5.6 - Geology and Soils

5.6.1 - Introduction

The analysis in this section is based on the Geologic Hazards Investigation prepared by Krazan & Associates, Inc. in June 2012, which included a review of County and State geological hazards mapping. The Geologic Hazards Investigation is provided in Appendix E-1.

5.6.2 - Environmental Setting

Study Area for Project Impacts

The study area for project impacts regarding geology and soils is the Planning Area because potential development under the General Plan and Development Code Update is limited to areas within the Planning Area.

Study Area for Cumulative Impacts

The study area for the analysis of cumulative geologic impacts is the Planning Area as well as areas within one mile of the Planning Area because sedimentation, erosion, and other soils-related effects have the potential to effect areas downstream, downwind, or downhill from within the Planning Area as well as from outside the Planning Area.

Regional Setting

The City of Fresno Planning Area is located along the eastern margin of the southern San Joaquin Valley portion of the Great Valley Geomorphic Province of California. The San Joaquin Valley is bordered to the north by the Sacramento Valley portion of the Great Valley, to the east by the Sierra Nevada, to the west by the Coast Ranges, and to the south by the Transverse Ranges. The San Joaquin sedimentary basin is separated from the Sacramento basin to the north by the buried Stockton arch and associated Stockton Fault. The 450-mile long Great Valley is an asymmetric structural trough that has been filled with a prism of Mesozoic and Cenozoic sediments up to 5 miles thick.

The Sierra Nevada, located east of the San Joaquin Valley, is a gently southwesterly tilted fault block comprised of igneous and metamorphic rocks of pre-Tertiary age that comprise the basement beneath the San Joaquin Valley. The Coast Ranges, located west of the San Joaquin Valley, are comprised of folded and faulted sedimentary and metasedimentary rocks of Mesozoic and Cenozoic age.

The San Joaquin River and the Kings River are the principal rivers in the Planning Area, with the alluvial fans formed by these rivers serving as the predominant geomorphic features in the area. The Planning Area is generally characterized by low alluvial fans and plains, which constitute a belt of coalescing alluvial fans of low relief between the dissected uplands, adjacent to the Sierra Nevada and the valley trough. Recent alluvial fan deposits from streams emerging from highlands surrounding the Great Valley and Pleistocene non-marine sedimentary deposits (Riverbank Formation) composed of older alluvium and dissected fan deposits underlain the subject site area.

Lithology

The thick accumulation of deposits within the San Joaquin Valley range in age from Jurassic to Holocene and include both marine and continental rocks and deposits. The 1965 Geologic Map of California, Fresno Sheet, indicates that the near-surface deposits in the City of Fresno Planning Area consist of Quaternary recent fan deposits and Quaternary Older alluvium (Pleistocene Nonmarine Sedimentary deposits).

The subsurface information obtained in conjunction with previous subsurface investigations performed within the Planning Area indicates that the surface and near-surface deposits generally consist of sandy silts, silty sands, sands, clayey sands, sandy clays, and clayey silts. These observed deposits are consistent with those mapped in the Planning Area.

Structures and Faults

The City of Fresno Planning Area is underlain by a homoclinal series of Cenozoic deposits dipping four to six degrees to the southwest toward the center of the San Joaquin Valley. The contact between the Cenozoic and basement rocks dips nearly eight degrees southwest, or at a slightly greater inclination than does the on-lapping homoclinal Cenozoic sequence. No active faults are mapped within the Planning Area.

Adjacent to the San Joaquin Valley, the Sierra Nevada and Coast Ranges are geologically young mountain ranges that possess active and potentially active fault zones. Major active faults and fault zones occur at some distance to the east, west, and south of the Planning Area.

Numerous active faults are present within the central Coast Ranges west of the Planning Area, including the San Andreas Fault located approximately 61 miles west of the area. The fault is considered active and serves as a primary concern in evaluating seismic hazards throughout western Fresno County. The 684-mile-long San Andreas Fault Zone is the principal element of the San Andreas Fault system, a network of faults with predominately dextral strike-slip displacement that collectively accommodates the majority of relative north-south motion between the North America and Pacific plates. The creeping section of the San Andreas Fault is approximately 61 miles from the Planning Area at its closest point. The San Andreas Fault Zone is considered to be the Holocene and historically active dextral strike-slip fault that extends along most of coastal California from its complex junction with the Mendocino Fault zone to the north, southwest to the northern Transverse Range, and inland to the Salton Sea, where a well-defined zone of seismicity transfers the slip to the Imperial fault along a right-releasing step.

Two major surface-rupturing earthquakes have occurred on the San Andreas Fault in historic time: the 1857 Forth Tejon and 1906 San Francisco earthquakes. Additional historic surface rupturing earthquakes include the unnamed 1812 earthquake along the Mojave section and the northern part of the San Bernardino Mountains section, and a large earthquake in the San Francisco Bay area that occurred in 1838 that was probably on the Peninsula section. Historic fault creep rates are as high as 32 millimeters per year for the 82-mile-long creeping section in central California, with creep rates gradually tapering to zero at the northwestern and southeastern ends of the section.

One of the nearest seismotectonic source is the Great Valley Fault Zone (Coast Ranges-Central Valley boundary zone), located approximately 34 miles west of the Planning Area. The Great Valley Fault zone is the geomorphic boundary of the Coast Ranges and the Central Valley and is underlain by a 300-mile long seismically active fold and thrust belt that has been the source of recent earthquakes, such as the 1983 magnitude 6.5 Coalinga and the 1985 magnitude 6.1 Kettleman Hills earthquakes. Nearly the entire thrust system is concealed or "blind." The basal detachment of this thrust system dips at a shallow angle to the west. East-directed thrusting over ramps in the detachment and west-directed thrusting on backthrusts are responsible for the uplift along the eastern range front of the Coast Ranges. Based on earthquake focal mechanisms, movement on the thrust zone is generally perpendicular to the strike of the geomorphic boundary and trend of the San Andreas Fault system. Shortening along the geomorphic boundary is driven by a component of the Pacific-North American Plate motion that is normal to the plate boundary. The Great Valley Fault Zone is considered the dominant seismic feature with potential for affecting the Planning Area.

The Ortigalita Fault zone is a major Holocene dextral strike-slip fault in the central Coast Ranges that is an eastern part of the larger San Andreas Fault system. The Ortigalita Fault zone is approximately 54 miles west of the Planning Area. The Ortigalita Fault zone extends from roughly 12.4 miles northwest of San Luis Reservoir southeast to the vicinity of Panoche Valley. The Ortigalita Fault zone is characterized by echelon fault traces separated by pull-apart basins. The fault zone is divided into four sections. The Little Panoche Valley section is the southernmost section and is closest to the Planning Area. The Little Panoche Valley section is late Holocene active. Late Quaternary slip rates and recurrence intervals are unknown, although the recurrence interval for the entire Ortigalita Fault zone is about 2,000 to 5,000 years.

