4.5 | GEOLOGY AND SOILS

INTRODUCTION

This section describes the City of Coachella's existing geologic, seismic, and soil conditions, and the existing Federal, State, and local regulations with which development must comply. Geologic and seismic impacts that could result from implementation of the proposed General Plan Update 2035 are identified. The Planning Area is highly diverse geologically. This diversity is strongly related to the youthful (in geologic terms) seismic setting of the surrounding region, which includes tectonic subsidence of the Coachella Valley and the ongoing uplift of the surrounding mountains. This, along with the effects of climate, has resulted in a landscape that is complex in geologic processes and hazards. As Coachella's population grows in the next decades, new development will be needed to meet the demand for homes. When meeting this demand, it is imperative to manage land uses in a responsible way, as development disrupts natural processes, often leading to negative impacts on the environment as well as on the development and adjacent projects. The impacts of land development can be minimized, however, if both site-specific and regional planning elements are recognized and considered, the projects incorporate knowledge gained from scientific research in developing and implementing a design appropriate to the area, and protective measures are constructed and maintained for the lifetime of the projects. The surrounding mountains not only form a dramatic backdrop to the City, but also greatly influence the area's climate, geology, and hydrology. These elements combine in various ways to create geologic hazards as well as benefits to the community.

EXISTING CONDITIONS

ENVIRONMENTAL BASELINE SETTING

REGIONAL GEOLOGY

The Southern California region is located on the boundary of two crustal or tectonic plates: the Pacific plate and the North American plate. Movement along these two plate boundaries causes seismic activity such as earthquakes as the Pacific plate slides past the North American plate in what is termed a right-lateral transform or strike-slip motion. The surface expression of this tectonic movement is expressed by the northwest trending system of faults known as the San Andreas fault system, which runs from north of the San Francisco area to the Bombay Beach area of the Salton Sea and includes a Coachella Valley segment located within the eastern portion of the planning area.

Coachella Valley forms the northerly part of the Salton Trough (at the lowest point of which is the Salton Sea) which is a structural and topographic depression that is related to complex interactions with the San Andreas Fault system. Offsets along various detachment faults produced Coachella Valley, which progressively grew as the detachment faults moved. During this offset, sediments were dumped from the topographic highs (mountains) to fill the lows (valleys) and developed geologic units in such areas as the Indio and Mecca hills, which are now exposed.

Erosion of these elevated areas along with deposition from the Gulf of California and Colorado River have provided as much as 12,000 feet of sediments in the basin. Soils of different ages and compositions have developed on these sedimentary units, and on the younger alluvial units filling the valley floor. Coachella Valley is underlain by a thick sequence of sedimentary deposits. Mountains surrounding the valley include the Little San Bernardino Mountains to the northeast, the foothills of the San Bernardino Mountains to the northwest, and the San Jacinto and Santa Rosa Mountains to the southwest of the Planning Area.

TOPOGRAPHY

Coachella is located within the eastern portion of the Coachella Valley, defined as a low and relatively flat desert basin bounded by mountainous terrain. The City is located south of the Little San Bernardino Mountains, southeast of the San Gorgonio Pass, east of the San Jacinto and Santa Rosa Mountains, north of the Salton Sea at 68 feet below sea level. Interstate 10 runs the length of the Coachella Valley, connecting the City of Coachella with nearby cities and the Southern California region. Coachella (including its SOI and planning area) is located in a portion of Coachella Valley that ranges in elevation from 1,000 feet in the Mecca Hills to the east, to approximately 160 feet below sea level south of Thermal. However, the majority of the City (including its SOI and planning area) is relatively flat, gently sloping from northwest to southeast, as shown on Figure 4.5-1: Regional Topography and Hillshade. The few areas of steep slope (greater than 15%) are located in and among the Mecca Hills in the northeastern part of the Plan area, as shown in Figure 4.5-2: Steep Slope Distribution. Major geographic features in the region include the Santa Rosa Mountains to the southwest of the Planning Area; the Mecca Hills to the south of the Planning Area; and the Indio Hills to the north of the City of Coachella (including its SOI and Planning Area).

