SLIDE. The idealized slope represents a worst-case condition, and, in addition to the cut slope, it was assumed that refuse disposal on top of and adjacent had been completed to an elevation of 265 feet AMSL, based on a limiting elevation of 265 feet AMSL that was the result of a previous analysis of interim fill configurations (Golder 2017). This condition results in the application of additional forces on the cut slope that contribute to the driving forces tending to destabilize the slope. The results of the stability analysis indicated that the modeled slope would be stable under the assumed conditions. Note that seismic stability was not evaluated, because the conditions modeled are temporary and would improve with time. After the cut slope is excavated and the liner system installed, refuse would be placed in the cell up against the slope. The placement of refuse would tend to buttress the cut slope and will increase the factor of safety against instability. Temporary slope conditions are rarely, if ever, analyzed for seismic stability. Excavation slopes around the sides of each future landfill module will be inclined at 2H:1V (Golder 2017).

The stability of the final cover system was evaluated with consideration of both static and dynamic loading conditions and demonstrated that the final grading plan for the existing WRSL exceeds the regulatory requirements of Title 27 and Subtitle D (Golder 2017). The final cover grades for the existing WRSL will consist of side slopes inclined at 3.5H:1V with intermediate benches every 50 vertical feet (Golder 2017).

9.1.6 Paleontological Resources Setting

Paleontology is the study of life in past geologic time, based on fossil plants and animals and includes phylogeny—the relationships to existing plants, animals, and environments—and the chronology of the Earth's history. Paleontological resources include tangible remains of past plant and animal life forms (fossils) left in the geologic record. A paleontological resource is a locality containing vertebrate, invertebrate, or plant fossils (for example, fossil location, fossil-bearing formation, or a formation with the potential to bear fossils). Paleontological resources are considered a fragile and nonrenewable scientific record of the history of life on Earth, and therefore, they represent an important and critical component of the natural heritage of the United States.

Paleontological resources comprise fossils and the geologic context in which they occur. Most fossil remains are the preserved hard parts of plants or animals and include bones and teeth of once-living vertebrate animals, shells or body impressions of invertebrate animals, and impressions or carbonized or mineralized parts of plants (for example, leaf impressions or "petrified wood"). Trace fossils include preserved footprints, trackways, and burrows of prehistoric animals and root marks created by plants. The geologic context in which fossils occur can provide important information regarding the age of the fossils and physical and biological features of the local ancient environment in which the represented plants and animals existed.

As described in Section 9.1.2, geologic units in the immediate project vicinity include Holocene-age alluvium and basin deposits; Riverbank Formation; Turlock Lake Formation; Pliocene-age Laguna Formation; and Miocene-Pliocene-age Mehrten Formation. The sand, silt, and gravel of the Turlock Lake

Formation are found at the surface and beneath the project site and surrounding area, as shown on Figure 9-2. Alluvium characterizing the basin deposits surround the Turlock Lake Formation at the surface to the south, west, and north, and the andesitic conglomerate, sandstone, and breccia of the Mehrten Formation outcrops east of the project site (Figure 9-2).

As described by IAEG (2018), thousands of fossils have been found in the greater Sacramento region within many local formations, from rocks ranging in age from the Paleozoic to the Holocene. The oldest fossils come from the Sierra Nevada foothills in indurated rock that was added to the area by plate tectonic activity. Fossils are also found in the thick sedimentary sequences of the Central Valley and eastern folded edges of the topographic Coast Range to the west.

As described in the Sunset Area Plan FEIR (Ascent 2019), paleontological resources are lithologically dependent; that is, deposition and preservation of paleontological resources are tied to the lithologic unit in which they occur. The potential for paleontological resources to be present is described as the paleontological sensitivity of a geological unit, in accordance with Society of Vertebrate Paleontology guidelines (SVP 2010, as referenced in Ascent 2019). The sensitivity ratings take into account factors such as lithology and proven fossil yield. As described in the Sunset Area Plan FEIR (Ascent 2019), the paleontological sensitivity rating is classified as high for the Turlock Lake Formation, Riverbank Formation, and Mehrten Formation.

Hausback and Hilton (1994, as referenced in IAEG 2018) reported that part of a horse hoof fossil was found in the Turlock Lake Formation from a railroad cut north of Roseville, California. A fossil pine branch with needles was also found near Roseville, in an outcrop suspected to be the Turlock Lake Formation.

Paleontological remains have been found at several localities in alluvial deposits referable to the Riverbank Formation in the Sacramento area, including mammoth remains found during the excavation of a Sacramento Municipal Utility District trench in Elk Grove (IAEG 2018). Curtis (1954, as referenced in IAEG 2018) noted that the clay beds within the Mehrten Formation contain fossil leaves. Moses (1985, as referenced in IAEG 2018) found no fossils in the Mehrten Formation in the Auburn-Folsom area other than a few unidentifiable root casts in the capping breccia (lahars). Over the years during construction in the area of Rocklin and Roseville, several plant fossils have been found in the finer mudrock between the coarse breccia of the lahars of the Mehrten Formation.

As described by Crawford Multari & Starr et al. (1994), fossil remains of prehistoric plant and animal life could be found in the sedimentary rocks and volcanic rock sedimentary materials that are present throughout western Placer County. Sediments associated with the Mehrten Formation in the Roseville area have been found to contain fossils of terrestrial vertebrates. Fossilized animal remains may also be present in caves associated with the limestone geology that can be found in the central part of the Sierra Nevada foothills.

There are no documented studies or observations of paleontological resources at or near the project site.

9.2 Regulatory Setting

9.2.1 Geology and Soils

Federal

Federal Earthquake Hazards Reduction Act.