Regional structure within the western Sierra Nevada north of the Planning Area is complex and generally consists of blocks separated by steeply eastward-dipping, north, and northwest striking reverse faults of the Foothills Fault system. The Foothills Fault system is located within approximately 32 miles north of the Planning Area. Based on mapping and historical seismicity, the seismicity of the Sierra Nevada foothills has been generally considered low by the scientific community. However, on August 1, 1975, a 5.7 Richter magnitude earthquake occurred near Oroville within the northern Sierra Nevada. Surface rupture along the Cleveland Hill Fault (part of the Foothills Fault System) was associated with the 1975 Oroville earthquake. As a result of this event, numerous studies were undertaken to evaluate further the seismicity of the Sierra Nevada foothills. Of particular note are the geologic and seismicity studies conducted by Woodward-Clyde Consultants (WCC) to evaluate the proposed Auburn Dam site. Based on these studies, WCC concluded that seismic events in the Sierra Nevada foothills are associated with very small, geologically infrequent, incremental displacements having minor geomorphic surface expression.

In addition, the eastern border of the southern San Joaquin Valley is cut by a series of en-eschelon rangefront faults. These faults are mainly northwest trending normal faults, down dropped to the west and with a near vertical dip. One of the range-front faults, the Clovis Fault, is mapped extending from an area just south of the San Joaquin River to a few miles south of Francher Creek approximately six miles northeast of the Planning Area. No evidence has been found of historic ground movement along this feature. These range-front faults have generally been considered

inactive, with no recognized Quaternary displacement. However, a September 1973 magnitude 4.4 earthquake that occurred approximately 4.3 miles north of the Planning Area may be related to this fault system.

The Nunez Fault is located approximately six to seven miles northwest of Coalinga and is roughly 48 miles southwest of the Planning Area. The fault is about 2.6 miles long and is considered active based on surface rupture associated with the 1983 Coalinga earthquake. The fault is divided into two north and south trending segments. Approximately 2.1 miles of right-reverse surface rupture occurred on the segments. Total displacement and timing of past fault movements are poorly constrained.

Tensional forces resulting in normal faults are reported to be related to crustal stress relief in the southeast portion of the San Joaquin Valley. Numerous relatively short, normal faults traverse this region. Creep activity is the prominent mode of slip on those faults in this region that are active. These movements have continued on an intermittent basis from the early Miocene to recent times. This faulting is directly related to and controls the accumulation of oil in several oil fields within the westerly portion of the valley. Most authors agree that current creep movements can be ascribed to subsidence promoted by extensive withdrawal of petroleum, and in some cases, groundwater. Those faults considered to be active in the southern valley are Kern Front and Pond Faults located at least 70 miles south of the Planning Area.

The Sierra Nevada and Owens Valley Fault Zones bound the eastern edge of the Sierra Nevada block more than 90 miles east of the Planning Area. The Owens Valley Fault zone branches to the east of the Sierra Nevada Fault zone approximately 2 miles south of the Alabama Hills. The Owens Valley Fault zone is roughly 75 miles long and extends to the west side of Owens Lake to a few miles north of Big Pine. The maximum width of the fault zone is about 2 miles. The Owens Valley Fault generated one of California's greatest historical earthquakes (Owens Valley Earthquake of 1872) and poses a significant hazard to the communities on the eastern side of the Sierra Nevada Mountains. The White Wolf Fault, responsible for a 1952 earthquake that caused extensive damage in the greater Bakersfield area, is located in the tectonically active Tehachapi Mountains at the southerly terminus of the valley, over 100 miles south of the Planning Area.

Planning Area Setting

General Setting and Surface Features

The City of Fresno Planning Area encompasses an approximate 166 square miles, just south of the San Joaquin River, in the central portion of Fresno County, California. The natural topography within the Planning Area generally trends from the northeast towards the southwest. The historically natural, agricultural, and manmade flow for drainage channels predominately follows the northeast to southwest trend. However, because the Planning Area was historically developed for agricultural use, there are also many subchannels designed to transport water in a northwest-southeast direction.

Surface faulting is absent from the Planning Area and the majority of the area is relatively flat. However, slopes associated with the San Joaquin River bluff are on the order five feet to greater than

100 feet high. The bluff slopes in the vicinity of existing developments were generally well maintained and appeared to be relatively stable. However, the bluff slopes in predominately undeveloped and/or agricultural areas are in relatively good to poor condition with varying degrees of instability and disrepair.

Subsurface Conditions

Subsurface soil conditions in the Planning Area have been previously explored by drilling hundreds of geotechnical borings to depths ranging from approximately 5 to 150 feet below existing site grade, using a truck-mounted drill rig. Penetration tests were performed to evaluate soil consistency and to obtain information regarding engineering properties of the subsoils. Soil samples were retained for laboratory testing. The soils encountered were continuously examined and visually classified in accordance with the Unified Soil Classification System.

The subsurface conditions encountered appear typical of those found in the geologic region of the Planning Area. Generally, the upper soils consisted of approximately 6 to 12 inches of very loose silty sand, silty sand with trace clay, sandy silt, clayey sand, or clayey gravel. These soils are disturbed, have low strength characteristics, and are highly compressible when saturated.

Below the loose surface soils, approximately two to four feet of loose/soft to very dense/hard clays, silts, sands, and gravels are typically encountered. Previous field and laboratory tests suggest that these soils are typically moderately strong and slightly to moderately compressible. The clayey soils had a low to high expansion potential. Penetration resistance ranged from less than 5 to greater than 100 blows per foot. Dry densities ranged from 80 to 120 per cubic foot (pcf). Representative soil samples typically consolidate approximately 0.5 to 12 percent under 2 kilos per square foot (ksf) load when saturated. Representative soil samples had angles of internal friction ranging from 11 to 40 degrees. Representative samples of the clayey soils had expansion indices ranging from 0 to l00+.

Below 3 to 5 feet, predominately clays, silts, sands, and gravels are usually encountered. Previous field and laboratory tests suggest that these soils are typically moderately strong and slightly compressible. Penetration resistance ranges from 10 to greater than 100+ blows per foot. Dry densities ranged from 90 to 140 pcf. Representative soil samples typically consolidate approximately two to three percent under a 2 ksf load when saturated. These soils usually have slightly stronger strength characteristics than the upper soils and extend to the termination depth of the borings.

Test boring locations were checked for the presence of groundwater during and immediately following the drilling operations. Groundwater was encountered near the surface in the vicinity of existing ponds, lakes, ditches, and canals, to depths greater than 100 feet below site grade during the field investigations. Review of groundwater elevation maps prepared by the California Department of Water Resources dating from 1961 to 2012 indicates that depth to free groundwater in the vicinity of the site ranged from one foot to greater than 100 feet below the existing grade within the Planning Area.

Geological Subgrade

The general soil profile within the City of Fresno Planning Area consists predominately of silty sands, sandy silts, clayey sands, sandy clayey silts, and sands. With the exception of a limited occurrence of near-surface loose soils, penetration resistance and laboratory testing indicate that these materials are typically at least medium dense. The Site Class, per Section 16 13.3.2 of the 2013 California Building Code, is assigned to a site based upon the types of soils present and their engineering properties. Site Class D is most consistent with the soil conditions in the Planning Area. However, within isolated locations through the Planning Area, and in close proximity to water features, Site Class E conditions (soft soil profile) may be encountered.

Geologic-related Hazards Settings

Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils behave similarly to a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when shallow groundwater; low density, fine, clean sandy soils; and high intensity motion occurs. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below foundations.

