4.6 Geology and Soils

This section describes the existing geological conditions of the project site and vicinity, identifies associated regulatory requirements, evaluates potential impacts, and identifies mitigation measures related to implementation of the proposed San Diego State University (SDSU) Mission Valley Campus Master Plan Project (proposed project).

Methods for Analysis

Information contained in this section is based on project site plans, geotechnical engineering reports prepared for the proposed project, the paleontological resources report prepared for the proposed project, and publicly available maps, data, and reports from the U.S. Geological Survey (USGS), U.S. Department of Agriculture, and the California Geological Survey. Geotechnical investigation reports were prepared for the overall project site development and the Stadium development. Copies of the geotechnical reports prepared for the proposed project are included as Appendix 4.6-1, Report of Geotechnical Investigation - Site Development, Appendix 4.6-2, Report of Geotechnical Investigation - Stadium Development and Appendix 4.6-3, Paleontological Resources Inventory Report for the San Diego State University Mission Valley Campus Master Plan Project.

Summary of Notice of Preparation Comments

A Notice of Preparation (NOP) was circulated from January 19, 2019, to February 19, 2019. A total of 150 letters were received during this comment period. Comments on the NOP related to geology and soils focused on the impacts of the proposed project on potential chemicals in the soil; project components below existing grade; and inconsistencies with cut and fill estimations. These public comments/concerns are addressed in the analysis within this section. Please see Appendix 1-1, Notice of Preparation Scoping Comments, for a complete compilation of comments received on the NOP.

4.6.1 Existing Conditions

Regional Physiography and Geology

The largest part of San Diego County consists of the interior upland (Peninsular Range) province, which is bordered on the west by the coastal plain and on the east by the Salton Basin. The province stretches from the Los Angeles basin southward to the tip of Baja California and is characterized by a series of northwest-trending mountain ranges separated by subparallel fault zones. The province is composed of ranges of steep-sloped hills and mountains separated by intermediate valleys that are generally of small extent. Most of the slopes that are underlain by granitic rocks are boulder covered, and some mountains and ranges underlain by these rocks are ledge-like. Terrain underlain by metamorphic rocks is subdued in the moist, coastal areas, but more resistant in the drier, inland areas. Metavolcanic rocks along the coast compose resistant hills and mountains (Weber 1963).

The project site is located within the Peninsular Ranges geomorphic province. The project site is located within the coastal plain transected by the west-flowing San Diego River drainage known as Mission Valley and is underlain at depth by Eocene-age sedimentary deposits mapped as the Friars Formation at elevations below approximately 160 feet. Regionally, the Friars Formation dips gently to the southwest between 3 and 5 degrees (Appendix 4.6-1). The Friars Formation consists of six intertonguing, depositionally time-equivalent facies ranging from deep marine, fine-grained siltstone and claystone to the southwest and continental, coarse-grained sandstone and conglomerate to the northeast. The Friars Formation are non-marine and near-shore deposits of lagoonal sandstone, siltstone, and claystone. The elevation of the top of Friars Formation ranges from 25 feet in the northwest portion of the overall site to less than 0 feet in the central portion of the overall site (including the existing San Diego County Credit Union [SDCCU] Stadium footprint).

Site Setting

The project site includes the existing SDCCU Stadium, parking lot, Metropolitan Transit System Trolley Green Line Stadium Station, and ancillary facilities. There are also several detached small buildings and improvements at the southwest corner of the project site (City of San Diego 2015). As stated in Section 2.1.3, Project Location, the project site is located in the northeast portion of the Mission Valley community, which is located in the central portion of the City of San Diego (City) metropolitan area (Figure 2-1, Concept Design – Site Plan; Figure 2-2, Regional Vicinity Map). The project site is surrounded by major freeways, roadways, existing urban development, and the San Diego River. The San Diego River, which flows east to west, is located south of the project site.

Topography

Topography in San Diego includes Mission Bay on the west, foothills towards the eastern parts of the City, and mountains/canyons in the easternmost portions of the City. Urban areas within the City are generally relatively flat, developed either in valleys or on mesa tops. Some residential areas are located in the foothills. Minimal development occurs within steep mountains and canyons; the majority of these are designated as preservation areas.

Topography of the project site generally slopes from east to west and from north to south with the perimeter around the Stadium structure elevated to create adequate drainage away from the Stadium structure. Existing elevations range from approximately 96 feet above mean sea level in the northwestern corner to approximately 48 feet above mean sea level in the southwestern corner of the project site.

Soils

Based on the National Resource Conservation Services online mapping tool, the project site consists of Made Land (Surficial Soils - Undifferentiated) and a small portion of River Wash on the southern boundary of the project site (Figure 4.6-1, Geologic Map). These soils consist of thick deposits of poorly consolidated, mostly granular alluvium associated with the San Diego River and Murphy Canyon Creek drainages, local deposits of slopewash and colluvium, and relatively shallow fill soils. Made Land soils are not classified as having a hydrologic group due to the varying composition of fill used (NRCS 2019).

Geotechnical explorations of the project site (one specifically for the Stadium and one for the remaining portion of the site development) were completed by Group Delta Consultants Inc. (Appendix 4.6-1 and Appendix 4.6-2). Geotechnical borings of the project site consisted of 16 exploratory borings and three infiltration tests, as well as 17 exploratory borings and five Cone Penetration Tests for the Stadium site. Soils found on the site include surface gravel/fill, middle sand/fine-grained soils, and basal gravel.

Surface gravel and fill deposits on the project site are likely due to deposition from river drainages (historically), as well as fill material from the current development of the site's Stadium and parking. Fill material from nearby areas is up to 35 feet thick in localized areas around the Stadium, to raise grades above the floodplain. These soils observed during the site investigations were found to consist of sand, silty and clayey sand, silty to clayey gravel, and gravel and cobbles.

Middle sand and fine-grained soils were observed in the site investigations and were found to consist of poorly to well-graded sand, silty and clayey sand, silty to clayey gravel, and gravel and cobbles. These soils were found throughout the project site.

Basal gravel located on the project site consists of San Diego River alluvium deposited unconformably on the erosional contact with the Friars Formation. The Basal Gravel appears to be located within the old San Diego River paleo-channels that formed from sea level changes and regional uplift over the past several hundred thousand years. These soils were encountered in borings that consisted of mostly sandy-course gravel and large boulders (up to 2 feet in diameter) throughout the site.

Minerals

Mineral resources are discussed in detail within Section 4.11, Mineral Resources, of this environmental impact report.

Paleontological Resources

Paleontological resources are those remains of prehistoric organisms preserved as fossils in geologic deposits. Paleontological resources are nonrenewable resources that contribute to our knowledge of extinct and extant organisms and their past environments.

A records search from the San Diego Museum of Natural History was performed. Literature searches were conducted to determine whether any previously recorded fossil localities occur within the project site, as well as to research the paleontological potential, stratigraphy, and general geology of the formation in the project site based on previous research. No paleontological survey was conducted due to the development of the project site and lack of native ground or soil exposures to examine. The geologic units from maps of the area were analyzed for their potential paleontological sensitivity based on existing literature and known localities. See Appendix 4.6-3 for additional information.

The project site is largely covered in artificial fill materials which have been emplaced or heavily disturbed by human activities. Fill consisting primarily of Stadium Conglomerate (clayey sand and gravel) and some of the underlying Friars Formation (likely clay, silt, and sand) sourced from cutting into the hills to the north of the project site was placed across the property in 1966 as part of the original site grading. While fill thicknesses are estimated to be as high as 50 feet (more in localized areas) around the perimeter of the existing SDCCU Stadium, cuts and fills appear to have been minor in the area of the proposed new Stadium, at approximately 5 feet or less. Cuts up to 35 feet were excavated in the northwestern quadrant of the project site and, while some fill was likely placed and compacted, fill depths are not known. Due to the fully developed nature of the project site, it is likely that additional artificial fill that has not been mapped covers portions of the site. Artificial fill has no paleontological resource sensitivity.

Geologic Hazards and/or Soil Constraints

Slope Failures and/or Mudflows and Landslides

Slope failures, mudflows, and landslides are common in areas where steep hillsides and embankments are present and have a high potential to slough during earthquakes and/or excessive rain events where the soils become saturated and dislodged and slide downhill.

