4.7 Geology and Soils

This section describes the existing geology and soils conditions of the project site and vicinity, identifies associated regulatory requirements, evaluates potential project and cumulative impacts, and identifies mitigation measures for any significant impacts related to implementation of the of the Laguna Creek Diversion Retrofit Project (Proposed Project). The analysis is based in part on a vertebrate paleontological records check for paleontological resources from the Natural History Museum of Los Angeles County (LACM) conducted for the Proposed Project.

A summary of the comments received during the scoping period for this environmental impact report (EIR) is provided in Table 2-1 in Chapter 2, Introduction, and a complete list of comments is provided in Appendix A. There were no comments related to geology and soils.

4.7.1 Existing Conditions

4.7.1.1 Regional Geologic Setting

The Laguna Creek Diversion Facility (Facility) is located along the western side of the Santa Cruz Mountains, in the central portion of the Coast Ranges Physiographic Province of California. This province consists of a series of coastal mountain chains paralleling the pronounced northwest-southeast structural grain of central California geology between Point Arguello, in Santa Barbara County, and the California/Oregon border. The project site and surrounding region are underlain by Miocene age sedimentary strata, which in turn is underlain by granitic and metamorphic rocks of the Salinian Block. This suite of basement rocks is separated from contrasting basement rock of the Franciscan Formation to the northeast by the San Andreas fault system. While the core of the mountain range is dominated by gneiss, schist, limestone, quartzite, and granite, Cretaceous through Holocene sedimentary rocks and lesser amounts of Tertiary volcanic rocks overlie much of the region (AECOM 2018; USGS 1981, 1997).

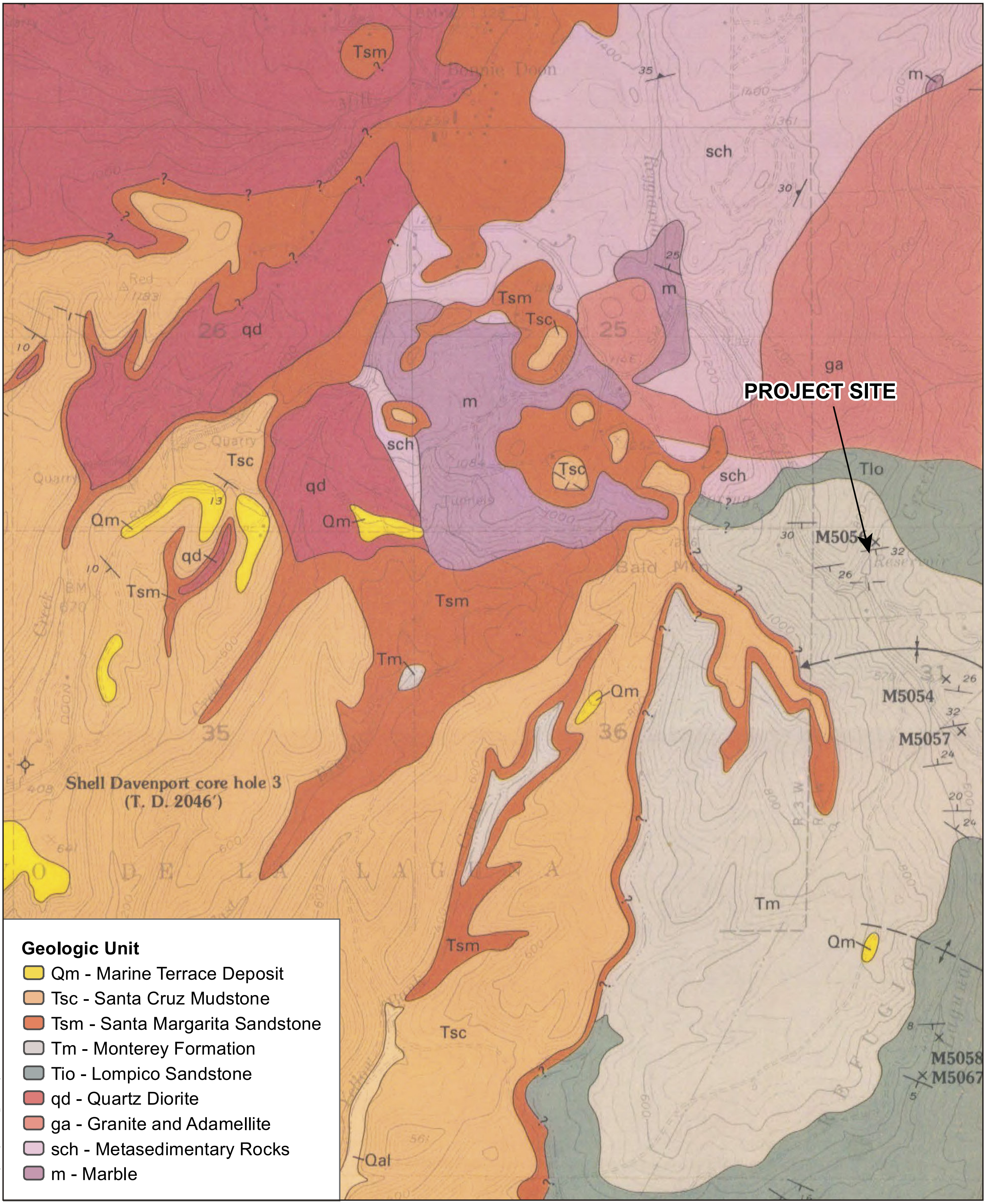
4.7.1.2 Site Geology and Stratigraphy

The project site is underlain by middle- to late-Miocene Monterey Formation (or Monterey Shale) bedrock, consisting of medium- to thick-bedded and laminated, olive-gray to light gray mudstone and sandy siltstone, including a few thick dolomite interbeds (see Figure 4.7-1). The bedrock beds dip about 26 degrees to the south-southeast. North of the project site, the Tertiary Lompico Sandstone underlies Laguna Creek (USGS 1981, 1997).