The predominant soils anticipated to be encountered within the Planning Area consist of varying combinations of very loose/very soft to very dense/hard silts, clays, sands, and gravels. Moderate cohesion strength is associated with the clayey soils. Groundwater has been encountered near the surface during exploratory drilling, in close proximity to water filled features such as canals, ditches, ponds, and lakes. Historically, groundwater in the Planning Area has been encountered at depths as shallow as 0 feet to greater than 100 feet below the ground surface.

Seismic Settlement and Lateral Spreading

Subsidence of the land surface can be induced by both natural and human phenomena. Natural phenomena that can cause subsidence can result from tectonic deformations and seismically induced settlements; from consolidation, hydrocompaction, or rapid sedimentation; from oxidation or dewatering of organic-rich soils; and from subsurface cavities. Subsidence related to human activity can result from withdrawal of subsurface fluids or sediment, such as pumping of groundwater.

Lateral spreading is the horizontal movement or spreading of soil toward an open face, such as a stream bank, the open side of fill embankments, or the sides of levees. The potential for failure from subsidence and lateral spreading is highest in areas where the groundwater table is high, where relatively soft and recent alluvial deposits exist, and where creek banks are relatively high. One of the most common phenomena during seismic shaking accompanying any earthquake is the induced settlement of loose unconsolidated soils. Due to the subsurface conditions within the Planning Area, and the relatively low to moderate seismicity of the region, the City of Fresno Planning Area is not located in an area within a seismic settlement or lateral spread hazard area.

Land Subsidence

Portions of the San Joaquin Valley have been subject to land subsidence due to fluid withdrawal (groundwater and petroleum). Land subsidence affects 3,500 square miles of productive farm land in the San Joaquin Valley as intense pumping of groundwater continues. Over 20 feet of subsidence has occurred in western Fresno County. Subsidence was first recognized in the valley in 1935, when surveys discovered differential settlements in areas of intensive pumping. With the accelerated use of groundwater for agriculture, subsidence has continued to the present. Today, one-third of the entire San Joaquin Valley is subsiding and damage costs and remedial expenditures represent many millions of dollars. Damage caused by subsidence has been restricted principally to significant changes in gradients of canals, aqueducts, and drainage systems, and breakage of deep water-well casings.

Within the San Joaquin Valley, subsidence is concentrated in the southern part and west side of the valley where rainfall is sparse and groundwater recharge is minimal. The subsidence has been greatest in three areas: an elongated trough close to the mountains west of Fresno, where more than 20 feet of subsidence occurred between 1920 and 1963 and total subsidence is approximately 28 feet; a location 30 miles south of Tulare, where more than 12 feet of subsidence has occurred; and an area located south of Bakersfield, where more than 8 feet of subsidence has occurred. These three areas are not located within the Planning Area. Subsidence rates vary greatly from year to year, and subsidence continues in all areas except south of Tulare where surface water imports have reversed the downward trends of water levels.

Expansive Soils

Expansive soils are composed largely of clays, which greatly increase in volume when saturated with water and shrink when dried. Because of this effect, building foundations may rise during the rainy season and fall during the dry season. If this expansive movement varies underneath different parts of a single building, foundations may crack, structural portions of the building may be distorted, and doors and windows may become warped so that they no longer function properly. The potential for soil to undergo shrink and swell is greatly enhanced by the presence of a fluctuating, shallow groundwater table. Volume changes of expansive soils can result in the consolidation of soft clays following the lowering of the water table or the placement of fill. The surface and near-surface soils observed throughout the City of Fresno Planning Area consist of varying combinations of clays, silts, sands, gravels, and cobbles. The clayey soils are considered to be slightly to moderately expansive.

Slope Stability, Slope Failure, and Landslides

Landslides are the release of rock, soil, or other debris and its subsequent movement down a slope or hillside. They are generally caused or controlled by a combination of geology, topography, weather, and hydrology, and can be influenced by development practices. Landslides vary greatly in size and composition, ranging from a thin mass of soil a few yards wide to deep-seated bedrock slides miles across. The travel rate of a landslide can range from a few inches per month to many feet per second depending on the slope, type of materials, and moisture content.

Any slope of 15 degrees or greater is susceptible to mud or landslides. Landslides and other ground failures occur during earthquakes, triggered by the strain induced in soil and rock by ground shaking

vibrations, and during non-earthquake conditions, most frequently during the rainy season. Both natural and man-made factors contribute to these slope failures.

Ground failure occurs when stresses in the ground exceed the resistance of earth materials to deformation or rupture. This instability can be triggered by earthquake shaking, which instantaneously places high stresses on earth materials by loss of soil strength due to saturation or seismic shaking. Ground failure can also be triggered by manmade changes, such as loading a steep slope or unstable soils.

Landslides are perhaps the most common form of ground failure that is not caused by earthquakes. In areas where a severe slope stability problem exists, landslide damage can best be avoided by not building on the unstable ground. In some landslide-prone areas, landslides can be totally removed or stabilized. Through good planning and careful controlled design, landslide losses can be all but eliminated.

Although slope failures are not expected to produce a regional disaster, there is a persistent risk of damage to public and private property, including individual residences, roads, canals, reservoirs, and other facilities. The two most important factors influencing the performance of slopes are the nature of the bedrock or surficial deposits and the slope angle. However, there are a number of other factors that have a profound effect on the stability of a particular hillside. These include the presence or absence of deep-rooted vegetation; surface and subsurface drainage conditions; thickness and engineering characteristics of soils and underlying weathered, partially decomposed rock; orientation of bedding; or locally high rainfall can exert a controlling effect on the intensity of natural processes occurring on a particular hillside.

City and County General Plans historically have recognized that major slope areas in excess of 26 percent are "not readily available" and "undevelopable," recognizing the cost and engineering difficulties of grading steep slopes as well as their inherent unsuitability. This development limit generally agrees with customary limits throughout the State, and varies only slightly from the 30 percent standard reference developed by the State Division of Mines and Geology as the maximum developable slope. This is a statewide reference that does not reflect special conditions such as clayey soils.

Whether a landslide will or will not occur at any specific, presently stable slope usually cannot be predicted under "natural conditions" because of the range of natural conditions and changes which occur with time. However, land that has experienced land sliding in the past is believed to be generally more slide-prone and is also more sensitive to man-induced changes, such as grading, watering, removing or changing the type of vegetation, and changing drainage patterns, among many possible factors.

5.6.3 - Regulatory Setting

Federal

Earthquake Hazards Reduction Act

The Earthquake Hazards Reduction Act was enacted in 1997 to "reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards and reduction program." To accomplish this, the act established the National Earthquake Hazards Reduction Program (NEHRP). This program was significantly amended in November 1990 by the National Earthquake Hazards Reduction Program Act (NEHRPA), which refined the description of agency responsibilities, program goals, and objectives.

NEHRP's mission includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improvement of building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improvement of mitigation capacity; and accelerated application of research results. The NEHRPA designates the Federal Emergency Management Agency (FEMA) as the lead agency of the program and assigns it several planning, coordinating, and reporting responsibilities.

State

Alquist-Priolo Earthquake Fault Zoning Act

In response to the severe fault rupture damage of structures by the 1971 San Fernando earthquake, the State of California enacted the Alquist-Priolo Earthquake Fault Zoning Act in 1972. This act required the State Geologist to delineate Earthquake Fault Zones (EFZs) along known active faults that have a relatively high potential for ground rupture. Faults that are zoned under the Alquist-Priolo Act must meet the strict definition of being "sufficiently active" and "well-defined" for inclusion as an EFZ. The EFZs are revised periodically, and extend 200 to 500 feet on either side of identified fault traces. No structures for human occupancy may be built across an identified active fault trace. An area of 50 feet on either side of an active fault trace is assumed to be underlain by the fault, unless proven otherwise. Proposed construction in an EFZ is permitted only following the completion of a fault location report prepared by a California Registered Geologist. This Act does not apply to areas within the Planning Area because no active faults cross the Planning Area.