Expansive and/or Compressible Soils

Expansion and contraction of soil volume can occur when expansive soils undergo alternating cycles of wetting and drying. Wetting causes soils to expand or swell, while drying periods cause soils to compress or shrink. During these types of cycles, the volume of soil can change significantly. Structural damage to buildings and infrastructure could occur if the potentially expansive soils were not anticipated in project design and development. A total of 22 expansion index tests were conducted on soils from approximately 5 feet below existing surface levels across the project site to determine expansion potential. The results are discussed in Section 4.6.4, Impacts Analysis, below.

Corrosive Soils

Corrosivity is a function of the chemical composition of the soils, and the materials from which it is derived. If not addressed by design measures and proper selection of building materials, corrosive soils could cause substantial damage to building foundations, pavements, utilities, and/or other improvements. Corrosion tests were performed at seven locations from cut and borrow areas for the Stadium (Appendix 4.6-2), and 13 locations from cut and borrow areas for the other development on the project site (Appendix 4.6-1). Soils were tested for water-soluble sulfate content.

Test results suggest that the on-site soils have a negligible potential for sulfate attack based on accepted criteria. The pH, resistivity, and chloride content of the soils were estimated to assess the reactivity of the site soils with buried metals. As reported in Appendix C of both Appendix 4.6-1 and Appendix 4.6-2, on-site soils were found to be moderately corrosive to very corrosive to future buried metals.

Soil Settlement and/or Collapse

Soil settlement or differential settlement could occur if buildings or other improvements were built on low-strength foundation materials (including imported fill) or if improvements straddle the boundary between different types of subsurface materials (e.g., a boundary between native material and fill). Although differential settlement generally occurs slowly enough that its effects are not dangerous to site inhabitants, it can cause significant building damage over time. Settlement or collapse has the potential to occur if buildings or other improvements were built on materials which are not suited for foundations of structures. Collapsible soils generally consist of loose, dry, low-density materials that collapse and compact under the addition of water or excessive loading. These soils are distributed throughout the southwestern United States, specifically in areas of young alluvial fans, debris flow sediments, and loess (wind-blown sediment) deposits.

Land Subsidence

Subsidence is primarily associated with groundwater extraction, where large amounts of groundwater are pumped out of a location and water does not replenish the area quickly enough, which causes a void in the earth above the groundwater aquifer and wells to collapse and sink. Other effects of subsidence include changes in the gradients of stormwater and sanitary sewer drainage systems in which the flow is gravity-driven. As stated in Appendix 4.6-1 and Appendix 4.6-2, the City is assessing the feasibility of developing the Mission Valley groundwater basin as a source of sustainable water. The City is considering developing three groundwater wells south and southwest of the proposed Stadium site. The project does not propose to pump groundwater or divert water from the San Diego River. It is noted that, due to the existing use as a largely impervious parking lot, the project site currently does not allow for groundwater infiltration. The project would reduce the amount of impervious surface due to the conversion of portions of the project site into landscape parks and recreation and open space areas as proposed by the project.

Seismic Hazards

Regional Seismicity and Faults

Geologic faults in the region of the project site are the result of plate boundary interactions between the lithospheric Pacific and North American plates. Geologic data on the plate boundary is recorded by the USGS. The San Andreas, San Jacinto, and Imperial fault zones are some of the most active in the region, all of which are located in the Imperial Valley and are the major causes for movement between the plates. Northwest-striking faults to the west, including the Elsinore and Newport-Inglewood-Rose Canton faults cause a significantly smaller portion of movement in the region. Offshore faults which also cause significantly smaller amounts of motion in the region include the Coronado Bank, San Diego Trough, and San Clemente fault zones.

Active faults are faults that have had evidence of movement within the last 11,000 years (Holocene). Active faults have the greatest risk of fault rupture hazards as well as being the potential sources of ground shaking. Older faults which have not have movement within the last 11,000 years are less likely to cause ground shaking due to the nature of older faults being stationary. Active faults are mapped by the State of California within Alquist-Priolo Special Studies Zones, or Earthquake Fault Zones. Any development within an Earthquake Fault Zone is required to have building setbacks from the trace (the intersection of a fault with the ground surface) of an active fault to reduce the risk of damage in the event of significant ground shaking. The nearest active fault is the Rose Canyon Fault as part of the Newport-Inglewood-Rose Canyon fault zone. The project site is not located within an Earthquake Fault Zone.

The major active faults in the region are listed in Table 4.6-1 below and depicted in Figure 4.6-2, Fault Map.

Table 4.6-1. Nearby Faults

Fault	Approximate Distance From Project Site (miles)1	Length (miles)
Newport-Inglewood-Rose Canyon Fault Zone	4	7.2
San Miguel-Vallecintos Fault Zone	35	6.9
Elsinore Fault Zone	35	7.0
San Jacinto Fault Zone	58	6.8
Southern San Andreas Fault Zone	85	7.2
Offshore		
Coronado Bank Fault Zone	15	7.6
San Diego Trough Fault Zone	25	7.5
San Clemente Fault Zone	50	7.7

Source: USGS 2019.
Note:
1 Distances are rounded down to the nearest whole number.

Ground Shaking and Historic Earthquakes

Due to nearby and distant/larger magnitude earthquakes, the project site could be subject to ground shaking and surface rupture. Through structural design of the buildings and ancillary components of the proposed project, ground shaking hazards would be minimized. These design features would adhere to the requirements for new developments put in place by the California Building Code (CBC). The CBC requires certain design features for specific soil types. For soil types that are uncommon or have the potential to be unique, geotechnical surveys and evaluations are required to ensure that proposed developments would be constructed to minimize risks.

Earthquakes are measured on a scale of magnitude and class of magnitude (see Table 4.6-2). The majority of earthquakes which occur each year are minor and do not cause significant damage to structures or buildings.

Table 4.6-2. Earthquake Magnitude and Class

Magnitude	Class	Physical Effects	Occurrences each year (approximately and can vary)
2.5 or less	Minor	Usually not felt, but can be recorded by seismographs	900,000
2.5 to 5.4	Light	Often felt, but only minor damages	30,000
5.5 to 6.0	Moderate	Slight damages to structures	500
6.1 to 6.9	Strong	Potential for significant damages	100
7.0 to 7.9	Major	Major earthquake event, significant damages to structures and life	20
8.0 or greater	Great	Total destruction of structures near epicenter and high potential for loss of life	One every 5 to 10 years

Source: UPSeis 2017.

In recent history, San Diego has experienced several thousand minor earthquakes, and a handful of moderate to major earthquakes. Below is a brief list of moderate (5.5) to great (8.0+) earthquakes which have occurred in San Diego (or been felt from nearby epicenters).

Table 4.6-3. Earthquakes Near San Diego, California

Magnitude	Date	Epicenter Location
From 2010 to Present		
5.5	March 28, 2016	San Felipe, Baja California, Mexico
6.3	December 14, 2012	Avalon, California
5.5	August 26, 2012	Brawley, California
7.2	April 4, 2012	Guadalupe Victoria, Baja California, Mexico
5.5	July 7, 2010	Borrego Springs, California
5.8	June 15, 2010	Seeley, California
From 2000–2010		
5.9	December 30, 2009	23 miles south of Calexico, California
7.2	June 14, 2005	90 miles off the Coast of Northern California (tsunami warning for Southern California)
5.6	June 12, 2005	Near Anza, California
Prior to 2000		
6.6	January 17, 1994	Northridge, California
7.3	June 28, 1992	Landers, California
6.2	November 23, 1987	Westmoreland, California
5.9	October 1, 1987	Pasadena, California
6.0	July 8, 1986	Palm Springs, California
6.6	February 9, 1971	San Fernando, California

Table 4.6-3. Earthquakes Near San Diego, California

Magnitude	Date	Epicenter Location
6.8	February 9, 1956	Ensenada, California
7.1	May 18, 1940	Imperial Valley, California
7.1	December 31, 1934	Colorado River delta
6.4	March 10, 1933	Southern California
6.3	June 22, 1915	Imperial Valley, California
5.75	October 23, 1894	San Diego, California
6.0	May 27, 1862	San Diego, California
6.9	December 8, 1812	Southern California
6.5	November 22, 1800	Oceanside, California (Rose Canyon Fault)

Sources: San Diego Tribune 2010; Earthquake Track 2019.

