4.5 GEOLOGY, SOILS AND PALEONTOLOGY

This section of the EIR presents an analysis of the potential geological, soils, and paleontological impacts associated with development and implementation of the proposed Master Plan, including five near-term development components (Project). This section presents the environmental setting, regulatory framework, impacts of the Project on the environment, and proposed measures to mitigate significant or potentially significant impacts.

Geologic and soils resources used to prepare this section include the CSUMB 2007 Master Plan EIR (Denise Duffy & Associates, Inc. [DDA] 2007) and its related technical resources; two geotechnical reports completed on-campus (GEOCON Consultants, Inc. 2012 and Pacific Crest Engineering, Inc. 2015); the U.S. Geological Survey (USGS) 7.5-minute Marina topographic quadrangle; geotechnical maps in Appendix A of the City of Marina General Plan; and published maps prepared by the California Geological Survey (CGS).

No public and agency comments related to geology, soils or paleontology were received during the public scoping periods in response to the original Notice of Preparation (NOP) or the Revision to Previously Issued NOP. For a complete list of public comments received during the public scoping periods, refer to Appendix B.

4.5.1 Environmental Setting

4.5.1.1 Study Area

The study area for the evaluation of impacts related to geology and soils includes the 1,396-acre CSUMB campus, located in the northwestern portion of the former Fort Ord military base.

4.5.1.2 Campus Setting

Topography and Stratigraphy

The CSUMB campus is located in the Coast Ranges geomorphic province, which generally consists of two core complexes: the Franciscan Formation and the Salinian Block. The Salinian Block, which underlies most of the Project region, consists of an elongated north-northwest-trending crustal block of granitic and metamorphic rock (CGS 2002). None of the bedrock units are known to be exposed with the campus (DDA 2007; Dibblee 1999).

The CSUMB campus is geomorphically characterized by bar and swale landforms of perennial, vegetation-stabilized dunes, which represent older (Pleistocene age) coastal dune sand. On the Main Campus, most of the original hummocky dune topography has been graded, resulting in relatively flat to gently sloping topography. Open space in the southern portion of the campus has retained some of the natural topography and localized moderately steep slopes, up to 30 feet, are present in the northern portion of the campus (GEOCON Consultants, Inc. 2012). The East Campus Housing area has been partially graded; however, much of the original dune topography remains, with relief up to 40 feet across the area. The East Campus Open Space Area has mostly retained its natural dune topography, with localized steep slopes and topographic relief up to 120 feet across the area.

The sand dunes range in thickness up to approximately 100 feet below the ground surface of the campus. Surface and subsurface soils are expected to be composed of fine to medium grained sand containing variable amounts of fines and gravel. The density of the sand is expected to vary significantly. Data compiled from geotechnical borings taken within the campus suggest that the upper 20 to 26 feet of this sand is typically medium to very dense. In some locations at the surface, the sand contains traces of clay (DDA 2007). Based on geotechnical borings drilled in association with construction of the Promontory student housing, in the northern portion of the campus, at the intersection of 8^{th} Street and Imjin Road, the dune sand deposits consist primarily of fine- to medium-grained sands with silt and silty sands, to a depth of 50 feet below ground. The sand deposits are primarily damp to moist, with relative densities ranging from loose to very dense and increasing in density with depth (GEOCON Consultants, Inc. 2012; Pacific Crest Engineering, Inc. 2015).

Surficial soils on the campus generally consist of Baywood sand in the northern portion and Oceano loamy sand in the southern portion. These soils occur on stabilized sand dunes, on 2 percent to 15 percent slopes; are somewhat excessively to excessively drained; have very low to low runoff; and are not prone to ponding or flooding (USDA NRCS 2019).

Soil erosion is the process by which soil particles are removed from a land surface by wind, water, or gravity. Most natural erosion occurs at slow rates; however, the rate of erosion increases when land is cleared of vegetation or structures or is otherwise altered and left in a disturbed condition. Erosion can occur as a result of, and can be accelerated by, site preparation activities (e.g., demolition, grading) associated with development. Vegetation removal in pervious landscaped areas can render the exposed soils more susceptible to erosive forces.

Sand deposits on the campus have a moderate to high potential for wind erosion (City of Marina 2010). Additionally, the soils underlying the campus have moderate limitations, which are defined as soil properties and site features that are unfavorable for most uses, but the limitations can be overcome or minimized by special planning, design, and engineering (City of Marina 2010).

Seismic Conditions

Seismically induced ground rupture occurs as the result of differential movement across a fault. An earthquake occurs when seismic stress builds to the point where rocks rupture. As the rocks rupture, one side of a fault block moves relative to the other side. The resulting shock wave is the earthquake. If the rupture plane reaches the ground surface, ground rupture occurs. The principal cause of damage from an earthquake is ground shaking. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and the distance from the epicenter. The entire campus is susceptible to damage from ground shaking in the event of an earthquake. Geological conditions can greatly influence the amount of shaking experienced.

The CSUMB campus is located in an area of potential moderate to significant seismically induced ground shaking (City of Marina 2010; GEOCON Consultants, Inc. 2012; Pacific Crest Engineering, Inc. 2015). The campus vicinity is seismically dominated by the presence of the active San Andreas Fault System. The campus is not traversed by a State-designated Alquist-Priolo Fault Zone, which delineate areas of potential surface fault rupture and regulate development within such zones. The closest Alquist-Priolo Fault Zone is associated with the San Andreas Fault Zone, located approximately 19 miles northeast of the campus (CGS 2010, 2015).

The CGS defines active faults as those that demonstrate evidence of activity within Holocene time (last 11,000 years). A potentially active fault shows evidence of movement during Pleistocene time (11,000 to 1.6 million years). Faults older than 1.6 million years are generally considered inactive. Active faults within 100 miles of the campus include those listed in Table 4.5-1.

Table 4.5-1
Regional Fault Summary

Fault Name	Approximate Distance to Site (miles)	Maximum Moment Magnitude (M_w)
Rinconada	3	7.3
Monterey Bay – Tularcitos/Navy	6	7.1
Cypress Point	10	6.2
Sur	13	6.7
Palo Colorado	14	7.0
Zayante-Vergeles	15	6.8
San Andreas (1906)	19	7.9
San Andreas (Pajaro)	19	6.8
San Andreas (Creeping)	20	6.5
San Andreas (Santa Cruz Mountains)	21	7.0
San Gregorio	22	7.3
Sargent	23	6.8
Calaveras (south of Calaveras Reservoir)	25	6.2

Source: CGS 2010; GEOCON Consultants, Inc. 2012; DDA 2007

The faults identified in Table 4.5-1 are sources of potential ground motion. However, earthquakes that might occur on numerous other faults within northern and central California area are also potential generators of significant ground motion and could subject the campus to intense ground shaking (GEOCON Consultants, Inc. 2012).

