4.6 GEOLOGY, SOILS, AND SEISMICITY

This section summarizes information on the geology, soils, and seismic hazards in the Specific Plan Area and evaluates the Project's potential environmental impacts as they relate to geology, soils, and seismic hazards.

A. Regulatory Framework

This section summarizes existing local and State law and regulations related to geology, soils, and seismic hazards that are relevant to this analysis.

1. State Laws and Regulations

a. Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed by the California Legislature in 1972 to mitigate the hazard of surface faulting to structures used for human occupancy. [1] The main purpose of the Act is to prevent the construction of such structures on top of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards, such as ground shaking or landslides.

The Act requires the State Geologist to establish regulatory zones (known as Earthquake Fault Zones or Alquist-Priolo Zones) around the surface traces of active faults, and to issue appropriate maps of these zones. The maps are then distributed to all affected cities, counties, and State agencies for their use in planning and regulating new or renewed construction. In general, the construction of structures intended for human occupancy within 50 feet of an active fault trace is prohibited. Based on a review of State-published maps and related indices, no Alquist-Priolo Earthquake Fault Zones have been mapped in the City of Tracy nor have any been mapped in the vicinity of the City.[2]

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[1] California Geological Survey (CGS), Alquist-Priolo Earthquake Fault Zones, http://www.conservation.ca.gov/CGS/rghm/ap/Pages/Index.aspx, accessed on February 15, 2013.

[2] California Geological Survey (CGS) Alquist-Priolo Earthquake Fault Zone Maps, http://www.quake.ca.gov/gmaps/ap/ap_maps.htm and http://www.consrv.ca.gov/cgs/rghm/ap/Pages/affected.aspx, accessed on February 15, 2013.

b. Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 addresses certain earthquake hazards other than surface fault rupture. These hazards include liquefaction and seismically-induced landslides. In practice, these seismic hazard zones are mapped by the California Geological Survey's (CGS's) Seismic Hazards Zonation Program to assist local governments in land use planning. The Act states that "it is necessary to identify and map seismic hazard zones in order for cities and counties to adequately prepare the safety element of their general plans and to encourage land use management policies and regulations to reduce and mitigate those hazards to protect public health and safety."[3] Section 2697(a) of the Act states that "cities and counties shall require, prior to the approval of a project located in a seismic hazard zone, a geotechnical report defining and delineating any seismic hazard."

According to the Seismic Hazards Zonation Program web site,[4] no seismic hazard zone maps have been compiled for the Midway CA and Tracy CA 7.5-minute quadrangles. Together, these two US Geological Survey (USGS) topographic maps embrace all of the Specific Plan Area.

c. California Building Code

The California Building Code (CBC), known as the California Building Standards Code, is included in Title 24 of the California Code of Regulations. The CBC in-corporates the International Building Code, a model building code that has been adopted across the United States.

The CBC is updated every three years, and the current 2010 CBC took effect January 1, 2011. Through the CBC, the State provides a minimum standard for building design and construction. The CBC contains specific requirements for seismic safety, excavation, foundations, retaining walls, and site

[3] California Public Resources Code, Division 2, Chapter 7.8, Article 7.8, Section 2691(c).

[4] California Geological Survey, Seismic Hazards Zonation Program, http://gmw.consrv.ca.gov/shmp/html/pdf_maps_no.html, accessed on February 15, 2013.

demolition. For example, the CBC requires the assignment of a Seismic Design Category to each proposed structure, and this category will be reflected in the building's structural design. The category assignment process considers a variety of seismic-related factors, including the expected force of an earthquake in the general vicinity of the structure, the soil type beneath the structure, and the anticipated type of occupancy. In addition to these seismic concerns, the CBC also regulates grading activities, including drainage and erosion control. Chapter 9.04 of the City of Tracy Municipal Code has adopted the 2010 California Building Code by reference.[5]

2. Local Regulations and Policies

a. City of Tracy General Plan

The Safety Element of the City of Tracy General Plan includes several policies that are relevant to geology, soils, and seismic hazards.[6] These policies are listed in Table 4.6-1 below. A full list of General Plan goals, policies, and objectives are set forth in Appendix C.

b. City of Tracy Municipal Code

i. Chapter 12.04, Adoption of Codes

In accordance with Title 9, Chapter 9.04, Section 9.04.030 of the City of Tracy Municipal Code, the City has adopted the 2010 CBC, Volumes 1 and 2, by reference. As previously noted, the CBC contains specific requirements for seismic safety, excavation, foundations, retaining walls, and site demolition.