The surrounding mountains range from 3,000 to 9,000 feet, with peaks ranging to over 11,000 feet (San Gorgonio peak). The overall valley gradient is from northwest to the Salton Sea with a current surface of approximately 220-feet below mean sea level. The Coachella Valley is surrounded by the Santa Rosa Mountains (Toro Peak, 8,715 feet) approximately five miles southwest. The north and northeast portion of the valley is defined by the Little San Bernardino Mountains (up to 5,267 feet) approximately two miles to the northeast. There are several natural rock outcroppings in the hillside areas of the east that provide a native desert appearance as viewed from the Valley floor. The northeastern portion of the Study Area contains the alluvial that forms the base of the Joshua Tree National Monument and the San Bernardino Mountains to the north (outside of the Study Area).

Figure 4.5-1: Regional Topography and Hillshade

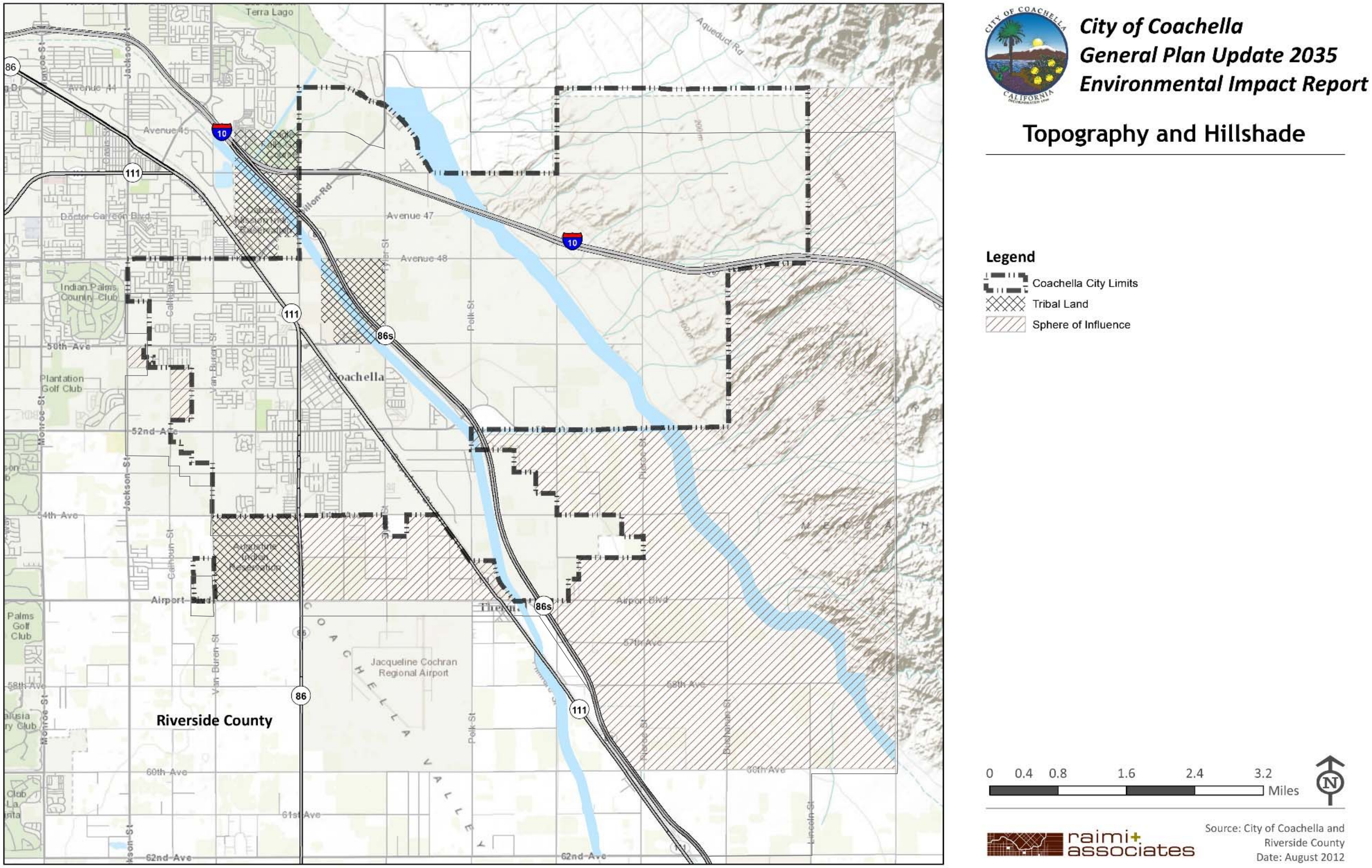
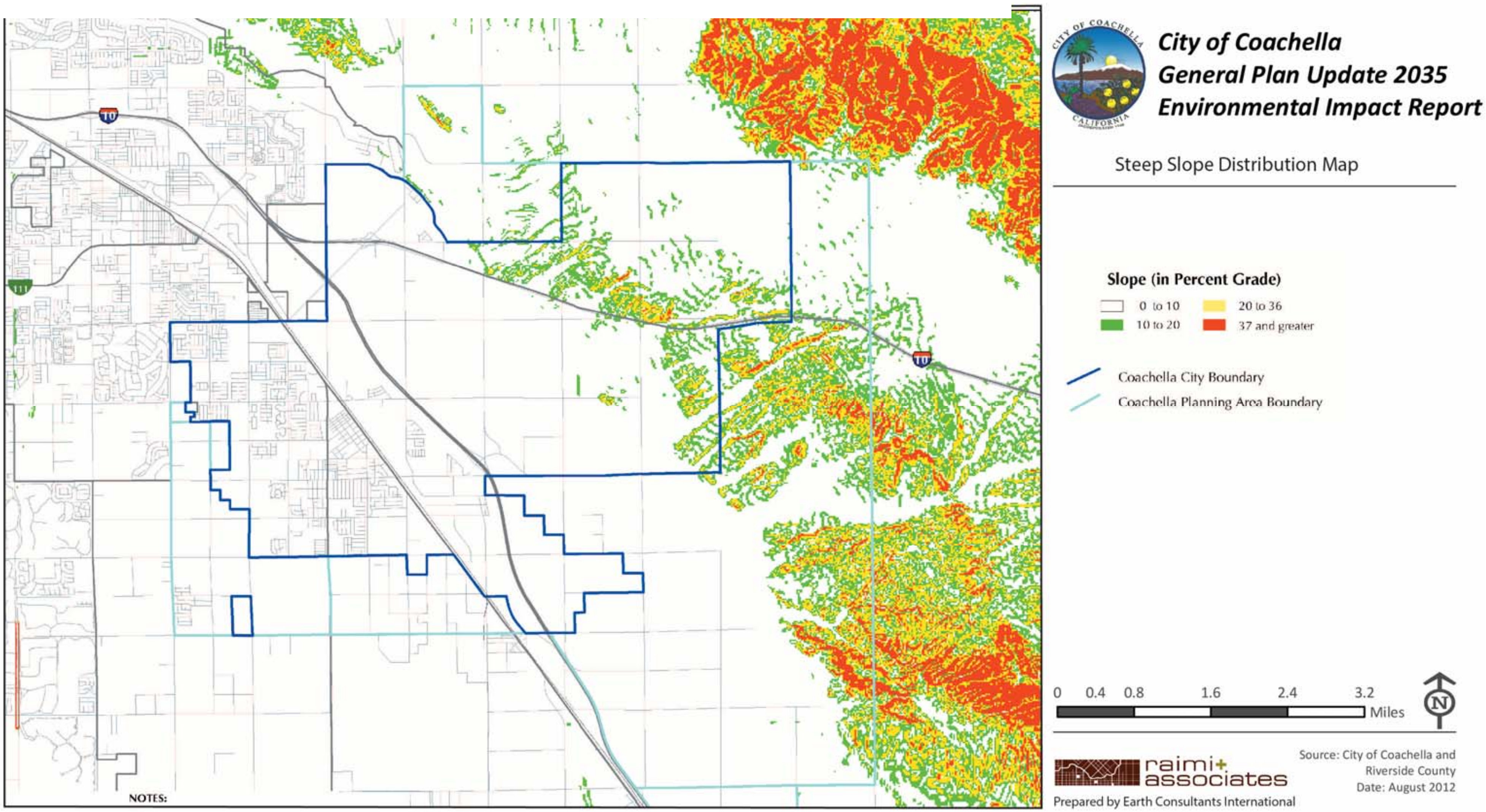


Figure 4.5-2: Steep Slope Distribution



SEISMIC HAZARDS

The following section describes the presence and characteristics of seismic hazards in the planning area including earthquake faults, seismicity, groundshaking, surface rupture, and liquefaction.