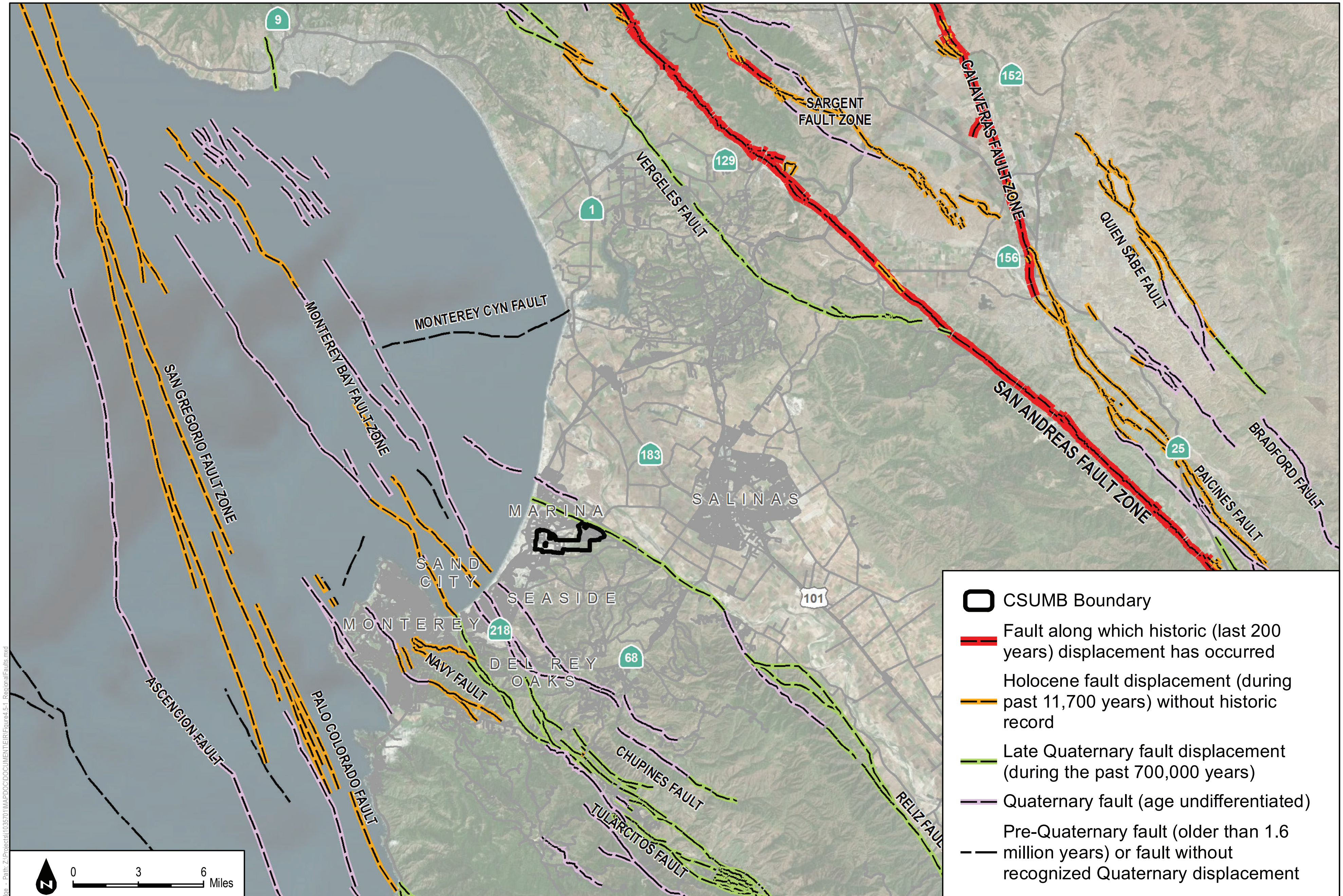
The vast majority of earthquake epicenters in the Project vicinity are concentrated along a linear trend that is roughly two to three miles wide and associated with the San Andreas fault. Earthquake fault zones are also observed in two general locations beneath Monterey Bay. One group is a linear zone that trends northwesterly along the San Gregorio fault zone and in central Monterey Bay. There is a small concentration of epicenters to the south where the Sur and Palo Colorado faults come ashore at the southern end of the San Gregorio fault zone, in the Big Sur area. Earthquakes also cluster between the Navy and the Cypress Point faults on the Monterey Bay Peninsula, as well as in the eastern Monterey Bay, east of the Monterey Bay fault zone and approximately 9 to 12 miles north of the campus (DDA 2007). See Figure 4.5-1 for a depiction of regional faults.

The potential for ground shaking was analyzed in a geotechnical report completed for the Promontory student apartments in the northern portion of the campus (GEOCON Consultants, Inc. 2012). The analysis estimated the peak ground acceleration (PGA) and modal (most probable) magnitude earthquake associated with a 475-year return period earthquake, which corresponds to an event with a 10 percent chance of exceedance in a 50-year period. The estimated PGA is 0.36g (percent of gravity) and the modal magnitude earthquake is 8.0. Figure A-3, *Seismic Shaking Hazards Within the City of Marina Planning Area*, of the City of Marina General Plan (City of Marina 2010), supports this conclusion of estimated PGA at the CSUMB campus.

While listing PGA is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including frequency and duration of motion and soil conditions underlying the campus. The campus could be subject to ground shaking in the event of an earthquake along the faults mentioned above or other area faults (GEOCON Consultants, Inc. 2012).

Liquefaction and Lateral Spreading

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary loss of shear strength due to pore pressure buildup under the cyclic shear stresses associated with intense earthquakes. Liquefaction induced lateral spreading occurs when a liquefied soil mass fails toward an open slope face or fails on an inclined topographic slope. Primary factors that trigger liquefaction include moderate to strong ground shaking (seismic source); relatively clean, loose granular soils (primarily poorly graded sands and silty sands); and saturated soil conditions (shallow groundwater). Due to the increasing overburden pressure with depth, liquefaction of granular soils is generally limited to the upper 50 feet of a soil profile.



SOURCE: Bing Maps 2018; CGS 2010

FIGURE 4.5-1

Regional Faults

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The CSUMB campus is located within the USGS 7.5-Minute Marina topographic quadrangle. This quadrangle has not been mapped by the CGS with respect to the potential for liquefaction. However, based on geotechnical investigations completed onsite, in-situ density of the dune sand deposits and lack of a static groundwater table within 50 feet of the existing ground surface, the potential for liquefaction and associated lateral spreading occurring on campus is considered to be low (GEOCON Consultants, Inc. 2012; Pacific Crest Engineering, Inc. 2015). Figure A-4, *Liquefaction and Lateral Spreading Potential Within the City of Marina Planning Area,* of the City of Marina General Plan (City of Marina 2010), supports this conclusion.