B. Existing Conditions

The following section describes and discusses the existing conditions within the Specific Plan Area and vicinity, including the regional and local geologic setting as well as soils and seismic considerations.

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[5] City of Tracy Municipal Code, Chapter 9.04, http://library.municode.com, accessed February 15, 2013.

[6] City of Tracy General Plan, adopted February 1, 2011.

TABLE 4.6-1 **TRACY GENERAL PLAN POLICIES RELEVANT TO GEOLOGY, SOILS, AND SEISMICITY**

Goal/ Policy No.	Goal/Policy Content
Safety Element	
Goal SA-1	A reduction in risks to the community from earthquakes and other geologic hazards.
Objective SA-1.1	*Minimize the impacts of geologic hazards on land development.*
Policy P1	Underground utilities, particularly water and natural gas mains, shall be designed to withstand seismic forces.
Policy P2	Geotechnical reports shall be required for development in areas where potentially serious geologic risks exist. These reports should address the degree of hazard, design parameters for the Project based on the hazard, and appropriate mitigation measures.
Objective SA-1.2	*Implement measures related to site preparation and building construction that protect life and property from seismic hazards.*
Policy P1	All construction in Tracy shall conform to the California Building Code and the Tracy Municipal Code including provisions addressing unreinforced masonry buildings.

Source: City of Tracy General Plan, 2011.

1. Seismicity

The Earth's crust includes tectonic plates that locally collide with or slide past one another along plate boundaries. California is particularly susceptible to such plate interactions, notably the largely horizontal or "strike-slip" movement of the Pacific Plate as it impinges on the North American Plate. In general, earthquakes occur when the accumulated stress along a plate boundary or fault is suddenly released, resulting in seismic slippage. This slippage can vary widely in magnitude, ranging in scale from a few millimeters or centimeters, to tens of feet.