Liquefaction and Lateral Spreading

Liquefaction is where loose, saturated, coarse-grained soils lose their strength and acquire mobility from strong ground motion induced by earthquakes or other seismic movements. The secondary effects of liquefaction include settlement, reduced soil shear strength, lateral spreading, and global instability. Seismic settlement can occur in dry sands as well. The City has developed hazard maps intended for planning purposes.

Tsunami and Seiche

A tsunami is a sea wave generated by a submarine earthquake, landslide, or volcanic action. The project site is outside of the tsunami inundation line area and is not mapped by the California Department of Conservation to be in a tsunami inundation area (DOC 2019). A seiche is an earthquake-induced wave in a confined body of water, such as a lake, reservoir, or bay. However, no portion of the project site lies near a confined body of water on which a seiche could be expected to occur.

4.6.2 Relevant Plans, Policies, and Ordinances

Federal

Occupational Safety and Health Administration Regulations

Excavation and trenching are among the most hazardous construction activities. OSHA's Excavation and Trenching standard, Title 29 of the Code of Federal Regulations, Part 1926.650, covers requirements for excavation and trenching operations. OSHA requires that all excavations in which employees could potentially be exposed to cave-ins be protected by sloping or benching the sides of the excavation, supporting the sides of the excavation, or placing a shield between the side of the excavation and the work area.

State

The statewide minimum public safety standard for mitigation of earthquake hazards (as established through the CBC, Alquist–Priolo Earthquake Fault Zoning Act, and the Seismic Hazards Mapping Act) is that the minimum level of mitigation for a project should reduce the risk of ground failure during an earthquake to a level that does not cause the collapse of buildings for human occupancy; in most cases, preventing or avoiding the ground failure itself is not required. It is not feasible to design all structures to completely avoid damage in worst-case earthquake scenarios. Accordingly, regulatory agencies have generally defined an "acceptable level" of risk as that which provides reasonable protection of the public safety, although it does not necessarily ensure continued structural integrity and functionality of a project (14 CCR 3721(a)). Nothing in these acts, however, precludes lead agencies from enacting more stringent requirements, requiring a higher level of performance, or applying these requirements to developments other than those that meet the acts' definitions of "project."

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code, Division 2, Chapter 7.5) was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The purpose of this act is to prohibit the location of most structures for human occupancy across the traces of active faults and thereby mitigate the hazard of fault rupture. In accordance with this act, the state geologist established regulatory zones, called Earthquake Fault Zones, around the surface traces of active faults and has published maps showing these zones. Earthquake Fault Zones are designated by the California Geological Survey and are delineated along traces of faults where mapping demonstrates surface fault rupture has occurred within the past 11,000 years. Construction within these zones cannot be permitted until a geologic investigation has been conducted to prove that a building planned for human occupancy will not be constructed across an active fault. These types of site evaluations address the precise location and recency of rupture along traces of the faults and are typically based on observations made in trenches excavated across fault traces.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 (California Public Resources Code, Chapter 7.8, Sections 2690–2699.6) directs the California Department of Conservation to protect the public from earthquake-induced liquefaction and landslide hazards (note that these hazards are distinct from the fault surface rupture hazard regulated by the Alquist-Priolo Earthquake Fault Zoning Act of 1972). This act requires the state geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones (i.e., zones of required investigation). Before a development permit may be granted for a site within a seismic hazard zone, a geotechnical investigation of the site must be conducted and appropriate mitigation measures incorporated into the proposed project design. Evaluation and mitigation of potential risks from seismic hazards within zones of required investigation must be conducted in accordance with the California Geological Survey, Special Publication 117A, adopted March 13, 1997, by the State Mining and Geology Board, as updated in 2008 (CGS 2008).

To date, Seismic Hazard Zone Maps have been prepared for portions of Southern California and the San Francisco Bay Area; however, no seismic hazard zones have yet been delineated for the project area (i.e., the Saint Helena USGS 7.5-minute quadrangle). As a result, the provisions of the Seismic Hazards Mapping Act would not apply to the proposed project.

California Building Code

The CBC has been codified in the California Code of Regulations as Title 24, Part 2. Title 24 is administered by the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 to be enforceable. The purpose of the CBC is to establish minimum standards to safeguard the public health, safety, and general welfare through structural strength, means of egress facilities, and general stability by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction.

The 2016 edition of the CBC is based on the 2015 International Building Code published by the International Code Conference. The 2016 CBC contains California amendments based on the American Society of Civil Engineers Minimum Design Standards 7-16, which provides requirements for general structural design and includes means for determining earthquake loads as well as other loads (such as wind loads) for inclusion into building codes. The provisions of the CBC apply to the construction, alteration, movement, replacement, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout California.

The CBC uses data on frequency of earthquakes, as well as locations of fault zones, in order to set forth requirements for new developments to be prepared for earthquake events. The earthquake design requirements also take into account the occupancy category of the structure, site class, soil classifications, and various other seismic coefficients, which are used to determine a Seismic Design Category (SDC) for a project. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site, and ranges from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are then determined according to the SDC.

Paleontological Resources

Paleontological resources are limited, nonrenewable resources of scientific, cultural, and educational value and are afforded protection under state laws and regulations, namely California Public Resources Code Section 21000 et seq. and California Public Resources Code, Section 5097.5. Paleontological resources are explicitly afforded protection by the California Environmental Quality Act (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]" (14 CCR 15000 et seq.). This provision covers scientifically significant fossils—remains of species or genera new to science, for example, or fossils exhibiting features not previously recognized for a given animal group—and 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 or history (14 CCR 15064.5 (a)(3)(D)). Paleontological resources would fall within this category. The California Public Resources Code, Chapter 1.7, Sections 5097.5 and 30244, also regulates removal of paleontological resources from state lands, defines unauthorized removal of fossil resources as a misdemeanor, and requires mitigation of disturbed sites.

The Board of Trustees of the California State University (CSU) is the CEQA lead agency for the proposed project. CEQA Guidelines require a determination as to whether a proposed project would directly or indirectly destroy a unique paleontological resource or site. If a project would destroy a unique paleontological resource or site, a paleontological assessment and mitigation and monitoring plan should be designed and implemented.

Local

Because SDSU is a component of the CSU, which is a state agency, the proposed project is not subject to local government planning and land use plans, policies, or regulations. However, for informational purposes, the proposed project has considered these planning documents and the project's site location within, and relationship to, each. The proposed project would be subject to state and federal agency planning documents described above, but would not be subject to regional or local planning documents such as the City's General Plan, Mission Valley Community Plan, or City municipal zoning code.

San Diego Municipal Code

The San Diego Municipal Code (SDMC) and the CBC require the preparation of a geotechnical investigation report in accordance with the criteria in SDMC 145.1801 and 145.1803 for projects within the City (City of San Diego 2018). The City uses the San Diego Seismic Safety Study to evaluate the relative hazard of the site. Geotechnical reports for projects must include hazards identified in the Seismic Safety Study maps as well as the Alquist-Priolo Earthquake Fault Zoning Act of 1972.

4.6.3 Significance Criteria

The significance criteria used to evaluate the project impacts to geology and soils are based on Appendix G of the CEQA Guidelines. According to Appendix G of the CEQA Guidelines, a significant impact related to geology and soils would occur if the project would:

1. Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:
   a. 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.
   b. Strong seismic ground shaking.
   c. Seismic-related ground failure, including liquefaction.
   d. Landslides.
2. Result in substantial soil erosion or the loss of topsoil.
3. 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.
4. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property.
5. 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.
6. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Methodology

Impacts with respect to geology, soils, and seismicity are assessed by comparing conditions expected under the proposed project to the existing environmental setting. The analysis evaluates if the proposed project would directly or indirectly place people, structures, or the general public at increased exposure to health and/or safety risks associated with soil, geologic, or seismic hazards.

Criteria Not Applicable to the Proposed Project

Septic Tanks

The proposed project does not include the use of septic tanks or alternative wastewater disposal systems as the proposed project would connect to the existing Municipal Separate Storm Sewer System (MS4) of the City. Therefore, there would be **no impact** and this issue is not further discussed.

