5.5 GEOLOGY AND SOILS

This section of the Draft Environmental Impact Report (EIR) addresses the geologic and seismic setting of the project area, identifies potential impacts associated with implementation of the proposed project, and as necessary, recommends mitigation to reduce the significance of impacts. The issues addressed in this section are risks associated with faults, strong seismic ground shaking, and seismic-related ground failure such as liquefaction, landslides, and unstable geologic units and/or soils. Information in this section is based on the *Geotechnical Report Mercy Wellness Center,* prepared by CGI Technical Services, Inc*.* (April 2016). The report is included in its entirety in Appendix 15.4, GEOTECHNICAL REPORT. The following analysis of the potential environmental impacts related to geology and soils is also derived from the following sources and are available for review at the City of Redding Development Services Department, Planning Division:

- City of Redding. *General Plan 2000 – 2020*. October 2000.
- City of Redding. *Local Hazard Mitigation Plan*. November 2015.
- City of Redding. *Redding Municipal Code Title 16, Buildings and Construction.* March 2018.

This section describes the affected environment and regulatory setting for geology and soils. It also describes the impacts on geology and soils that would result from implementation of the proposed project and measures that would reduce these impacts.

5.5.1 ENVIRONMENTAL SETTING

The project site is located in the northern Sacramento Valley near the northern margin of the Great Valley Physiographic province. The Great Valley province is bordered to the north by the Klamath and Cascade Physiographic provinces, to the east by the Cascade and Sierra Nevada Physiographic provinces, to the west by the Klamath and Coast Ranges Physiographic provinces, and to the south by the Transverse Ranges Physiographic province.

The Great Valley Physiographic province is about 50 miles wide and 400 miles long. The Sacramento Valley, which forms the northern portion of the province, is about 150 miles long and 40 miles wide (Hinds, 1952). According to Hackel (1966), "The Great Valley is a large elongate northwest-trending asymmetric structural trough that has been filled with a tremendously thick sequence of sediments ranging from Jurassic to recent." Sediment thicknesses of up to 10 miles are reported within the Sacramento Valley; however, in the project area, being at the northern margin of the valley, those thicknesses have been projected to be less than one-mile (Hackel, 1966). Sediments within the Great Valley consist of both marine and continental deposits, with most of the sediments underlying the project area consisting of continental deposits.

Onsite surface drainage occurs as sheet flow westerly towards the Sacramento River. The site is relatively level with onsite elevations ranging from 467 to 497 feet above mean sea level (msl). The project site is underlain by a mixture of artificial fill and native alluvial soils composed predominately of granular soils consisting of silty sand, silty gravel and gravel with varying amounts and sizes of cobbles and boulders. Near the northwest and central portions of the project, gravelly clay and sandy clay are encountered within the upper 12 to 14 feet of the soil profile.

SOILS

Onsite soils are composed predominately of granular soils consisting of silty sand, silty gravel, and gravel with various sizes of cobbles and boulders (CGI, 2016). Soils in the vicinity of the project site are comprised of cobbly alluvial soils, reiff fine sandy loam, and deep riverwash. According to the mapping performed by the Natural Resources Conservation Service the site is approximately 50 percent riverwash, 29 percent reiff fine sandy loam, 0 to 3 percent slopes, 15 percent cobbly alluvial land, and one percent reiff fine sandly loam, deep, 0 to 3 percent slopes. Because the area is along the Sacramento River is part of a singular watershed there is minimal variability. Refer to Figure 5.5-1, SOIL UNIT MAP.

GROUNDWATER

The project site is located towards the northern edge of the Redding Groundwater Basin, as defined by the California Department of Water Resources (DWR). At present, the DWR monitors numerous wells in the Redding Groundwater Basin. Searches were performed through the California Department of Water Resources Water Data Library (2016) and the California State Water Resources Control Board Geotracker Database (2016) to estimate the depth to groundwater beneath the project site.