Sediments within the creek bed on the upstream side of the dam generally consist of cobbles, gravel, sand, and silt. Sediments within the creek bed on the downstream side of the dam consist of well-graded gravel, with sand and cobbles. Bedrock exposed at the right/west and left/east dam abutments consists of moderately weathered, fine-grained, interbedded silty sandstone and mudstone of the Monterey Formation. The mudstone is weaker and more erodible than the sandstone (B&V 2018).

Surficial Soils

Based on mapping by the U.S. Department of Agriculture Soil Conservation Service, the surficial soils underlying the project site consist of the Lompico-Felton soil complex, which consists of moderately deep, well-drained soils on mountains. These soils formed in residuum derived from sandstone, shale, siltstone, or mudstone, on 30% to 50% slopes, and have a high to very high erosion potential (see Figure 4.7-2) (USDA Soil Conservation Service 1980, 2020).



SOURCE: USGS 1981, 1997

FIGURE 4.7-1

Project Area Geology

Laguna Creek Diversion Retrofit Project - EIR

DUDEK

SOURCE: Bing Maps 2020, USDA 2020

DUDEK

0 50 100 Feet

FIGURE 4.7-2

Project Area Soils

Laguna Creek Diversion Retrofit Project - EIR

Kast Terrain

Karst terrain is present in the vicinity of the project site but does not underlie the site. Karst terrain is formed from the dissolution of soluble rocks, such as limestone, dolomite, and gypsum. Karst has also been documented for more weather-resistant rocks, such as quartzite, given the proper conditions. Karst is characterized by underground drainage systems with sinkholes and caves, which can be susceptible to collapse. These sinkholes create topography that is characterized by the absence of an integrated surface drainage system, as the sinkholes form closed depressions. Approximately 0.25 miles upstream from the Facility, the creek crosses the contact between sedimentary rocks of the Lompico Sandstone/Monterey Shale and older metamorphic rocks of schist and marble, which are also intruded by granitic rock, as shown on Figure 4.7-1. Based on visual observations, marble bedrock and karst terrain are present in this older metamorphic rock, located 1,400 feet north of the Facility at the closest point (USGS 1981; Zinn 2020).

Slope Stability

The right/west dam abutment is built into the base of an approximate 10- to 15-foot-high, gentle to moderately steep slope (B&V 2020b). Similarly, the left/east abutment is built into the base of an approximate 15-foot-high gentle slope. No significant slope instability is present in the immediate vicinity of the Facility. The existing Facility is founded on bedrock. The bedrock orientation was neither adverse nor favorable with respect to slope stability (B&V 2018), indicating the bedrock is grossly stable.

The California Geological Survey (CGS) has completed Seismic Hazard Zone maps, which include seismically induced landslide zones, for select U.S. Geological Survey (USGS) 7.5-minute quadrangle maps in California. The project site is located in the USGS Davenport Quadrangle map. A Seismic Hazard Zone map has not been completed for this quadrangle (CGS 2020).

Subsidence

Subsidence occurs when a large portion of land is vertically displaced, usually due to the withdrawal of groundwater, oil, or natural gas, or as a result of decomposition of natural organic materials. Soils that are particularly subject to subsidence include those with high silt or clay content and/or high organic content. The effects of subsidence include damage to buildings and infrastructure, increased flood risk in low-lying areas, and lasting damage to groundwater aquifers and aquatic systems. The project site is not located in an area of historic or recent subsidence due to groundwater extraction (Luhdorff & Scalmanini Consulting Engineers, Inc. and California Water Foundation 2020). In addition, the project site does not overlie an oil and gas field (CalGEM 2001); therefore, the potential for subsidence due to oil and gas extraction is low. As described above, the project site is underlain by Monterey Shale bedrock, with overlying sediments in the creek bed consisting of cobbles, gravel, sand, and silt. These deposits are not high in silt, clay, or organic content and therefore would not be susceptible to subsidence due to high organic content.

Expansive Soils

Expansive soils are composed largely of clays, which greatly increase in volume when saturated with water and shrink when dried. Expansive soils can cause structural foundations to rise during the rainy season and fall during the dry season. If this expansive movement varies underneath different parts of the structure, foundations may crack and portions of the structure may be distorted. The potential for soil to undergo shrink and swell is greatly enhanced by the presence of a fluctuating, shallow groundwater table. Changes in the volume of expansive soils can result in the consolidation of soft clays after the lowering of the water table or the placement of fill. As previously discussed, the project site is underlain by Monterey Shale bedrock, with overlying sediments in the creek bed consisting of cobbles, gravel, sand, and silt. These deposits are not high in clay content and therefore would not be susceptible to soil expansion. Similarly, surficial soils underlying the hillsides adjacent to the creek bed consist of the Lompico-Felton soil complex, which consists of moderately deep, well-drained soils, which are generally sandy and permeable. These deposits are not high in clay content and therefore would not be susceptible to soil expansion.