California Building Code

Title 24, Part 2, of the California Code of Regulations, also known as the California Building Code (CBC), sets forth minimum requirements for building design and construction. Title 24 is administered by the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. The CBC is reviewed every three years by the California Building Standards Commission. The Commission makes certain State modifications, and adopts the new code edition for use throughout the State. Once the Commission votes to adopt the new code edition, it will become effective on the first of January of the upcoming year, regardless of whether local cities or counties formally adopt it. The current version, the 2013 California Buildings Standard Code, became effective on January 1, 2014.

The California Building Standards Code is a compilation of three types of building standards from three different origins:

- Building standards that have been adopted by state agencies without change from building standards contained in national model codes
- Building standards that have been adopted and adapted from the national model code standards to meet California conditions
- Building standards, authorized by the California legislature, that constitute extensive additions not covered by the model codes that have been adopted to address particular California concerns

In the context of earthquake hazards, the California Building Standards Code's design standards have a primary objective of assuring public safety and a secondary goal of minimizing property damage and maintaining function during and following a seismic event. Recognizing that the risk of severe seismic ground motion varies from place to place, the California Building Standards Code seismic code provisions will vary depending on location (Seismic Zones 0, 1, 2, 3, and 4; with 0 being the least stringent and 4 being the most stringent). The earthquake design requirements take into account the occupancy category of the structure, site class, soil classifications, and various 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.

Counties and cities may modify their adoption of the California Buildings Standard Code to address local conditions. Most California cities and counties modify the State adopted version of the Building Standards Code to address local circumstances related to the local climate, topography, or geology. Since modifications cannot be less restrictive, California Building Standards Code provides a minimum standard for protecting public health, safety and welfare that is applicable throughout the Planning Area and study area for cumulative impacts.

Local

2025 Fresno General Plan

The 2025 Fresno General Plan contains objectives and policies that address geology and soils. The following General Plan objective and policies are applicable to the proposed project.

Safety Element

I-3 Objective: Ensure the public's health, safety, and welfare by recognizing potentially geologically unstable conditions that could endanger the lives and property of the Fresno-Clovis Metropolitan Area residents.

I-3-a Policy: The City of Fresno shall enforce the latest adopted Uniform Building Code and the Dangerous Building Ordinance (Article 12 of Fresno Municipal Code, Chapter 12) to ensure seismic protection for new and existing construction.

I-3-c Policy: In areas having potential geologic and/or soils hazards, development shall not have on-site drainage or disposal for wastewater, stormwater runoff, swimming pool/spa water, unless a soil analysis by a registered civil engineer (or engineering geologist specializing in soil geology) concludes that on-site drainage/disposal will not induce, worsen or spread geologic hazards.

I-3-d Policy: Development shall be prohibited in areas where analysis by a registered civil engineer or registered geologist determines that no corrective measures could feasibly mitigate potential geologic hazards.

I-4 Objective: Minimize the loss of life and property on the San Joaquin River bluffs that could occur due to geologic hazards.

I-4-a Policy: Maintain and enforce the requirements of the city's Bluff Preservation (BP) Overlay Zone District. Development within 300 feet of the toe of the San Joaquin River bluffs shall require an engineering soils investigation and evaluation report that demonstrates that the site is, or methods by which the site could be made, sufficiently stable to support the proposed development.

I-4-b Policy: The minimum setback from the San Joaquin River bluff edge (as the bluff edge is defined in the Fresno Municipal Code) for all future structures (including swimming pools, spas, and accessory structures) shall be thirty (30) feet. However, a building setback of less than thirty (30) feet may be permitted if it can be demonstrated to the satisfaction of the City's Building Official and Planning and Development Department Director that a proposed structure will meet the objective of the Bluff Preservation Overlay Zone District, as stated in the Fresno Municipal Code; but in no case shall the minimum building setback from the bluff edge be less than twenty (20) feet for any structure, and no rear yard encroachments shall be allowed within that twenty (20) feet.

Public Facilities Element

E-19 Objective: Preserve groundwater quality and ensure that the health and safety of the community is not impaired by use of private on-site disposal systems.

E-19-a Policy: Continue to require mandatory abatement of existing septic systems and mandatory connection to the city's public sewage collection and disposal system including those areas outside the city's adopted sphere of influence where determined necessary for public health and safety reasons.

E-19-b Policy: Discourage use of septic systems, community wastewater disposal systems or other non-regional sewage treatment and disposal systems within the Fresno Metropolitan Area and including areas located outside the city's sphere of influence if these types of wastewater treatment facilities would cause discharges that could result in groundwater degradation, or if such systems are not economically feasible.

City of Fresno Municipal Code

Section 11-101. California Building Code

The City of Fresno Municipal Code has incorporated and adopted the CBC, 2013 Edition, as promulgated by the California Building Standards Commission, which incorporates the adoption of the 2012 edition of the of the International Building Code, as amended with necessary California amendments and the 2012 International Building Code of the International Code Council, with the exception of Appendix B. Together with the City's amendments to the CBC provided in Section 11-102, these shall be referred to as the Fresno Building Code. One copy of the CBC is on file and available for use by the public in the Development and Resource Management Department, Building and Safety Services Division.

Section 12-1022. Soils Report

(a) **Preliminary Soils Report.** A preliminary soils report, prepared by a civil engineer registered in this state, and based upon adequate test borings, shall be required for every subdivision for which a final map is required and shall be submitted to the City Engineer.

(b) **Waiver.** A preliminary soils report may be waived by the City Engineer if he finds that, due to the knowledge the city has as to the soils qualities of the soils in the subdivision, no preliminary analysis is necessary.

(c) **Soils Investigation.** If the city has knowledge of, or the preliminary soils report indicates, the presence of critically expansive soils or other soils problems, which, if not corrected, would lead to structural defects, a soils investigation of each lot in the subdivision may be required by the City Engineer. Such soils investigation shall be done by a civil engineer registered in this state, who shall recommend the corrective action, which is likely to prevent structural damage to each structure proposed to be constructed in the area where such soils problems exist.

(d) **Approval of Corrective Action.** The Commission may approve the subdivision or portion thereof where such soils problems exist if it determines that the recommended action is likely to prevent structural damage to each structure to be constructed, and as a condition to the issuance of any building permit may require that the approved recommended action be incorporated in the construction of each structure.

(e) **Geologic Impact Standards.** To minimize potential geologic and soil hazards, the following provisions shall apply to all subdivisions **and** development within Bluff Zones I, II and III of the San Joaquin River Bluffs environs:

(1) General provisions for grading, drainage, and erosion:

(i) Locations of streets, utilities and other facilities shall be approved by the Director and the Director of the Department of Public Works.

(ii) Requirements for the location, design, construction and maintenance of surface and subsurface drainage facilities shall be as determined by the Fresno Metropolitan Flood Control District.

(iii) All development within Bluff Zones I, II and III shall comply with the applicable provisions of the Uniform Building Code as adopted and amended by the City of Fresno.