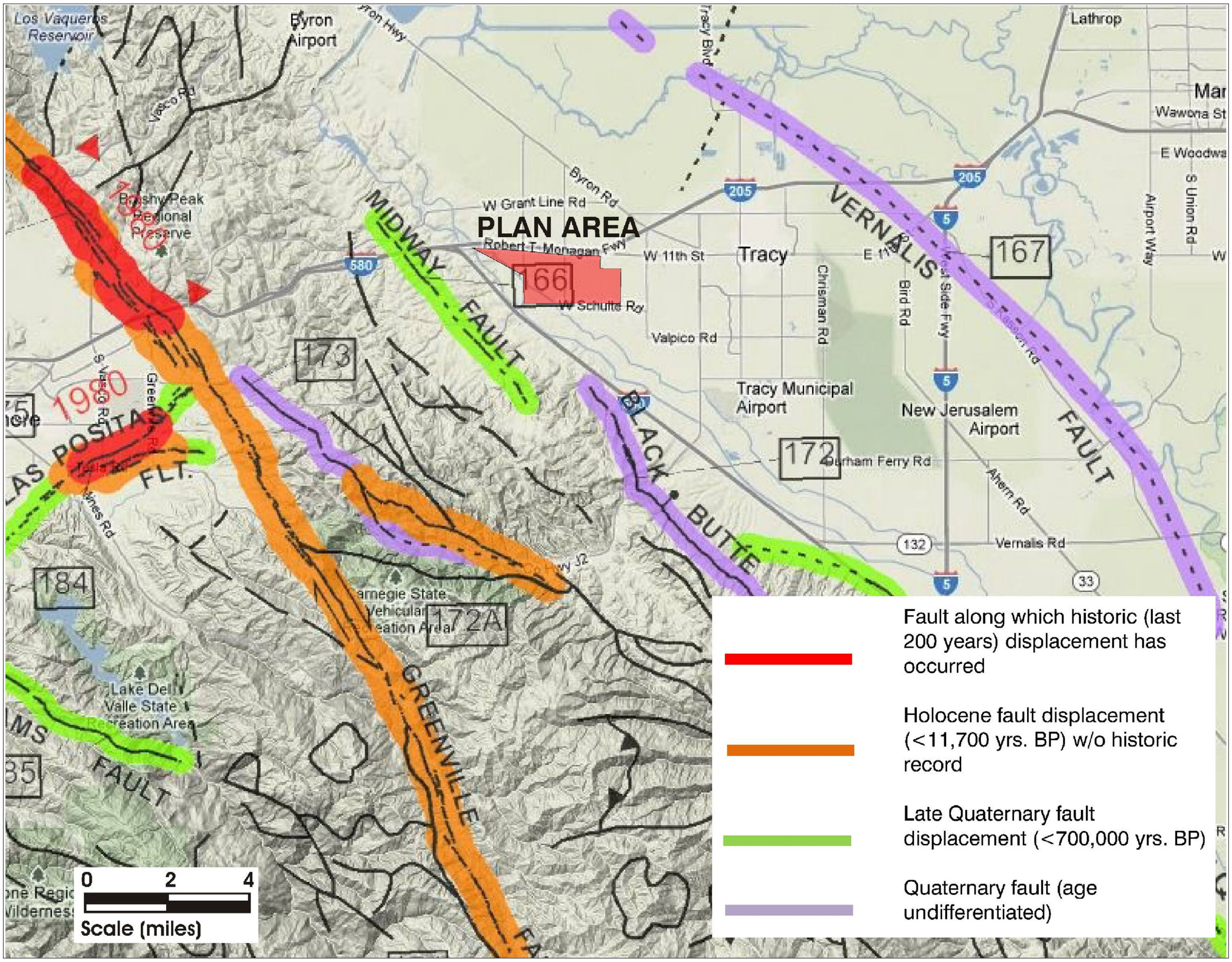
The performance of man-made structures during a major seismic event depends on a number of factors: location with respect to active fault traces or areas prone to liquefaction or seismically-induced landslides; the type of building construction (i.e. wood frame, unreinforced masonry, non-ductile concrete frame); the proximity, magnitude, and intensity of the seismic event itself; and other variables. In general, evidence from past earthquakes shows that wood frame structures tend to perform well especially when their foundations are properly designed and anchored. Older, unreinforced masonry structures, on the other hand, tend not to perform as well, especially if they have not undergone appropriate seismic retrofitting. Applicable building code requirements, such as those found in the City of Tracy Municipal Code, include seismic requirements that are designed to ensure the satisfactory performance of building materials under prescribed seismic conditions.

a. Faults

The City of Tracy, like much of the neighboring San Francisco Bay Area, is vulnerable to seismic activity due to the presence of several active earthquake faults in the region. The closest, and most prominent active faults near the City that have historically been the source of earthquakes felt in the vicinity of the Specific Plan Area include the San Andreas, Calaveras, Hayward, and Greenville Faults. Of these, the Greenville Fault is closest. Its mapped trace is as close as 8.8 miles west of the Specific Plan Area.

In addition to prominent earthquake faults in the region, several faults with evidence of Quaternary activity (i.e., within the past 1.6 million years) have been identified in the vicinity of the Specific Plan Area. Figure 4.6-1 shows the location of these faults as mapped by the CGS. Two such faults have been identified within a roughly 2-mile radius of the Specific Plan Area:[7] the Midway Fault, whose trace passes as close as 1.6 miles southwest of the Specific Plan Area; and the Black Butte Fault, whose northernmost extent lies approximately 2.1 miles south of the Specific Plan Area. Neither fault is considered "active" (i.e., displaying evidence of surface displacement within Holocene time) by the CGS, a threshold that would trigger evaluation under the Alquist-Priolo Earthquake Fault Zoning Act, as would potentially active

[7] US Geological Survey (USGS), California Quaternary Faults, online database, http://geohazards.usgs.gov/qfaults/ca/California.php, accessed February 18, 2013.