4.7.1.3 Regional Seismicity and Seismic Hazards

The project site is located in a seismically active region of California, between two major Holocene-active faults, including the San Andreas Fault, located approximately 12 miles to the northeast, and the San Gregorio Fault, located approximately 6 miles to the southwest, as shown on Figure 4.7-3. Historical earthquakes along the San Andreas Fault and its branches have caused substantial seismic shaking in Santa Cruz County in historical times. The two largest historical earthquakes to affect the area were the moment magnitude (Mw) 7.9 San Francisco earthquake of April 18, 1906, and the Mw 6.9 Loma Prieta earthquake of October 17, 1989 (corresponding to Richter magnitudes of 8.3 and 7.1, respectively) (City of Santa Cruz 2012). The Facility, originally constructed in 1890, endured both of these large earthquakes.

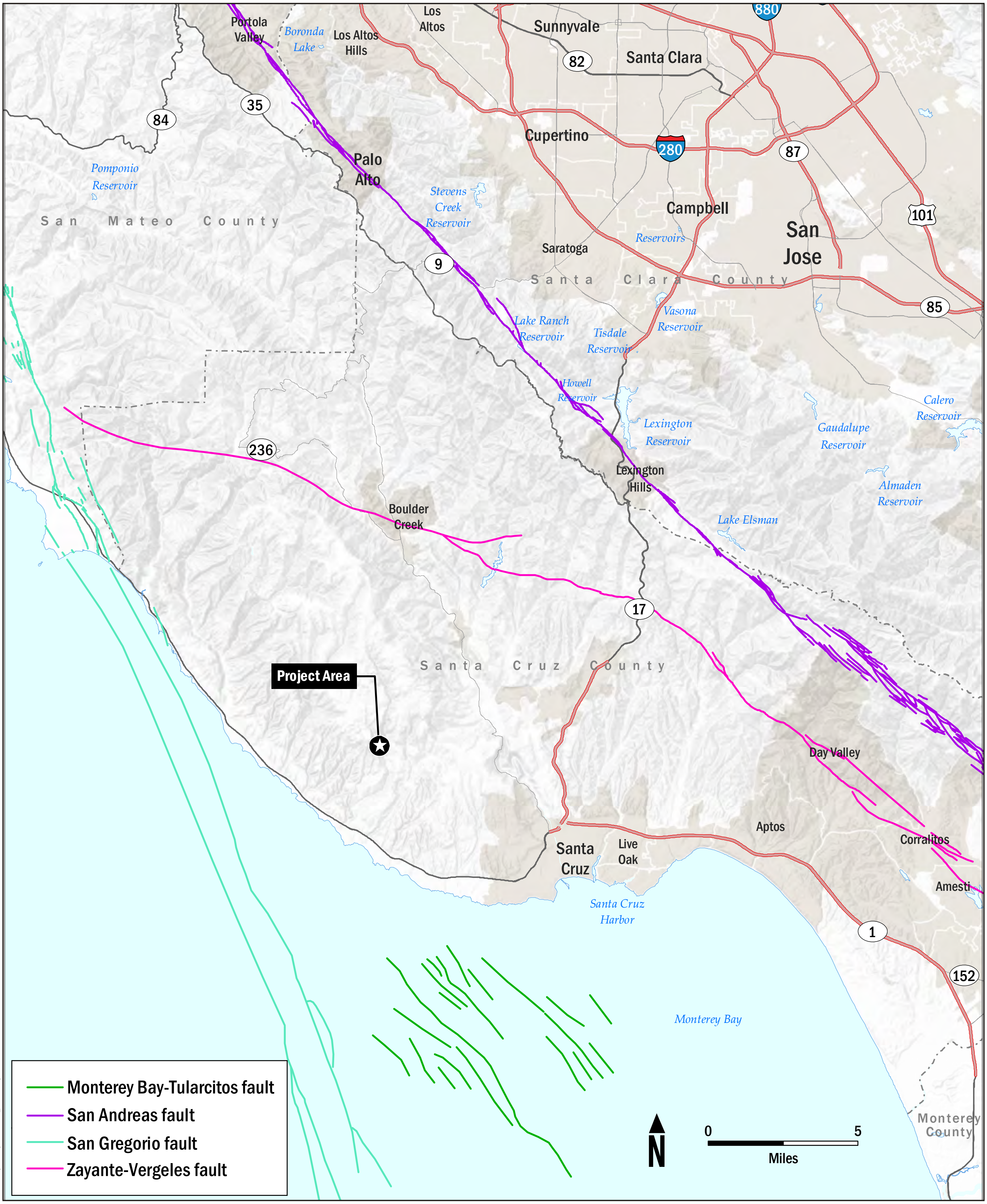
The San Francisco earthquake caused severe seismic shaking and structural damage to many buildings in the Santa Cruz Mountains. The Loma Prieta earthquake may have caused more intense seismic shaking than the 1906 event in localized areas of the Santa Cruz Mountains, although its regional effects were not as extensive. Based on a seismometer located at the University of California Santa Cruz (UCSC) campus, approximately 4.5 miles from the project site, peak ground accelerations during the Loma Prieta earthquake were approximately 0.5 g (percent of gravity). There were also major earthquakes in northern California along or near the San Andreas Fault in 1838, 1865, and possibly 1890 (AECOM 2018; City of Santa Cruz 2012).

Regional Faulting

As previously discussed, Santa Cruz County is located in a portion of California that is crossed by a number of faults. The CGS classifies faults as:

- Holocene-active faults, which are faults that have moved during the past approximate 11,700 years. These faults are capable of surface rupture.
- Pre-Holocene faults, which are faults that have not moved in the past 11,700 years. This class of fault may be capable of surface rupture, but is not regulated under the Alquist-Priolo Earthquake Fault Zoning Act of 1972.
- Age-undetermined faults, which are faults where the recency of fault movement has not been determined (CGS 2018).