(iv) Drainage of storm and irrigation water shall be directed away from the Bluff Face to public rights-of-way or to drainage facilities approved by the Fresno Metropolitan Flood Control District. A drainage plan shall be provided and approved by the Director for each separate lot within the Bluff Influence Area, establishing methods for conveying surface water from roofs and landscaping, and drain water from all swimming pools or decorative pools to approved locations away from the Bluff Face.

(v) To minimize erosion, the following shall apply to all graded, altered or unstable bluff areas:

1. Landscaping with drought-tolerant, low-fuel plants, compatible with the bluff environs, from a list prepared by the Director of the Parks and Recreation Department shall be provided;

2. Landscape irrigation shall utilize drip irrigation or low precipitation systems, and must be approved by the civil engineer prior to installation;

3. Hydroseeding, netting and mulch shall be utilized to re-establish plant life, to control erosion and to discourage rodent burrowing.

(2) **Soils investigation.** The following types of soil evaluations shall be performed and reported:

(i) **Bluff Zone I.** A civil engineer or soils engineer registered in this state shall investigate and report on soil and geologic conditions, utilizing methods consistent with accepted practice. The report shall evaluate soils and geologic conditions for development proposals located outside Bluff Zone II and shall be similar in scope to a preliminary soils investigation required under subsection (a), above; the investigation and report shall identify potential surface and subsurface drainage problems that may ultimately affect the stability of the bluffs and any measures to mitigate such effects.

(ii) **Bluff Zone II.** A civil engineer or soils engineer shall provide a detailed Soils Investigation and Evaluation Report using **methods** consistent with accepted practice and shall include the following:

1. Evaluation of existing stability;

2. Evaluation of post-development slope stability;

3. Documentation of existing conditions for rock falls, block caving, creep failures, shear failures, excessive erosion and sloughing;

4. Evaluation of slope angles, subsurface drainage, proposed grading, structures, utility trenches, potential rodent population, storm drain disposal, surface irrigation and drainage, erosion, traffic vibration, potential seismic hazards, and on-site sewage disposal approximate to the bluffs;

5. Evaluation of the influence of future development and grading along the Bluff Toe for its effect on slope stability;

6. Evaluation of the adverse effect of increased surface and subsurface drainage;

7. Coordination, review and approval of site grading and drainage plans prepared by the project civil engineer for conformance to soils and geologic reports;

8. Laboratory tests to evaluate the soil parameters to be used in determination of slope stability;

9. Determination and establishment of the location of the Bluff Toe, Bluff Edge and of any building setbacks.

(iii) **Bluff Zone III.** A civil engineer or soils engineer registered in this state shall complete a Soils Investigation and Evaluation Report, involving detailed study of individual lots within the River Bluff Influence Area, as follows:

1. Zone III soils investigations will address the details of the configuration, location, type and loading of the proposed structures and drainage plan;

2. The report shall provide detailed recommendations for foundations, drainage, and other items critical to bluff stability.

(3) Filing of Soils Investigation and Evaluation Reports shall be required as follows:

(i) A Zone I, Zone II or Zone III Soils Investigation and Evaluation Report and a grading plan shall be filed at the time of filing any tentative tract map or parcel map providing for lots or portions of lots within Zone I, Zone II or Zone III, or at the time of filing any application for rezoning or for special permits for parcels of land within Zone I, Zone II or Zone III;

(ii) For parcels of land within Zone I, Zone II or Zone III, that are not the subject of the filing of a tentative map or tentative parcel map, or that are not the subject of any application for rezoning or a special permit, a Zone I, Zone II or Zone III Soils Investigation and

Evaluation Report and a grading plan shall be filed with any request for a building permit.

(4) **Certification.** The Soils Investigation and Evaluation Reports shall be certified as follows:

(i) The engineer responsible for the soils investigation and evaluation report and for the grading plan shall certify that the proposed project will not cause any significant increase in the risk of damage to the bluff from erosion, slippage, subsidence or other movement when grading, drainage and other slope protection have been done in accordance with the soils investigation and evaluation report and the grading plan. The certificate may be executed on the face of the subdivision map or parcel map or may be contained in a separate instrument delivered to the Director.

(ii) The engineer responsible for the soils investigation and evaluation report and for the grading plan for parcels of land for which certification is not provided above shall file written certification with any request for a building permit that the proposed project will not cause any significant increase in the risk of damage to the bluff from erosion, slippage, subsidence or other movement, when grading, drainage and other slope protection have been done in accordance with the soils investigation and evaluation report and the grading plan.

(5) **Completion of Erosion Controls.** All erosion control measures shall be completed before the issuance of occupancy permits for residences constructed on lots within or partially within Zone II, and shall be completed before the issuance of building permits for structures constructed on lots within or partially within Zone III.

Section 12-1023. Grading and Erosion Control

Every map approved pursuant to this article shall be conditioned on compliance with the requirements for grading and erosion control, including the prevention of sedimentation or damage to off-site property, set forth in Appendix Chapter 70 of the Uniform Building Code, 1973 Edition, Volume I, as adopted and amended by the city as part of this Code.

County of Fresno General Plan

The County of Fresno General Plan contains goals and policies that address geology and soils. The following General Plan goal and policies are applicable to the proposed project.

Public Facilities Element

Policy PF-D.6. Onsite Sewage Disposal Systems. The County shall permit individual on-site sewage disposal systems on parcels that have the area, soils, and other characteristics that permit installation of such disposal facilities without threatening surface or groundwater quality or posing any other health hazards and where community sewer service is not available and cannot be provided. (RDR)

Health and Safety Element

Goal HS-D. To minimize the loss of life, injury, and property damage due to seismic and geologic hazards.

Policy HS-D.2. The County shall ensure that the General Plan and/or County Ordinance Code is revised, as necessary, to incorporate geologic hazard areas formally designated by the State Geologist (e.g., Earthquake Fault Zones and Seismic Hazard Zones). Development in such areas, including public infrastructure projects, shall not be allowed until compliance with the investigation and mitigation requirements established by the State Geologist can be demonstrated.

Policy HS-D.3. The County shall require that a soils engineering and geologic-seismic analysis be prepared by a California-registered engineer or engineering geologist prior to permitting development, including public infrastructure projects, in areas prone to geologic or seismic hazards (i.e., fault rupture, groundshaking, lateral spreading, lurchcracking, fault creep, liquefaction, subsidence, settlement, landslides, mudslides, unstable slopes, or avalanche).

Policy HS-D.4. The County shall require all proposed structures, additions to structures, utilities, or public facilities situated within areas subject to geologic-seismic hazards as identified in the soils engineering and geologic-seismic analysis to be sited, designed, and constructed in accordance with applicable provisions of the Uniform Building Code (Title 24 of the California Code of Regulations) and other relevant professional standards to minimize or prevent damage or loss and to minimize the risk to public safety.

Policy HS-D.8. The County shall require a soils report by a California-registered engineer or engineering geologist for any proposed development, including public infrastructure projects, that requires a County permit and is located in an area containing soils with high “expansive” or “shrink-swell” properties. Development in such areas shall be prohibited unless suitable design and construction measures are incorporated to reduce the potential risks associated with these conditions.