4.6.4 Impacts Analysis

Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:

a. ***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 based on other substantial evidence of as known fault.***

Construction

The proposed project is not within an Alquist–Priolo Earthquake Fault Zone and, therefore, is not subject to the requirements of the Alquist-Priolo Earthquake Fault Zoning Act. Further, the project site is not located on an active or potentially active fault. The nearest active fault is the Rose Canyon Fault located approximately 4 miles west of the project site. The project site is not located within an Earthquake Fault Zone or in an area mapped by the City as a fault hazard zone.

The proposed project would demolish the existing SDCCU Stadium and surrounding affiliated infrastructures and build an SDSU Mission Valley campus, including approximately 1.6 million square feet of facilities for educational, research, and office uses; a new, 35,000-capacity multipurpose Stadium in a different quadrant of the project site; campus residential and hotel facilities; and approximately 86 acres of parks, recreation, and open space, including a San Diego River Park as contemplated by SDMC 22.0908. Construction would potentially involve the use of explosives to implode and demolish the existing SDCCU Stadium as well as its foundation.

While not anticipated at this time, due to the presence of the existing SDCCU Stadium structure and the project construction schedule, implosion of the existing SDCCU Stadium or portions thereof may be determined to be the most efficient and preferred method for demolition to implement the proposed project. At the current stage of the proposed project design, a blasting study has not been completed, and no specific blasting timelines or blast parameters are available. Implosion may be initiated in one coordinated event. Implosion in one event would reduce the length of time neighboring areas would be subject to the noise, ground vibrations, and other inconvenience from a lengthy conventional demolition approach. Implosion methods use highly specialized explosives to undermine the supports of a structure so it collapses either within its own footprint or in a predetermined path. Project-specific demolition methods and explosives would be determined based on a demolition plan by a demolition consultant/company. The demolition plan would include enforcement of a human safety standoff distance of a minimum of 1,000 feet, as directed by the demolition consultant/company, during the implosion.

The anticipated construction schedule is a total of approximately 17 years beginning in 2020 and ending in approximately 2037. Demolition is anticipated be completed within the first phase of construction, and implosion of the existing SDCCU Stadium would last less than 1 day. During the remaining years, construction activities would not include explosions or blasting activities, and would not have the potential to rupture nearby active faults. The project site is not located over an active fault, and project demolition and construction would not cause rupture of a fault. Therefore, impacts associated with fault rupture during construction of the proposed project would be **less than significant.**

Operation

The proposed project would include the development of the campus components, including residential, innovation, research and development, hospitality, and commercial land uses. During operation of the proposed project, the project and the vicinity could experience moderate to severe ground shaking from earthquakes. The proposed project is not located on an active fault and would not include any activities that could rupture an active nearby fault. The proposed project would be designed to adhere to all requirements of the CBC. Based on the absence of fault rupture hazard and the planned compliance with the CBC requirements for seismic design, the impacts of fault rupture would be reduced to an acceptable level of risk. Therefore, impacts associated with fault rupture during operation of the proposed project would be **less than significant**.

b. Strong seismic ground shaking?

Construction

As stated above, during demolition activities of the existing SDCCU Stadium, the use of explosives to implode and demolish the existing SDCCU Stadium as well as its foundation is not anticipated; however, implosion of the existing Stadium or portions thereof may be determined to be the most efficient or preferred method for demolition to implement the proposed project. These activities would not last more than a few moments of implosion and could have the potential to cause significant ground shaking on and in the immediate vicinity of the project site. A demolition plan would be developed and would include enforcement of a human safety standoff distance during the implosion, as directed by a demolition consultant/company. The project site is not located over an active fault and project demolition and construction would not cause rupture of a fault. Therefore, impacts associated with strong seismic ground shaking would be **less than significant.**

Operation

As stated above, the project site is located in a region that is seismically active. Historically, major earthquake events have caused significant damages to structures and buildings in the region, with several earthquakes being in or near enough to the City to be felt. Ground shaking from seismic activity is inevitable in the region of the project site. During operation of the proposed project, the project and the vicinity have the potential to experience moderate to severe ground shaking from earthquakes. The operation of the proposed project would not include any activities that would cause strong ground shaking. The proposed project would be designed to adhere to all applicable requirements of the CBC. Based on the CBC requirements for seismic design, the impacts from strong seismic ground shaking would be reduced to an acceptable level of risk for patrons and residents. Therefore, impacts associated with strong seismic ground shaking during operation of the proposed project would be **less than significant.**

c. Seismic-related ground failure, including liquefaction?

Construction

The project site is mapped on the Geologic Hazards and Faults map as an area of High Potential for liquefaction due to shallow groundwater, major drainages, and hydraulic fills (Zone 31) (City of San Diego 2008). As described in Appendix 4.6-1 and Appendix 4.6-2, soil testing of the project site determined that the project site has potentially liquefiable soils and that secondary effects could include sand boils, settlement, and instabilities with sloping ground. Liquefaction potential is considered widespread throughout the Surficial Soils - Undifferentiated below the groundwater table.

Construction would involve cut and fill levels that would have potential for groundwater influence. As shown in Table 4.6-4, distance to groundwater was determined to be less than 50 feet from the finished subgrade elevation. Analysis determined that groundwater may influence deep construction activities due to working near or below the groundwater level depending on the location within the project site, requiring dewatering.

Table 4.6-4. Depth to Groundwater

Development Area	Finished Subgrade Elevation, Feet	Measured Elevation of Groundwater, Feet	Distance between Finished Subgrade and Groundwater Level, Feet
New Stadium Levels			
Field Level	56 (cut)	37 to 49	7 to 19
Service Level- Loading Dock (Partially Below Grade)	56 (cut)	37 to 49	7 to 19
Service Level- Locker Room (Partially-Below Grade)	60 (cut)	37 to 49	11 to 23
Main Concourse	87 (fill)	37 to 49	38 to 50
Development Area			
Campus Office, Research and Innovation Area(with Garage Parking)	55 (cut)	43 to 45	15 to 17
Campus Office, Research and Innovation Area (with Garage Parking)	75 (cut)	45 to 48	27 to 30
Hotel and Conference Center	85 (fill)	43 to 49	36 to 42
Residential – North (R1 to R9)	70 (cut)	44 to 49	23 to 26
Residential – South (R10 to R15)	65 (cut)	44 to 52	13 to 21

Sources: Appendix 4.6-1 and Appendix 4.6-2.

Dewatering best management practices, such as dewatering tanks or weir tanks that will hold the excavated groundwater, may be used during the construction phase to reduce the potential for liquefaction. All dewatering would be conducted in compliance with the California National Pollutant Discharge Elimination System Construction Stormwater General Permit (Order No. 2009-009-DWQ, as amended by Order 2010-0014-DWQ and 2012-006-DWQ) and the San Diego Regional Water Board's General Waste Discharge Requirements for Groundwater Extraction Discharges to Surface Waters within the San Diego Region (Order No. R9-2015-0013, National Pollutant Discharge Elimination System No. CAG919003).

Post-construction, no dewatering discharges are to be expected, as the finished subgrades will be designed to be above the groundwater table. If needed, permanent dewatering discharges will be managed to prevent impacts to the San Diego River and groundwater supplies by recharging the dewatering back to groundwater at a suitable location on the project site. As noted above, due to the existing use as a largely impervious parking lot, the project site currently does not allow for groundwater infiltration. The project would reduce the amount of impervious surface due to the conversion of portions of the project site into landscape parks and recreation and open space areas as proposed by the project.

As analyzed in Appendix 4.6-1 and Appendix 4.6-2, liquefaction is widespread throughout the project site and there are significant variations in the estimated liquefaction-induced settlement on the project site. Consequently, differential settlement is likely to exceed thresholds that would allow for shallow foundations. As stated in Appendix 4.6-1 and Appendix 4.6-2, soil settlement and collapse are a consideration at the project site due to the thickness of non-liquefiable soils at the surface and the placement of fill materials on the project site. Through a liquefaction analysis in Appendix 4.6-1 and Appendix 4.6-2, settlement was also evaluated in each development area. Table 4.6-5 shows estimated total dynamic settlement within each proposed development area on the project site.