Source: California Geological Survey (CGS), 2010 Fault Activity Map of California, Geologic Data Map No. 6.

FIGURE 4.6-1

REGIONAL FAULTS

faults whose characteristics are "sufficiently active" and "well-defined" so as to require zoning under the Act.[8] Thus, both of these faults are regarded as "potentially active," although their fault rupture risk does not rise to the level that would require zoning under the Alquist-Priolo Earthquake Fault Zoning Act. The closest Alquist-Priolo zone is the one associated with the Greenville fault zone, a right-lateral, strike-slip fault that exhibited minor surface fault rupture as recently as January 1980.[9] The trace of this fault zone lies as close as 8.8 miles west of the Specific Plan Area.

2. Geology

In addition to proximity to active earthquake faults, the characteristics of the soil that underlies a community also influences the severity of potential seismic hazards. The Specific Plan Area is located on the west edge of the Central Valley, an important geomorphic province that trends northwest-southeast, lying between the Sierra Nevada Mountains to the east and the Coast Ranges to the west. The Central Valley represents a deep sedimentary trough, and it spans a length of more than 400 miles through the geographic center of the state. In turn, the Coast Range province is comprised of a series of parallel, linear ranges separated by structural depressions. The Diablo Range, which lies immediately west of the Specific Plan Area, is the easternmost of these linear ranges. Numerous faults and shear zones are present in the ranges, the most prominent of which is the San Andreas Fault system.

The landform of the Specific Plan Area vicinity is typified by very flat topography, with typical slopes of less than 1 degree.[10] Based on a review of topographic maps in the vicinity of the Specific Plan Area, surface water flow is

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[8] California Geological Survey (CGS), Fault-Rupture Hazard Zones in California, Special Publication 42, Interim Revision 2007.

[9] Bryant, W.A. and Cluett, S.E., Compilers, 2002, Greenville Fault Zone, Marsh Creek-Greenville Section, Quaternary Fault and Fold Database of the United States, US Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults, accessed February 18, 2013.

[10] US Geological Survey (USGS), Midway and Tracy 7.5-minute quadrangle maps, 1:24,000 scale.

generally directed to the northeast. In the vicinity of the Specific Plan Area, the otherwise natural drainage pattern is intersected by two prominent, engineered features. The Delta-Mendota Canal is a nearly 120 mile-long aqueduct that is part of the Central Valley Project.[11] Its function is to restore water to the San Joaquin River drainage that has been diverted at upstream locations to the southeast, notably, the Friant Dam located roughly 15 miles northeast of Fresno, California. The second feature is the California Aqueduct, part of the California State Water Project (SWP). At nearly 450 miles in length, the aqueduct is a key part of the nation's largest state-built water and power development and conveyance system.[12] One important role of the aqueduct is the transfer of water from the Sacramento Delta in north-central California for agricultural use and domestic consumption elsewhere in Central and Southern California.

3. Seismic and Geologic Hazards

a. Ground Shaking

Seismically-induced ground shaking has the potential to produce various types of ground failure, including liquefaction, settlement, lateral spreading, lurch-cracking and earthquake-induced landslides. When the very flat topography of the Specific Plan Area is considered, the likelihood of landsliding and slumping is judged to be low. The other four ground failure phenomena are described in greater detail below:

- Liquefaction refers to the loss of soil strength resulting from seismic forces acting on water-saturated fine-grained soil. This weakening of the soil can make it temporarily behave like a fluid (a.k.a. “quicksand”).
- Settlement or subsidence refers to the compaction of soils and alluvium as a result of ground shaking. Compaction typically occurs in places that are underlain by soft, water-saturated, low-density alluvial material.

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[11] San Luis and Delta-Mendota Water Authority website, http://www.sldmwa.org/, accessed on February 15, 2013.

[12] California Department of Water Resources, California State Water Project Overview, http://www.water.ca.gov/swp/index.cfm, accessed on February 18, 2013.