In 1997, the U.S. Congress passed the Earthquake Hazards Reduction Act to reduce the risks to life and property from future earthquakes by establishing and maintaining an effective earthquake hazards and reduction program. To accomplish this, the act established the National Earthquake Hazards Reduction Program (NEHRP). The agencies responsible for coordinating NEHRP are the Federal Emergency Management Agency (FEMA), the National Institute of Standards and Technology, the National Science Foundation, and USGS. In 1990, NEHRP was amended by the NEHRP Act, which refined the description of the agency responsibilities, program goals, and objectives. The four goals of the NEHRP are as follows:

A. Develop effective practices and policies for earthquake loss reduction and accelerate their implementation.

B. Improve techniques to reduce seismic vulnerability of facilities and systems.

C. Improve identification of seismic hazards and risk-assessment methods and their use.

D. Improve the understanding of earthquakes and their effects.

Title 40, Part 258 of the CFR, Solid Waste Disposal Facility Criteria.

Federal standards regarding municipal solid waste landfills are contained in Title 40, Part 258 of CFR, “Solid Waste Disposal Facility Criteria,” commonly referred to as Subtitle D. By enacting Subtitle D, the U.S. Environmental Protection Agency (EPA) intended that states maintain the lead role in implementing and enforcing Subtitle D through approved state permit programs. Title 27 contains the current regulations of the California Department of Resources Recycling and Recovery and the State Water Resources Control Board (SWRCB) pertaining to landfill disposal of municipal solid wastes. California’s solid waste permit program was approved by EPA. As a result, California’s solid waste regulations were determined to be functionally equivalent to Subtitle D. Accordingly, throughout this section, references to pertinent regulations will be to Title 27 regulations.

State.

The Title 27 regulatory scheme governing landfill disposal of municipal solid wastes is a blend of prescriptive and performance standards covering every aspect of the design, construction, and operation of landfill disposal facilities. These standards include siting criteria, seismic design standards, and containment system design and construction strategies to prevent impacts on surface water and groundwater resources. The following subchapters from Chapter 3 of Title 27 (Criteria for all Waste Management Units, Facilities, and Disposal Sites) are relevant to geology and hydrogeology:

- Subchapter 2 – Siting and Design
- Subchapter 3 – Water Monitoring

Additional requirements for these siting and design criteria are provided in the following subchapters of Title 27 for the operational, closure, and post-closure periods:

- Subchapter 4 – Criteria for Landfills and Disposal Sites
- Subchapter 5 – Closure and Post-Closure Maintenance

Section 20240, Classification and Siting Criteria: Waste management units and engineered structures will meet the following criteria:

- **5-Foot Separation.** All new landfills, waste piles, and surface impoundments will be sited, designed, constructed, and operated such that wastes will be a minimum of 5 feet above the highest anticipated elevation of underlying groundwater. Existing landfills, waste piles, and surface impoundments will be operated such that wastes will be a minimum of 5 feet above the highest anticipated elevation of underlying groundwater (Subsection [c]).
- **Unit Foundation.** All engineered structures (including containment structures) constituting any portion of a unit will have a foundation or base capable of providing support for the structures, and capable of withstanding hydraulic pressure gradients to prevent failure caused by settlement, compression, or uplift and all effects of ground motions resulting from at least the maximum probable earthquake for Class III Units, as certified by a registered civil engineer or certified engineering geologist (Subsection [d]).

- **Section 20250, Class II: Waste Management Units for Designated Waste:** Waste management units and engineered structures shall meet the following criteria [in addition to the more restrictive Class III requirements under Section 20260]:

- **General.** Class II waste management units (Class II Units) shall be located where site characteristics and containment structures isolate waste from waters of the state.
- **Geologic Setting.** As described in Subsection (b) of Section 20250:

1) New and existing Class II landfills or waste piles shall be immediately underlain by natural geologic materials which have a hydraulic conductivity of not more than $1x10^{-6}$ cm/sec (i.e., 1 foot/year) and which are of sufficient thickness to prevent vertical movement of fluid, including waste and leachate, from Units to waters of the state for as long as wastes in such units pose a threat to water quality. Class II units shall not be located where areas of primary (porous) or secondary (rock opening) hydraulic conductivity greater than $1x10^{-6}$ cm/sec (i.e., 1 foot/year) could impair the competence of natural geologic materials to act as a barrier to vertical fluid movement.

2) Natural or artificial barriers shall be used to prevent lateral movement of fluid, including waste and leachate.

3) A liner system with a hydraulic conductivity of not more than $1x10^{-6}$ cm/sec (i.e., 1 foot/year) shall be used for landfills and waste piles when natural geologic materials do not satisfy the requirements in (b)(1).

4) Flooding – New and existing Class II Units shall be designed, constructed, operated, and maintained to prevent inundation or washout due to floods with a 100-year return period. MSW landfills are also subject to any more-stringent flood plain and wetland siting requirements referenced in SWRCB Resolution No. 93-62 (i.e., see s258.11 and s258.12 of 40CFR258).

5) Ground Rupture – New Class II Units and expansions of existing Class II units, shall have a 200-foot setback from any known Holocene fault. Other units (that are subject to this section) can be located within 200 feet of a known Holocene fault, provided the RWQCB finds that the Unit's containment structures are capable of withstanding ground accelerations associated with the maximum credible earthquake.

6) Rapid Geologic Change – New and existing Class II Units can be located within areas of potential rapid geologic change only if the RWQCB finds that the Unit's containment structures are designed, constructed, and maintained to preclude containment failure. MSW landfills are also subject to any more-stringent unstable area siting requirements referenced in SWRCB Resolution No. 93-62 (i.e., see s258.15 and s258.16 of 40 CFR 258).