Table 4.6-5. Estimated Dynamic Settlement

Exploration Identification	Location on Project Site	Thickness of Liquefiable Soils (feet)	Total Settlement (inches)
B-14	Campus Office, Research and Innovation Area	25	2.5
B-15		27	3.5
B-16		47	9.0
B-17		36	5.0
B-27	Campus Office, Research and Innovation Area	48	5.0
S-8		54	9.5
S-13		50	10
B-20	Residential – North	31	4.0
B-21		27	6.0
B-23		32	4.5
B-24		42	3.0
B-26	Residential – South	41	5.0
B-27		48	5.0
B-28		41	2.0
B-30		46	3.0
B-31	Hotel	45	7.0
S-1		24	5.5

Source: Appendix 4.6-1.

There is also potential for strength loss within the saturated fine-grained layers within the alluvium and settlement of dry sands above the groundwater table. These hazards could result in excessive settlement that could damage a structure supported at grade. Such impacts would be **potentially significant** (**Impact GEO-1**).

To minimize the potential for liquefaction and secondary effects that could cause distress to the proposed project, the proposed Stadium would either be supported on deep foundations extending to the underlying dense soil or formational material, or on shallow or deep foundations supported by soil that has been densified/stiffened using ground improvement techniques such as stone columns, deep dynamic compaction, deep soil mixing, or other such techniques as determined appropriate for each building. Ground improvement, if used, would be limited to within about 10 feet of the structure. Liquefiable soils and seismic-related ground failure could potentially impact the proposed project's construction.

Operation

During operation of the proposed project, the project site could experience seismic ground shaking as stated earlier, which also could result in the underlying soils experiencing liquefaction. As shown in Figure 4.6-3, Seismic Safety Map, the site is within Geologic Hazard Category 31, which is characterized as having high potential for liquefaction due to "shallow groundwater, major drainages, or hydraulic fills."

Due to the presence of liquefiable soils on the project site as observed during both geotechnical site investigations (Appendix 4.6-1 and Appendix 4.6-2), as well as the relatively high groundwater table, the potential for liquefaction within portions of the site is moderate to high. There is potential for strength loss within the saturated fine-grained soils on the project site. The potential for soils to experience liquefaction and structural loss has the potential to cause damages to structures and developments on the project site. To minimize risks, the Stadium and other developments would need to be supported by either deep foundations for structural integrity, extending deeper than liquefiable soils, or on shallow or deep foundations that are supported by soils that are suitable for large structures (e.g., replacing current soils with fill materials).

Ground and soil improvement could reduce static and dynamic settlement on the project site. Importing new, more structurally sound soils onto the project site could be economically feasible, rather than using deep foundations that would need to penetrate beyond the underlying soils. Soil improvements through importation would be of soils that would be in conformance with the CBC's requirements for structures. Liquefiable soils and seismic-related ground failure could potentially impact the proposed project's operation. Such impacts would be **potentially significant** (**Impact GEO-2**).

d. Landslides?

The proposed project is not at risk of landslide or mudflow because it is relatively flat, and because there are no substantial slopes or hillside areas in the immediate vicinity. In addition, the project site is not at risk of mudflow or debris flow runout because the nearest mountains or large hills are located several miles to the east. Therefore, impacts would be **less than significant.**

Would the project result in substantial soil erosion or the loss of topsoil?

Construction

A substantial impact would occur if accelerated and significant soil erosion were to be sufficient in magnitude to undermine structures or compromise slope stability. The project site does not contain any topsoil as the project site is developed and topsoil has been replaced with fill material for the existing SDCCU Stadium and parking lot. During construction activities, approximately 930,000 cubic yards of cut material and approximately 1,335,000 cubic yards of fill material would be needed for the proposed project (Appendix 4.6-1 and Appendix 4.6-2). Extensive cut and fill activities would be required during construction and soil erosion could occur as a result of disturbed soil.

As discussed in Section 4.9, Hydrology and Water Quality, surface stormwater runoff and sedimentation during construction activities would be controlled with the preparation and implementation of a Storm Water Pollution Prevention Plan that would include best management practices specific for the project site and stages of construction. Impacts to soil erosion during construction would be **less than significant.**

Operation

Potential impacts of erosion on water quality are discussed in the Section 4.9. Impacts with regard to agricultural resources (e.g., prime soils) are not addressed due to the lack of agriculture and top soil on the project site due to the site being almost entirely developed and the lack of topsoil. Additionally, the full build out of the proposed project would add open spaces and fill of topsoil for landscaped areas. Stormwater drainage systems would be located throughout the project site and generally funnel all stormwater on site to retention basins. Surface water such as generated during larger storms would be directed to catchment basins near the southern edge of the project site, which would outlet into the San Diego River, located at the southern edge of the project site. The connections are shown on Figure 2-10D, Site Utilities – Concept Drainage Plan.

During operation of the proposed project, the project site would include operational best management practices that would limit wind or surface stormwater erosion of soils. This would include the proposed project's design and development of a retention basin in accordance with (MS4) requirements. Increased landscaped areas as part of the proposed project's design would further reduce surface stormwater runoff potential. The proposed project is designed to decrease impervious surfaces on the project site from approximately 166 acres in the existing condition to approximately 85.9 acres (50.1% of the project site). Runoff would be managed and discharged into existing stormwater infrastructure and the retention basin. The significant decrease of impervious surfaces on the project site, the integration of stormwater treatment basins, and the relatively flat nature of the project site would greatly reduce the potential for off-site erosion from gullies and rills as compared to the project site's current, paved condition. Operational impacts associated with soil erosion would be **less than significant.**

Would the project 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?

Construction

As discussed previously, the proposed project is expected to be underlain by fill (primarily coarse grained), highly variable alluvial deposits (sand, gravel, silt, and clay), and Friars Formation sandstone. Near-surface material is primarily granular in nature, consisting of sand and gravel, although some clay soils are present within the alluvium and possibly within the fill. Therefore, there is some limited potential that expansive soil could be present at the project site. In addition, ground surface settlement could occur as a result of the consolidation of loose and soft alluvial soil layers due to significant fill placement. The potential for other soil phenomena, including collapse and subsidence, is considered low. During construction of the proposed project, earthwork would be conducted per applicable requirements of the CBC and the project specifications. Impacts during construction would be considered **less than significant.**

Operation

Subsurface investigation and laboratory testing performed as part of project geotechnical studies evaluated the potential for expansive soil at the project site, and recommendations were provided for mitigation of the hazard to the proposed project.

Based on laboratory tests of the project site, soils located near the cut and borrow areas are likely to have a very low to medium potential for expansion. Within Appendix C of Appendix 4.6-1, results of 17 expansion index tests performed on soils from approximately 5 feet below existing surface levels revealed that the expansion index ranged from 6 to 75 with an average of 40 (Low Potential Expansion) and a median of 36 (Low Potential Expansion).

Compressible soils were found under the project site. Most of the soils underneath the project site are sands and gravels that are likely to settle with the addition of initial fill and structures. There are local zones of thick clay that could experience time-dependent consolidation settlement (Appendix 4.6-1 and Appendix 4.6-2).

Within the area of the proposed Stadium, nine expansion index tests were conducted on soils from approximately 5 feet below existing surface levels. These tests revealed that the expansion index ranged from 6 to 75, averaging 43 (Low Potential Expansion) with a median of 50 (borderline Low-Medium Potential Expansion) (Appendix C of Appendix 4.6-2.)

Expansive soil may be locally removed and replaced with non-expansive material. Smaller structures and surface improvements that are not supported on deep foundations would be designed to accommodate the expected settlement, and/or the earthwork would be programmed to limit long-term settlement by placing surcharge loads or implementing other measures.

Appendix 4.6-1 and Appendix 4.6-2 both recommend ground improvement of soils on the project site to provide a stable foundation for the proposed project's vertical components. Most improved grounds and soils often support allowable bearing pressures up to 4,000 pounds per square foot and would provide settlement tolerances ranging from 0.5 inches to 1 inch over a horizontal distance of approximately 30 to 40 feet. Deep dynamic compaction, vibro-replacement, deep soil mixing, and vertical drains are viable options that could be implemented for improving soil quality on the project site. However, each of these improvement options are unique and each portion of the project site would need to be evaluated in order to choose the most suitable method to improve the soils in a particular area for each project component. Schedule and costs of each option are variable and would need to be evaluated, as would the accessibility of each method in order for future subsurface quality control investigations to be conducted. However, because the project site is underlain by soils located on a geologic unit or soil that may become unstable and potentially result in liquefaction or collapse, impacts would be **potentially significant** (**Impact GEO-3**).

Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?

As discussed above, the available data suggest that due to the presence of loose to medium dense granular material and a high groundwater level, the potential for liquefaction within the sandy alluvium at the site is moderate to high (**Impacts GEO-1** and **GEO-2**). Further, there is some potential for strength loss within the saturated fine-grained layers within the alluvium and settlement of dry sands above the groundwater table. Given that there is a potential for liquefaction, as well as the presence of sloping ground, the potential exists for lateral spreading or flow sliding to occur at the site. As discussed previously, the potential for lateral spreading or flow sliding is considered low; however, this would need to be verified by detailed site-specific geotechnical studies conducted in accordance with the requirements in the CBC.

The potential impacts to the proposed project that could result from liquefaction and secondary effects, including lateral spreading, are discussed above. Design features intended to reduce the potential consequences of soil liquefaction and secondary effects are also discussed above. With the implementation of the project design features in accordance with the CBC, the potential for these hazards to impact the proposed project would be reduced to an acceptable level of risk and, therefore, would be considered **less than significant**.

Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

The surface geological mapping (Kennedy 1975; Kennedy and Tan 2008) details the underlying geology within the study area as being Holocene young alluvial floodplain deposits and Pleistocene old alluvial floodplain deposits, with Eocene Friars Formation underlying the younger deposits. Numerous construction projects within sedimentary deposits throughout the City have produced scientifically significant paleontological resources (Appendix 4.6-3, Paleontological Resources Technical Report). The potential, or sensitivity, of a given geological unit to produce scientifically significant paleontological resources is based on past fossil discoveries within the unit.

A review of the records search results letter provided by the San Diego Natural History Museum (SDNHM) indicates that the study area is underlain by geological units of low, moderate, and high paleontological potential (Table 4.6-6) (County of San Diego 2009).

Table 4.6-6. Geological Units, Paleontological Sensitivities, and San Diego Natural History Museum Localities within 1-Mile of the Study Area

Geological Unit	Epoch, Period, or Era	Geological Age (Millions of Years)	Paleontological Sensitivity	No. of SDNHM Localities within One Mile of Program Area
Young Alluvial Floodplain deposits (Qya)	Holocene	<0.120	Low	N/A
Old Alluvial Floodplain deposits (Qoa)	Pleistocene	~ 2.6 – 0.13	Moderate	0
Friars Formation (Tf)	Middle Eocene	~ 46–47	High	11

Source: Appendix 4.6-3.
Note: SDNHM = San Diego Natural History Museum.

Based on the record search results conducted by the SDNHM, no records were found of fossil localities within the boundaries of the project site. However, 11 fossil localities are located within a 1-mile radius of the study area; these are from the same deposits that underlie the study area at depth (the Friars Formation) and have yielded Eocene-age fossils throughout the City (Appendix 4.6-3). The following summarizes the records search results.

The middle-Eocene Friars Formation likely partially or entirely underlies the proposed project at unknown depths, and the SDNHM has 11 fossil collection localities from this formation within a 1-mile radius of the project site (Appendix A to Appendix 4.6-3). Fossils recovered from the Friars Formation within the 1-mile buffer include a coprolite (fossilized feces), an internal mold of a freshwater or terrestrial snail, and fossil terrestrial vertebrates including frogs, turtles, crocodilians, lizards, birds, marsupials, rodents, insectivores, bats carnivores, artiodactyls, brontotheres, rhinoceroses, and primates (Appendix A to Appendix 4.6-3).

The Holocene young alluvial floodplain deposits area generally too young to yield significant paleontological resources, and thus, no fossil localities from this geological unit were reported by the SDNHM. Old alluvial floodplain deposits, which are similar to young alluvial floodplain deposits, but are Pleistocene-age, have produced significant paleontological resources in western San Diego County. However, the SDNHM did not report any fossil localities from this geological unit within the proposed project boundaries or the 1-mile buffer (Appendix A to Appendix 4.6-3). Fossils collected from this geological unit outside the 1-mile buffer include reptiles, birds, and small and large mammals. The large mammals are typical Pleistocene (Ice-Age) megafauna such as mammoth, bison, horse, and camel.

The Friars Formation is considered to have high paleontological potential, the old alluvial floodplain deposits are considered to have moderate paleontological potential, and Holocene-age alluvium are considered to have low paleontological potential. Because the proposed project is underlain by a formation that is considered to have a high paleontological potential, and because the SDNHM has 11 fossil collection localities from this formation within a 1-mile radius of the project site, the proposed project's impacts to paleontological resources are considered **potentially significant** (**Impact GEO-4**).

Would the project result in a cumulative impact to geology and soils?

For cumulative analysis, the geologic and soil geographic scope is generally the area immediately surrounding the project site for soils, and in the general region for geology and seismic concerns. Most potential impacts related to geology and soil risks would be minimized due to compliance with regulatory requirements. These regulations, as detailed in Section 4.6.2, minimize potential for risks associated with the geology and soil of the project site. Cumulative projects would also be subject to federal, state, and local regulations related to development requirements, as well as paleontological resources. In a manner similar to the proposed project, adherence to these regulatory requirements would reduce incremental impacts in each of the affected project areas. Additionally, paleontological impacts are localized, generally affecting a specific site area, thus minimizing the potential for an impact to combine with another project to create a cumulative scenario. Because cumulative projects would be fully regulated, thus reducing the potential for impacts, cumulative impacts associated with geology and soils would be less than significant. Through mitigation and compliance with regulatory requirements, the construction or operation of the proposed project itself would not create significant impacts to geology or soils that could combine with other project impacts to create a significant and cumulatively considerable impact. For these reasons, the proposed project would **not result in cumulatively considerable impacts** related to geology and soils.

4.6.5 Summary of Impacts Prior to Mitigation

Based on the geologic conditions in the site area, the proposed project has the potential to result in the following impacts.

Impact GEO-1 Liquefiable soils and seismic-related ground failure could potentially impact the proposed project's construction.

Impact GEO-2 Liquefiable soils and seismic-related ground failure could potentially impact the proposed project's operation.

Impact GEO-3 The proposed project has the potential to be significantly impacted by potentially unstable soils located on the project site.

Impact GEO-4 During construction activities, the proposed project has the potential to create a significant impact to paleontological resources that may be present on the project site.

4.6.6 Mitigation Measures

The following mitigation measures would be implemented to reduce all impacts described in this section to levels below significance.

MM-GEO-1 Prior to the commencement of construction of any of the proposed project's vertical components, California State University (CSU)/San Diego State University or its designee shall retain a qualified geotechnical engineer to prepare a final geotechnical report (or reports) for the portions of the project site proposed for construction, which shall include, at minimum, the following analyses of the project site's soils for the vertical footprint of each development component of the project:

1. Corrosivity of soils,
2. Liquefiable soils,
3. Potentially unstable soils, including compressible, expandable soils, and
4. Suitability of fill materials to be used.

The final geotechnical report shall also include recommendations on the types of methods that should be utilized to improve soil quality in the footprint of each vertical development component. The final geotechnical report shall be submitted to, and approved by, the CSU Building Official or its designee prior to the issuance of construction permits for any phase of the project. The final geotechnical report shall conform to all applicable laws, regulations, and requirements. All geotechnical recommendations provided in the final geotechnical report shall be followed during grading and construction at the project site.

MM-GEO-2 A geotechnical consultant in the field shall perform geotechnical observation and/or laboratory testing during grading to identify areas of potential liquefaction and unstable soils, and shall develop conclusions and recommendations. All soils in areas of proposed development or future fill subject to potential liquefaction and/or instability shall be treated per the recommendations of the final geotechnical report and field observations. Prior to approval of final inspection of site grading for each phase of the affected areas of the proposed project, the recommendations shall be reviewed and approved by the California State University Building Official or its designee.

MM-GEO-3 Prior to the commencement of any grading activity, California State University (CSU)/San Diego State University or its designee shall retain a qualified paleontologist to ensure the implementation of a paleontological monitoring program. The Society of Vertebrate Paleontology defines a qualified paleontologist as having the following:

1. A graduate degree in paleontology or geology, and/or a publication record in peer reviewed journals; and demonstrated competence in field techniques, preparation, identification, curation, and reporting in the state or geologic province in which the project occurs. An advanced degree is less important than demonstrated competence and regional experience.
2. At least two full years professional experience as assistant to a Project Paleontologist with administration and project management experience; supported by a list of projects and referral contacts.
3. Proficiency in recognizing fossils in the field and determining significance.
4. Expertise in local geology, stratigraphy, and biostratigraphy.
5. Experience collecting vertebrate fossils in the field.