This fault classification is consistent with criteria of the Alquist-Priolo Earthquake Fault Zoning Act of 1972 (see Section 4.7.2, Regulatory Framework, for information about this act). Distances to regional faults, maximum probable earthquake magnitudes, and recurrence intervals are shown in Table 4.7-1.



SOURCE: AECOM 2018

FIGURE 4.7-3

Fault Map

Laguna Creek Diversion Retrofit Project - EIR

DUDEK

Table 4.7-1. Distances to Local Faults

Fault	Distance from Project Site (miles)	Maximum Probable Earthquake Magnitude (moment magnitude)	Approximate Time Between Major Earthquakes (years)
San Gregorio	6	7.5	400
Zayante-Vergeles	7	7.5	8,821
Monterey Bay-Tularcitos	8	6.5	2,841
San Andreas	12	7.8	210

Sources: AECOM 2018; City of Santa Cruz 2012; USGS 2017a, 2017b, 2017c, 2020.

The project site is located approximately 7 miles southwest of the Zayante-Vergeles Fault (see Figure 4.7-3) (USGS 2020), which is mapped by the USGS as a late Pleistocene to possibly Holocene fault active within the past 15,000 years (i.e., Holocene-active to pre-Holocene fault). The Zayante-Vergeles Fault is marked by a zone of relatively parallel fault traces that extend from the vicinity of West Waddell Creek, southeast through the Santa Cruz Mountains, beneath Quaternary alluvium of the Pajaro River, and across the northern Gabilan Range, where the fault has a complex junction with the San Andreas Fault, approximately 5 miles southeast of Hollister (USGS 2000). For planning purposes, the maximum probable earthquake associated with the Zayante-Vergeles Fault is Mw 7.5 (USGS 2017a).

The project site is located approximately 12 miles southwest of the San Andreas Fault (see Figure 4.7-3) (USGS 2020), which is a 680-mile network of Holocene-active faults that collectively accommodate the majority of the north-south motion between the North American and Pacific tectonic plates. The San Andreas Fault Zone is considered to be a Holocene-active and historically active strike-slip fault that extends along most of coastal California, from its complex junction with the Mendocino Fault Zone on the north, southeast to the northern Transverse Range, and inland to the Salton Sea, where a well-defined zone of seismicity (i.e., the Brawley Seismic Zone) transfers slip to the Imperial Fault. Two major surface-rupturing earthquakes have occurred in historic time, including the 1857 Fort Tejon earthquake and the 1906 San Francisco earthquake (USGS 2002). For planning purposes, the maximum probable earthquake associated with the San Andreas Fault is Mw 7.8 (USGS 2017b).

The project site is located approximately 6 miles east-northeast of the San Gregorio Fault (see Figure 4.7-3) (USGS 2020), which is a Holocene-active (past 11,700 years), structurally complex fault zone as much as 3 miles wide. The fault zone is primarily located offshore, west of San Francisco Bay and Monterey Bay, with onshore locations at promontories, such as Moss Beach, Pillar Point, Pescadero Point, and Point Año Nuevo. The San Gregorio Fault is a complex fault zone consisting of several named faults, including the Seal Cove, Frijoles, Coastways, Greyhound Rock, Carmel Canyon, Denniston Creek, and Año Nuevo Faults. This fault zone extends from Bolinas Lagoon south to the Point Sur region (USGS 1999). For planning purposes, the maximum probable earthquake associated with the San Gregorio Fault is Mw 7.5 (USGS 2017c).

The project site is located approximately 8 miles north of the Monterey Bay-Tularcitos Fault Zone (see Figure 4.7-3), which is generally considered late Quaternary (past 15,000 years) (USGS 2020); however, portions of this fault are considered Holocene-active (past 11,700 years). This offshore fault zone is a complex, generally northwest-trending zone up to 9 miles wide, consisting primarily of right-lateral, reverse/thrust faults, extending across Monterey Bay southeast to the Monterey Peninsula, to near the crest of the Sierra de Salinas (USGS 2001). For planning purposes, the maximum probable earthquake associated with the Monterey Bay-Tularcitos Fault Zone is Mw 7.3 (USGS 2017d).

In addition, the project site is located approximately 4 miles west-southwest of the Ben Lomond Fault, which has been mapped generally along the San Lorenzo River from Boulder Creek to Felton, as well as within west Santa Cruz, traversing the coastline just east of Mitchell's Cove. This late Quaternary fault (past 130,000 years) is not well-located throughout much of the area east of the project site and therefore is not included on Figure 4.7-3 (USGS 1981, 2020).

Surface Rupture

Surface rupture involves the displacement and cracking of the ground surface along a fault trace. Surface ruptures are visible instances of horizontal or vertical displacement, or a combination of the two, typically confined to a narrow zone along the fault. Surface rupture is more likely to occur in conjunction with Holocene-active fault segments, where earthquakes are large, or where the location of the movement (earthquake hypocenter) is shallow.

As discussed in Section 4.7.2, Regulatory Framework, the Alquist-Priolo Earthquake Fault Zoning Act of 1972 regulates development near Holocene-active faults to mitigate the hazard of surface fault rupture. This Act requires the State Geologist to establish regulatory zones (known as Alquist-Priolo Earthquake Fault Zones) around the surface traces of Holocene-active faults and to issue appropriate maps. Local agencies must regulate most development projects within the zones. The CGS has completed Seismic Hazard Zone maps, which include Alquist-Priolo Earthquake Fault Zones, for select USGS quadrangle maps in California. The project site is located in the USGS 7.5-minute Davenport Quadrangle map. As stated above, a Seismic Hazard Zone map has not been completed for this quadrangle (CGS 2020). The Alquist-Priolo Earthquake Fault Zone located closest to the project site is associated with the onshore portion of the San Gregorio Fault, located approximately 10 miles west-northwest of the project site (CGS 2020; CDMG 1982). Therefore, the project site is not subject to fault rupture.