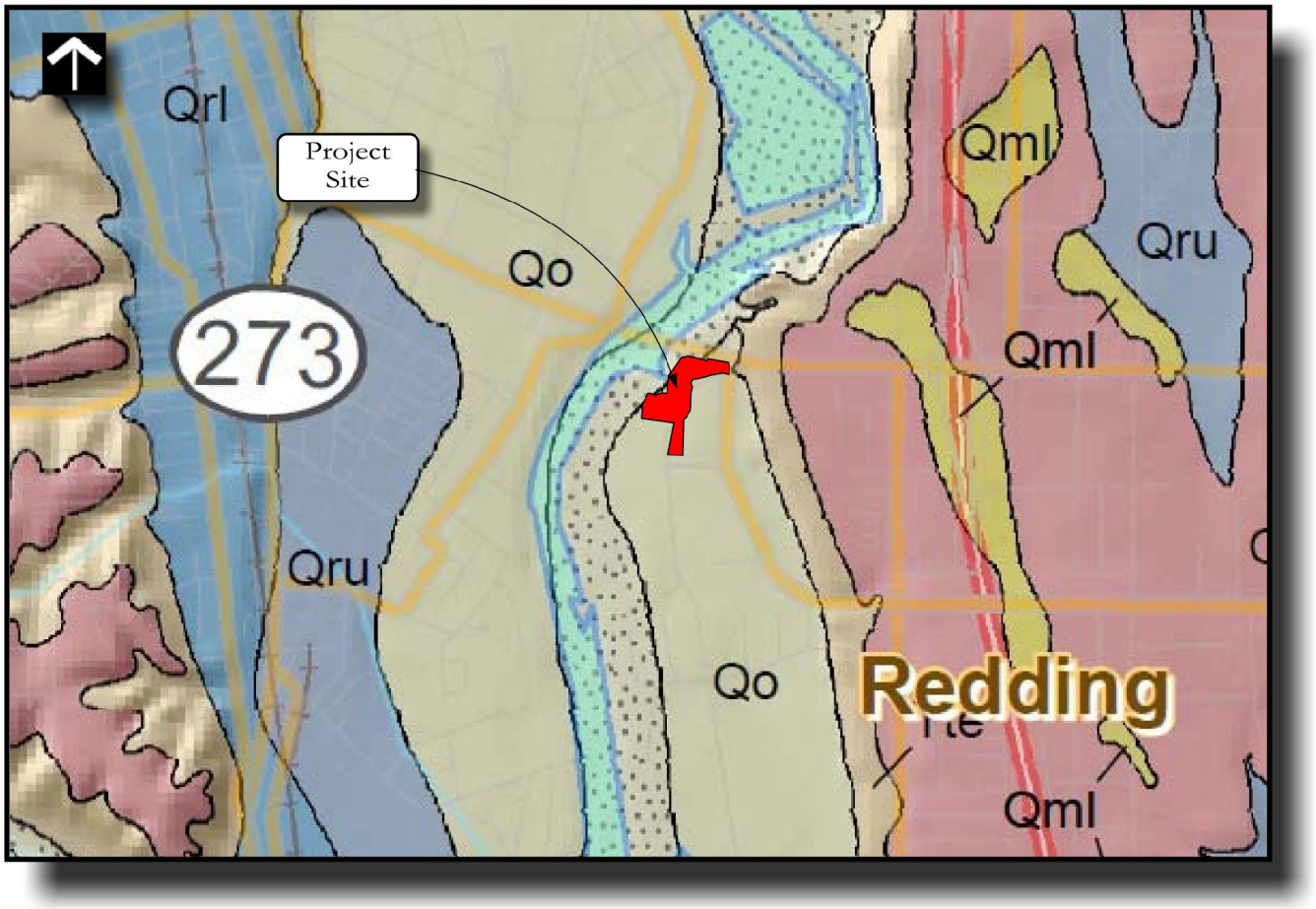
Neither of the above identified databases recorded any groundwater depth information within at least one-mile of the project site. In addition to exploration of the project site done in 2003 by Kleinfelder, exploration of the site performed in 2015 by CGI Technical Services observed groundwater at depths of approximately 10 to 22 feet below ground surface (refer to Table 5.5-1, GROUNDWATER INFORMATION, below).

Table 5.5-1
GROUNDWATER INFORMATION

Study	Exploration No.	Depth to Water	Water Surface Elevation
CGI Study	DH-2	22	459
	DH-4	10	465
	DH-5	14	461
Kleinfelder (2006)	D	25	464
	E	24	465
	F	27	463
	I	35	455
	J	34	456

Source: CGI Technical Services, Inc. *Geotechnical Report.* April 2016.

Groundwater elevations will fluctuate over time. The depth to groundwater can vary throughout the year and from year to year. Intense and long duration precipitation, modification of topography, and cultural land uses, such as irrigation, water well usage, onsite waste disposal systems, and water diversions can contribute to fluctuations in groundwater levels, as well as changes in management of the adjacent Sacramento River and upstream Keswick and Shasta Dams.



Qsc Stream Channel Deposits

Qo Overbank Deposits

Qml Modesto Formation Lower Unit

Qrl Riverbank Formation Lower Unit

Qru Riverbank Formation Lower Unit

Qrb Red Bluff Formation

Tte Tehama Formation

Geologic Contact: dashed where approximate, dotted where covered, queried where uncertain

Fault: showing dip of fault and and trend of striae on fault surface (arrow); bar and ball on downthrown side; dashed where approximate, dotted where concealed; queried where uncertain

Basemap from Helley & Harwood (1985)

Scale Undetermined

SHN	Dignity Health North State Pavilion Project	Soil Unit Map Figure 5.5-1

FAULTING AND SEISMICITY

Seismic Setting

The State of California designates faults as active, potentially active, and inactive depending on the activity of movement that can be substantiated for a fault (refer to Table 5.5-2, FAULT ACTIVITY RATINGS).

Table 5.5-2
FAULT ACTIVITY RATINGS

Fault Activity Rating	Geologic Period of Last Rupture	Time Interval (Years)
Active	Holocene	Within last 11,000 years
Potentially Active	Quaternary	>11,000 to 1.6 million years
Inactive	Pre-Quaternary	Greater than 1.6 million years

Source: CGI Technical Services, Inc. *Geotechnical Report.* April 2016.