Unsaturated Seismic Soil Settlement

Strong seismic shaking can induce settlement of unsaturated, loose sandy soil through cyclic densification. Based on anticipated seismic accelerations at the campus, the loose to medium dense sands within the upper 15 to 20 feet below existing grade are susceptible to settlement during a seismic event. Such settlements would likely be one-quarter inch or less, which is considered minimal (GEOCON Consultants, Inc. 2012; Pacific Crest Engineering, Inc. 2015).

Landslides

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. The size of a landslide usually depends on the geology and the initial trigger event of the landslide. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Areas at risk from landslides include areas on or close to steep hills and steep road cuts or excavations, or areas where existing landslides have occurred. Landslides and debris flows can occur rapidly and without warning during periods of exceptionally high rainfall.

There are no known landslides on or near the site. Based on the relatively flat to gently sloping topography across the Main Campus (see Figure 4.5-2), the potential for slope instability is low. However, localized slopes, up to 30 feet in height, are present within the dune topography on campus, such as along the northern campus perimeter. Such localized slopes could potentially be prone to failure (GEOCON Consultants, Inc. 2012; Pacific Crest Engineering, Inc. 2015).

Expansive Soil

Expansive soils are composed largely of clays, which greatly increase in volume when saturated with water and shrink when dried. If expansive soils are present, changes in moisture content cause the clay soils to shrink or expand, which can damage building foundations and cause structural instability. The CSUMB campus is underlain by older dune sand, which does not contain clay-rich soils. Therefore, there is a low potential of soil expansion on the CSUMB campus (City of Marina 2010). A site-specific geotechnical investigation on campus by GEOCON Consultants, Inc. (2012) similarly determined the on-site soils to have a low expansion potential.

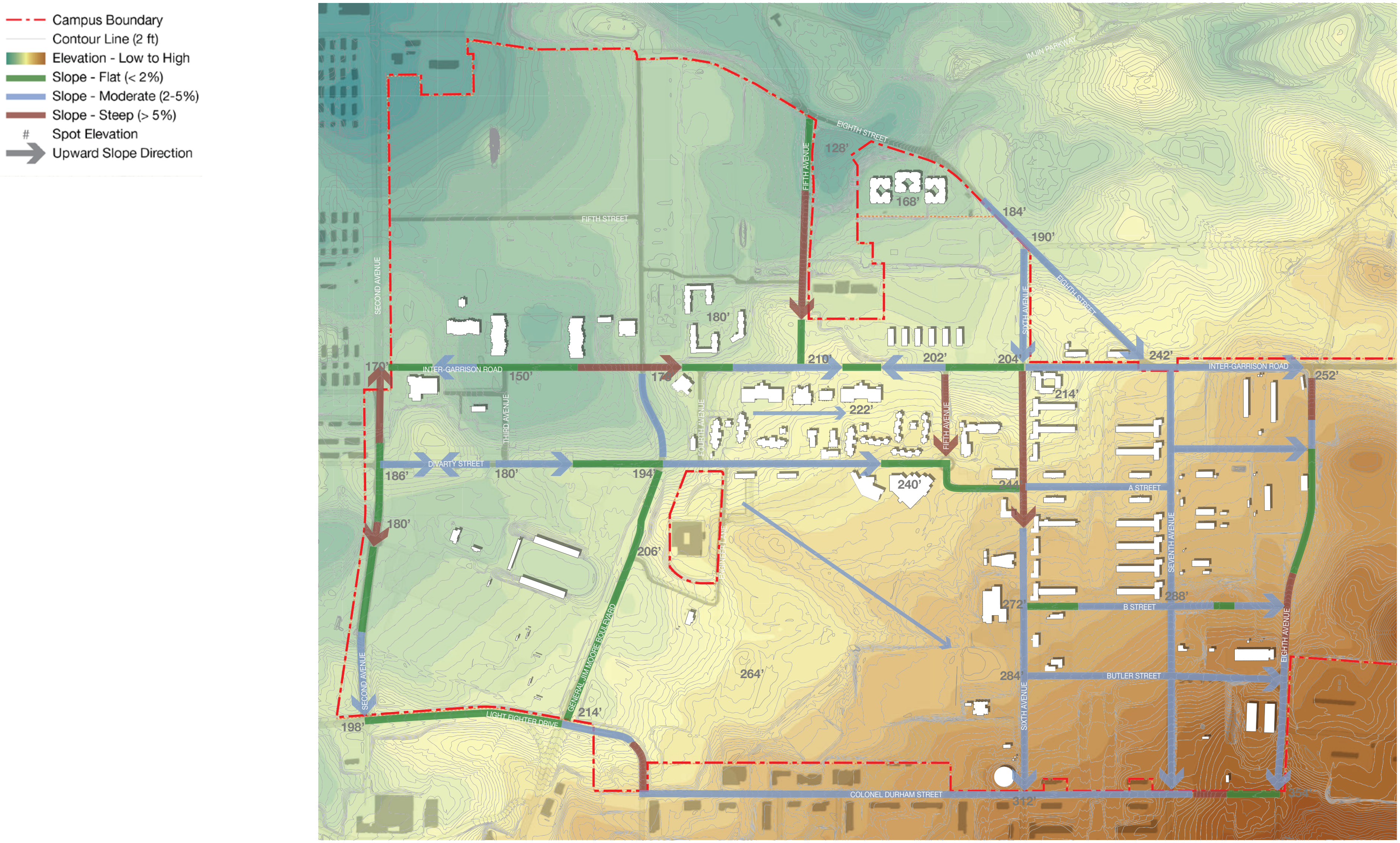
Paleontological Resources and Unique Geologic Features

As previously discussed, the CSUMB campus is geomorphically characterized by older coastal dune sand (map units Qos and Qar) and either Baywood sand (in the northern portion of the campus) or Oceano loamy sand (in the southern portion of the campus), based on surficial geological mapping of Dibblee (2007) at a scale of 1:24,000. Coastal older dune sand is generally Pleistocene age (~ 2.58 million years ago – 11,700 years ago) and is likely underlain by older Pleistocene alluvial deposits. On the Main Campus, most of the original hummocky dune topography has been graded, resulting in relatively flat to gently sloping topography. Open space in the southern portion of the campus has retained some of the natural topography; however, these older sand dunes are not considered unique geologic features in the area.