Regional Faults

The fault classification criteria adopted by the California Geological Survey defines Earthquake Fault Zones along active or potentially active faults. Based on the classification system of the Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act), of 1972 and revised in 1997, an active fault is defined as a fault that has "had surface rupture in the Holocene times (about the last 11,000 years)." This definition does not mean that faults lacking evidence of surface displacement within Holocene times are necessarily inactive. A fault may be presumed to be inactive based on satisfactory geologic evidence. However, the evidence necessary to prove inactivity is sometimes difficult to obtain and locally may not exist. A fault that has ruptured during the last 1.8 million years (Quaternary time), but is not proven by direct evidence to have moved or not moved within the Holocene, is considered to be potentially active. A potentially active fault is a fault that shows evidence of surface displacement during Quaternary time (last 1.6 million years).

Three designated Alquist-Priolo Earthquake fault zones traverse the Planning Area (USGS, 2008, Treiman, 1998), as shown in Figure 4.5-3: Faults and Fault Zones. According to the City's General Plan 2020, other active or potentially active faults that have not yet been included as Alquist-Priolo Earthquake fault zones also transect the Planning Area. Each of these faults traverses the Planning Area in a northwest to southeast direction and include the fault zones shown in. Alquist-Priolo Earthquake fault zones are periodically updated as new information and technologies become available. As a result, it is possible that the precise boundaries of the zones included in this document may be adjusted or altered over time. In this regard, the City of Coachella made a request in May 2008 to the Department of Geological Survey to review and amend the Alquist-Priolo Earthquake Fault Zone for the San Andreas Fault in the City of Coachella and included geotechnical studies performed within the San Andreas Fault Zone to support the request.1 The Geological Survey responded in June 2008 by agreeing that the studies demonstrated that a modification in the Alquist-Priolo Earthquake Fault Zone for the San Andreas Fault appears warranted, and has requested additional site investigation reports (discussed at a May 21, 2008 meeting between the City and the Geological Survey).[2] Thus, the change is pending.

[1] City of Coachella letter from Tim Brown, City Manager, City of Coachella to William A. Bryant, California Geological Survey, May 19, 2008.

[2] California Geological Survey letter from William Bryant, Alquist Priolo Program Manger to Tim Brown, City Manager, City of Coachella, June 2, 2008.