Liquefaction

The CGS has completed Seismic Hazard Zone maps, which include liquefaction zones, for select USGS quadrangle maps in California. As stated above, the project site is located in the USGS 7.5-minute Davenport Quadrangle map and a Seismic Hazard Zone map has not been completed for this quadrangle (CGS 2020). However, the loose, unconsolidated alluvial materials within the creek bed, upstream and downstream of the Facility, may be susceptible to liquefaction and associated lateral spreading (B&V 2018).

4.7.1.4 Paleontological Resources

Paleontological resources are the fossilized remains, traces, and associated data of plants and animals, preserved in earth's crust, and are generally considered to be older than middle Holocene (approximately 5,000 years before present) (SVP 2010). Body fossils include bones, teeth, shells, leaves, and wood, while trace fossils include trails, trackways, footprints, and burrows. With the exception of fossils found in low-grade metasedimentary rocks, significant paleontological resources are found in sedimentary rock units that are old enough to preserve the remains or traces of plants and animals. To determine paleontological sensitivity of individual rock units present within the project site, a paleontological records search was requested from the LACM on May 7, 2020 and desktop geological and paleontological research were conducted.

According to surficial geological mapping at 1:62,500 scale and the LACM records search results received on May 21, 2020 the project site is underlain by the middle- to late-Miocene (approximately 17 million years ago to 5 million years ago), marine, Monterey Formation (identified as Monterey Shale by some authors) (Brabb [USGS] 1997; McLeod 2020). The LACM reported no paleontological localities within project site boundaries, but indicated they have a fossil locality (LACM [CIT] 384) located south-southeast of the project site in the mountainous area on the north side of Carmel Valley. This locality yielded a fossil specimen of snake mackerel (*Thyrsocles kriegeri*).

Named after the type section near the City of Monterey, the Monterey Formation is an abundantly fossiliferous, widespread geological unit extending from Orange County in the south to north of San Francisco Bay. Throughout its extent, the Monterey Formation has produced thousands of fossil traces, invertebrates, and vertebrates. Vertebrate taxa include sharks, bony fish, reptiles, and marine mammals (Koch et al. 2004). Dozens of bony fish species from multiple localities were reported from the Monterey Formation in a catalog of Neogene bony fishes from California (Fierstine et al. 2012). Furthermore, a new genus and species of eared seal was reported from the Monterey Formation of Los Angeles County (Downs 1956). In addition to vertebrate fossils recovered from the Monterey Formation, numerous Monterey Formation fossil invertebrates have been described in the scientific literature including two new stomatopod crustacean species (Hof and Schram 1998). Finally, a small, Monterey Formation invertebrate fauna was published in the literature, which consisted of bivalves, gastropods, and an echinoid that were collected during excavations for a housing development in south Orange County (Rugh 2018). Overall, the Monterey Formation has produced scientifically significant fossils and is considered to have high paleontological resources sensitivity (SVP 2010).

4.7.2 Regulatory Framework

4.7.2.1 Federal

There are no federal regulations directly applicable to geology and soils at the project site.

4.7.2.2 State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Act (Public Resources Code [PRC] Sections 2621 through 2630) was passed in 1972 to mitigate the hazard of surface faulting to 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. A structure for human occupancy is defined as any structure used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person-hours per year. 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 structure for human occupancy can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, the local agency must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (PRC Sections 2690 through 2699.6 et seq.), passed by the California State Legislature in 1990, 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, strong ground shaking, or other earthquake and geologic hazards.

California Building Standards Code

The state regulations protecting structures from geo-seismic hazards are contained in the California Building Standards Code (24 California Code of Regulations Part 2) (the California Building Code), which is updated every 3 years. These regulations apply to public and private buildings in the state. Until January 1, 2008, the California Building Code was based on the then-current Uniform Building Code and contained additions, amendments, and repeals specific to building conditions and structural requirements of the State of California. The 2019 California Building Code, effective January 1, 2020, is based on the current (2018) International Building Code and enhances the sections dealing with existing structures. Seismic-resistant construction design is required to meet more stringent technical standards than those set by previous versions of the California Building Code. Construction activities are also subject to Chapter 33 of the California Building Code.

California Division of Occupational Safety and Health

Construction activities are subject to occupational safety standards for excavation and trenching, as specified in California Division of Occupational Safety and Health (also known as Cal/OSHA) regulations (Title 8 of the California Code of Regulations),. These regulations specify the measures to be used for excavation and trench work where workers could be exposed to unstable soil conditions. The Proposed Project would be required to employ these safety measures during excavation and trenching.

State Earthquake Protection Law

The State Earthquake Protection Law (Health and Safety Code Section 19100 et seq.) requires that structures be designed and constructed to resist stresses produced by lateral forces caused by wind and earthquakes, as provided in the California Building Code. Chapter 16 of the California Building Code sets forth specific minimum seismic safety and structural design requirements, requires a site-specific geotechnical study to address seismic issues, and identifies seismic factors that must be considered in structural design. Because the project site is not located within an Alquist-Priolo Earthquake Fault Zone, as noted above, no special provisions would be required for the Proposed Project related to fault rupture.