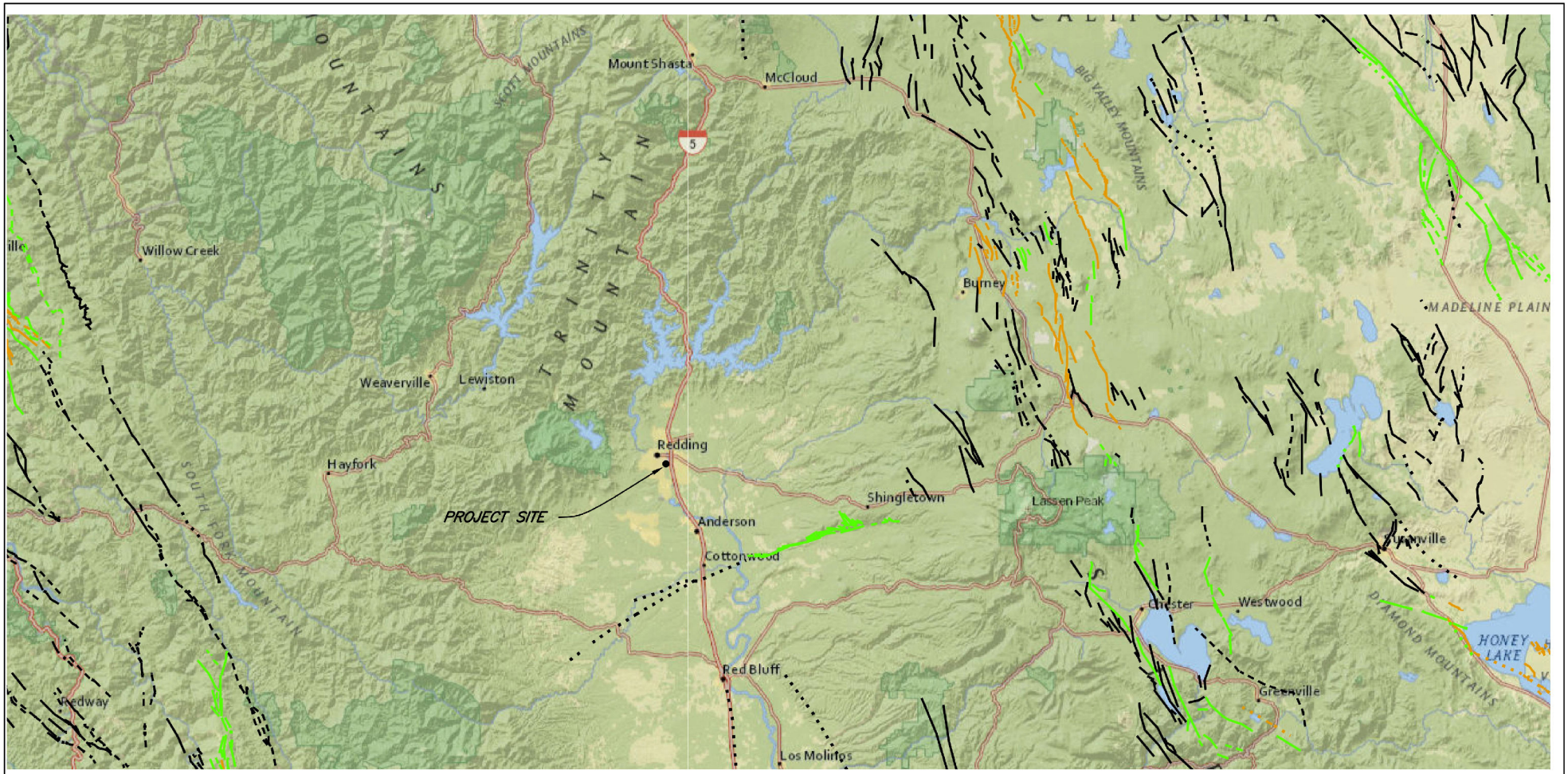
The California Geologic Survey (CGS) evaluates the activity rating of a fault in fault evaluation reports (FER). FERs compile available geologic and seismologic data and evaluate if a fault should be zoned as active, potentially active, or inactive. If a FER evaluates a fault as active, then it is typically incorporated into a Special Studies Zone in accordance with the Alquist-Priolo Earthquake Hazards Act. The project site is not located within an Alquist-Priolo Earthquake Fault Zone and no active faults are known to pass through the project site. However, the potentially active Battle Creek fault is mapped approximately 16 miles south of the project site. The closest fault mapped to thje site is the inactive Bear Creek fault, located approximately 13 miles to the southwest. The closest known active fault, as zoned by the State, is the Hat Creek-McCarthur fault, located approximately 48 miles northeast of the site. Refer to Figure 5.5-2, REGIONAL FAULTING.

In addition to the continental faulting noted above, the project area rests above the Cascadia subduction zone. West of the site, off the coast of California, the oceanic crust of the Gorda plate is being subducted beneath the continental crust of the Pacific Plate, in an area known as the Gorda Escarpment. The descending ramp caused by that subduction, called the Cascadia Subduction zone, extends beneath the project area at a depth of about 20 to 25 miles. That ramp is capable of storing elastic stress that periodically causes earthquakes that could affect the project area.

Earthquakes

Historically over the last approximately 200 years, 25 earthquakes with local magnitudes (ML) equal or greater than 5.5 have occurred within approximately 50 kilometers of the site, based on a search of selected earthquake catalogs (Toppozada and Branum, 2002). The most recent significant earthquake to affect the project area was an earthquake (Vacaville-Winters) with a moment magnitude (Mw) of 6.4 that occurred on April 19, 1892 approximately 150 miles from the site.

Local earthquakes can also be expected from Lassen Peak if it enters a phase nearing eruption or if subsurface migration of magma occurs. Those earthquakes, similar to earthquakes experienced prior to eruption of Mt. St. Helens or at Mammoth Mountain (without eruption), typically occur as swarms with earthquake magnitudes of low to moderate intensity. Estimated peak horizontal ground accelerations were estimated for the project site and are shown in Table 5.5-3, DETERMINISTIC GROUND MOTION DATA.



LEGEND

- Undifferentiated Quaternary (< 130,000 years), well constrained location
- Undifferentiated Quaternary (< 130,000 years), moderately constrained location
- Undifferentiated Quaternary (< 130,000 years), inferred location
- Latest Quaternary (<15,000 years), well constrained location
- Latest Quaternary (<15,000 years), moderately constrained location
- Late Quaternary (< 130,000 years), well constrained location
- Late Quaternary (< 130,000 years), moderately constrained location

SCALE

0 10 20 40 mi

0 15 30 60 km

SHN Consulting Engineers & Geologists, Inc.	Dignity Health North State Pavilion Project		Regional Faulting Quaternary Faults SHN 518008
	April 2019	518008-QFLTS	Figure 5.5-2

SHN

Dignity Health North State Pavilion Project

Regional Faulting / Quaternary Faults

Figure 5.5-2

Table 5.5-3
DETERMINISTIC GROUND MOTION DATA

Fault Name	Maximum Credible Magnitude (M_w)	Distance from Site (km)	Fault Data		Estimated Peak Ground Acceleration (g)	
			Length (km)	Slip Rate (mm/yr)[A]	M[B]	M + *S*[B]
Battle Creek	6.5	25	29	0.50±0.40	0.16	0.26
Foothills Fault System	6.5	39	360	0.05±0.03	0.12	0.20
Hat Creek-McArthur	7.0	77	96	1.5±1.0	0.10	0.15
Cedar Mtn-Mahogany Mtn	6.9	119	78	1.0±50	0.07	0.10

Source: CGI Technical Services, Inc. *Geotechnical Report.* April 2016.