Many Monterey County fossils are the skeletons of micro-organisms (i.e., foraminifera or diatoms) or invertebrates found in sedimentary rocks ranging from Cretaceous (~145 – 66 million years ago) to Pleistocene age. However, no paleontological sites have been recorded on the CSUMB campus, nor in other older dune sand deposits in the County (Rosenberg 2001).

In addition to fossil invertebrates, fossil vertebrates have been recovered from unspecified late Pleistocene deposits in Monterey County. In his compilation of Pleistocene to Holocene fossils from California, Jefferson (1991) listed fossil specimens of horse (*Equus* sp.), bison (*Bison latifrons*), and camel (*Camelops* sp.) from Monterey County. More recently, an exceptional Columbian mammoth specimen (*Mammuthus columbi*) was reported in the news along with fossilized bison, horses, camels, and giant ground sloths (The Californian 2014). This fossil locality is situated approximately 8 miles north-northeast of the campus in the City of Castroville.

Older coastal dune sand has yielded significant paleontological resources in southern California; however, published Pleistocene fossil localities from Monterey County do not specify whether they were recovered from coastal dune sand or alluvial deposits. Because age-equivalent coastal dune sand has yielded significant paleontological resources outside of Monterey County and is likely underlain by Pleistocene alluvium with high paleontological sensitivity, coastal dune sand has high paleontological sensitivity per the Society of Vertebrate Paleontology (SVP) guidelines for paleontological mitigation (SVP 2010).



SOURCE: CSUMB 2017

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FIGURE 4.5-2

Existing Elevation and Slopes

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4.5.1.3 Site Conditions for Near-Term Development Components

The existing geologic and soils setting for the near-term development component sites is generally described above. All of the sites are located on older (i.e., Pleistocene) coastal dune sand and either Baywood sand (in the northern portion of the campus) or Oceano loamy sand (in the southern portion of the campus) with high paleontological sensitivity. The soil characteristics are generally the same throughout the campus. Additional information is provided below related to specific conditions on each site, including existing development conditions, slope, and landscaping. Chapter 3, Project Description provides additional information about the location of each development component site.

Student Housing Phase III

The approximately 6.4-acre Student Housing Phase III site and potential staging area are flat to gently sloping and mostly paved with an existing surface parking lot and an unused paved area. Vegetation and paved pathways border the component site on the west and south.

Academic IV

The approximately 4.0-acre Academic IV site gently slopes down to the northeast and is mostly paved or developed. Vegetation and paved pathways border the development site on all sides. The two potential staging areas are located on flat sites; the staging area on the west is paved and the staging area on the east is mostly unpaved.

Student Recreation Center Phases I and II

The approximately 8.5-acre Student Recreation Center site slopes gently down to a sharper drop to the north at Divarty Street and is partially paved or developed. Vegetation and paved pathways border the development site on the north and west sides of the site. The parking lot and potential staging area along the south of the site slopes gently down to the north and is mostly unpaved and vegetated.

Student Housing Phase IIB

The approximately 7.2-acre Student Housing Phase III site and potential staging area are relatively flat and mostly paved. Vegetation borders a portion of the entire site on the north, west and south.

Academic V

The approximately 2.7-acre Academic V site is relatively flat and partially paved or developed. Vegetation and paved pathways border the development site on all sides. Construction staging for this development would use the same potential staging area as that identified for the Student Recreation Center.

4.5.2 Regulatory Framework

This section describes the applicable regulatory plans, policies, and ordinances related to geology and soils for the Project.

4.5.2.1 Federal

There are no federal regulations directly applicable to geology, soils, and paleontology at the campus. Nonetheless, installation of underground infrastructure/utility lines must comply with national industry standards specific to the type of utility (e.g., National Clay Pipe Institute for sewers, American Water Works Association for water lines), and the discharge of contaminants and sediments must be controlled through the National Pollutant Discharge Elimination System (NPDES) permitting program for management of construction and municipal stormwater runoff. As indicated in Section 4.8, Hydrology and Water Quality, CSUMB has a waiver from the requirements of the Municipal Stormwater Program (Central Coast RWQCB 2017b), but complies with the NPDES construction requirements, where relevant, as individual development projects are implemented. These requirements contain construction specifications that reflect site-specific geologic and soils conditions.

4.5.2.2 State

The primary state regulations protecting the public from geologic and seismic hazards are contained in the Seismic Hazards Mapping Act, the California Building Code, and the State Earthquake Protection Law. The California State University (CSU) Office of the Chancellor has established additional state requirements. Each is described below.

Alquist-Priolo Earthquake Fault Zoning Act of 1972

In response to the 1971 San Fernando Earthquake, which damaged numerous homes, commercial buildings, and other structures, California passed the Alquist-Priolo Earthquake Fault Zoning Act (Cal. Pub. Resources Code § 2621-2630 *et seq*.). The goal of the act is to avoid or reduce damage to structures, like that caused by the San Fernando Earthquake, by preventing the construction of buildings on active faults.

In accordance with the law, the CGS maps active faults and the surrounding earthquake fault zones for all affected areas. Any project that involves the construction of buildings or structures for human occupancy, such as residential housing, is subject to review under this law. The intent of the act is to ensure public safety by prohibiting the siting of most structures for human occupancy across traces of active faults that constitute a hazard to structures from surface faulting or fault creep. Structures for human occupancy must be constructed at least 50 feet from any active fault.

Locations of Earthquake Fault Zone boundaries are controlled by the position of fault traces shown on the Official Maps of Earthquake Fault Zones. Zone boundaries have been drawn approximately 500 feet away from major active faults and about 200 to 300 feet away from well-defined, minor faults, to accommodate imprecise locations of the faults and possible existence of active branches.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (Cal. Pub. Resources § 2690-2699.6 *et seq*.), passed by the California 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. To date, the CGS has only created liquefaction hazard maps for USGS quadrangle maps in the greater Los Angeles and San Francisco Bay areas (CGS 2007).

California Building Code

The state regulations protecting structures from geo-seismic hazards are contained in the California Building Code (Cal. Code Regs. tit. 24, part 2) (the California Building Code), which is updated on a triennial basis. 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 2016 California Building Code, effective January 1, 2017, is based on the current (2015) 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.

Chapter 16 and 16A of the 2016 California Building Code include structural design requirements governing seismically resistant construction, including (but not limited to) factors and coefficients used to establish seismic site class and seismic occupancy category for the soil/rock at the building location and the proposed building design. Chapters 18 and 18A include (but are not limited to) the requirements for foundation and soil investigations (Sections 1803 and 1803A); excavation, grading, and fill (Sections 1804 and 1804A); damp-proofing and water-proofing (Sections 1805 and 1805A); allowable load bearing values of soils (Sections 1806 and 1806A); the design of foundation walls, retaining walls, embedded posts and poles (Sections 1807 and 1807A), and foundations (Sections 1808 and 1808A); and design of shallow foundations (Sections 1809 and 1809A) and deep foundations (Sections 1810 and 1810A). Chapter 33 of the 2016 California Building Code includes (but is not limited to) requirements for safeguards at work sites to ensure stable excavations and cut or fill slopes (Section 3304).