California Environmental Quality Act

The California Environmental Quality Act (CEQA) Guidelines require that all private and public activities not specifically exempted be evaluated against the potential for environmental damage, including effects to paleontological resources. Paleontological resources, which are limited, nonrenewable resources of scientific, cultural, and educational value, are recognized as part of the environment under these state guidelines. This analysis satisfies project requirements in accordance with CEQA (13 PRC Section 21000 et seq.) and PRC Section 5097.5 (Stats 1965, c. 1136, p. 2792). This analysis also complies with guidelines and significance criteria specified by the Society of Vertebrate Paleontology (SVP) (SVP 2010).

Paleontological resources are explicitly afforded protection by CEQA, specifically in Section VII(f) of CEQA Guidelines Appendix G, the "Environmental Checklist Form," which addresses the potential for adverse impacts to "unique paleontological resource[s] or site[s] or … unique geological feature[s]." This provision covers fossils of signal importance—remains of species or genera new to science, for example, or fossils exhibiting features not previously recognized for a given animal group—as well as localities that yield fossils significant in their abundance, diversity, preservation, and so forth. Further, CEQA provides that generally, a resource shall be considered "historically significant" if it has yielded or may be likely to yield information important in prehistory (PRC Section 15064.5[a][3][D]).

Paleontological resources would fall within this category. Chapter 1.7, Sections 5097.5 and 30244 of the PRC defines unauthorized removal of fossil resources as a misdemeanor and requires mitigation of disturbed sites.

4.7.2.3 Local

County of Santa Cruz General Plan and Local Coastal Program

The Conservation and Open Space Chapter of the Santa Cruz County General Plan outlines policies and programs for the protection of hydrological, geological, and paleontological features (County of Santa Cruz 2020). Table 4.11-1 in Section 4.11, Land Use and Planning, discusses applicable General Plan/Local Coastal Program policies related to geology and soils.

Chapter 16.44 (Paleontological Resource Protection) of the Santa Cruz County Code outline methods and regulations for the identification and treatment of paleontological resources within the County.

City of Santa Cruz General Plan and Local Coastal Program

The project site is located in unincorporated Santa Cruz County, and therefore, the City of Santa Cruz General Plan and Local Coastal Program do not apply to the Proposed Project. Therefore, the policies of these plans are not summarized or further evaluated in this section.

4.7.3 Impacts and Mitigation Measures

This section contains the evaluation of potential environmental impacts associated with the Proposed Project related to geology and soils. The section identifies the standards of significance used in evaluating the impacts, describes the methods used in conducting the analysis, and evaluates the Proposed Project's impacts and contribution to significant cumulative impacts, if any are identified.

4.7.3.1 Thresholds of Significance

The standards of significance used to evaluate the impacts of the Proposed Project related to geology and soils are based on Appendix G of the CEQA Guidelines, as listed below. A significant impact would occur if the Proposed Project would:

A. Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:
    i. 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.
    ii. Strong seismic ground shaking.
    iii. Seismic-related ground failure, including liquefaction.
    iv. Landslides.
B. Result in substantial soil erosion or the loss of topsoil.

C. 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.

D. Be located on expansive soil, as defined in the 2019 California Building Code, creating substantial direct or indirect risks to life or property.

E. 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.

F. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

4.7.3.2 Analytical Methods

The following analysis considers whether the Proposed Project would directly or indirectly cause geologic and soils impacts, taking into account state-mandated construction methods, as specified in the California Safety and Health Administration regulations (Title 8 of the California Code of Regulations) and in Chapter 33 of the California Building Code. Moreover, the analysis considers whether a unique paleontological resource, site, or unique geologic feature would be directly or indirectly destroyed as a results of the Proposed Project.

4.7.3.3 Project Impact Analysis

Areas of No Impact

The Proposed Project would not have impacts with respect to the following standards of significance for the following reasons:

- **Earthquake Fault Rupture (Significance Standard A-i).** The Proposed Project would not have the potential to directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault because the site is not located within an Alquist-Priolo Earthquake Fault Zone or underlain by any Holocene-active or pre-Holocene faults.
- **Septic Tanks/Alternative Wastewater Disposal (Significance Standard E).** The Proposed Project would not entail wastewater disposal. During construction, temporary portable toilets would be installed for construction workers. Waste from the portable toilets would be transported off-site in vacuum trucks for disposal at the City's wastewater treatment facility. Therefore, the Proposed Project would have no impacts related to soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems.

Impacts

This section provides a detailed evaluation of geology and soils impacts associated with the Proposed Project. Construction-related impacts associated with soil erosion/loss of topsoil (Significance Standard B) and potential sedimentation of downstream Laguna Creek is addressed in Section 4.10, Hydrology and Water Quality.

Impact GEO-1: Seismic Hazards (Significance Standards A-ii and A-iii). The Proposed Project would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death resulting from seismic ground shaking or seismic-related ground failure, including liquefaction. ***(Less than Significant)***

As discussed above, the project site is located in a seismically active region of California between two major Holocene-active faults: the San Andreas Fault, located approximately 12 miles to the northeast, and the San Gregorio Fault, located approximately 6 miles to the southwest (see Figure 4.7-3). In addition, the project site is located approximately 7 miles southwest of the Zayante-Vergeles Fault, which is mapped by the USGS as a late Pleistocene to possibly Holocene fault (past 15,000 years). Loose, unconsolidated alluvial materials within the creek bed, upstream and downstream of the Facility, may be susceptible to liquefaction and associated lateral spreading in the event of strong seismically induced ground shaking. However, because the Facility is constructed on bedrock and the abutments are bedrock, it is unlikely that soil liquefaction would have a significant adverse effect on the stability of the structure (B&V 2018). In addition, the Proposed Project has been designed in accordance with geotechnical design data of the 2018 Conditions Assessment Report (B&V 2018) and engineered design plans of the 2020 Draft Basis of Design (B&V 2020a). Proposed Project facilities would be constructed in accordance with provisions of the California Building Code under the supervision of a California Geotechnical Engineer and/or California Certified Engineering Geologist. In addition, construction and operation of Proposed Project facilities would not increase the potential for earthquakes or seismically induced ground failure to occur. Therefore, the Proposed Project would have a less-than-significant impact related to seismic hazards.