The project site could be subjected to horizontal ground accelerations of at least 0.16g from the rupture of continental faults. The causative fault that is responsible for that peak horizontal ground acceleration is the Battle Creek fault, located approximately 16 miles from the project site. The relatively infrequent Cascadia Subduction Zone events are estimated to produce a peak horizontal ground acceleration of up to 0.5g.

Local earthquakes can also be expected from Mt. Shasta and Lassen Peak if either enters a phase of nearing eruption of if subsurface migration of magma occurs. Those earthquakes, similar to earthquakes experienced prior to eruptions of Mt. St. Helens or at Mammoth Mountain (without eruption), typically occur as swarms with earthquake magnitudes of low to moderate intensity.

Evaluation of the anticipated shaking the site may experience can be estimated by looking at all the faults in a region and estimating the probability of large earthquakes occurring on those faults during given time exposures. These probabilistic evaluations typically look at specific time exposures (return periods) and estimate the strong ground motions during those exposure periods. Table 5.5-4, PROBABILISTIC GROUND MOTION DATA, presents results of those evaluations based on the two most commonly utilized exposure periods.

Table 5.5-4
PROBABILISTIC GROUND MOTION DATA

Earthquake Level	Probabilistic Estimate Exposure Period (years)	Probability of Exceedance (%)	Return Period (years)	Estimated Peak Horizontal Ground Acceleration (g)
Upper-Bound Ground-Motion	100	10	949	0.27
Design-Basis Ground-Motion	50	10	475	0.20

Source: CGI Technical Services, Inc. *Geotechnical Report.* April 2016.

Ground Failure

Liquefaction is described as the sudden loss of soil shear strength due to a rapid increase of soil pore water pressure caused by cyclic loading from a seismic event. In simple terms, in means that a liquefaction soil acts more like a fluid than a solid when shaken during an earthquake. In order for liquefaction to occur granular soils (sand, silty sand, sandy silt, and some gravels), a high groundwater table, and a low density in the granular soils underlying the site are needed. If those criteria are present, then there is a potential that the soils could liquefy during a seismic event.

The adverse effects of liquefaction include local and regional ground settlement, ground cracking, and expulsion of water and sand, the partial or complete loss of bearing and confining forces used to support loads, amplification of seismic shaking, and lateral spreading. Lateral spreading is defined as lateral earth movement of liquefied soils, or soil riding a liquefied soil layer, down slop towards an unsupported slope face, such as a creek bank, or an inclined slope face. Lateral spreading has been observed on low to moderate gradient slopes, but has been noted on slopes inclined as flat as one degree.

In general, the effects of liquefaction on the proposed project could include lateral spreading, vertical settlement, and/or the soils surrounding lifelines can lose their strength and those lifelines can become damaged or severed. The proposed project is underlain by dense to very dense granular soils. Because of the density of the sediments as well as the grain size, liquefaction hazards pose a low risk to the project site.

Landslides

The proposed project is located on a relatively flat site. No signs of landslides were observed on or adjacent to the proposed project.

Non-Seismic Geologic Hazards

Non-seismic geologic hazards include expansive soils, regional subsidence, tsunami and seiche potential, and volcanic hazards. Expansive soils swell when wet and shrink as they dry. Expansive soils generally contain mixed layer clays, known as smectite, that expand when moisture is absorbed into the crystal structure. According to mapping performed by the Natural Resources Conservation Service, the site is underlain by cobbly alluvial land, Reiff fine sandy loam, and riverwash. Granular soils typically have a low potential to be expansive. Testing on two samples selected from the site had plasticity index values ranging from nonplastic to approximately 11. A plasticity index value of 11 indicates a low to very low expansion potential (CGI, 2016). Refer to Table 5.5-5, EXPANSION POTENTIAL-PLASTICITY INDEX CORRELATION, below.

Table 5.5-5
EXPANSION POTENTIAL-PLASTICITY INDEX CORRELATION

Plasticity Index	Correlated Expansion Potential
0-10	Very Low
10-15	Low
15-25	Medium
25-35	High
35+	Very High

Source: CGI Technical Services, Inc. *Geotechnical Report.* April 2016.

Regional subsidence typically occurs due to sustained withdrawal of subsurface fluids or gas, leading to consolidation of the subsurface reservoirs and surface settlement. There are no known reports of regional ground subsidence in the northern Sacramento Valley. The closest reported subsidence is in the Colusa area and is related to groundwater withdrawal. No published data have been presented for subsidence in Shasta County. As a result, no known regional subsidence is occurring in the project area.

A tsunami, or seismically generated sea wave, is generally created by a large, distant earthquake occurring near a deep ocean trough. A seiche is an earthquake-induced wave in a confined body of

water, such as a lake or reservoir. Damage from tsunamis is confined to coastal areas that are about 100 feet or less above sea level. Since the project site is not located near the coast or confined bodies of water, the risk of inundation from a tsunami or seiche is considered negligible. In addition, the proposed project lies within an area subject to potential hazards from future eruptions of Mt. Shasta and Lassen Peak. The potential hazards would be in the form of ash and debris fall.

5.5.2 REGULATORY SETTING

The following is a description of State and local environmental laws and policies that are relevant to the California Environmental Quality Act (CEQA) review process.