Construction activities are subject to occupational safety standards for excavation and trenching, as specified in the California Safety and Health Administration regulations (Cal. Code Regs. tit. 8) and in Chapter 33 of the California Building Code. These regulations specify the measures to be used for excavation and trench work where workers could be exposed to unstable soil conditions. The Project would be required to employ these safety measures during excavation and trenching.

As indicated above, the California Building Code is updated and revised every 3 years. The 2019 version of the California Building Code will be effective January 1, 2020. It is anticipated that future development on the campus would use the most current California Building Code at the time of specific Project building activity. The CSU is responsible for enforcement of the California Building Code. The Chief of Architecture and Engineering in Capital Planning, Design, and Construction (CPDC) at the Office of the Chancellor, is the Building Official for the CSU. By delegation, one person at each campus is a Campus Deputy Building Official for that campus and its other administrative locations. This person is responsible for enforcing the requirements of the California Building Code for all construction at the campus. An assigned CSU Peer Reviewer provides the technical review of the seismic aspects of projects, as indicated in the CSU Seismic Requirements below (CSU 2018).

State Earthquake Protection Law

The State Earthquake Protection Law (Cal. Health and Safety Code § 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 campus is not located within an Alquist-Priolo Earthquake Fault Zone, as noted above, no special provisions would be required for Project development related to fault rupture.

California Environmental Quality Act

Paleontological resources are limited, nonrenewable resources of scientific, cultural, and educational value and are afforded protection under state (CEQA) laws and regulations. This study satisfies project requirements in accordance with CEQA (Cal. Pub. Resources Code § 2100 et seq.; § 5097.5). This analysis also complies with guidelines and significance criteria specified by the 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 significant 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 (Cal. Pub. Resources Code § 15064.5 [a][3][D]). Paleontological resources would fall within this category. The removal of paleontological resources from state lands, defines unauthorized removal of fossil resources as a misdemeanor, and requires mitigation of disturbed sites (Cal. Pub. Resources Code §§ 5097.5 and 30244).

CSU Seismic Requirements

The CSU Seismic Requirements (CSU 2018), prepared by the CSU Office of the Chancellor, include specific requirements for the construction of new buildings and the rehabilitation of existing buildings to ensure that all CSU buildings provide an acceptable level of earthquake safety, per the California Building Code. The policy adopted by the CSU Board of Trustees in 1993 supplements the requirements of the California Building Code and is provided below.

> *It is the policy of the Trustees of the California State University that to the maximum extent feasible by present earthquake engineering practice to acquire, build, maintain, and rehabilitate buildings and other facilities that provide an acceptable level of earthquake safety for students, employees, and the public who occupy these buildings and other facilities at all locations where University operations and activities occur. The standard for new construction is that it meets the life safety and damageability objectives of Title 24 provisions; the standard for existing construction is that it provides reasonable life safety protection, consistent with that for typical new buildings. The California State University shall cause to be performed independent technical peer reviews of the seismic aspects of all construction projects from their design initiation, including both new construction and remodeling, for conformance to good seismic resistant practices consistent with this policy. The feasibility of all construction projects shall include seismic safety implications and shall be determined by weighing the practicality and cost of protective measures against the severity and probability of injury resulting from seismic occurrences.*

The CSU Seismic Requirements describe the CSU framework used to implement the Board of Trustees’ Seismic Policy. All new construction is required to meet the life, safety, and damage objectives of Title 24 of the California Building Code, while the standard for rehabilitating existing structures is that reasonable life safety protection is provided, consistent with that for typical new structures.

Geotechnical investigations are required by the CSU Seismic Requirements to assess and classify a building site’s soils. Any geotechnical investigation conducted for future developments shall include consideration of all seismically induced site failure hazards, including liquefaction, differential settlement, lateral spreading, landsliding, and surface faulting. As the CSU has determined campus-specific seismic design ground motion parameters to be used for new and modification of existing buildings that supersede those given in the California Building Code, geotechnical investigations do not require additional site exposure work for determining seismic design requirements. These seismic design ground motion parameters are used by the geotechnical engineer during project design.

Independent technical peer reviews shall be conducted concerning the seismic aspects of all construction projects from their design initiation, including both new construction and remodeling, for conformance with good seismic-resistant practice consistent with this policy. The CSU Seismic Review Board is charged with implementing the independent peer review requirements and advises CSU on structural engineering issues for specific projects.

4.5.3 Impacts and Mitigation Measures

This section presents the evaluation of potential environmental impacts associated with the Project related to geology, soils and paleontology. The section includes the thresholds of significance used in evaluating the impacts, the methods used in conducting the analysis, and the evaluation of Project impacts and the Project's contribution to significant cumulative impacts. In the event significant impacts within the meaning of CEQA are identified, appropriate mitigation measures, where feasible, are identified.

4.5.3.1 Thresholds of Significance

The significance thresholds used to evaluate the impacts of the Project related to geology, soils and paleontology are based on Appendix G of the CEQA Guidelines. Based on Appendix G, a significant impact related to geology, soils and paleontology would occur if the 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; or

    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 I the Table 18-1-B of the Uniform Building Code (1994), 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 wastewater.

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

4.5.3.2 Analytical Method

Program- and Project-Level Review

The geological, soils and paleontological impact analysis in this section includes a program-level analysis under CEQA of the proposed Master Plan and project design features (PDFs), as described in Chapter 3 Project Description. The analysis also includes a project-level analysis under CEQA of the 5 near-term development components that would be implemented under the Master Plan. Both construction and operation of the Project are considered in the impact analysis, where relevant. The impact analysis assumes that Project development, including 5 near-term developments, would be constructed in compliance with the most current provisions of the California Building Code, as well as the CSU Seismic Requirements, as described in Section 4.7.2, Regulatory Framework. In addition, buildings implemented as part of the Project would undergo an independent technical peer review regarding seismic design, in accordance with CSU Seismic Requirements (CSU 2016). In the event significant adverse environmental impacts would occur with the implementation of the Project even with incorporation of applicable regulations and proposed PDFs, mitigation measures would be identified to reduce impacts to less than significant, where feasible.

Project Design Features

The proposed PDF relevant to this topic is PDF-OS-3, which identifies Construction Best Management Practices to avoid or minimize erosion and sedimentation, where possible. During demolition and construction of new buildings, CSUMB would implement this PDF to avoid or minimize erosion and sedimentation on all development sites, regardless of site acreage.