Figure 4.5-3: Faults and Fault Zones

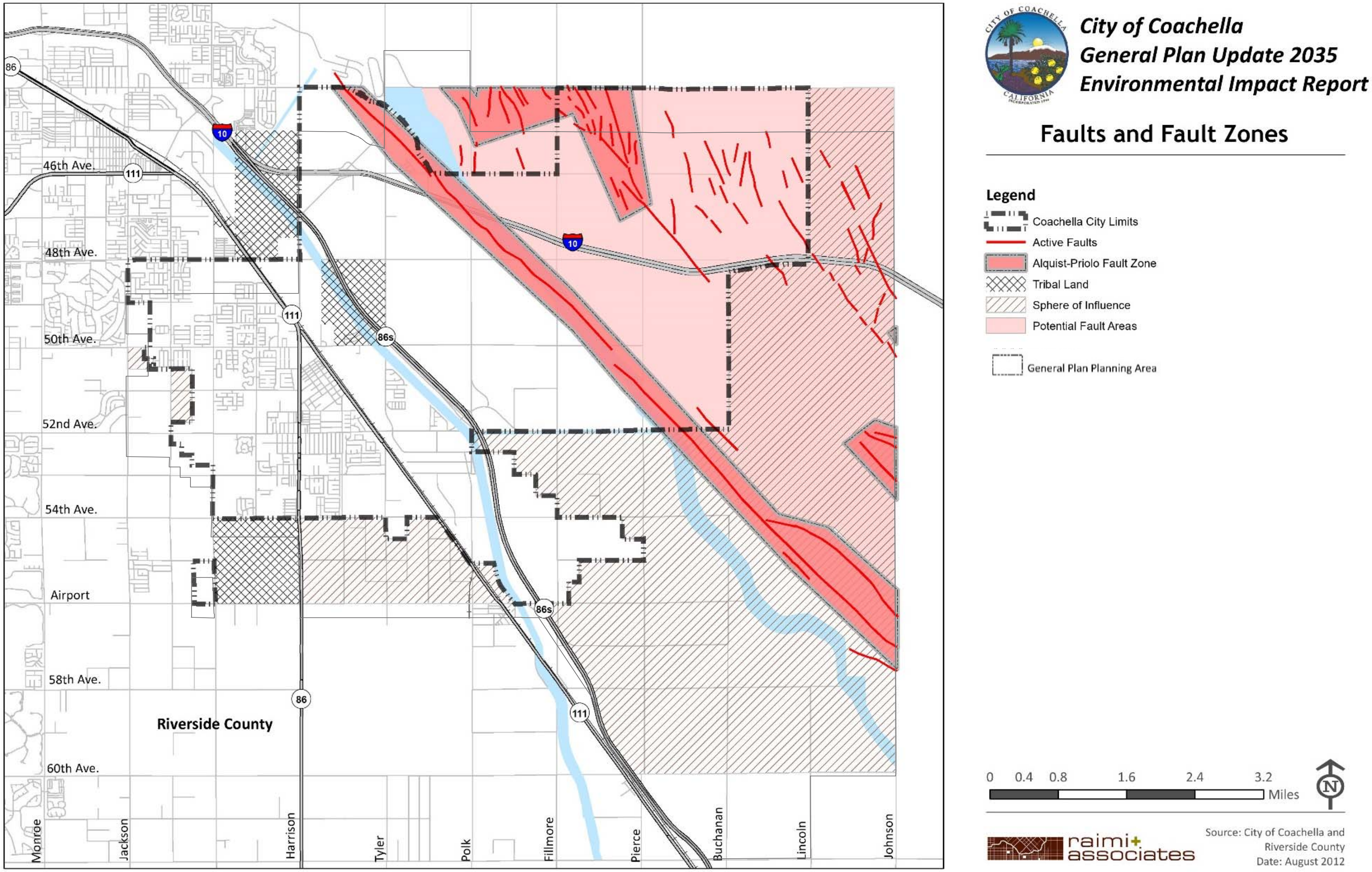


Table 4.5-1: Fault Zones in the Project Vicinity

Fault Zone	Distance from the Project area	Regency of Faulting[a]	Slip Rate[b] (mm/year)	Maximum Moment Magnitude
San Andreas	3 miles east	Historic	34	6.8 to 7.9
San Jacinto	22 miles southwest	Historic	4–12	7.2
Whittier-Elsinore	40 miles southwest	Holocene	4–5	7.1

[a] Regency of faulting from Jennings, 1994. Historic: displacement during historic time (within last 200 years), including areas of known fault creep; Holocene: evidence of displacement during the last 10,000 years; Quaternary: evidence of displacement during the last 1.6 million years; Pre-Quaternary: no recognized displacement during the last 1.6 million years (but not necessarily inactive). Multiple periods are listed when different branches have shown displacement for different geologic periods.

[b] Slip Rate = Long-term average total of fault movement including earthquake movement, slip, expressed in millimeters.

SOURCES: Hart, 1997, Jennings, 1994, Peterson et al., 1996.

San Andreas Fault

The San Andreas Fault Zone is a major structural feature that forms at the boundary between the North American and Pacific tectonic plates. It extends from the Salton Sea in Southern California to north of Point Arena Along the northern California coast, where the fault trace extends out into the Pacific Ocean. In the south, the San Gabriel Mountains roughly denote the path of the San Andreas Fault. The San Andreas Fault is a strike-slip-type fault[3] that traverses Los Angeles County and has experienced movement within the last 150 years.

San Jacinto Fault

The San Jacinto Fault is the most seismically active fault in southern California, with significant earthquakes (>M5.5), including surface rupturing earthquakes in 1968 (M6.6 Borrego Mountain earthquake) and 1987 (M6.6 Superstition Hills and M6.2 Elmore Ranch earthquakes), and numerous smaller shocks within each of its main sections. The fault zone is divided from north to south into: San Bernardino section, San Jacinto Valley section, Anza section, Coyote Creek section, Borrego Mountain section, Superstition Hills section, and Superstition Mountain section. Slip rates in the northern half of the fault system are around 12 mm/yr but are only around 4 mm/yr for faults in the southern half where strands overlap or are sub-parallel.