Policy HS-D.9. The County shall seek to minimize soil erosion by maintaining compatible land uses, suitable building designs, and appropriate construction techniques. Contour grading, where feasible, and revegetation shall be required to mitigate the appearance of engineered slopes and to control erosion.

Policy HS-D.11. The County shall not approve a County permit for new development, including public infrastructure projects where slopes are over thirty (30) percent unless it can be demonstrated by a California-registered civil engineer or engineering geologist that hazards to public safety will be reduced to acceptable levels.

Policy HS-D.12. In known or potential landslide hazard areas, the County shall prohibit avoidable alteration of land in a manner that could increase the hazard, including concentration of water through drainage, irrigation, or septic systems, undercutting the bases of slopes, removal of vegetative cover, and steepening of slopes.

County of Fresno Code of Ordinances

Section 15.28.010. Chapter 18, Chapter 33 and Appendix J of the 2013 California Building Code and Section R300 of the California Residential Code are adopted by reference and except as herein otherwise provided are applicable to and shall cover all grading and excavation within the unincorporated area of the County of Fresno.

5.6.4 - Thresholds of Significance

CEQA Thresholds

In accordance with CEQA, the effects of a project are evaluated to determine if they will result in significant adverse impact on the environment. The criteria used to determine the significance of an impact to geology and soils are based on the Environmental Checklist in Appendix G of the State CEQA Guidelines. Accordingly, geology and soils impacts resulting from the proposed project are considered significant if the project would:

a) Expose 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? Refer to Division of Mines and Geology Special Publication 42. (See Earthquakes, Impact GEO-1)

   ii. Strong seismic ground shaking? (See Seismic Ground Shaking, Impact GEO-2)

   iii. Seismic-related ground failure, including liquefaction? (See Seismic Ground Failure, Impact GEO-3)

   iv. Landslides? (See Landslides, Impact GEO-4)

b) Result in substantial soil erosion or the loss of topsoil? (See Erosion or Topsoil Loss, Impact GEO-5)

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse? (See Unstable Geologic Location, Impact GEO-6)

d) 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? (See Expansive Soil, Impact GEO-7)

e) 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? (See Wastewater Disposal Systems, Impact GEO-8)

5.6.5 - Impact Analysis, Mitigation Measures, and Level of Significance After Mitigation

Earthquakes

Impact GEO-1	**The project would not expose 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? Refer to Division of Mines and Geology Special Publication 42.

Project Specific Impact Analysis

The proposed General Plan Update would accommodate future development within the General Plan Update Planning Area. According to the Fault Rupture Zones Map prepared by the California Department of Conservation in 2007, the Planning Area is not located within a Fault-Rupture Hazard Area. Moreover, no active faults have been identified within the Planning Area. The nearest zoned fault to the Planning Area is a portion of the Nunez Fault, located approximately 48 miles southwest of the Planning Area. Therefore, because no active faults occur within the Planning Area, impacts associated with fault rupture would be less than significant.

Cumulative Impact Analysis

Since the nearest zoned fault is located approximately 48 miles from the Planning Area, cumulative development within one mile of the Planning Area would experience less than significant fault rupture impacts. With future development within the Planning Area not being exposed to a zoned fault and fault ruptures are site specific, the implementation of the proposed project would not contribute to cumulative impacts associated with a fault rupture. Therefore, the project's contribution to fault rupture impacts would be less than cumulatively considerable and thus less than cumulatively significant.

Mitigation Measures

Project Specific

No mitigation measures are required.

Cumulative

No mitigation measures are required.

Level of Significance After Mitigation

Project Specific

Less than significant impact.

Cumulative

Less than significant impact.

Seismic Ground Shaking

Impact GEO-2	**The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:**
	ii) Strong seismic ground shaking.

Project Specific Impact Analysis

As with most areas within the State of California, the Planning Area would be exposed to ground shaking from seismic events on local and regional faults. However, the Fresno area has historically experienced a low to moderate degree of seismicity. Between 1800 and 2012, 114 events have occurred with magnitudes greater than 4.0 within 60 miles of the Planning Area, and 136 events exceeded magnitude 5.0 within 100 miles of the Planning Area.

A review of geological literature indicates that groundshaking of VII intensity (Modified Mercalli Scale) was felt in the Planning Area from the 1872 Owens Valley Earthquake, which is the largest known earthquake to have historically affected the Planning Area. A VII intensity represents negligible damage in buildings of good design and construction, and slight to moderate damage in well-built ordinary structures. The most recent significant earthquake to affect the Fresno area is the 1983 Coalinga earthquake, a magnitude 6.7 event that occurred in the Coastal Range, west of the City. The Coalinga earthquake had a Modified Mercalli Intensity of VII in the Planning Area, but no significant damage was reported in the Planning Area.

Although the Planning Area occurs in an area with historically low to moderate level of seismicity, strong ground shaking could occur within the Planning Area during seismic events and occurrences have the possibility to result in significant impacts. Major seismic activity along the nearby Great Valley Fault Zone or the Nunez Fault, or other associated faults, could affect the Planning Area through strong seismic ground shaking. Strong seismic ground shaking could potentially cause structural damage to existing or proposed projects in the Planning Area, possibly resulting in damage to facilities and interruption of service.

Proposed projects in the Planning Area would be designed to withstand strong ground shaking, because all built projects are required to comply with the CBC to minimize the potential effects of ground shaking and other seismic activity. To reduce ground shaking impacts, the General Plan Update also includes the following objective and policies, and the City of Fresno Municipal Code includes Sections 11-101, 12-1022, and 12-1023, which are discussed in Section 5.6.4 above.

Noise and Safety

Objective NS-2. Minimize risks of property damage and personal injury posed by geologic and seismic risks.

Policy NS-2-a. Seismic Protection. Ensure seismic protection is incorporated into new and existing construction, consistent with the Fresno Municipal Code.

Policy NS-2-b. Soil Analysis Requirement. Identify areas with potential geologic and/or soils hazards, and require development in these areas to conduct a soil analysis and mitigation plan by a

registered civil engineer (or engineering geologist specializing in soil geology) prior to allowing on-site drainage or disposal for wastewater, stormwater runoff, or swimming pool/spa water.

Policy NS-2-c. Landfill Areas. Require proposed land uses on or near landfill areas to be designed and maintained to comply with California Code of Regulations, Title 27, Section 21190, Post Closure Land Use.

Policy NS-2-d. Bluff Preservation Overlay Zone. Maintain the requirements of the Bluff Preservation Overlay Zone District, which include provisions to:

- Require proposed development within 300 feet of the toe of the San Joaquin River bluffs to undertake an engineering soils investigation and evaluation report that demonstrates that the site is sufficiently stable to support the proposed development, or provide mitigations to provide sufficient stability; and
- Establish a minimum setback of 30 feet from the San Joaquin River bluff edge for all future structures and rear yards.

With the implementation of the above objective and policies as well as adherence to Municipal Code Section 12-1022 and other applicable sections, the implementation of development in accordance with the General Plan Update would reduce potential seismic ground shaking impacts to less than significant.

Cumulative Impact Analysis

The implementation of cumulative projects in the Planning Area and immediately adjacent areas (i.e., within one mile of the Planning Area) would not increase the potential for impacts associated with seismic ground shaking to occur. Cumulative projects would be exposed to similar ground shaking during seismic events, but would not increase the potential for impacts to occur within the Planning Area. Cumulative projects will also be required to comply with state and federal regulations, including the CBC, which would reduce potential seismic ground shaking impacts to less than significant levels. Since implementation of the General Plan Update would not contribute to or increase the potential for cumulative seismic ground shaking impacts, the project's contribution to cumulative impacts would be less than cumulatively considerable, and therefore, less than cumulatively significant.