Section 20260, Class III: Landfills for Nonhazardous Solid Waste: Waste management units and engineered structures shall meet the following criteria:

- **General.** Class III landfills shall be located where site characteristics provide adequate separation between solid waste and waters of the state (Subsection [a]).
- **Geologic Setting.** Municipal solid waste landfills shall be sited where soil characteristics, distance from waste to groundwater, and other factors will ensure no impairment of beneficial use of surface water or of groundwater beneath or adjacent to the landfill (Subsection [b]). Factors that shall be evaluated include: (A) size of the landfill; (B) hydraulic conductivity and transmissivity of underlying soils; (C) depth to groundwater and variations in depth to groundwater; (D) background quality of groundwater; (E) current and anticipated use of the groundwater; and (F) annual precipitation. Where consideration of these factors indicates that site characteristics alone do not ensure protection of the quality of groundwater or surface water, Class III landfills shall be required to have a single clay liner with hydraulic conductivity of $1\text{x}10^{-6}$ centimeters per second (cm/sec) or less. (The liner requirement in Section 20260 was superseded by SWRCB Resolution No. 93-62, incorporating Subtitle D requirements, which requires a composite liner that comprises a 2-foot-thick compacted soil layer having a maximum permeability of 1×10^{-7} cm/sec overlain by a geomembrane having a minimum thickness of 40 mils.)
- **Flooding.** New Class III landfills shall be designed, constructed, operated, and maintained to prevent inundation or washout due to floods with a 100-year return period (Subsection [c]).
- **Ground Rupture.** New Class III landfills shall not be located on a known Holocene fault (Subsection [d]). A Holocene fault is defined as a fault which is or has been active during the last 11,000 years.
- **Rapid Geologic Change.** New Class III landfills can be located within areas of potential rapid geologic change only if the RWQCB finds that the Unit’s containment structures are designed, constructed, and maintained to preclude failure (Subsection [e]).

Section 20330, SWRCB – Liners: Liners shall be designed and constructed to contain the fluid, including landfill gas, waste, and leachate, as required in the above siting criteria.

Section 20340, SWRCB – Leachate Collection and Removal Systems (LCRS): LCRSs are required for Class III landfills which have a liner or which accept sewage or water treatment sludge. The LCRS shall be installed directly above underlying containment features or landfill and waste piles and installed between the liners for surface impoundments.

Section 20360, Subsurface Barriers: Subsurface barriers are cutoff walls that are used in conjunction with natural geologic materials to ensure that the lateral hydraulic conductivity standards are satisfied where there is potential for lateral movement of fluid. Cutoff walls shall be installed at Class III landfills as required by RWQCB.

Section 20365, Precipitation and Drainage Controls: Units and their respective containment structures shall be designed and constructed to limit, to the greatest extent possible, ponding, infiltration, inundation, erosion, slope failure, washout, and overtopping.

Section 20370, Seismic Design: Class III Units shall be designed to withstand the maximum probable earthquake (MPE) without damage to the foundation or to the structures which control leachate, surface drainage, erosion, or gas. As required in Section 21750(f)(5), a stability analysis, including a determination of the expected peak ground acceleration of the Unit associated with the MPE for Class III landfills shall be included as part of the report of waste discharge (ROWD) (or Joint Technical Document [JTD]) for the proposed Unit. Section 21750(f)(5) also requires an updated stability analysis be included as part of the final closure and post-closure maintenance plan if the original analysis no longer reflects the conditions at the Unit.

Alquist-Priolo Earthquake Fault Zoning Act (*California Public Resources Code*, Division 2, Chapter 7.5) of 1971, as amended in 1993

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act is to address the hazard of surface fault rupture through the regulation of development in areas of Holocene-active faults; that is, a fault that has had surface displacement within Holocene time (the last 11,700 years) (CGS 2018). The stated intent of the act is to "provide policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibility to prohibit the location of developments and structures for human occupancy across the trace of active faults" (CGS 2018). The State Geologist continually reviews new geologic and seismic data and revises earthquake fault zones or delineates additional earthquake fault zones when warranted by new information. The project site is not located within an Alquist-Priolo earthquake fault zone (CGS 2018).

California Building Standards Code (California Code of Regulations, Title 24) of 2013, as amended in 2017

The *California Building Standards Code*, Section 1808.2, Design for Capacity and Settlement, requires that foundations be designed so that the allowable bearing capacity of the soil is not exceeded, and that differential settlement is minimized. Foundations placed on or within the active zone of expansive soils shall be designed to resist differential volume changes and to prevent damage to the supported structure.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act was enacted in 1997 to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and from other hazards caused by earthquakes. This act requires the State Geologist to map areas subject to seismic hazards. In cases where site-specific seismic hazard risks are present, a geotechnical investigation of the site must be conducted, and appropriate mitigation measures must be incorporated into the project design before development permits would be granted. Additionally, the act requires that a Standardized Natural Hazards Disclosure Statement form be completed by real estate sellers if a property is within one of the designated natural hazards areas.

Local

The WPWMA is a Joint Powers Authority (JPA) composed of Placer County and the cities of Lincoln, Rocklin, and Roseville to own and operate a regional recycling facility and sanitary landfill. As a JPA, the WPWMA considers local regulations and consults with local agencies, but the County and city regulations are not applicable, because the County and cities do not have jurisdiction over the proposed project. Accordingly, the following discussion of local goals and policies associated with geological and soil resources is provided for informational purposes only.

The Placer County General Plan Update Countywide General Plan Final EIR states that the western and central parts of the County generally have low seismicity (Placer County 1994). The Placer County General Plan (Placer County 2013) includes the following relevant goal and policies regarding seismic and geological issues as they relate to public health and safety and natural resources:

- GOAL 8.A: To minimize the loss of life, injury, and property damage due to seismic and geological hazards.
  - Policy 8.A.1: The County shall require the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to geological or seismic hazards (i.e., ground shaking, landslides, liquefaction, critically expansive soils, avalanche).