The qualified paleontologist shall attend any preconstruction meetings, present a worker environmental training to construction personnel, and manage the paleontological monitor(s) if he or she is not doing the monitoring. A paleontological monitor shall be on site during all excavations below the depth of previously disturbed sediments. The Society of Vertebrate Paleontology defines a qualified paleontological monitor as having the following:

1. BS [bachelor of science] or BA [bachelor of arts] degree in geology or paleontology and one year experience monitoring in the state or geologic province of the specific project. An associate degree and/or demonstrated experience showing ability to recognize fossils in a biostratigraphic context and recover vertebrate fossils in the field may be substituted for a degree. An undergraduate degree in geology or paleontology is preferable, but is less important than documented experience performing paleontological monitoring, or
2. AS [associate of science] or AA [associate of arts] in geology, paleontology, or biology and demonstrated two years experience collecting and salvaging fossil materials in the state or geologic province of the specific project, or
3. Enrollment in upper division classes pursuing a degree in the fields of geology or paleontology and two years of monitoring experience in the state or geologic province of the specific project.
4. Monitors must demonstrate proficiency in recognizing various types of fossils, in collection methods, and in other paleontological field techniques.

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 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 remove the rope and allow grading to recommence in the area of the find.

Following the paleontological monitoring program, a final monitoring report shall be submitted to CSU for approval. The report shall summarize the monitoring program and include geological observations and any paleontological resources recovered during paleontological monitoring for the proposed project.

4.6.7 Level of Significance After Mitigation

The proposed project is not located on a known earthquake fault and therefore the proposed project would result in less than significant impacts during construction. The project site is located within a region that is seismically active. The proposed project would design project components to be in accordance with applicable requirements of the CBC to ensure that the proposed project would minimize impacts from earthquakes. Therefore, the proposed project would result in a **less than significant impact** in regards to fault zones and strong seismic ground shaking.

The proposed project is located on soils which are susceptible to liquefaction and structural failure (**Impacts GEO-1** and **GEO-2**). Through implementation of recommended project design and site preparations as indicated in Appendix 4.6-1 and Appendix 4.6-2, as well as a final geotechnical report (**MM-GEO-1**) and field recommendations from a certified geotechnical consultant (**MM-GEO-2**), the proposed project would result in a **less than significant impact** in regards to liquefaction and structural failure.

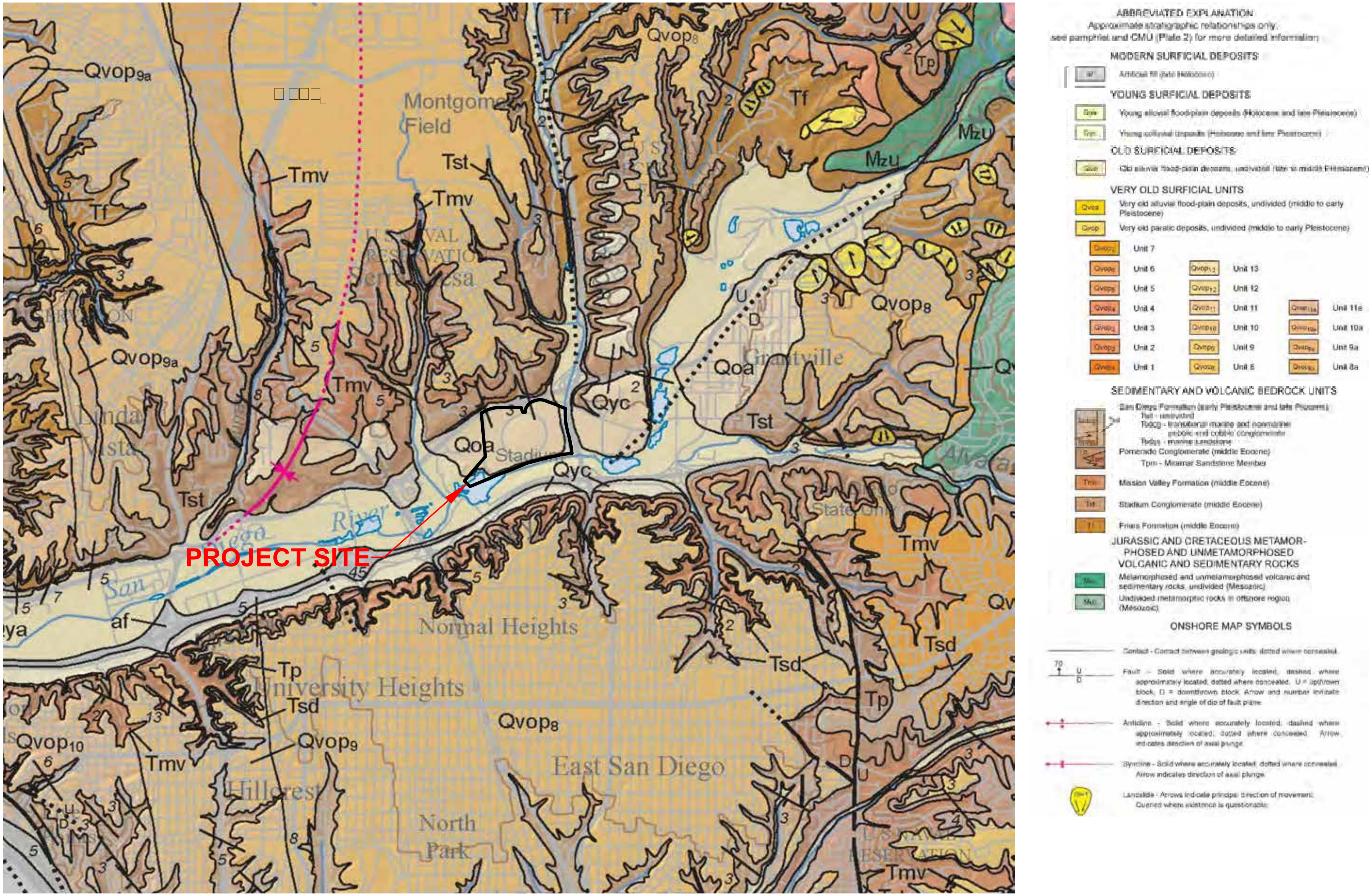
The project site and vicinity are relatively flat, are not located on a hill or steep area, and are not subject to landslides from nearby hills or steep areas. There would be **no impact** to or from landslides with the implementation of the proposed project.

The project site does not contain topsoil and, therefore, the proposed project would not impact the loss of topsoil on the project site. There would be **no impact** to the loss of topsoil on the project site.

The project site is underlain by soils located on a geologic unit or soil that may become unstable and potentially result in collapse (**Impact GEO-3**). With implementation of the recommendations contained in the final geotechnical report, as required by the design process in conformance with the CBC, and field recommendations from a certified geotechnical consultant (**MM-GEO-2**), the potential for unstable soil to impact people, the project, or adjacent properties (**Impact GEO-3**) would be reduced to **less than significant.**

The proposed project does not include the use of septic tanks or alternative wastewater disposal systems, and therefore there would be **no impact** with respect to septic-suitable soils on the project site.

Demolition of the existing SDCCU Stadium and associated facilities and construction of proposed components of the proposed project have the potential to result in potentially significant impacts to paleontological resources (**Impact GEO-4**). To mitigate this potentially significant impact, the proposed project would implement mitigation measure **MM-GEO-3**. Implementation of this mitigation measure would reduce impacts to **less than significant** during demolition and construction activities.