Whittier-Elsinore Fault

The Whittier-Elsinore Fault is a major strike-slip fault zone that is part of the San Andreas Fault system. The fault has been divided into sections, from north to south: Whittier section, Chino section, Glen Ivy section, Temecula section, Julian section, Coyote Mountain section, and Laguna Salada section. Research studies have been done to assess faulting on most of the sections, and have documented Holocene activity for the length of the fault zone with a slip rate around 4-5 mm/yr. Multiple events have only been dated on the Whittier fault and Glen Ivy North fault strand, so interaction between faults and adjacent sections is not well-known. Although no known historic earthquakes have occurred on this fault, at least one surface rupturing earthquake has occurred in the past 9,598 yr (Treiman, 1998).

[3] “Strike-slip” faults primarily exhibit displacement in a horizontal direction, but may have a vertical component. Right-lateral strike slip movement of the San Andreas Fault, for example, means that the western portion of the fault is slowly moving north while relative motion of the eastern side is to the south.

Groundshaking

Ground movement during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and type of geologic material. Areas underlain by bedrock typically experience less severe ground shaking than those underlain by loose, unconsolidated materials. Areas most susceptible to intense ground shaking are those located closest to the earthquake-generating fault, and areas underlain by thick, loosely unconsolidated and saturated sediments.

The San Andreas and other fault zones within the Coachella area are seismically active and are capable of generating strong groundshaking. The common way to describe ground motion during an earthquake is with the motion parameters of acceleration and velocity in addition to the duration of the shaking. A measure of ground motion is typically characterized by the peak ground acceleration (PGA). The PGA for a given component of motion is the largest value of horizontal acceleration obtained from a seismograph. PGA is expressed as the percentage of the acceleration due to gravity (g), which is approximately 980 centimeters per second squared. In terms of automobile accelerations, one "g" of acceleration is a rate of increase in speed equivalent to a car traveling 328 feet from rest in 4.5 seconds. Probabilistic seismic hazard maps indicate that peak ground acceleration in the planning area could reach or exceed 0.67g which is capable of causing considerable damage in structures not designed to withstand such groundshaking.[4] The potential hazards related to ground shaking are discussed further in the Impacts and Mitigations section of this section. Refer to Figure 4.5-4: Ground Shaking Risk for a summary of potential groundshaking in the Planning Area.

Surface Fault Rupture

Surface rupture occurs when movement on a fault deep within the earth breaks through to the surface. Fault ruptures usually follow preexisting faults, which are zones of weakness. Ruptures may occur suddenly during an earthquake or slowly in the form of fault creep. Sudden displacements are more damaging to structures because they are accompanied by shaking, while fault creep is the slow rupture of the earth's crust.

Liquefaction

Throughout the Planning Area, there is a high potential for liquefaction from seismic events (refer to Figure 4.5-5: Liquefaction Risk). Liquefaction is a hazard associated with intense ground shaking. During seismic events, the earth accelerates and soils can destabilize, particularly when sufficient water is present in the soil. The destabilized soil and water can mix, resulting in liquefaction. Liquefaction is generally associated with shallow groundwater conditions and the presence of loose and sandy soils or alluvial deposits.

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4 A probabilistic seismic hazard map shows the predicted level of hazard from earthquakes that seismologists and geologist believe could occur. The map's analysis takes into consideration uncertainties in the size and location of earthquakes and the resulting ground motions that can affect a particular site. The maps are typically expressed in terms of probability of exceeding a certain ground motion. These maps depict a 10% probability of being exceeded in 50 years. There is a 90% chance that these ground motions will NOT be exceeded. This probability level allows engineers to design buildings for larger ground motions than seismologists think will occur during a 50-year interval, making buildings safer than if they were only designed for the ground motions that are expected to occur in the 50 years. Seismic shaking maps are prepared using consensus information on historical earthquakes and faults. These levels of ground shaking are used primarily for formulating building codes and for designing buildings.