The *Placer County Code of Ordinances*, *Placer County Code Article 15.48*, contains the Grading, Erosion and Sediment Control Ordinance, enacted for the purpose of regulating grading on property within the unincorporated area of Placer County to safeguard life, limb, health, property, and public welfare; to avoid pollution to watercourses with hazardous materials, nutrients, sediment, or other earthen materials generated on or caused by surface runoff on or across the permit area; and to confirm that the intended use of a graded site is consistent with the Placer County General Plan (2013), any specific plans, and applicable Placer County ordinances. The most common activities requiring a grading permit include filling or excavating more than 250 cubic yards; disturbing 10,000 square feet of vegetation on slopes of 10 percent or greater; building retaining walls that are more than 4 feet in height, as measured from the bottom of the footing to the top of the retained soil or supporting a surcharge; grading or conducting other construction activity with ground disturbance of 1 acre or more; grading in or adjacent to a drainage course or wetland; or grading in a floodplain.

Section 15.48.360 of the *Placer County Code* specifies when geotechnical investigations are required. A soil or geologic investigation report shall accompany the application in any of the following circumstances when required by the agency director:

- When the proposed grading includes a cut or fill exceeding 10 feet in depth at any point; however, for vehicular ways, a soil investigation shall not be required unless the grading includes a proposed cut or fill that exceeds 10 feet in depth and the slope of the natural ground exceeds 30 percent.
- When highly expansive soils are present.
- In areas of known or suspected geological hazards, including landslide hazards and hazards of ground failure stemming from seismically induced ground shaking.

The Placer County Land Development Manual establishes minimum standards for the design and construction of development improvements. These requirements apply to the design and construction of development improvements to be dedicated to the public or accepted by the County for operation and maintenance, as well as improvements constructed in accordance with an agreement entered into between the County and a developer.

The Engineering and Surveying Division of the Placer County Community Development Resource Agency maintains policies and guidelines regarding grading, erosion control, stormwater design, inspection, and permitting. County-issued permits and plans related to earthwork and utilities that may be required within the project area include the following:

- Grading permits
- Storm water quality plans
- Utility encroachment permits
- Improvement plans

The Environmental Health Services Division of the Placer County Department of Health and Human Services administers well installation, drilling and destruction permitting within Placer County.

9.2.2 Paleontological Resources

Federal

Given that California's solid waste permit program was approved by EPA, and California's Title 27 solid waste regulations were determined to be functionally equivalent to Subtitle D, only California Environmental Quality Act (CEQA) requirements for paleontological resources are applicable to the project site.

State

CEQA requires that project proponents assess potential impacts to paleontological resources, including whether the project would directly or indirectly destroy a unique paleontological resource (Association of Environmental Professionals 2020). *California Public Resources Code* (PRC) Chapter 1.7 Section 5097.5, Archaeological, Paleontological, and Historical Sites, defines any unauthorized disturbance or removal of a fossil locality or remains on public land as a misdemeanor. PRC Section 30244 requires reasonable mitigation of adverse environmental impacts on paleontological resources that result from the development of public land.

Local

The WPWMA is a JPA composed of Placer County and the cities of Lincoln, Rocklin, and Roseville to own and operate a regional recycling facility and sanitary landfill. As a JPA, the WPWMA considers local regulations and consults with local agencies, but the County's and cities' regulations are not applicable, because the County and cities do not have jurisdiction over the proposed project. Accordingly, the following discussion of local goals and policies associated with paleontological resources is provided for informational purposes only.

The Placer County General Plan (2013) includes the following relevant goals and policies regarding paleontological issues:

- GOAL 5.D: To identify, protect, and enhance Placer County's important historical, archaeological, paleontological, and cultural sites, and their contributing environment.
  - Policy 5.D.6: The County shall require that discretionary development projects identify and protect from damage, destruction, and abuse, important historical, archaeological, paleontological, and cultural sites and their contributing environment. Such assessments shall be incorporated into a Countywide cultural resource data base, to be maintained by the Division of Museums.

  - Policy 5.D.7: The County shall require that discretionary development projects are designed to avoid potential impacts to significant paleontological or cultural resources whenever possible. Unavoidable impacts, whenever possible, shall be reduced to a less than significant level and/or shall be mitigated by extracting maximum recoverable data. Determinations of impacts, significance, and mitigation shall be made by qualified archaeological (in consultation with recognized local Native American groups), historical, or paleontological consultants, depending on the type of resource in question.

9.3 Impact Analysis and Mitigation Measures

9.3.1 Thresholds of Significance

The thresholds of significance for assessing impacts come from the CEQA Environmental Checklist. For geology and soils, the CEQA Checklist asks whether the project would do the following:

- Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving the following:
  - 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? (CGS 2018)
  - Strong seismic ground shaking?
  - Seismic-related ground failure, including liquefaction?
  - 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 offsite landslide, lateral spreading, subsidence, liquefaction, or collapse?
- Be located on expansive soil, as defined in Table 18-1-B of the *Uniform Building Code* (*Public Resources Code 21000-21189* and the *California Code of Regulations*, Title 14, Division 6, Chapter 3, Sections 15000-15387), creating substantial direct or indirect risks to life or property?

Because the site operations do not include use of septic systems for either plan concept, the CEQA Checklist item referencing the ability of the site soils to support septic tanks or alternative wastewater disposal systems is not evaluated in this Draft EIR (DEIR).

Paleontological Resources.

For paleontological resources, the CEQA Checklist asks whether the proposed project would

- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Appendix G (part V) of the CEQA Guidelines provides guidance relative to significant impacts on paleontological resources, which states, “a project will normally result in a significant impact on the environment if it will…disrupt or adversely affect a paleontological resource or site or unique geologic feature, except as part of a scientific study.” PRC Section 5097.5 specifies that any unauthorized removal of paleontological remains is a misdemeanor.