- Lurch-cracking refers to fractures, cracks, and fissures that can arise from ground shaking, and the resultant settlement of poorly consolidated soil or fill. Lurch-cracking can occur many miles from an earthquake's epicenter. The potential for lurch-cracking is greatest in areas where the water table is high and the earth materials are poorly consolidated.
- Lateral spreading is the horizontal movement or spreading of soil toward an exposed face such as a stream bank, an embankment, or the side of a levee. Areas most likely to be affected are artificial fill deposits that were poorly engineered or that have steep and unstable embankments.

In general, seismically-induced ground shaking is the cause of most earthquake damage. The intensity of ground shaking can be several times greater at sites underlain by thick deposits of saturated, unconsolidated sediments compared to sites that are underlain by bedrock.

When earthquake faults within the San Francisco Bay Area were considered, the USGS recently estimated that the probability of a magnitude (M) 6.7 or greater earthquake prior to year 2032 is 62 percent, or roughly a two-thirds probability over this timeframe.[13] The forecasted probability for individual faults to produce a M 6.7 or greater seismic event by the year 2032 was 27 percent for the Hayward Fault and 21 percent for the San Andreas Fault. By contrast, the corresponding probability for the closest active fault to the Specific Plan Area, the Greenville Fault, was only 3 percent. Thus, significant ground shaking within the Specific Plan Area is much more likely to be caused by earthquakes on faults situated at least 25 to 40 miles to the west.

b. Fault Rupture

Primary fault rupture can occur along fault traces during seismic events. Because no active faults have been identified within the Specific Plan Area or in its immediate vicinity, the risk from primary fault rupture is considered low.

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[13] US Geological Survey (USGS), San Francisco Region Earthquake Probability, http://earthquake.usgs.gov/regional/nca/wg02/images/percmap-lrg.html, accessed February 18, 2012.

c. Liquefaction

Liquefaction generally occurs in areas where moist, fine-grained, cohesion-less sediment, or fill material are subjected to strong, seismically-induced ground shaking. Under certain circumstances, the ground shaking can temporarily transform an otherwise solid material to a fluid state. Liquefaction is a serious hazard because buildings in areas that experience liquefaction may subside and suffer major structural damage. Liquefaction is most often triggered by seismic shaking, but it can also be caused by improper grading, landslides, or other factors. In dry soils, seismic shaking may cause soil to consolidate rather than flow, a process known as densification.

The potential for liquefaction is greater in certain geologic and hydrologic environments that may be characterized by loosely consolidated, silty sediments together with shallow groundwater. In the vicinity of the Specific Plan Area, the sediments most susceptible to liquefaction include Holocene (less than 10,000-year-old) delta, river channel, flood plain, and aeolian deposits, and poorly compacted fills. By contrast, dense soils, including well-compacted fills, are less susceptible to liquefaction.

To date, the Seismic Hazards Zonation Program of the CGS has not identified any seismically-induced liquefaction zones in the City of Tracy or in the Specific Plan Area, although the US Department of Agriculture has mapped the soils in the vicinity of the Specific Plan Area as finely to moderately textured (equivalent to sandy or silty clay, to silty clay loam or clay loam).[14] Under certain circumstances, these fine-grained soils could be prone to liquefaction.

A site-specific geotechnical study has been conducted at the Specific Plan Area (See Appendix G). Given its scope, level of detail, and specificity, this evaluation is considered the most reliable indicator of liquefaction potential.[15] The

[14] US Department of Agriculture, Soil Conservation Service, *Soil Survey of San Joaquin County*, issued October 1992.

[15] KC Engineering Company, 2000, *Geotechnical Investigation Report on Cordes Ranch.*

investigation included the drilling, sampling, and testing of 61 exploratory borings that spanned the length and breadth of the central part of the Specific Plan Area. The data used to evaluate liquefaction potential included in-situ Standard Penetration tests, grain-size distribution, soil density, in-situ moisture content, groundwater levels, proximity to active faults, and forecasted ground surface acceleration. Based on the field and laboratory tests and observations, the report concluded that the soils at the Specific Plan Area site do not meet the criteria for liquifiable soils and the potential for liquefaction was considered "low to nil."