CEQA is the major environmental statute that guides the design and construction of projects on non-Federal lands in California. This statute sets forth a specific process of environmental impact analysis and public review. Recent case law, however, has narrowed the scope of analysis of geological issues compared with past practices, at least with respect to seismic issues and how they might affect project users. In *California Building Industry Association v. Bay Area Air Quality Management District* (2015) 62 Cal.4th 369, 377, the California Supreme Court held that "agencies subject to CEQA generally are *not* required to analyze the impact of existing environmental conditions on a project's future users or residents." (Italics added.) For this reason, the court found the following language from State *CEQA Guidelines* §15126.2, subdivision (a), to be invalid: "[A]n EIR on a subdivision astride an active fault line should identify as a significant effect the seismic hazard to future occupants of the subdivision. The subdivision would have the effect of attracting people to the location and exposing them to the hazards found there." (*Id*. at p. 390.)

The court did not hold, however, that CEQA never requires consideration of the effects of existing environmental conditions on the future occupants or users of a proposed project. But the circumstances in which such conditions may be considered are narrow: "when a proposed project risks exacerbating those environmental hazards or conditions that already exist, an agency must analyze the potential impact of such hazards on future residents or users. In those specific instances, it is the project's impact on the environment—and not the environment's impact on the project—that compels an evaluation of how future residents or users could be affected by exacerbated conditions." (*Id*. at pp. 377-378.) Because this exception to the general rule would presumably never apply to existing seismic hazards, the court concluded that this particular topic was outside the ambit of CEQA. (*Id.* at p. 390.)

STATE

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 (originally enacted as the Alquist-Priolo Special Studies Zones Act and renamed in 1994) and is intended to reduce the risk to life and property from surface fault rupture during earthquakes. The main purpose of the law is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The law only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards. The Alquist-Priolo Act requires the State Geologist to establish regulatory zones known as "Earthquake Fault Zones" around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning efforts. Local agencies must regulate most development projects within the zones. Projects include all land divisions

and most structures for human occupancy. There are no Earthquake Fault Zones subject to the Alquist-Priolo Earthquake Fault Zoning Act within the proposed project.

Seismic Hazard Mapping Act

The Seismic Hazard Mapping Act (SHMA) was adopted by the state in 1990 to protect the public from the effects of nonsurface fault rupture earthquake hazards, including strong ground shaking, liquefaction, seismically induced landslides, or other ground failure caused by earthquakes. The goal of the act is to minimize loss of life and property by identifying and mitigating seismic hazards. The California Geological Survey prepares seismic hazard zone maps and provides them to local governments; these maps identify areas susceptible to amplified shaking, liquefaction, earthquake-induced landslides, and other ground failures. SHMA requires responsible agencies to only approve projects within seismic hazard zones following a site-specific investigation to determine if the hazard is present, and if so, the inclusion of appropriate mitigation(s). In addition, the SHMA requires real estate sellers and agents at the time of sale to disclose whether a property is within one of the designated seismic hazard zones.

2016 California Building Code

The California Building Code (CBC), which is codified in CCR Title 24, Part 2, was promulgated to safeguard the public health, safety, and general welfare by establishing minimum standards related to structural strength, egress facilities, and general building stability. The purpose of the CBC is to regulate and control the design, construction, quality of materials, use/occupancy, location, and maintenance of all building and structures within its jurisdiction. 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 or they are not enforceable.

Current law states that every local agency enforcing building regulations, such as cities and counties, must adopt the provisions of the California Building Code (CBC) within 180 days of its publication. The publication date of the CBC is established by the California Building Standards Commission, and the code is updated every three years. It is in Title 24, Part 2, of the California Code of Regulations. The most recent building standard adopted by the legislature and used throughout the state is the 2016 CBC, which took effect on January 1, 2017. Local jurisdictions may add amendments based on local geographic, topographic, or climatic conditions.

The CBC contains necessary California amendments that are based on the American Society of Civil Engineers (ASCE) Minimum Design Standards 7-10. ASCE 7-10 provides requirements for general structural design and includes means for determining earthquake loads as well as other loads (flood, snow, wind, etc.) for inclusion in building codes. In accordance with these standards, the CBC design provisions prescribe minimum lateral forces to withstand groundshaking. Seismic design provisions of building code generally prescribe minimum lateral forces applied statically to the structure, combined with the gravity forces of dead and live loads. The prescribed lateral forces are generally considered to be substantially smaller than the actual peak forces that would be associated with a major earthquake. Consequently, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse, but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake.

However, it is reasonable to expect that a well-designed and well-constructed structure would not collapse or cause loss of life in a major earthquake. 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 including the proposed project.

California Building Code Section 1802

Requirements for geotechnical investigations for subdivisions requiring tentative and final maps and for other types of structures are in California Health and Safety Code, Sections 17953 to 17955, and in Section 1802 of the CBC. Testing of samples from subsurface investigations is required, such as from borings or test pits. Studies must be done as needed to evaluate slope stability, soil strength, position and adequacy of load-bearing soils, the effect of moisture variation on load-bearing capacity, compressibility, liquefaction, differential settlement, and expansiveness.

LOCAL

City of Redding Municipal Code

The City of Redding has incorporated and adopted the 2016 CBC with the City's amendments as RMC §16.02.010. A geotechnical soils report is required under RMC §17.40.040.6 for final maps and parcel maps, and under RMC §16.12.060(C), *Clearing, Grading, Fills and Excavation*. The report must be prepared by a registered civil or soils engineer and must include data on the nature, distribution, and strength of existing soils; conclusions and recommendations for grading procedures; design criteria for corrective measures; or other criteria as may be necessary to support the construction. Recommendations included in the geotechnical soils report, and approved by the City engineer, must be incorporated into the grading plans or specifications.