9.3.2 Impacts and Mitigation Measures

IMPACT 9-1	**Risks Related to Seismic Activity**. The proposed project is not expected to directly or indirectly cause potential substantial adverse effects associated with earthquake faults, strong seismic shaking, liquefaction, or landslides. Therefore, this impact would be **less than significant.**

Plan Concept 1

Site-Wide.

The project site is not located within an Alquist-Priolo earthquake fault zone (CGS 2018), and there are no known active faults located within the project site (Idriss 2001, as referenced in Golder 2017) (Figure 9-3). The nearest active faults are the Spenceville fault and Mysterious Ridge segment, which are located 13 miles east and 27 miles west, respectively. These two faults represent the primary sources of potential seismic shaking at the site. As discussed in Section 9.1.3, a major seismic event on either of these faults is not expected to result in significant ground motion (less than 0.15g, corresponding to strong perceived shaking and light potential damage) (Idriss 2001, as referenced in Golder 2017). Furthermore, the western and central parts of Placer County generally experience low seismicity (Placer County 1994). The project would be required to be designed and constructed in accordance with the current *California Building Standards Code* (CBC), which contains specifications to minimize adverse effects on structures caused by ground shaking from earthquakes and to minimize secondary seismic hazards (such as ground lurching and liquefaction).

The project site is not expected to experience a ground rupture or strong seismic ground shaking because of a known earthquake fault. Because the solid waste management project facilities, including complementary and programmatic elements, would be designed in conformance with CBC building requirements, if the site did experience a large seismic event, impacts would result in minimal adverse impacts. Thus, implementation of the proposed project would not directly or indirectly expose people or structures to substantial adverse effects related to seismic hazards, including the risk of loss, injury, or death involving these events. This impact would be less than significant.

The sandy clay and silty sand deposits at the project site are generally classified as nonliquefiable, based on site-specific geotechnical laboratory testing. The site-specific geotechnical testing also indicated liquefaction potential of sand deposits at the project site is negligible (Golder 2017). No areas indicating liquefaction potential have been delineated at the project site (Figure 9-4). Therefore, the project site is not expected to experience liquefaction, and the proposed project would not directly or indirectly expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving a liquefaction event. Therefore, this impact would be less than significant.

Landfill Expansion.

Because of the project site's relatively flat terrain, landslides are not a concern for most of the solid waste elements and for all of the complementary and programmatic elements. However, the operation of a landfill includes the establishment of artificial slopes that can become unstable if not properly designed. This instability can occur along cut slopes, interim refuse fill slopes, soil stockpile slopes, and final cover slopes.

During the design of individual landfill modules, the interim refuse fill slopes are evaluated for stability. This includes the submittal of an engineering design report to the regulatory agencies for review and approval. The engineering design report presents a maximum interim refuse fill plan with supporting slope stability calculations that consider static and dynamic loading conditions. A similar slope stability analysis is conducted for proposed soil stockpiles to prevent the slopes of the stockpiles from failing.

For the existing WRSL, the stability of excavated (cut) slopes required to achieve proposed base grades was evaluated by Golder (2017). An idealized cut slope inclined at 2H:1V into the onsite soils was analyzed as a worst-case condition, and, in addition to the cut slope, it was assumed that refuse disposal on top of and adjacent had been completed to an elevation of 265 feet AMSL, based on a limiting elevation of 265 feet AMSL. The results of the stability analysis indicated that the modeled slope will be stable under the assumed conditions. The analysis assumed that after the cut slope is excavated and the liner system installed, refuse will be placed in the cell up against the slope. The placement of refuse will tend to buttress the cut slope and will increase the factor of safety against instability. Based on this analysis, excavation slopes around the sides of the landfill modules still to be constructed within the WRSL are proposed to be inclined at 2H:1V (Golder 2017).

The stability of the final cover system for the existing WRSL was evaluated with consideration of both static and dynamic loading conditions. The evaluation demonstrated that the final grading plan exceeds the regulatory requirements of Title 27 and Subtitle D (Golder 2017). The final cover grades for the existing WRSL include side slopes inclined at 3.5H:1V with intermediate benches every 50 vertical feet (Golder 2017).

Implementation of Plan Concept 1 would include expansion of the existing Class II landfill. Title 27 would require the proposed landfill (Class II or III) expansion to be designed for stability under both static and dynamic loading conditions. Therefore, the expanded landfill would not be expected to directly or indirectly cause substantial adverse effects, including the risk of loss, injury, or death involving seismic activity. This impact would be less than significant.

Plan Concept 2

As described in Chapter 3, Project Description, the primary differences between Plan Concept 1 and Plan Concept 2 are related to where various facilities would be located on the WPWMA's property and when various facilities would be developed. These differences do not change the conclusions identified for Plan Concept 1. Implementation of Plan Concept 2 would include the construction of a new Class II or III landfill on the western property that would create artificial slopes similar to those evaluated at the WRSL. The proposed project would be required to conform to design requirements in Title 27, Section 20250, for Class II landfills or Title 27, Section 20370, Seismic Design for Class III landfills, which requires that Class II landfills be designed to withstand the MPE without damage to the foundation or to the structures that control leachate, surface drainage, erosion, or landfill gas. In addition, Title 27 requires the preparation of a stability analysis prior to landfill module construction activities. This stability analysis would include the preparation of an engineering design report that would evaluate slope stability and identify appropriate slope angles for the cut slopes, interim refuse fill slopes, soil stockpile slopes, and final cover slopes. Because the slopes associated with the new landfill would be required by Title 27 to be designed to be stable, the new landfill would not be expected to directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic activity. As such, impacts related to seismic activity as a result of implementing Plan Concept 2 would be the same as those described for Plan Concept 1.