Document Path: Z:/Projects/j155501/MAPDOC/DOCUMENT_NAME/EIR/4.6 Geology and Soils/Figure 4.6-1_Geologic_Map

SOURCE: GROUP DELTA CONSULTANTS. 2019

SDSU Mission Valley Campus Master Plan EIR

SAN DIEGO STATE UNIVERSITY

Figure 4.6-1
Geologic Map

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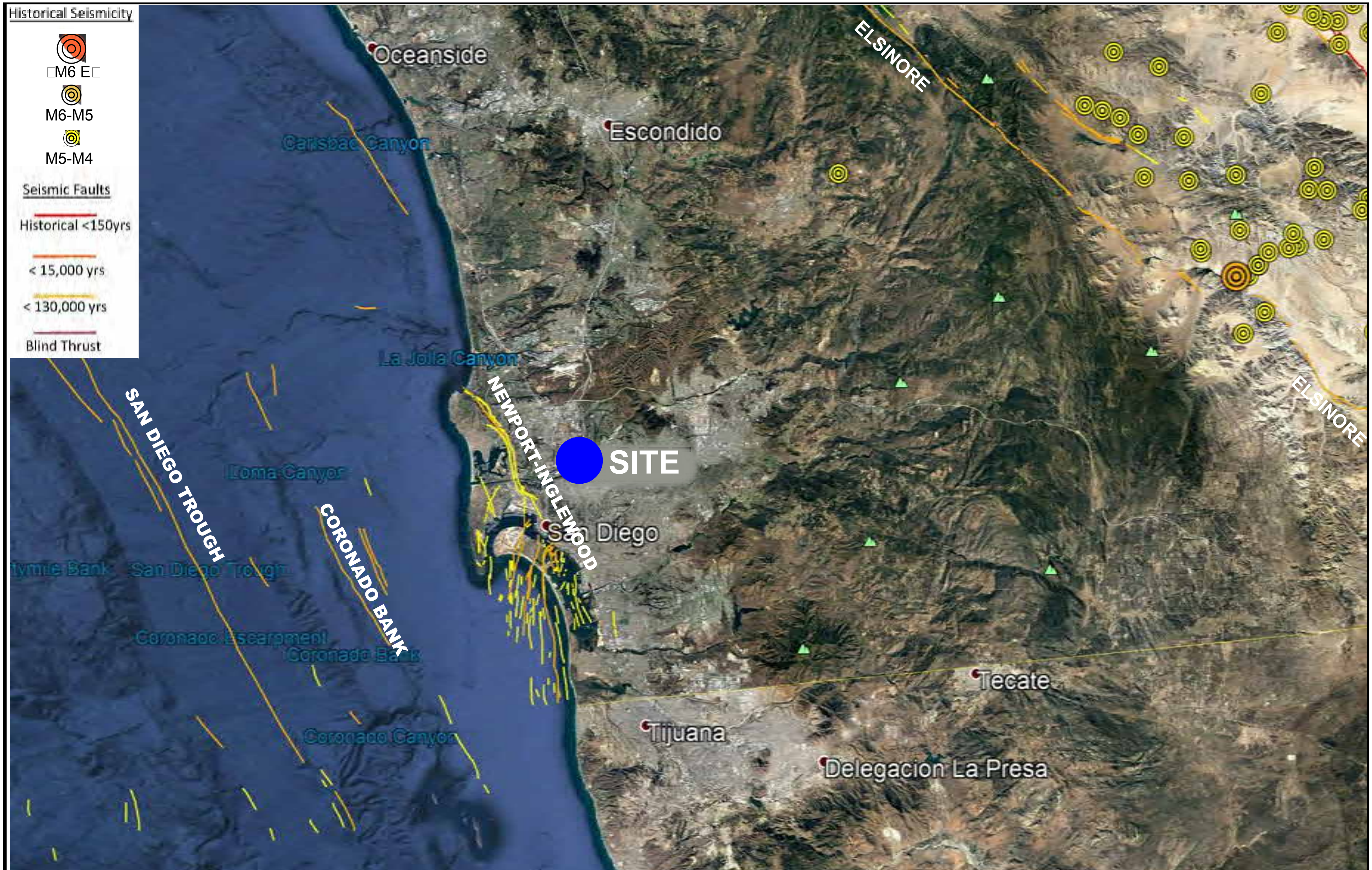

REFERENCE: U.S. GEOLOGICAL SURVEY AND CALIFORNIA GEOLOGICAL SURVEY, 2006, QUATERNARY FAULT AND FOLD DATABASE FOR THE UNITED STATES, ACCESSED 3/4/2019, FROM USGS

SOURCE: GROUP DELTA CONSULTANTS. 2019

SDSU Mission Valley Campus Master Plan EIR

SAN DIEGO STATE UNIVERSITY

Figure 4.6-2
Fault Map

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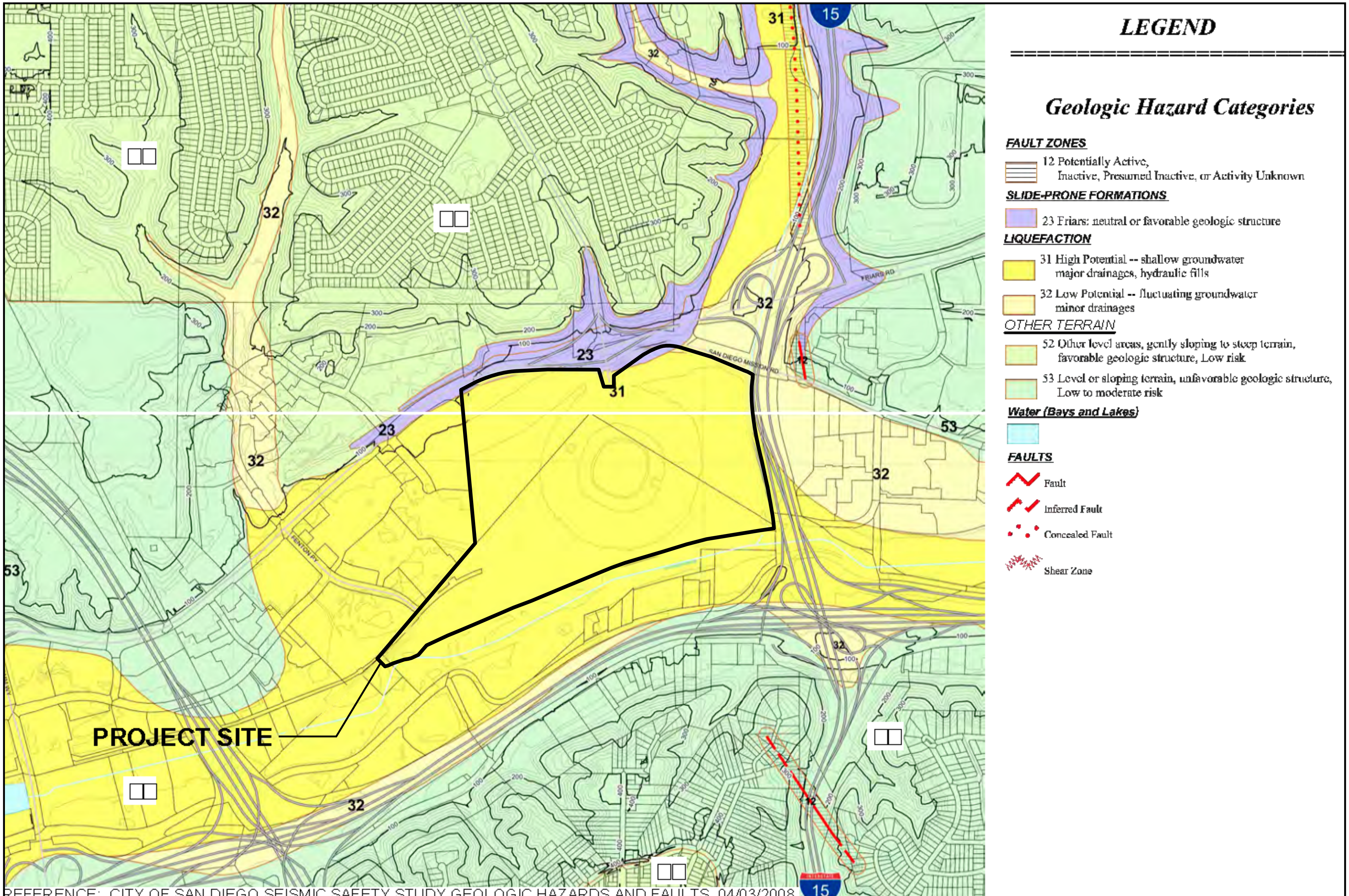

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SOURCE: GROUP DELTA CONSULTANTS. 2019

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Figure 4.6-3
Seismic Safety Map

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