Impact GEO-2: Unstable Geologic Unit or Soils (Significance Standards A-iv and C). The Proposed Project would not cause adverse effects involving landslides or be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Proposed Project, and potentially result in on- or off-site landslide, slope failure/instability, subsidence, or collapse. ***(Less than Significant)***

The new Coanda screen intake structure would require excavation of creek materials upstream and downstream of the dam to allow the dam to be notched and the bedrock to be exposed; anchoring of the structure's foundation to the bedrock and dam; installation of rebar and pouring concrete for the structure; and placement of the Coanda screen and other intake components. The downstream side of the dam would be excavated to the bedrock for the Coanda screen concrete structure and foundation for the new valve fault. Excavation activities would result in temporary slopes that, if not constructed properly, could be prone to failure, which in turn could result in safety impacts to construction personnel and damage to infrastructure. However, these temporary slopes would be designed in accordance with engineered design plans of the 2020 Draft Basis of Design (B&V 2020a) and would be constructed in accordance with provisions of the California Building Codeand Cal/OSHA, under the supervision of a California Geotechnical Engineer and/or California Certified Engineering Geologist, thereby minimizing the potential for slope failure. In addition, riprap would be placed in areas where creek bank protection is required. Any riprap slopes greater than 1:1 would be locked in place with grout, thus eliminating the potential for slope failure during operations.

Three private, unpaved roads may be improved to allow access to the site by construction equipment, which would entail limited road widening, grading, compaction, and placement of aggregate. Minor cut-and-fill grading would be required and may include alterations of existing, small (i.e., generally 15 feet high or less) moderately steep slopes. Such slope alterations could result in temporary oversteepening and slope failure, if not completed properly. However, slope modifications would be designed in accordance with final engineered design plans and would be constructed in accordance with provisions of the California Building Code, under the supervision of a California Geotechnical Engineer and/or California Certified Engineering Geologist. In addition, the City has identified Standard Construction Practices that would be implemented by the City and its contractors during construction activities associated with the Proposed Project. As described in in Section 3.6.3, Standard Construction Practices, finished slopes would be covered in non-toxic soil binders and/or hydroseed (Standard Construction Practice #4), which would encourage plant growth, thus further stabilizing the slopes. In addition, all temporarily disturbed areas would be replanted with native vegetation (Standard Construction Practice #14), thus contributing to long-term slope stability.

As previously discussed, the project site is not located in an area prone to subsidence due to groundwater withdrawal, oil and gas extraction, or peat deposits. In addition, the project site is not located on karst topography. The closest karst topography is located approximately 1,400 feet north of the dam. Therefore, ground settling and collapse is not expected in association with the Proposed Project.

As discussed above, the Proposed Project would not be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Proposed Project, and potentially result in on- or off-site landslide, slope failure/instability, subsidence, or collapse. Therefore, the Proposed Project would have less-than-significant impacts related to unstable geologic units or soils.

Impact GEO-3: Expansive Soils (Significance Standard D). The Proposed Project would not be located on expansive soil, as defined in the 2019 California Building Code. ***(Less than Significant)***

As previously discussed, the project site is underlain by middle Monterey Shale bedrock, with overlying sediments within the creek bed consisting of cobbles, gravel, sand, and silt. Surficial soils on adjacent slopes consist of the Lompico-Felton soil complex, which consists of moderately deep, well-drained soils, which are generally sandy and permeable. These deposits are not high in clay content and therefore would not be susceptible to soil expansion. As a result, the Proposed Project would not be located on expansive soil, as defined in the 2019 California Building Code, and would not create substantial direct or indirect risks to life or property that can be associated with such soils. Therefore, the Proposed Project would have less-than-significant impacts related to expansive soils.

Impact GEO-4: Paleontological Resources (Significance Standard F). The Proposed Project could potentially directly or indirectly destroy a unique paleontological resource or site during construction. However, the Proposed Project would not directly or indirectly destroy a unique geological feature. ***(Less than Significant with Mitigation)***

As discussed above, the project site is underlain by the middle to late Miocene Monterey Formation and is not anticipated to be underlain by a unique geological feature. However, the Monterey Formation has produced scientifically significant fossils and is considered to have high paleontological resources sensitivity per the SVP (2010) mitigation guidelines. The LACM did not report any vertebrate fossil localities from within the project site but did have a locality in the vicinity, south-southeast of the project site, which consisted of a snake mackerel (*Thyrsocles kriegeri*). In addition, a review of the paleontological literature indicated the Monterey Formation has yielded abundant invertebrate and vertebrate remains in California. Any significant grading, excavations, trenching, or augering that is below the depth of topsoil, if present, could potentially result in disturbance of paleontological resources. Such disturbance of paleontological resources during construction of the Proposed Project could result in significant impacts.

The LACM recommended paleontological monitoring of all excavations within the project site with the potential to impact the Monterey Formation (McLeod 2020). MM GEO-4 in Section 4.7.3.5, Mitigation Measures, consists of preparation of a Paleontological Resources Impact Mitigation Program, which includes requirements for Worker Environmental Awareness Training and paleontological monitoring. With implementation of MM GEO-4, the Proposed Project's potential impacts on paleontological resources would be reduced to a less-than-significant level by ensuring proper treatment of paleontological resources exposed during project excavations.