The purpose of RMC §16.12.060(C), *Clearing, Grading, Fills and Excavation*, is to safeguard life, health, property, the environment, and the public welfare by establishing minimum requirements for grading, clearing, and erosion control (Ordinance 2246 § 2 (part), 1999). The code sets forth rules and regulations that control clearing and grading, the prevention of erosion and other environmental damage; establishes administrative procedures for issuance and enforcement of permits; and provides for the approval of plans and inspection of grading and erosion-control operations. Cuts, fills, drainage, and erosion control are required to be designed and constructed per the Standard Specifications for Public Works Construction (Green Book), latest edition, and the City of Redding Construction Standards and, if the grading is proposed to support structures, the California Building Code (Ordinance 2246 §2 (part), 1999).

RMC §16.12.060(C) applies to any development project resulting in the excavation of fifty cubic yards or more of earth material. The ordinance also ensures compliance with the City's National Pollutant Discharge Elimination System (NPDES) Permit, which is issued by the Regional Water Quality Control Board (RWQCB). As part of the Grading Ordinance, the City of Redding Public Works Department requires an Interim and a Final Erosion and Sediment Control Plan for all new development projects (RMC Title 16, §16.12.060). These plans are required to outline the implementation procedures for controlling erosion, sedimentation, and other pollutant runoff and require a plan for soil storage before, during, and after construction.

City of Redding Hazard Mitigation Plan

The City's *Local Hazard Mitigation Plan* identifies local hazards and the likelihood of occurrence and potential magnitude of damage. The City of Redding Local Hazard Mitigation Plan includes resources and information to assist in planning for hazards. The plan provides a list of actions that may assist the City of Redding in reducing risk and preventing loss from future hazard events. The actions address hazards, as well as specific activities for, Wildland Fire, Flood, Hazardous Material, Severe Winter Weather, Earthquakes, Utility Disruption, Aviation Disaster, Chemical, Biological, Radiological, Nuclear, Explosives (CBRNE), Dam Overflow or Failure, and Volcanic issues.

City of Redding General Plan

The City's *General Plan* sets forth goals and policies to ensure public safety during seismic events and potential geologic effects, including liquefaction and subsidence. The applicable goals and policies are discussed below in Table 5.5-6, CONSISTENCY WITH APPLICABLE CITY OF REDDING GENERAL PLAN GOALS AND POLICIES FOR GEOLOGIC RESOURCES.

5.5.3 STANDARDS OF SIGNIFICANCE

SIGNIFICANCE CRITERIA

In accordance with State *CEQA Guidelines*, the effects of a project are evaluated to determine whether they would result in a significant adverse impact on the environment. An EIR is required to focus on these effects and offer mitigation measures to reduce or avoid any significant impacts that are identified. The criteria used to determine the significance of impacts may vary depending on the nature of the project. The following significance thresholds related to geology and soils have been derived from Appendix G of the State *CEQA Guidelines*:

- *Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving* (refer to Impact 5.5-1, below)*:*
    - *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 substantial evidence of a known fault;*
    - *Strong seismic ground shaking;*
    - *Seismic-related ground failure, including liquefaction; and*
    - *Landslides.*

- *Be located on a geologic unit or soil that is unstable, or that would become unstable and potentially result in on or offsite landslides, lateral spreading, subsidence, liquefaction or collapse.* Refer to Impact 5.5-1, below.

- *Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.* Refer to Impact 5.5-2, below.

- *Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.* Refer to AREAS OF NO PROJECT IMPACT, below.

Table 5.5-6
CONSISTENCY WITH APPLICABLE CITY OF REDDING GENERAL PLAN GOALS AND POLICIES FOR GEOLOGIC RESOURCES

General Plan Goals and Policies	Consistency Analysis
GENERAL PLAN GOAL CDD3 *ENSURE A PROPER BALANCE BETWEEN DEVELOPMENT AREAS AND THE NATURAL ENVIRONMENT.*	
Policy ED2A: Prohibit development in natural floodplains or on hillsides with slope areas exceeding 20 percent. Minor encroachments into these areas for new developments may be authorized without a General Plan amendment if necessary to facilitate installation of infrastructure, provide emergency-access opportunities, or otherwise facilitate construction of the project as approved by the City (See Policy NR10A). Where an entire site designated for residential use is subject to flooding or has slopes over 20 percent, a density of 1.0 dwelling units per 20 acres may be permitted by use permit subject to appropriate standards.	**Consistent.** A portion of the proposed site does fall in the FEMA 100-year floodplain, however there are modifications that will change the extent of the inundation and will not have a measurable impact on the floodplain (refer to Section 5.8, HYDROLOGY AND WATER QUALITY). There are no slopes on the project site that are greater than 20 percent.
GENERAL PLAN GOAL HS1 *MINIMIZE THE LOSS OF LIFE, INJURY, AND PROPERTY DAMAGE DUE TO SEISMIC AND GEOLOGIC HAZARDS.*	
Policy HS1A: Continue to require that new structures and alterations to existing structures comply with the seismic safety requirements of the Uniform Building code (UBC); adopt updated provisions of the UBC related to seismic safety as they become available.	**Consistent.** The proposed project will be constructed in accordance with California Building Code (CBC) seismic design parameters.
Policy HS1B: Require liquefaction mitigation plans for proposed developments, including necessary infrastructure in areas determined to have a "high" liquefaction potential.	**Consistent.** The evaluation of the site completed concluded that there is low potential for liquefaction during a seismic event.
Policy HS1C: Require determination of the landslide, slope-instability, and erosion potential of proposed development sites located in potential hazard areas. Utilize building setbacks, grading techniques, or appropriate measures when constructing in or near unstable areas.	**Consistent.** The potential for onsite landslides has been determined to be low due to the lack of steep topography onsite. The potential for slope-instability is also considered low. The potential for erosion would be mitigated by utilizing drought-resistant vegetation, riprap, and other appropriate design and implementation measures as defined by City of Redding Construction Standards and the CBC.