IMPACT 9-2	**Potential for Soil Loss or Erosion**. The proposed project is not anticipated to cause substantial soil erosion or the loss of topsoil, because of the implementation of best management practices to control erosion. The impact of soil loss or erosion from implementation of the proposed project would be **less than significant**.

Plan Concept 1

Site-Wide.

Native soil types at the project site have moderate to severe water erosion potentials. Surface soils and near-surface soils potentially subject to excavation during construction at the project site are predominantly fine-grained silts and clays. Grading would expose soil to erosion by removing the vegetative cover. Rain and wind may potentially further detach soil particles and transport them offsite. Construction activities associated with project site development, including grading, vegetation clearing, and excavation, have the potential to cause soil erosion or result in loss of topsoil. These impacts are discussed in further detail in the following sections for each of the Plan Concept 1 elements.

Landfill Expansion

The existing SWPPP identifies best management practices (BMPs) that are required to be implemented at the WRSL (Michael Baker International 2015). Most areas of the project site are relatively flat with natural slopes ranging up to 9 percent with limited erosion potential. However constructed slopes associated with the engineered landfill part of the site are significantly greater, ranging up to 35 percent for the final cover, as indicated by the topographic map on Figure 9-1. As described by Golder (2017), erosion and soil loss at the landfill are controlled through a system of engineered controls and practices. These practices would be required to be implemented at the expanded landfill proposed on the eastern property associated with Plan Concept 1 and are described as follows:

- By September 1 of each year, the landfill operator provides a winter operations plan describing wet-weather operations, stormwater and waste-contact-water control, erosion, and sediment control.
- Straw wattles, straw bales, riprap, and silt fences, are placed on slopes and low areas to control erosion as appropriate.
- Erosion is controlled and runoff conveyed to the surface water management system at manageable, nonscouring flow rates.
- Erosion-control-lined V-ditches convey stormwater runoff, with drainage ditches having greater than 3 percent slope lined with asphalt concrete of other erosion protection material.
- A 1-foot thick vegetative erosion-control layer by the application of appropriate shallow rooting plants is used to protect slopes from erosion caused by storm water runoff.
- Quickly repair erosion damage or cracks that develop in intermediate soil cover layers, which are placed in areas of the landfill where filling with waste is not anticipated within 180 days.
- Applying water or planting temporary vegetative cover on intermediate soil cover layers when windy conditions might cause recurrent fugitive dust or soil loss.
- Intermediate soil covers placed after the waste has been brought up to final grade consist of 12 inches of soil compacted to minimize erosion with at least the top 6 inches free of waste or other deleterious materials.

- Local depressions and erosion gullies in intermediate soil cover layers are repaired before final cover is placed.
- Minimum landfill final cover requirements include an erosion-resistant layer that consists of one of the following: (1) a minimum of 1-foot-thick vegetative soil layer capable of sustaining native plant species and resisting foreseeable erosion from wind and precipitation or (2) a mechanically erosion-resistant layer that is not susceptible to ultraviolet light degradation and is capable of resisting foreseeable erosion from wind and precipitation such as a 1-foot thick layer of cobbles and gravel.
- Regular landfill cover inspection and maintenance is performed.

The erosion potential associated with existing landfill operations was also considered when developing the site's storm water management system and BMPs described in the SWPPP. The components of the SWPPP are described in further detail in Chapter 12, Hydrology and Water Quality, of this DEIR. The SWPPP would be required to be updated to include specific measures and stormwater system designs applicable to the expanded landfill on the eastern property associated with Plan Concept 1. Because erosion associated with the landfill expansion element would be temporary and controlled through the use of BMPs, impacts would be less than significant.

In-Place Waste Excavation

Plan Concept 1 includes the excavation of existing buried waste previously placed in non-Subtitle D lined Modules 1, 2, 10, and 11 and relocating the waste to an onsite Subtitle D-compliant module. Waste relocation activities at the pre-Subtitle D area would include removal of leachate and landfill gas collection infrastructure, buried waste, soil cover, and, as appropriate, any underlying soils affected by a release from the landfill and posing a threat to water quality or the environment. The relocation of the contents of these modules to new modules is estimated to require a total of 300 days to complete but may be implemented in phases (Golder 2018).

The erosion of soil and exposed, previously buried waste during excavation and relocation activities would be controlled under separate, project-specific SWPPPs (or modification to an existing SWPPP) that would include BMPs to control soil and exposed waste erosion. Implementation of the BMPs would be expected to protect workers, the public, and local surface water drainages from exposure to contaminants. Examples of BMPs that would be implemented include the following:

- Covering exposed waste at the end of each work day with a minimum of 6 inches of compacted earthen material or an approved alternative daily cover (for example, tarps) to control vectors, fires, odors, blowing litter, and scavenging.
- Placing intermediate cover over exposed waste and temporary waste slopes where no additional waste excavation or waste relocation work would occur within 180 days. Intermediate cover would consist of a minimum 1-foot-thick layer of compacted earthen material, including daily cover soil. The intermediate cover would protect otherwise exposed waste, thereby controlling vectors, fires, odors, blowing litter, and scavenging during any potential lapses in waste relocation activities (Golder 2018).
- Provide positive drainage at the top of excavation slopes to control stormwater run-on into the excavation. The remaining excavation would be graded such that precipitation from the 100-year, 24-hour design storm would drain and prevent water from rising above the waste at the toe of the temporary waste slope. This would prevent ponding water from posing a threat for seeping into buried waste and causing a potential for leachate development. WPWMA personnel or their designee would also visit the site after precipitation events that exceed 2 inches of rainfall and coordinate ponded water pumping if needed. Slopes that would be cut from native soils would be constructed without the intermediate cover (Golder 2018).