Mitigation Measures

Project Specific

No mitigation measures are required.

Cumulative

No mitigation measures are required.

Level of Significance After Mitigation

Project Specific

Less than significant impact.

Cumulative

Less than significant impact.

Seismic Ground Failure

Impact GEO-3	**The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:**
	iii) Seismic-related ground failure, including liquefaction.

Project Specific Impact Analysis

The predominant soils within the Planning Area consist of varying combinations of loose/very soft to very dense/hard silts, clays, sands, and gravels. Groundwater has been encountered near the ground surface in close proximity to water-filled features such as canals, ditches, ponds, and lakes. Based on these characteristics, the potential for soil liquefaction within the Planning Area ranges from very low to moderate due to the variable density of the subsurface soils and the presence of shallow groundwater. Implementation of the General Plan Update could result in the exposure of people or structures to liquefaction impacts that would be considered significant. However, the General Plan Update includes an objective and policies and the Fresno Municipal Code includes standards to reduce potential liquefaction impacts. These objective and policies include Objective NS-2 and Policies NS-2-a through NS-2-d. With the implementation of the objective, policies, and standards, potential soil liquefaction impacts would be less than significant.

In addition to liquefaction, the Planning Area could be susceptible to induced settlement of loose unconsolidated soils or lateral spread during seismic shaking events. Based on the nature of the subsurface materials and the relatively low to moderate seismicity of the region, seismic settlement and/or lateral spread are not anticipated to represent a substantial hazard within the Planning Area during seismic events. If induced settlement or lateral spread does occur, development projects could experience significant impacts. However, as each development project is proposed, implementation of the General Plan Update Objective NS-2 and Policies NS-2-a through NS-2-d and the Fresno Municipal Code, including Sections 11-101, 12-1022, and 12-1023, would reduce potential settlement and lateral spread impacts to less than significant levels.

Cumulative Impact Analysis

Development of cumulative projects in areas immediately adjacent to the Planning Area (i.e., within one mile) could expose people or structures to seismic-related ground failures such as liquefaction and lateral spread; however, cumulative projects will also be required to comply with the same Federal and State regulations, and to similar local regulations, as proposed development projects under the General Plan Update. Adherence to these standards would reduce potential seismic-related ground failure impacts associated with cumulative development to less than significant levels. Since the proposed project would also result in less than significant impacts, the project's

contribution to effects associated with seismic-related ground failure would be less than cumulatively considerable and thus less than cumulatively significant.

Mitigation Measures

Project Specific

No mitigation measures are required.

Cumulative

No mitigation measures are required.

Level of Significance After Mitigation

Project Specific

Less than significant impact.

Cumulative

Less than significant impact.

Landslides

Impact GEO-4	**The project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:**
	iv) Landslides.

Project Specific Impact Analysis

The Planning Area occurs within an area that consists of mostly flat topography within the Central Valley. Accordingly, there is no risk of large landslides in the majority of the Planning Area. However, there is the potential for landslides and slumping along the steep banks of rivers, creeks, or drainage basins such as the San Joaquin River bluff and the many unlined basins and canals that trend throughout the Planning Area.

The City of Fresno Municipal Code Section 12-2022 requires a preliminary soils report to be prepared for every subdivision and special geotechnical investigations to be performed in the vicinity of the San Joaquin River bluff prior to any new developments or modifications to the bluff area. These special investigations are identified as Bluff Zone I, II, and III investigations, which have specific requirements for evaluation of existing slope stability; post-development slope stability; documentation of existing conditions for rock falls, block carving, creep failures, sheer failures, excessive erosion and sloughing; evaluation of slope angles, subsurface drainage, proposed grading, structures, utility trenches, potential rodent population, storm drain disposal, surface irrigation, and drainage, erosion, traffic vibration, potential seismic hazards, on-site sewage disposal approximate to the bluffs, influence of future development and grading along the bluff toe for its effect on slope stability; and the adverse effect of increased surface and subsurface drainage. Compliance with these and other provisions of the City's Municipal Code would ensure that implementation of the General Plan Update would not expose people or structures to potential substantial adverse impacts

associated with landslides. Therefore, the project would result in less than significant impacts related to landslides.

Cumulative Impact Analysis

Cumulative projects could be proposed in areas immediately adjacent to the Planning Area (i.e., within one mile), which is primarily relatively flat. There are areas adjacent to the Planning Area that have steep hillsides, such as the areas adjacent to the San Joaquin River, or in areas near the slopes of unlined basins and canals. Cumulative projects will be required to adhere to federal and state regulations, including the foundation support and grading parameters of the CBC, as well as to their own local ordinances, such as Chapter 15.28 of the County of Fresno Ordinance Code, the City of Clovis Municipal Code Section 9.2.308, and the County of Madera Code of Ordinances, Title 17. Adherence to these federal, state, and local requirements would ensure that potential landslide impacts from cumulative development remain less than significant. Since implementation of the General Plan Update would result in less than significant impacts pertaining to landslides, and because cumulative projects would also result in less than significant impacts pertaining to landslides, the project's contribution to cumulative landslide impacts would be less than cumulatively considerable, and thus a less than cumulatively significant impact.

Mitigation Measures

Project Specific

No mitigation measures are required.

Cumulative

No mitigation measures are required.

Level of Significance After Mitigation

Project Specific

Less than significant impact.

Cumulative

Less than significant impact.

Soil Erosion or Topsoil Loss

Impact GEO-5 The project would not result in substantial soil erosion or the loss of topsoil.

Project Specific Impact Analysis

Natural forces, both chemical and physical, are continually at work breaking down soils. Erosion poses two hazards: (1) it removes soils, thereby undermining roads and buildings and producing unstable slopes, and (2) it deposits eroded soil in reservoirs, lakes, and drainage structures, and on roads as mudslides. Natural erosion is frequently accelerated by human activities such as site preparation for construction and alteration of topographic features. The following analysis focuses on the potential geotechnical effects of erosion related to project development. For a discussion of

potential effects on water quality due to erosion and sedimentation caused by construction activities or urban runoff, please see Section 5.9, Hydrology and Water Quality.

Implementation of the proposed General Plan Update would result in site preparation activities, such as grading and trenching, at future project sites located throughout the Planning Area. The development of any onsite or offsite storm drainage facilities (e.g., new or expanded channels or peak attenuation facilities such as swales or basins) would permanently alter existing topography. As discussed in Impact GEO-4, side slopes of channels or excavations during construction can be eroded by natural forces if proper slope angles are not maintained. Future projects would also result in the addition of impervious surfaces within the Planning Area, and depending on the location of the project, could possibly result in the alteration of topographic features at the project site. The alteration of topographic features could lead to increased erosion by creating unstable rock or soil surfaces, by changing the permeability or runoff characteristics of the soil, or by modifying or creating new pathways for drainage. Because much of the Planning Area is relatively flat and the locations of projects that would substantially alter topography are limited, there would be minimal geotechnical effects related to erosion. Since the Fresno Municipal Code Section 12-1022 requires the preparation of a preliminary soils report that would identify any potential site-specific soil issues, foundation support and grading parameters would be incorporated into the design as required by the Code. Further, Fresno Municipal Code Section 12-1023 requires every approved map to be conditioned on compliance with the requirements for grading and erosion control, including the prevention of sedimentation or damage to off-site property, set forth in Appendix Chapter 70 of the Uniform Building Code, 1973 Edition, Volume I, as adopted and amended by the city as part of this Code. Compliance with these policies and with other pertinent regulations will ensure that potential soil erosion impacts, or the potential loss of topsoil, would be less than significant.