d. Landslides and Ground Failure

Landslides are gravity-driven movements of earth materials that may include rock, soil, unconsolidated sediment, or combinations of such materials. The rate of land-slide movement can vary widely. Some move rapidly, as in a soil or rock avalanche, while other landslides creep or move slowly for extended periods of time. The susceptibility of a given area to landslides depends on many variables, although the general characteristics that influence landslide hazards are well understood. The factors that influence the probability of a landslide and its relative level of risk include the following:

- Slope Material: Loose, unconsolidated soils and soft, weak rocks are more hazardous than are firm, consolidated soils or hard bedrock.
- Slope Steepness: Most landslides occur on moderate to steep slopes.
- Structure and Physical Properties of Materials: This includes the orientation of layering and zones of weakness relative to slope direction.
- Water Content: Increased water content increases landslide hazard by decreasing friction and adding weight to the materials on a slope.
- Vegetation Coverage: Abundant vegetation with deep roots promotes slope stability.
- Proximity to Areas of Erosion or Man-made Cuts: Undercutting slopes can greatly increase landslide potential.

- **Earthquake Ground Motions:** Strong seismic ground motions can trigger landslides in marginally stable slopes or loosen slope materials. Such motions can also increase the risk of future landslides.

Considering the prevailing flat topography, the landslide risk in the Specific Plan Area, is considered very low. The site-specific geotechnical investigation concurred, stating that some limited potential for slope instability risk exists for grading and construction activities, where slopes could be over-steepened.[16] The report concluded that cut and fill slopes should remain stable if slopes are no steeper than 2:1.

e. Land Subsidence

Land subsidence, or settlement, is a lowering of the ground surface that can be caused by a variety of factors. Typically, subsidence occurs in areas underlain by highly compressible soils such as soft clays or silts and unconsolidated sand or fill material. The aforementioned geotechnical investigation concluded that the soil types present were not compressible or otherwise prone to settlement.

Although it is not directly related to the soils or sediments in the Specific Plan Area, regional subsidence throughout the San Joaquin Valley and Sacramento River Delta is a well-known phenomenon that is generally ascribed to long-term groundwater over-extraction (i.e., overdraft) and the decomposition of organic-rich sediments. Regional subsidence is being addressed through a comprehensive monitoring program overseen by the USGS's California Water Science Center (CAWSC) as well as improved groundwater resource management.[17]

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[16] KC Engineering Company, 2000, *Geotechnical Investigation Report on Cordes Ranch*.

[17] US Geological Survey (USGS), California Water Science Center (CAWSC), http://ca.water.usgs.gov/index.html, accessed on February 19, 2013.

f. Expansive Soil

Expansive soils can change dramatically in volume depending on moisture content. When wet these soils can expand and when dry they can shrink. Sources of moisture that can trigger this shrink-swell phenomenon include seasonal rainfall, landscape irrigation, utility leakage, and/or perched groundwater. Expansive soil can exhibit wide cracks in the dry season, and changes in soil volume have the potential to damage concrete slabs, foundations, and pavement. Special building/structure design or soil treatment are often needed in areas with expansive soils. Expansive soils are typically very fine grained with a high to very high percentage of clay, typically montmorillonite, smectite, or bentonite clay.

The 1992 US Department of Agriculture (USDA) soil survey of San Joaquin County mapped the soils in the vicinity of the Specific Plan Area as the Capay-Stomar-Zacharias soil unit.[18] This study concluded that where buildings are planned on this soil type, structural damage could result due to the soil's high shrink-swell potential and that these limitations should be considered when foundations and buildings are designed. The geotechnical investigation of the Specific Plan Area arrived at similar findings, stating "the site's existing foundation soils are considered to be highly to critically expansive and subject to volume changes due to moisture fluctuations."[19] The report also recommended mitigation through standard grading practices and/or modifications to the proposed foundation depths and loading.

C. Standards of Significance

The proposed Project would have a significant impact with regard to geology and soils if it would:

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[18] US Department of Agriculture, Soil Conservation Service, Soil Survey of San Joaquin County, issued October 1992.

[19] KC Engineering Company, 2000, *Geotechnical Investigation Report on Cordes Ranch.*

1. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:
   - 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.
   - Strong seismic ground shaking.
   - Seismic-related ground failure, including liquefaction.
   - 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, creating substantial risks to life or property.
5. 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.