Source: City of Redding. *2000 - 2020 General Plan*. October 2000.

As noted earlier, the California Supreme Court has held that "agencies subject to CEQA generally are not required to analyze the impact of existing environmental conditions on a project's future users or residents. But when a proposed project risks exacerbating those environmental hazards or conditions that already exist, an agency must analyze the potential impact of such hazards on future residents or users. In those specific instances, it is the project's impact on the environment—and not the environment's impact on the project—that compels an evaluation of how future residents or users could be affected by exacerbated conditions." (*California Building Industry Association v. Bay Area Air Quality Management* District (2015) 62 Cal.4th 369, 377-378.) Thus, where the discussion below considers the effects of existing geological hazards on future users of the project site, such analysis goes beyond the bounds of CEQA. The City has included such analysis, however, as it intends to use its police power to ensure that the project is designed in a manner that is safe for such future users.

Based on these standards, the effects of the proposed project have been categorized as either a less than significant impact or a potentially significant impact. Mitigation measures are recommended for potentially significant impacts. If a potentially significant impact cannot be reduced to a less than significant level through the application of mitigation, it is categorized as a significant and unavoidable impact.

AREAS OF NO PROJECT IMPACT

In June 2018, the City conducted an Initial Study to determine significant effects of the proposed project. In the course of this evaluation, certain impacts of the proposed project were found to not to be significant because of the inability of a project of this scope to create such impacts or the absence of project characteristics producing effects of this type. The effects determined not to be significant are not required to be included in primary analysis sections of the Draft EIR. As such, the following impacts either are not applicable to the proposed project or are not reasonably foreseeable and are not addressed further within this section (refer to Section 10.0, EFFECTS FOUND NOT TO BE SIGNIFICANT):

- *Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.*

5.5.4 POTENTIAL IMPACTS AND MITIGATION MEASURES

METHODOLOGY

SHN staff reviewed all project-related information provided by the applicant, as well as geologic maps and information available from Shasta County and the City of Redding. Evaluation of the potential impacts are based on information obtained from the Shasta County USDA Soil Survey, the *Geotechnical Report Mercy Wellness Center*, prepared by CGI Technical Services, Inc. (April 2016), and applicable City of Redding policies and codes, the California Building Code, as well as field visits.

Geology and soil impacts are analyzed below according to topic. Mitigation measures directly correspond with an identified impact.

IMPACT 5.5-1	***Implementation of the proposed project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault; strong seismic ground shaking; seismic-related ground failure, including liquefaction; and landslides.***

Significance: Less Than Significant Impact.

Impact Analysis: The following discussion addresses potential onsite impacts associated with seismic activity.

Earthquake Fault / Seismic Ground Shaking

Earthquakes on any of the region's active or potentially active faults could produce moderate to strong ground shaking on the proposed project site, depending on the magnitude and location of the seismic event. However, it is possible that earthquakes on unmapped faults or very large magnitude events could result in strong ground shaking at the site that could damage structures and infrastructure in the vicinity of the proposed project.

The proposed project site is not located within an Alquist-Priolo Earthquake Fault Zone and no active faults have been identified to pass through the project site. The potentially active Battle Creek fault is mapped approximately 16 miles south of the project site. The closest known active fault, as zoned by the State, is the Hat Creek-McArthur fault, located approximately 48 miles northeast of the site. The risk of surface fault rupture beneath the proposed project is considered negligible, however, damage could result were an earthquake of a large or very large magnitude would occur on one of these active faults, regardless of distance.

Soil conditions modeled in the deterministic studies consisted of stiff soils[1]. The site could be subjected to horizontal ground accelerations of at least 0.16g from the rupture of continental faults. The relatively infrequent Cascadia Subduction Zone events are estimated to produce a peak horizontal ground acceleration of up to 0.5g. The peak ground acceleration for the proposed project for an earthquake with a 10 percent probability of exceedance within a 50-year period is 0.20g. The hazard of strong seismic ground shaking is not significantly different than other parcels within the City.

The proposed project site is located in an area designated in the Health and Safety Element of the *General Plan* as having low ground-shaking potential from earthquakes. Project design and construction must conform to CBC seismic safety standards, which are based on factors such as occupancy type, the types of soil and rock onsite, and the strength of ground motion with a specified probabilities of occurrence at the site. The CBC is updated on a three-year cycle; the current 2016 CBC took effect in January 2017. Because the City requires a geotechnical report as part of the building permit process, and the building must be designed to meet seismic standards consistent with the CBC, this impact would not exacerbate seismic ground shaking risks onsite. Impacts are considered *less than significant*.

[1] "Stiff soil" is geotechnical term related to the consistency of fine-grained soils (clay).

Lateral Spreading

Lateral spreading is defined as lateral earth movement of liquefied soils, or soil riding on a liquefied soil layer, down slope toward an unsupported slope face, such as a creek bank, or an inclined slope face. The site is underlain by dense to very dense granular soils. Because of the grain size characteristics and relative density of the sediments, these materials are considered to have a low potential for liquefaction during a seismic event. Therefore, the proposed project does not have the potential to exacerbate lateral spreading risks in the area. Impacts are considered *less than significant*.

Seismic Inducted Settlement

Another potentially adverse secondary seismic effect is co-seismic compaction of moderately consolidated, sandy, relatively cohesionless soils above or below groundwater. Co-seismic compaction is soil densification resulting from dynamic loading of relatively loose, non-cohesive soil materials. That is, shaking or vibration can densify loose to moderately consolidated granular soils, resulting in settlement of the ground surface. Onsite soils are reported to be very dense granular soils and soils encountered during the investigation are estimated to have a low potential for seismic induced settlement under the anticipated seismic ground motions at the site. Therefore, the proposed project does not have the potential to exacerbate seismic induced settlement risks in the area. Impacts are considered *less than significant*.