4.5.3.3 Issues Not Evaluated Further

The Project would not have impacts with respect to the following thresholds of significance and therefore these topics are not further evaluated:

- Earthquake Fault Rupture (Threshold A-i). As described in Section 4.5.1, Environmental Setting, no active faults, including Alquist-Priolo Fault Zones, traverse the campus. Therefore, surface fault rupture is not anticipated at the campus and the Project would have no impacts related to fault rupture.

- Expansive Soils (Threshold D). As described in Section 4.5.1, Environmental Setting, the campus is not underlain by expansive soils. Therefore, the Project would have no impacts related to expansive soils.

- Septic Tanks/Alternative Wastewater Disposal (Threshold E). The Project would be served by sewers rather than septic tanks or alternative wastewater disposal systems. Therefore, the Project would have no impacts related to the capability of soils to support alternative wastewater disposal systems.

4.5.3.4 Project Impacts and Mitigation Measures

This section provides a detailed evaluation of geological, soils and paleontological impacts associated with the Project.

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

Master Plan

The proposed Master Plan would result in construction of approximately 3.0 million gross square feet (GSF) of new academic and support facilities, including housing, administration, student life, recreational, and institutional partnership buildings (see Chapter 3, Project Description, Table 3-4 and Figures 3-5 and 3-6). As indicated in Section 4.5.1, Environmental Setting, the campus is located in an area that is seismically active with numerous known active faults traversing the region, including the Rinconada, Monterey Bay-Tularcitos/Navy, Palo Colorado, Zayante-Vergeles, Cypress Point, Sur, and San Andreas faults. However, earthquakes that might occur on numerous other faults within northern and central California area are also potential generators of significant ground motion and could subject the campus to intense ground shaking. Based on prior geotechnical analyses on the campus, the estimated PGA for the campus is 0.36g (percent of gravity) and the modal magnitude earthquake is 8.0k. Based on these analyses, it is reasonable to assume that the site will experience significant seismic shaking episodically during the lifetime of the project (Pacific Crest Engineering, Inc. 2015).

In the event of a major earthquake, ground shaking is a main cause of structural damage. The strength of ground shaking depends on the magnitude of the earthquake, type of fault, and distance from the epicenter. Although onsite soils are not prone to liquefaction, the entire campus would be susceptible to damage from ground shaking in the event of an earthquake, including seismically-induced settlement. However, all proposed buildings and infrastructure would be constructed and/or renovated to meet the California Building Code and CSU Seismic Requirements and would provide an acceptable level of earthquake safety for students, employees, and the public who occupy these building and facilities.

Geotechnical investigations would be required by the CSU Seismic Requirements to assess and classify each proposed building site's soils. Any geotechnical investigation conducted for future developments shall include consideration of all seismically induced site failure hazards, including liquefaction, differential settlement, lateral spreading, landsliding, and surface faulting. As the CSU has determined campus-specific seismic design ground motion parameters to be used for new buildings and the modification of existing buildings which supersede those given in the California Building Code, geotechnical investigations for individual development projects under the proposed Master Plan do not require additional site exposure work for determining seismic design requirements.

All new buildings would also be subject to review and plan approval by CSU building officials, prior to and during construction, to ensure that all new buildings and building renovations provide an acceptable level of earthquake safety, per the California Building Code (CSU 2004). In addition, an independent technical peer review regarding seismic design is required for major capital projects and all minor capital projects are required to be seismically assessed per the CSU Seismic Requirements.

Compliance with the California Building Code and the CSU Seismic Requirements, including preparation and implementation of a geotechnical investigations, would help to offset potential risks to structures and people associated with a major earthquake event. In addition, the Project would not exacerbate the potential for seismic activity to occur and therefore would not directly or indirectly cause potential adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking and seismic-related ground failure. Therefore, the seismic-related impacts of the proposed Master Plan would be *less than significant*.

Near-Term Development Components

All near-term development components would be required to comply with the California Building Code and CSU Seismic Requirements, including the preparation and implementation of a geotechnical investigation, which would help to offset potential risks to these structures and their residents associated with a major earthquake event. In addition, the components would not exacerbate the potential for seismic activity to occur and therefore would not directly or indirectly cause potential adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking and seismic-related ground failure. Therefore, seismic-related impacts of the near-term development components would be *less than significant*.

Mitigation Measures

Mitigation measures are not required because a significant impact has not been identified.

Impact GEO-2:	**Landslides (Threshold A-iv).** The Project would not directly or indirectly cause potential adverse effects, including the risk of loss, injury, or death involving landslides. *(Less than Significant)*

Master Plan

As indicated in Section 4.5.1, Environmental Setting, there are no known landslides on or near the site. Based on the relatively flat to gently sloping topography across most of the Main Campus (see Figure 4.5-2), the potential for slope instability is low. Localized moderately steep slopes, up to 30 feet in height, are present in the northern portion of the campus, such as adjacent to the existing Promontory student housing at 8th Street and Imjin Road. A slope stability analysis completed by GEOCON Consultants, Inc. (2012) indicated that this adjacent slope is stable with respect to deep-seated instability in both static and pseudostatic (seismic) conditions. No proposed development under the Master Plan would occur adjacent to this slope. In addition, proposed construction across the campus would not occur on or adjacent to steep slopes such as this.

The topography in all areas of proposed construction is relatively flat to gently sloping, and locally undulating due to the dune topography. The proposed Master Plan would reduce the potential for landslide impacts by focusing new construction to areas of existing development and generally maintaining the natural state of the East Campus Open Space, such that natural slopes potentially prone to failure would not be disturbed. The East Campus Open Space is the area of campus with the highest topographic relief due to the undulating dune topography in this area. While approximately 50 acres of this area is designated as a staff faculty housing reserve, the Project does not propose development in the East Campus Open Space at this time. Proposed trails in this area would not alter the topography such that slope instability would occur.

In addition, as previously discussed, the Project is required to comply with the California Building Code, which outlines specific design, engineering, and development standards for structures proposed in areas with unstable soils. Additionally, all new buildings would be subject to review and plan approval by CSU building officials, prior to and during construction (CSU 2004). Compliance with the current California Building Code would ensure that all structures are designed and built to current standards to minimize impacts associated with ground failure, including landslides. The relatively flat to gently sloping nature of most of the campus would reduce the risk of landslide hazards. In addition, the Project would not exacerbate the potential for landslides to occur and therefore would not directly or indirectly cause potential adverse effects, including the risk of loss, injury, or death involving landslides. Therefore, the landslide-related impacts of the proposed Master Plan would be *less than significant*.