D. Impact Discussion

1. Project Impacts

a. Exposure of People or Structures to Potential Substantial Adverse Effects, Including the Risk of Loss, Injury or Death Involving:

i. Rupture of a Known Earthquake Fault, as Delineated on the Most Recent Alquist-Priolo Earthquake Fault Zoning Map Issued by the State Geologist for the Area or Based on Other Substantial Evidence of a Known Fault.

Primary fault rupture occurs along the traces of active earthquake faults. As previously discussed, the Specific Plan Area is not located within an Alquist-Priolo Earthquake Fault Zone nor have any such zones been identified in the vicinity. No active earthquake faults have been identified in the Specific Plan

Area, and fault rupture is unlikely to occur. As a consequence, the Specific Plan Area is not considered susceptible to the risk of loss, injury, or death due to fault rupture and the associated impacts would be *less than significant*.

ii. Strong Seismic Ground Shaking

Considering the forecasted probability of earthquakes along the prominent active faults in the region, and the proximity of those faults to the Specific Plan Area, strong seismic ground shaking could occur within the Specific Plan Area during a major seismic event. Ground shaking notwithstanding, the City of Tracy's existing building permit process, together with adherence to the California Building Code requirements (adopted by reference in the City's Municipal Code), would help ensure that any new buildings within the Project would incorporate appropriate seismic design criteria, thereby affording the building occupants an added measure of safety. In addition, the City's Development Review process, described in Chapter 3 (Project Description, Section E), as well as the City's building permit process, would ensure that development would proceed in adherence to the applicable requirements. In light of these protections, the development of the Project would result in a *less than significant* impact related to the risk of loss, injury, or death due to strong seismic ground shaking.

iii. Seismic-Related Ground Failure, Including Liquefaction

As previously discussed, the Seismic Hazards Zonation Program of the CGS has not identified any seismically-induced liquefaction zones in the City of Tracy or in the Specific Plan Area. More specifically, a detailed geotechnical investigation of the Specific Plan Area concluded that the soils at the Specific Plan Area site did not meet the criteria for liquifiable soils and the potential for liquefaction was considered "low to nil." Considering the findings of this study, the Specific Plan Area is not considered susceptible to the risk of loss, injury, or death due to seismic-related ground failure including liquefaction and the associated impacts of full buildout of the Project would be *less than significant*.

iv. Landslides

Considering the prevailing flat topography, the landslide risk in the Specific Plan Area is considered very low. The site-specific geotechnical investigation concurred, stating that due to the flat-lying nature of the site and the minimal topographic relief, "landsliding and/or slumping are not expected to occur." Some limited potential for slope instability risk could arise during grading and construction activities, where slopes could be over-steepened. This risk is mitigated by adhering to relevant California Building Code requirements for grading as well as adhering to the geotechnical report recommendations regarding maximum steepness for cut and fill slopes. Given these safeguards, the risk of loss, injury, or death the risk of loss, injury, or death due to landslides is considered very low and the impacts associated with full buildout of the Project would be *less than significant.*

b. Substantial Soil Erosion or the Loss of Topsoil

Construction activities during full buildout of the Project could result in the loss of topsoil and soil erosion. However, construction activities in the Specific Plan Area would be required to adhere to the applicable grading requirements in the then-current California Building Code. Furthermore, such construction would be regulated under a construction-related stormwater control permit, generally administered by the State Water Resources Control Board (SWRCB), as described more fully in Chapter 4.9 (Hydrology and Water Quality). The SWRCB's Construction General Permit (CGP) requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) that describes the BMPs that would be used to prevent erosion and protect storm water runoff. The construction of new buildings and structures as part of the Project would also create new impervious areas, such as sidewalks, driveways, parking lots, and rooftops. These impervious areas often result in increased stormwater runoff which can exacerbate soil erosion. As discussed more fully in Chapter 4.9 (Hydrology and Water Quality), the Project would be subject to the City of Tracy's Storm Water Management Program and the City's Stormwater Quality Control Standards that require the design and implementation of a range of stormwater control measures that include: general site design control measures, site-specific source control measures, treatment measures, and other controls. Without imposition of these controls and safeguards, the Project's impacts associated with substantial soil erosion and loss of topsoil would be *significant.*