- Excavated areas to be developed with a Subtitle D composite liner system would be graded at about 1.5 to 3.5 percent to flow to the northeastern corner of the excavation. Slopes would be seeded at the conclusion of construction to control erosion. Additional erosion controls, such as diversion berms, hay bales, and straw wattles, would be used as necessary during construction in accordance with applicable SWPPPs (Golder 2018).

Construction would be temporary, and the potential for offsite soil erosion would be controlled by using the previously described BMPs. Therefore, soil erosion associated with the excavation and reburial of existing waste would be considered a less-than-significant impact.

Complementary and Programmatic Elements

In addition to solid waste elements, complementary and programmatic elements may be developed on WPWMA properties. Under the project level, for Plan Concept 1, up to 300,000 square feet of building plus exterior infrastructure are reserved in the northern part of the western property for the complementary solid waste management elements. Under the programmatic level, for Plan Concept 1, up to 1.9 million square feet have been reserved for these elements primarily within the northern and southern extents of the western property, and on the center property. However, opportunities may arise that would support locating some of these complementary and programmatic elements nearer to the solid waste project elements or within areas not yet developed with solid waste project elements.

Construction activities associated with the project-level complementary elements include excavating for utilities and building foundations and grading for internal roadways and parking lots. These construction activities have the potential to cause soil erosion or result in loss of topsoil. The proposed complementary elements included in this project would require a project-specific SWPPP that would include BMPs to control soil erosion. BMPs would include the following:

- Install sediment and stormwater controls before initiating surface-disturbing activities.
- Schedule construction activities to avoid direct soil and water disturbance during periods of the year when heavy precipitation and runoff are likely to occur.
- Install suitable stormwater and erosion-control measures to stabilize disturbed areas and waterways before seasonal shutdown of project operations or when severe or successive storms are expected.
- Maintain erosion and stormwater controls as necessary for proper and effective functioning.
- Routinely inspect construction sites to verify that erosion and stormwater controls are implemented and functioning as designed and are appropriately maintained.
- Mechanical erosion-control measures may include wattles, erosion nets, terraces, side drains, blankets, mats, riprapping, mulch, tackifiers, pavement, soil seals, and windrowing construction slash at the toe of fill slopes.
- Vegetative erosion-control measures are generally a supplementary device used to improve the effectiveness of mechanical measures, but they can be effective and complete by themselves. Mechanical and vegetative measures will be periodically inspected to determine their effectiveness. BMPs included in the SWPPP will be included in applicable project plans, contract provisions, and specifications. Project construction inspectors and their supervisors will monitor work accomplishment and effectiveness to verify that design standards, project plan management requirements, and BMPs are met.

Construction activities associated with the build-out of project-level complementary elements would be temporary, and the potential for offsite soil erosion would be controlled by using the previously described

BMPs. Therefore, construction of the project-level complementary elements would have a less-than-significant impact on soil erosion.

Build-out of the programmatic elements involve the same construction activities identified for the project level. Construction of the additional programmatic elements (1.6 million square feet) would also require separate, project-specific SWPPPs for each project. Therefore, construction of the program level of complementary and programmatic elements would have a less-than-significant impact on soil erosion.

Plan Concept 2

As described in Chapter 3, Project Description, the primary differences between Plan Concept 1 and Plan Concept 2 are related to where various facilities would be located on WPWMA's property and when various facilities would be developed. These differences do not change the conclusions identified for Plan Concept 1. As such, impacts related to soil loss or erosion as a result of implementation of Plan Concept 2 would be the same as described for Plan Concept 1.

IMPACT 9-3	**Potential for Unstable Soils**. The project site is not located on a geologic unit or soil that is unstable, and the project elements would not be expected to experience unstable soil conditions. Therefore, this impact would be **less than significant**.

Plan Concept 1

Site-Wide.

The project site is not located on a geologic unit or soil that is unstable. As described under Impact 9-1, the Plan Concept 1 elements would not be exposed to hazards such as onsite or offsite landslides, surface ruptures, ground failures, liquefaction, or collapse that would contribute to unstable conditions. Factors affecting soil stability include soil saturation and slope. Given the depth to groundwater of approximately 90 feet below ground surface at the site, soil saturation from rising groundwater is not expected to adversely affect soil stability. Given the relatively flat slopes of the native surface soils and the requirement that the Plan Concept 1 elements be constructed consistent with the CBC and any applicable building permit requirements, the solid waste and complementary and programmatic elements, excluding the landfill discussed in the following section, would not be expected to be affected by unstable soils.

Landfill Expansion.

The operation of a landfill includes the establishment of artificial slopes that can become unstable if not properly designed and constructed. This instability can occur along cut slopes, interim refuse fill slopes, soil stockpile slopes, and final cover slopes. However, as described under Impact 9-1, because the slopes associated with the new landfill would be required by Title 27 to be designed to be stable, the new landfill would not be expected to result in unstable soil conditions. Small, localized areas of settlement of non-native soils in the engineered landfill cover may occur and be observed periodically during landfill inspections. However, these settlement areas would be promptly repaired as part of routine landfill cover repair and maintenance practices described by Golder (2017). Thus, the proposed expanded landfill on the eastern property associated with Plan Concept 1 would not be exposed to unstable soils, and this impact would be less than significant.

Plan Concept 2

As described in Chapter 3, Project Description, the primary differences between Plan Concept 1 and Plan Concept 2 are related to where various facilities would be located on the WPWMA's property and when various facilities would be developed. These differences do not change the conclusions identified for Plan Concept 1. Implementation of Plan Concept 2 would include the construction of a new landfill on the western property that would create artificial slopes similar to those evaluated at the WRSL. Title 27 requires the preparation of a stability analysis prior to landfill module construction activities. This stability analysis would include the preparation of an engineering design report for the new western landfill that would evaluate slope stability and identify appropriate slope angles for the cut slopes, interim refuse fill slopes, soil stockpile slopes, and final cover slopes. Because the slopes associated with the new landfill would be required by Title 27 to be designed to be stable, the new landfill would not be expected to result in unstable soil conditions. As such, impacts related to unstable soils as a result of implementation of Plan Concept 2 would be the same as described for Plan Concept 1.