Liquefaction

Liquefaction potential is a combination of unconsolidated soil type and high groundwater combined with high potential for seismic activity. The proposed project is underlain by predominately cobbly alluvial soil and reiff fine sandy loam, most of which are dense to very dense, and due to the grain size, characteristics, and density of the soils have low potential for liquefaction. Due to these conditions, liquefaction hazards pose a low risk to the proposed project site. Additionally, the risk of adverse effects from secondary seismic effects, such as lateral spreading, occurring during a large earthquake event is negligible. Therefore, the proposed project does not have the potential to exacerbate liquefaction risks in the area. Impacts are considered *less than significant*.

Landslides

The proposed project is located on a relatively flat parcel surrounded by similar terrain. No signs of landslides, either former or impending, were observed on or adjacent to the proposed project site. No impacts would occur in this regard.

Mitigation Measures: No mitigation measures are required.

Level of Significance After Mitigation: No mitigation measures are required. Impacts would be *less than significant*.

IMPACT 5.5-2	***The proposed project is not located on soil that has potential to be substantially expansive.***

Significance: Less Than Significant Impact.

Impact Analysis: Expansive soils swell when wet and shrink as they dry. The *Geotechnical Report Mercy Wellness Center* identifies soils within the project area with a low to moderate expansion potential. According to mapping performed by the Natural Resources Conservation Service, the site is underlain by soils of cobbly alluvial soil, reiff fine sandy loam, and riverwash. The soils on the property have been tested and have low to very low plasticity (CGI, 2016). Additionally, structures proposed on the project site are required by State law and City ordinance to be constructed in accordance with the latest edition of the CBC. With compliance with State and local regulations, the proposed project does not have the potential to exacerbate risks associated with expansive soils. Impacts would be *less than significant*.

Mitigation Measures: No mitigation measures are required.

Level of Significance After Mitigation: No mitigation measures are required. Impacts would be *less than significant*.

5.5.5 CUMULATIVE SETTING, IMPACTS, AND MITIGATION MEASURES

The analysis of cumulative impacts focuses on those effects that, when combined together with other similar activities or projects could result in a large enough effect or impact that would be considered cumulatively significant. If the individual project's contribution is substantial enough, it may be considered cumulatively significant. In some instances, a project-specific impact may not combine with effects from other activities, in which case, the project's contribution to a cumulative effect would be less than considerable.

Development projects are analyzed on an individual basis and must comply with established requirements of the City of Redding and the California Building Standards Code as they pertain to protection against known geologic hazards and potential geologic and soil-related impacts. Analysis of cumulative impacts takes into consideration the entirety of impacts that the projects discussed in Section 4.0, BASIS OF CUMULATIVE ANALYSIS, would have on geologic resources. This geographic extent is appropriate as geology and soil-related impacts are generally site-specific and are determined by a particular site's soil characteristics, topography, and proposed land uses.

IMPACT 5.5-3	***Implementation of the proposed project, combined with future development, would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault; strong seismic ground shaking; seismic-related ground failure, including liquefaction; and landslides.***

Significance: Less Than Significant Impact.

Impact Analysis: With regard to the proposed project's potential to expose people or structures to hazards associated with the rupture of a known earthquake fault or from strong seismic ground shaking, damage to onsite structures and facilities could occur from direct rupture of a fault in the project site, however, the proposed project is located outside of known fault traces. In the event of an earthquake

and seismic ground shaking, the proposed project would be designed to comply with all applicable City standards and the CBC requirements. Therefore, this potential impact is not cumulatively considerable and would not be expected to combine with similar impacts of past, present, or reasonably foreseeable projects to result in a cumulative impact related to exacerbating the risk of earthquake fault rupture or strong seismic ground shaking.

With regard to the proposed project's potential to expose people or structures to hazards associated with seismic-related ground failure, including liquefaction, it is unlikely for liquefaction to occur at the project site because density of onsite soils have low potential for liquefaction. As previously described above, the proposed project would be designed to comply with all applicable City standards and the CBC requirements and it is expected that the same or similar requirements would be placed on all other cumulative projects. Therefore, this potential impact is not cumulatively considerable and would not be expected to combine with similar impacts of past, present, or reasonably foreseeable projects to result in a cumulative impact related to exacerbating seismic-related ground failure or liquefaction in the area.

Regarding the proposed project's potential to expose people or structures to hazards associated with landslides, the proposed project is not mapped in a landslide area, the project site is relatively flat, and the project site is not adjacent to any area susceptible to landslides. Therefore, this potential impact is not cumulatively considerable and the proposed project would not have the potential to combine with similar impacts of past, present, or reasonably foreseeable projects to result in a cumulative impact related to exacerbating the risk of landslides.

Mitigation Measures: No mitigation measures are required.

Level of Significance After Mitigation: No mitigation measures are required. Impacts related to rupture of a known earthquake fault; strong seismic ground shaking; seismic-related ground failure, including liquefaction; and landslides would be cumulatively *less than significant*.

IMPACT 5.5-4	***Implementation of the proposed project, combined with future development, would not result in cumulative impacts related to expansive soils.***

Significance: Less Than Significant Impact.

Impact Analysis: With regard to the proposed project's potential to place buildings and support infrastructure on soil that is unstable or expansive, the soils within the project area with a low to moderate expansion potential. The proposed project would be designed to comply with all applicable City standards and CBC requirements. All other cumulative projects would be expected to conform to the same or similar standards and implement mitigation to reduce associated impacts to less than significant. Therefore, this potential impact is not cumulatively considerable and would not have the potential to combine with similar impacts of past, present, or reasonably foreseeable projects to exacerbate expansive soil risks in the area.

Mitigation Measures: No mitigation measures are required.

Level of Significance After Mitigation: No mitigation measures are required. Impacts related to expansive soils would be cumulatively *less than significant*.