c. Location 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

As previously discussed in this chapter, a site-specific geotechnical investigation performed concluded that the soils underlying the Specific Plan Area were not compressible or otherwise prone to settlement. Typically, subsidence occurs in areas underlain by soils that are highly compressible, such as soft clays or silts and unconsolidated sand or fill material. Thus, development of the Project would have a *less than significant* impact relative to geologically unstable soils.

d. Location on Expansive Soil, Creating Substantial Risks to Life or Property

As previously noted, USDA soil surveys of San Joaquin County, as well as a site-specific geotechnical investigation, both concluded that the soils beneath the Specific Plan Area are highly expansive and subject to significant volume changes due to moisture fluctuations. The geotechnical study emphasized the need to follow the investigation report recommendations concerning foundation design, provisions to reduce foundation or flatwork damage, and preventative measures regarding the wetting of foundation soils.

Additional safeguards are provided by California Building Code requirements (adopted by the City of Tracy Municipal Code) and the City's building permit program. Per the CBC, geotechnical studies are required prior to the construction of buildings in areas where significant geologic risks exist, such as the presence of highly expansive soils.[20] Chapter 18, Section 1803.1.1.2 of the CBC requires the conduct of a soil investigation where critically expan-

[20] 2010 California Building Code, Volumes 1 and 2, effective date January 1, 2011.

sive soils are known to be present. In this circumstance, the investigation report must develop recommendations for corrective action to prevent structural damage to the proposed buildings. Furthermore, the CBC also requires the implementation of these recommendations as part of the building permit approval process. Thus, compliance with the CBC and implementation of the geotechnical recommendations would ensure that Project impacts related to expansive soils would be *less than significant*.

e. 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

The Project would be served by the City of Tracy's wastewater treatment plant, which is managed by the City's Utilities Division in the Public Works Department and their wastewater facilities. Chapter 4.15, Utilities and Service Systems, of this Draft EIR contains a discussion of the City's wastewater infrastructure. No septic tanks or alternative wastewater disposal systems would be required to serve new development in the Specific Plan Area. As a consequence, there would be *no impact*.

2. Cumulative Impacts

This section analyzes potential impacts related to geologic and seismic hazards that could occur from a combination of the proposed Project with other past, present, and reasonably foreseeable projects in the near vicinity. The cumulative assumptions considered in this section are discussed in Chapter 4, Environmental Evaluation, of this Draft EIR. For purposes of this cumulative analysis, the geographic scope is the City of Tracy and its Sphere of Influence (SOI). As development proceeds within the City of Tracy and its SOI, the number of inhabited structures that may be subject to risks from geologic and seismic hazards is likely to increase.

The impacts associated with geology, soils, and seismicity are often site-specific. The Project, as well as other past, present, and foreseeable projects in the vicinity would be subject to similar State and local policies and regulations that govern seismic and geologic hazard impacts. Examples of these policies and regulations include, but are not limited to the City's building permit process and required adherence to the California Building Code, required performance of geotechnical studies where significant site-specific geologic risks are known to be present, and incorporation of geotechnical recommendations into the design and construction of new buildings. Compliance with these requirements at the Project as well as compliance at other past, present, and foreseeable projects in the vicinity, would ensure that the cumulative impacts related to geology, soils, and seismic impacts would be reduced to the maximum extent practicable.

E. Impacts and Mitigation Measures

Impact GEO-1: Without appropriate mitigation measures in place, construction, and operation activities associated with the Project could be associated with substantial soil erosion and loss of topsoil, thereby resulting in a significant impact.

> Mitigation Measure GEO-1: Implement Mitigation Measures HYDRO-1a, HYDRO-1b, HYDRO-2a, HYDRO-2b, and HYDRO-2c as described in Chapter 4.9, Hydrology and Water Quality, of this Draft EIR.
>
> Significance After Mitigation: *Less Than Significant*