IMPACT 9-4	**Presence of Expansive Soils**. The presence of expansive soils on the site could expose building foundations to damage caused by soil expansion and contraction, which can create risks to life and property. This potential risk to life and property associated with the presence of expansive soils on the site would be a **significant** impact.

Plan Concept 1

As discussed in Section 9.1.4, soils at the site are generally moderately to highly expansive, with areas of low-expansive soils. Thus, there is a potential for buildings and other structures associated with the solid waste management and complementary and programmatic elements of Plan Concept 1 to be located on expansive soil, which, through the action of expansion or contraction, can lead to cracking, lifting, subsidence, and structural damage to utilities, building foundations, and occupied overlying structures. Damage to the proposed project's buildings and facilities could create risks to life or property if a failure were to occur. The potential for expansive soils to create risks to life or property with implementation of the proposed project would be a significant impact.

Plan Concept 2

As described in Chapter 3, Project Description, the primary differences between Plan Concept 1 and Plan Concept 2 are related to where various facilities would be located on the WPWMA's property and when various facilities would be developed. These differences do not change the conclusions identified for Plan Concept 1. As such, impacts related to expansive soils as a result of implementation of Plan Concept 2 would be the same as described for Plan Concept 1.

Mitigation Measure 9-4: Presence of Expansive Soils

Consistent with CBC Section 1808.2 and Placer County General Plan Policy 8.A.1, the WPWMA will conduct a geotechnical investigation prior to constructing any buildings or other structures designed for human occupancy that may be exposed to expansive soils. The geotechnical report will be prepared by a qualified and licensed civil engineer, geotechnical engineer, or certified engineering geologist. During project construction, all recommendations outlined in the geotechnical report will be implemented, subject to revision by the civil or geotechnical engineer or engineering geologist, where needed, and verified by a construction quality assurance observer. Typical recommendations could include over-excavating the foundations, reinforcing the foundations, and using fill soil to minimize the exposure of the foundations to the effects of the expansive soils.

Level of Significance after Mitigation

Implementation of Mitigation Measure 9-4 requires the WPWMA to conduct a geotechnical investigation prior to constructing any buildings or other structures designed for human occupancy in conformance with CBC Section 1808.2. Under CBC Section 1808.2, foundations placed on or within expansive soils must be designed to resist differential volume changes and to prevent damage to the supported structures. With implementation of Mitigation Measure 9-4, the potential for expansive soils to create risks to life and property as a result of the proposed project would be reduced to **less than significant**.

IMPACT 9-5	**Potential Destruction of Paleontological Resources**. Fossils are known to occur in the project vicinity, and ground disturbance from project construction activities could disturb or destroy paleontological resources. Impacts on previously undiscovered paleontological resources from ground-disturbing construction activities would be **significant**.

Plan Concept 1

Fossils have been found in the greater Sacramento region within many local formations, including the Turlock Lake, Riverbank, and Mehrten formations. The Turlock Lake Formation is found at the surface and beneath the project site and surrounding area. Fossils have been found in the Turlock Lake Formation in the Roseville area, including a horse hoof fossil from a railroad cut and a fossil pine branch with needles. There are no documented studies or observations of paleontological resources at or near the project site. Given that the Turlock Lake Formation is present at the surface at the project site and has been documented to contain fossils in the Roseville area, as close as approximately 1 mile southeast of the project site, paleontological resources potentially could be encountered during grading and excavation activities associated with the implementation of the solid waste management and complementary and programmatic elements for Plan Concept 1.

Although the potential for disturbance to paleontological resources would be very low because of the lack of previous finds at the site and the limited number of discoveries in the region, their discovery is possible, based on the presence of geologic formations known to contain such resources. Therefore, the potential for ground-disturbing construction activities associated with implementation of the solid waste management and complementary and programmatic elements to disturb or destroy undiscovered paleontological resources would be a significant impact.

Plan Concept 2

As described in Chapter 3, Project Description, the primary differences between Plan Concept 1 and Plan Concept 2 are related to where various facilities would be located on the WPWMA's property and when various facilities would be developed. These differences do not change the conclusions identified for Plan Concept 1. As such, impacts related to paleontological resources as a result of implementation of Plan Concept 2 would be the same as described for Plan Concept 1.

Mitigation Measure 9-5: Potential Destruction of Paleontological Resources

If evidence of any paleontological features or deposits are discovered during construction-related earth-moving activities (for example, vertebrate, invertebrate, or plant fossils, traces, or trackways), the WPWMA shall halt ground-disturbing activity in the area of the discovery and retain a qualified paleontologist to assess the significance of the find. If the paleontologist determines that the find does not constitute a significant or unique resource, construction may proceed. If the paleontologist determines that further information is needed to evaluate significance, a data recovery plan will be prepared. If the find is determined to be significant by the qualified paleontologist, they will work with the WPWMA to avoid disturbance to the resources. If complete avoidance is not feasible in light of project design, economics, logistics, or other factors, accepted professional standards for documentation of any find and recovery of important fossils will be followed.

Level of Significance after Mitigation.

Implementation of Mitigation Measure 9-5 establishes the required procedures to be followed if paleontological resources are discovered during construction activities, including immediately stopping work and retaining a qualified paleontologist to evaluate the find and determine significance. Because this mitigation would result in the avoidance of paleontological resources if they are discovered or other appropriate measures (for example, documentation or recovery) if avoidance is not possible, the impact would be reduced to **less than significant**.

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