4.7.3.4 Cumulative Impacts Analysis

This section provides an evaluation of cumulative geology and soils impacts associated with the Proposed Project and past, present, and reasonably foreseeable future projects, as identified in Table 4.1-1 in Section 4.1, Introduction to Analysis, and as relevant to this topic. The geographic area considered in the cumulative analysis for geology and soils is generally the vicinity of the project site. The geographic area of analysis for cumulative impacts to paleontological resources is the Laguna Watershed.

The Proposed Project would not contribute to cumulative impacts related to earthquake fault rupture (Significance Standard A-i) or septic tanks/alternative wastewater disposal (Significance Standard E) because it would have no impacts related to these standards as described above. Therefore, these significance standards are not further evaluated. Erosion-related cumulative impacts (Significance Standard B) are addressed in Section 4.10, Hydrology and Water Quality.

Impact GEO-5: Cumulative Geologic Hazards (Significance Standards A-ii, A-iii, A-iv, C, and D). The Proposed Project, in combination with past, present, and reasonably foreseeable future development, would not result in a significant cumulative impact related to geology and soils. ***(Less than Significant)***

Known cumulative projects planned within the vicinity of the project site include the Santa Cruz Water Rights Project (SCWRP), the Laguna Pipeline portion of the North Coast System Repair and Replacement Project, and the Reggiardo Diversion upgrade identified in the Anadromous Fisheries Habitat Conservation Plan. No construction or development within the Laguna Watershed is proposed as part of the SCWRP, and therefore this project would not contribute to cumulative construction impacts in the watershed. The Laguna Pipeline and the Reggiardo Diversion upgrade would be constructed after the Proposed Project is constructed and impacts associate with these projects are anticipated to be reduced to a less-than-significant level with standard mitigation measures similar to those identified in this EIR.

As indicated in Section 4.1, there are not any known substantive proposed or pending development projects in the project vicinity that would be under the jurisdiction of the County. However, if any such projects are proposed they would be subject to County approval; such projects that require discretionary approval are assumed to be designed or otherwise conditioned to avoid and minimize impacts to geology and soils. Furthermore, potential cumulative impacts on geological, seismic, and soil conditions would be reduced on a site-by-site basis by modern construction methods and compliance with California Building Code regulatory requirements that ensure building safety. Additionally, cumulative projects would be required to prepare and submit a site-specific geotechnical report for review and approval prior to the issuance of grading or building permits. As described in the analysis above, the Proposed Project would not result in construction (including grading/excavation) or design features which could directly or indirectly contribute to an increase in a cumulative geological hazard. The Proposed Project would not cumulatively alter geological conditions or features.

Therefore, the Proposed Project, in combination with the past, present, and reasonably foreseeable future projects in the project vicinity, would result in less-than-significant cumulative impacts related to geological hazards, and no further mitigation measures are required.

Impact GEO-6: Cumulative Paleontological Resources Impacts (Significance Standard F). The Proposed Project, in combination with past, present, and reasonably foreseeable future development, would not result in a significant cumulative impact related to paleontological resources. ***(Less than Significant)***

Known cumulative projects planned within the Laguna Watershed are described above. Potential cumulative impacts on paleontological resources could result from these or other projects that combine to create an environment where fossils, exposed on the surface, are vulnerable to destruction by earthmoving equipment, looting by the public, and natural causes such as weathering and erosion. The majority of impacts to paleontological resources are site-specific and are therefore generally mitigated on a project-by-project basis. Additionally, as needed, projects would incorporate individual mitigation for site-specific geological units present on each individual project site. Furthermore, the mitigation measure provided in this analysis are prescribed to preserve significant paleontological resources uncovered during project excavations by properly analyzing and salvaging by the on-site paleontological monitor. Therefore, the Proposed Project, in combination with the past, present, and reasonably foreseeable future projects in the project vicinity, would result in less-than-significant cumulative impacts to paleontological resources, and no further mitigation measures are required.

4.7.3.5 Mitigation Measures

Implementation of the following mitigation measure would reduce potentially significant geology and soil impacts of the Proposed Project related to paleontological resources, identified in Impact GEO-4 above, to a less-than-significant level.

MM GEO-4: Paleontological Resources Impact Mitigation Program and Paleontological Monitoring. Prior to commencement of any grading activity on site, the applicant shall retain a qualified paleontologist per the Society of Vertebrate Paleontology (SVP) (2010) guidelines. The paleontologist shall prepare a Paleontological Resources Impact Mitigation Program (PRIMP) for the Proposed Project. The PRIMP shall be consistent with the SVP (2010) guidelines and outline requirements for pre-construction meeting attendance and worker environmental awareness training, where paleontological monitoring is required within the project site based on construction plans and/or geotechnical reports, procedures for adequate paleontological monitoring and discoveries treatment, and paleontological methods (including sediment sampling for microinvertebrate and microvertebrate fossils), reporting, and collections management. The qualified paleontologist shall attend the pre-construction meeting and a qualified paleontological monitor shall be on site during all rough grading and other significant ground-disturbing activities (including augering) in previously undisturbed, Monterey Formation deposits, as defined by the PRIMP. In the event that paleontological resources (e.g., fossils) are unearthed during grading, the paleontological monitor will temporarily halt and/or divert grading activity to allow recovery of paleontological resources. The area of discovery will be roped off with a 50-foot radius buffer. Once documentation and collection of the find is completed, the monitor will allow grading to recommence in the area of the find.

4.7.4 References

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