Cumulative Impact Analysis

Cumulative projects in areas immediately adjacent to the Planning Area (i.e., within one mile) would result in similar construction and operational erosion impacts and impacts to topsoil. However, individual cumulative projects would also be required to comply with mandatory regulations during construction and operation. The jurisdictions in areas immediately adjacent to the Planning Area, such as the County of Fresno, City of Clovis, and the County of Madera, have implemented regulations to ensure the identification of potential soils impacts and the implementation of corrective actions. These regulations include Ordinance Code Section 15.28 (County of Fresno), Municipal Code Section 9.2.308 (City of Clovis), and County Code, Title 17 (County of Madera). The implementation of these regulations would reduce potential soil erosion and minimize the loss of topsoil associated with cumulative projects, thus ensuring that impacts to such resources remain less than significant. Since future development in accordance with the General Plan Update would also result in less than significant soil erosion and loss of topsoil impacts, the project's contribution to cumulative soil impacts would be less than cumulatively considerable, and thus less than cumulatively significant.

Mitigation Measures

Project Specific

No mitigation measures are required.

Cumulative

No mitigation measures are required.

Level of Significance After Mitigation

Project Specific

Less than significant impact.

Cumulative

Less than significant impact.

Unstable Geologic Location

Impact GEO-6	**The project would not 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.**

Project Specific Impact Analysis

Issues associated with liquefaction and lateral spreading are discussed in Impact GEO-3, and the potential for landslides are discussed in Impact GEO-4, above. As previously discussed, impacts associated with liquefaction, lateral spreading, and landslides would be less than significant. Portions of the San Joaquin Valley have been subject to land subsidence or collapse due to groundwater and petroleum extraction. Damage caused by subsidence or collapse has been restricted principally to significant changes in gradients of canals and aqueducts, and breakage of deep-water well casings. Within the San Joaquin Valley, subsidence or collapse is concentrated in the southern part and the west side of the valley where rainfall is sparse and groundwater recharge is minimal. Although subsidence or collapse is a significant concern in western Fresno County, as well as other portions of the San Joaquin Valley, the Planning Area is not known to be subject to such subsidence or collapse hazards. Accordingly, the impacts associated with this subsidence or collapse would be less than significant.

Cumulative Impact Analysis

As discussed in Impact GEO-3 and Impact GEO-4, above, the project's contribution to cumulative liquefaction, lateral spreading, and landslides is less than cumulatively considerable. As discussed above, subsidence or collapse occurs in the southern part and west side of the San Joaquin Valley, where rainfall is sparse and groundwater recharge is minimal. Neither the Planning Area nor the areas within one mile of the Planning Area are subject to such subsidence or collapse. Since all projects must comply with the federal, state, and pertinent local regulations regarding structural stability, as cumulative development occurs, less than significant subsidence or collapse impacts would occur. Since the proposed project would experience less than significant impacts associated with subsidence or collapse impacts and these potential impacts are site-specific, the project's

contribution to cumulative subsidence or collapse is less than cumulatively considerable, and thus less than cumulatively significant.

Mitigation Measures

Project Specific

No mitigation measures are required.

Cumulative

No mitigation measures are required.

Level of Significance After Mitigation

Project Specific

Less than significant impact.

Cumulative

Less than significant impact.

Expansive Soil

Impact GEO-7	**The project could be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), however, substantial risks to life or property would not be created.**

Project Specific Impact Analysis

The surface and near-surface soils observed throughout the Planning Area consist of varying combinations of clays, silts, sands, gravels, and cobbles. The clayey soils are considered to be slightly to moderately expansive. Previously developed areas within the Planning Area contained expansive clayey soils, and it is anticipated that there are localized areas within the Planning Area that contain expansive soils. However, the specific locations are not known at this time. As future projects in accordance with the General Plan Update are proposed, preliminary soil reports in compliance with the City of Fresno Municipal Code Ordinance Section 12-1022 are required to be prepared to identify potential site-specific soil issues such as expansive soils and include foundation support and grading parameters in the project design. Further, grading and erosion control measures are required under Section 12-1023 of the City of Fresno Municipal Code. The implementation of the requirements in the City of Fresno Municipal Code would reduce potential expansive soil impacts to less than significant levels.

Cumulative Impact Analysis

Cumulative projects proposed for the areas within one mile of the Planning Area could be associated with expansive soils. However, individual cumulative projects would be required to comply with the same mandatory federal and state regulations. In addition, the jurisdictions that abut the Planning Area, such as the County of Fresno, City of Clovis, and the County of Madera, have implemented local regulations to ensure that potential expansive soils impacts are identified and corrective actions are taken. These regulations include Ordinance Code Section 15.28 (County of Fresno), Municipal Code Section 9.2.308 (City of Clovis), and County Code, Title 17 (County of Madera).

Compliance with these regulations would reduce potential expansive soil impacts associated with cumulative projects to less than significant. Since implementation of the General Plan Update would result in less than significant expansive soil impacts, the project's contribution to cumulative soil impacts would be less than cumulatively considerable, and thus less than cumulatively significant.

Mitigation Measures

Project Specific

No mitigation measures are required.

Cumulative

No mitigation measures are required.

Level of Significance After Mitigation

Project Specific

Less than significant impact.

Cumulative

Less than significant impact.

Wastewater Disposal Systems

Impact GEO-8	**The project would not 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.**

Project Specific Impact Analysis

Although septic tanks are allowed within the portion of the Planning Area that is currently under the jurisdiction of the County of Fresno, the implementation of the General Plan Update would require mandatory abatement of existing septic systems. This requirement is the same as the requirement identified in the 2025 General Plan Economic Development Element, E-19-a Policy. As development is proposed in compliance with the General Plan Update, septic systems would be removed and public sewage collection and disposal systems would be installed. Potential soil impacts associated with septic tanks would not occur because no new septic tanks would be installed. Therefore, the proposed General Plan Update would result in no impacts associated with soils that are incapable of supporting septic tanks.

Cumulative Impact Analysis

Cumulative development within one mile of the Planning Area could propose to install septic tank systems in the future, particularly within areas under the jurisdiction of the County of Fresno, County of Madera, and City of Clovis. While it is possible that soils in the vicinity of future cumulative projects that use septic systems could be incapable of adequately supporting the use of septic tanks, development under the General Plan Update would not contribute to potential impacts on the soils. Since the proposed project would not involve the installation of new septic tanks, the implementation of the proposed project would not contribute to potential cumulative impacts

related to soils supporting septic systems. Therefore, the proposed project would result in no cumulative impacts related to soils that are incapable of supporting septic systems.

Mitigation Measures

Project Specific

No mitigation measures are required.

Cumulative

No mitigation measures are required.

Level of Significance After Mitigation

Project Specific

No impact.

Cumulative

No impact.