Near-Term Development Components

All near-term development component sites are flat to gently sloping and no slope stability hazards have been identified on these sites. Compliance with the current California Building Code would ensure that these new buildings are designed and built to current standards to minimize impacts associated with ground failure, including landslides. As these components would not cause landslides, they would not directly or indirectly cause potential adverse effects, including the risk of loss, injury, or death involving landslides. Therefore, the landslide-related impacts of the near-term development components would be *less than significant*.

Mitigation Measures

Mitigation measures are not required because a significant impact has not been identified.

Impact GEO-3:	**Soil Erosion (Threshold B).** Project-related grading and construction would potentially result in soil erosion. *(Less than Significant)*

Master Plan

As indicated in Section 4.5.1, Environmental Setting, the campus is underlain by older dune sand, consisting primarily of fine- to medium-grained sands with silt and silty sands. Demolition and construction activities associated with the Project, including vegetation removal, excavations, and grading, would temporarily expose underlying soils, thereby increasing the potential to cause wind- and water-induced soil erosion. The effects of erosion are intensified with an increase in slope (as water moves faster, it gains momentum to carry more debris) and the narrowing of runoff channels (which increases the velocity of water).

As the Project proposes new construction primarily in already developed areas, as shown in Chapter 3, Project Description (Figures 3-5 and 3-6), and avoids areas with steep slopes, erosion would be minimized. During demolition and construction of new buildings, CSUMB would implement Construction Best Management Practices as part of PDF-OS-3 to avoid or minimize erosion and sedimentation on all development sites, regardless of site acreage. Additionally, CSUMB would be required to implement erosion control measures stipulated in a SWPPP, pursuant to project specific NPDES discharge requirements for construction on sites greater than 1 acre, as discussed in Section 4.8, Hydrology and Water Quality. Implementation of a SWPPP on constructions sites greater than 1 acre would avoid or minimize erosion and sedimentation by including and specifying BMPs designed to reduce and capture soil erosion. Upon completion of Project construction, structures, roadways, artificial turf, and landscaping or revegetated areas would eventually cover any soils exposed during construction, thus minimizing the potential for wind erosion and water-induced erosion. Therefore, the erosion-related impacts of the proposed Master Plan would be *less than significant*.

Near-Term Development Components

The flat to gently sloping nature of the near-term development component sites would reduce the potential for erosion. During demolition and construction of these developments, CSUMB would implement Construction Best Management Practices as part of PDF-OS-3 to avoid or minimize erosion and sedimentation on all development sites, regardless of site acreage. Additionally, CSUMB would be required to implement erosion control measures stipulated in a SWPPP, given that the near-term development component sites are greater than 1 acre. Upon completion of construction, structures, roadways, artificial turf, and landscaping or revegetated areas would eventually cover any soils exposed during construction, thus minimizing the potential for wind erosion and water-induced erosion. Therefore, the erosion-related impacts of the near-term development components would be *less than significant*.

Mitigation Measures

Mitigation measures are not required because a significant impact has not been identified.

Impact GEO-4:	**Unstable Geologic Units or Soils (Threshold C).** New Project construction would be located on dune sand, which could become unstable as a result of the Project and potentially result in collapse. *(Less than Significant)*

Master Plan

As indicated in Section 4.5.1, Environmental Setting, dune sands underlying the campus have moderate limitations, which are defined as soil properties and site features that are unfavorable for most uses, but the limitations can be overcome or minimized by special planning, design and engineering. The dune sands generally consist of fine- to medium-grained sands that would be prone to collapse as a result of excavations during grading and construction. Collapse of excavation walls not only create problems for construction but can be dangerous to onsite workers.

However, as previously discussed, proposed Master Plan implementation would be required to comply with the California Building Code, which outlines specific design, engineering, and development standards for structures proposed in areas with unstable soils. Compliance with the current regulations would ensure that all structures are designed and built to current standards to minimize impacts associated with ground failure, including soil collapse. CSUMB's designated building inspectors would review Project plans to ensure compliance with Chapter 33 of the California Building Code, which includes (but is not limited to) requirements for safeguards at work sites to ensure stable excavations and cut or fill slopes (Section 3304). Construction activities are also subject to occupational safety standards for excavation and trenching, as specified in the California Safety and Health Administration regulations (Cal. Code Regs. tit. 8). These regulations specify the measures to be used for excavation and trench work where workers could be exposed to unstable soil conditions. Additionally, all temporary excavations would be completed in accordance with the Occupational Safety and Health Administration, with respect to protection of worker safety. Temporary shoring would be utilized to prevent caving of collapsible soils. Therefore, the soil collapse-related impacts of the proposed Master Plan would be *less than significant*.

Near-Term Development Components

The near-term development components would be required to comply with the California Building Code, the California Safety and Health Administration and the Occupational Safety and Health Administration requirements for construction of structures proposed in areas with unstable soils, due to cut or fill slopes or other conditions. Additionally, temporary shoring would be utilized to prevent caving of collapsible soils. Therefore, the soil collapse-related impacts of the near-term development components would be *less than significant*.

Mitigation Measures

Mitigation measures are not required because a significant impact has not been identified.

Impact GEO-5:	**Paleontological Resources (Threshold F).** Project construction could directly or indirectly destroy a unique paleontological resource or site. *(Potentially Significant)*

Master Plan

As indicated in Section 4.5.1, Environmental Setting, the campus is underlain by older dune sands that are Pleistocene age. Pleistocene fossils have been recovered from several localities in Monterey County; however, it is not known if they were recovered from older dune sands or other Pleistocene geological units. Consequently, the older dune sands are considered to have high paleontological sensitivity per the SVP (2010) guidelines. Proposed Master Plan implementation has the potential to affect unique paleontological resources to the extent that excavations extend into native dune sands and directly or indirectly destroy unique paleontological resources. While the proposed Master Plan proposes development in already developed areas that are likely underlain by variable amounts of artificial fill, Project construction and associated excavations have the potential to extend into native dune sands and therefore impacts on unique paleontological resources could be *potentially significant*.

Near-Term Development Components

All of the near-term development component sites are partially disturbed with buildings and/or pavement and likely contain varying amounts of artificial fill. However, these sites are underlain by older dune sands that are Pleistocene age and are considered to have high paleontological sensitivity per the SVP (2010) guidelines. If excavations for near-term development components extend below disturbed soils or artificial fill into native undisturbed older dune sands, impacts on unique paleontological resources could be *potentially significant*.

Mitigation Measures

MM-GEO-1 Monitoring, Discovery, and Treatment of Paleontological Resources. Prior to the commencement of any grading activity, CSUMB shall retain a qualified paleontologist, as defined by the Society of Vertebrate Paleontology, to determine when, where, and the duration of paleontological monitoring that is warranted. The qualified paleontologist shall make these determinations based on construction plans, geotechnical reports if available, and subsurface geological observations that indicate the likely depth to undisturbed native sands that possess high paleontological sensitivity. The level of monitoring may range from full-time, part-time (spot-check), or unnecessary based on the qualified paleontologist's review of plans and relevant documentation as well as observations. Monitoring shall not be required under any conditions if excavations for proposed development do not extend into undisturbed native sands that possess high paleontological sensitivity. If it is determined that paleontological monitoring is required, qualified paleontologist shall attend any preconstruction meetings and manage the paleontological monitor(s) if he or she is not doing the monitoring.

For monitoring that is required in a given work area, the paleontological monitor shall be equipped with necessary tools for the collection of fossils and associated geological and paleontological data. The monitor shall complete daily logs detailing the day's excavation activities and pertinent geological and paleontological data. In the event that paleontological resources (e.g., fossils) are unearthed during grading, the paleontological monitor shall temporarily halt and/or divert grading activity to allow recovery of paleontological resources. The area of discovery shall be roped off with a 50-foot radius buffer. Once documentation and collection of the find is completed, which in most circumstances, is less than a day, the monitor shall remove the rope and allow grading to recommence in the area of the find. If it will require more than one (1) day to document and/or salvage the find, the qualified paleontologist shall work with CSUMB to determine an appropriate treatment plan to ensure the protection of fossil resources while not impeding development.

Following the paleontological monitoring program, a final monitoring report shall be submitted to CSUMB for approval. The report should summarize the monitoring program and include geological observations and be accompanied by any paleontological resources recovered during paleontological monitoring for the development. The qualified paleontologist shall be responsible for ensuring that all fossils associated with the paleontological monitoring program are permanently curated with an accredited institution that maintains paleontological collections.

Significance After Mitigation

Implementation of MM-GEO-1 would avoid directly or indirectly destroying a unique paleontological resource by using a qualified paleontologist to determine the need for and extent of paleontological monitoring during construction based on site conditions, construction plans, geotechnical reports and subsurface geological observations; and protecting, recovering and documenting any paleontological find that may be discovered during construction. With the implementation of this mitigation measure, the potentially significant impact on unique paleontological resources would be reduced to *less than significant*.

4.5.3.5 Cumulative Impacts

This section provides an evaluation of geologic and soils impacts associated with the Project, including near-term development components, when considered together with other reasonably foreseeable cumulative development, as identified in Table 4.0-1 in Section 4.0, Introduction to Analysis, and as relevant to this topic. The geographic area considered in the cumulative analysis for this topic is described in the impact analysis below.

Impact GEO-6:	**Cumulative Geology, Soils and Paleontological Impacts (Thresholds A-ii, A-iii, A-iv, B, C and F).** The Project would not result in a cumulatively considerable contribution to significant cumulative impacts related to seismic-related ground shaking and/or failure, landslides, soil erosion, unstable soils and/or paleontological resources, with the implementation of mitigation. *(Less than Significant)*

The geographic area for the analysis of cumulative impacts resulting from seismic-related ground shaking and/or failure, landslides, soil erosion, and/or unstable soils impacts is generally site-specific. Impacts related to geologic and seismic hazards depend on the specific conditions and features on the particular project site and its immediate vicinity, such as soil composition and slope. Thus, these site-specific impacts would not combine with one another to create cumulative impacts, unless the project sites overlapped or were immediately adjacent to one another. Therefore, the geographic area considered for potential cumulative seismic-related ground shaking and/or failure, landslides, soil erosion, and/or unstable soils impacts consists of the CSUMB campus and areas immediately adjacent to the campus.

Based on review of Table 4.0-1 and Figure 4.0-1, the Project building sites would not physically overlap with other cumulative development sites located on the campus or adjacent the campus to the south and west. The cumulative projects that would be constructed on the campus include the already approved Monterey Bay Charter School and Freeman Stadium Renovation Project, and the possible development on the campus's Second Avenue site. The cumulative projects that are proposed to be constructed near the campus include the Campus Town Specific Plan to the south of the campus along Colonel Durham Street, the Dunes on Monterey Bay, to the north and west of campus, the Projects at Main Gate Specific Plan, to the southwest and the Concourse Auto Dealership, further to the southwest of the campus along Second Avenue.

The effects of the Project and other cumulative development would not result in significant cumulative impacts related to seismic-related ground shaking and/or failure, landslides, soil erosion, or unstable soils. Such impacts would be similar to what is described for the Project under Impacts GEO-1 through GEO-4 and would be addressed on a project-by-project basis through compliance with the California Building Code, NPDES general construction permit discharge requirements, California Safety and Health Administration regulations, Occupational Safety and Health Administration regulations, CSU Seismic Requirements for CSUMB development projects, and local agency code requirements for local development projects. Compliance with these requirements would: (1) offset potential risks to structures and people associated with a major earthquake event; (2) ensure that all structures are designed and built to current standards to minimize impacts associated with ground failure and landslides; (3) avoid or minimize erosion and sedimentation; and (4) prevent caving of collapsible soils and associated risks to construction workers. Additionally, the Project and other cumulative development would not themselves exacerbate the potential for seismic activity to occur and therefore would not directly or indirectly cause potential adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking and seismic-related ground failure. Given the above, cumulative impacts related to seismic-related ground shaking and/or failure, landslides, soil erosion, and unstable soils would be *less than significant*.

Implementation of the Project has the potential to affect paleontological resources to the extent that excavations extend into native dune sands, which have high paleontological sensitivity, and directly or indirectly destroy unique paleontological resources. As indicated in Impact GEO-5, the potentially significant Project impact on paleontological resources would be reduced to less than significant with the implementation of MM-GEO-1. MM-GEO-1 would reduce the impact by using a qualified paleontologist to determine the need for and extent of paleontological monitoring during construction based on site conditions, construction plans, geotechnical reports, and subsurface geological observations. It also provides for protection, recovery, and documentation of any paleontological find that may be discovered during construction.

CSUMB would require the implementation of adopted mitigation measures for the approved Monterey Bay Charter School and Freeman Stadium Renovation Project, as demonstrated by the CEQA documents prepared for these projects (DDA 2016 and 2021), and would require similar mitigation for the possible development on campus's Second Avenue site. Off-campus cumulative projects should also be required to assess impacts to paleontological resources as part of the discretionary approval process and should incorporate individual mitigation for site-specific geological units present on each individual project site. However, it is possible that these cumulative projects could have a significant cumulative impact if individual projects are not properly mitigated. With the implementation of MM-GEO-1, the Project would not have a considerable contribution to the significant cumulative impact. As such, the cumulative impact of the Project on paleontological resources would be *less than significant*.

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