Figure 4.5-4: Ground Shaking Risk

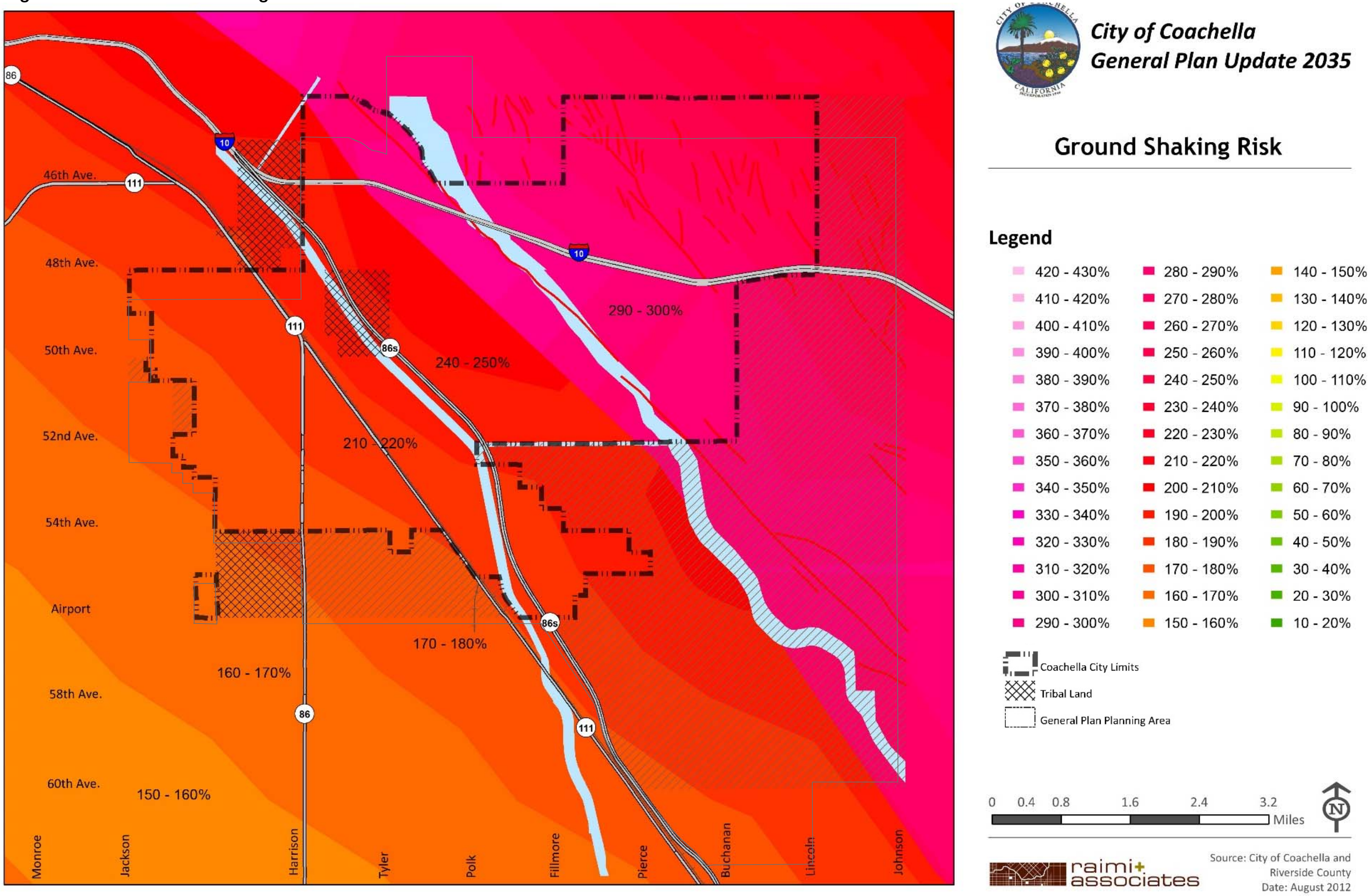
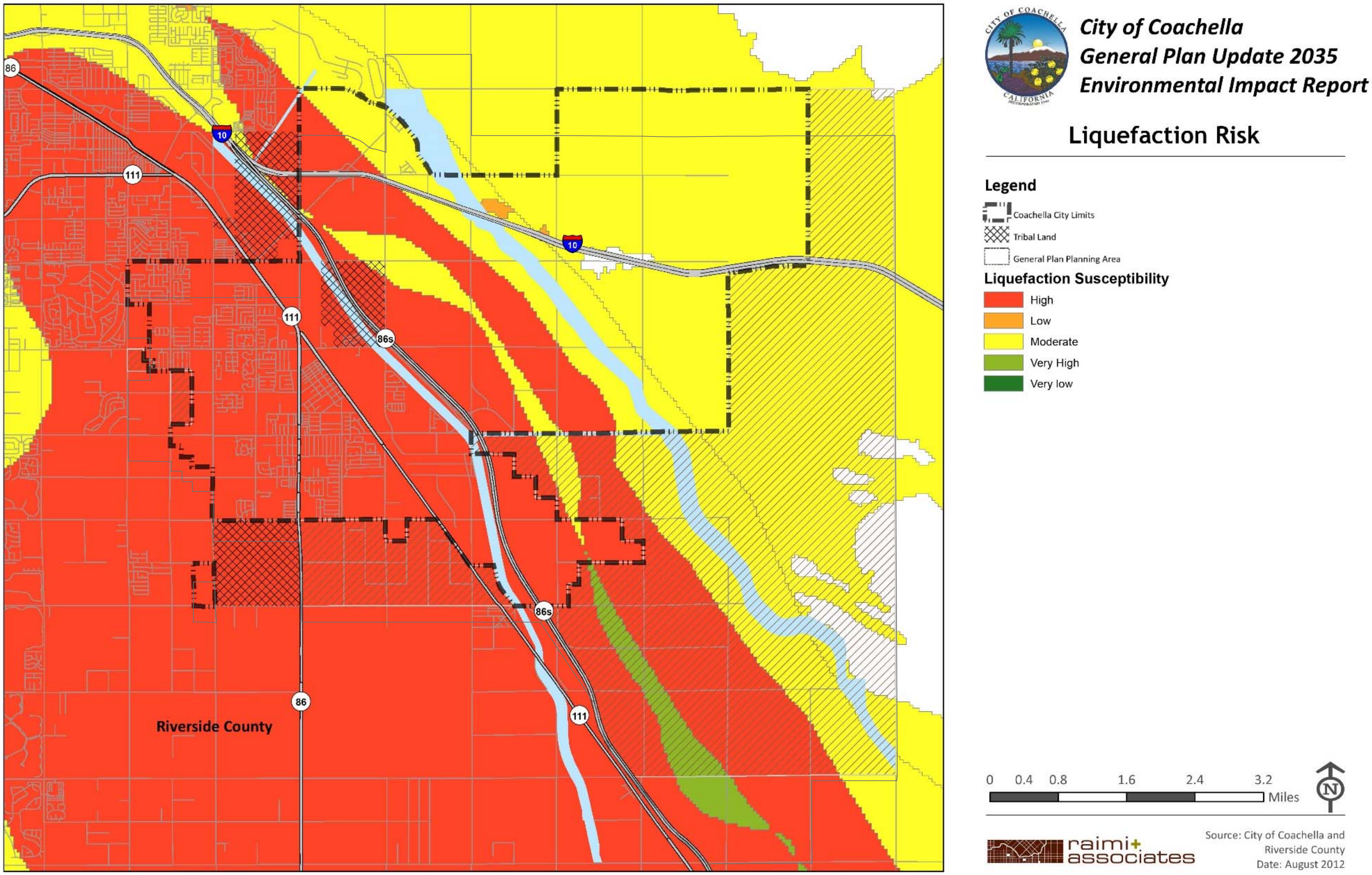


Figure 4.5-5: Liquefaction Risk



Liquefaction can cause excessive structural settlement, sand boils, ground rupture, lateral spreading (movement), or failure of shallow bearing foundations. Liquefaction is typically limited to the first 50 feet below ground surface level. The following four conditions are generally required before liquefaction can occur:

- The soils must be saturated below a relatively shallow groundwater level.
- The soils must be loosely deposited (low to medium relative density).
- The soils must be relatively cohesion-less (not clayey). Clean, poorly graded sands are the most susceptible. Silt (fines) content increase the liquefaction resistances in that more cycles of ground motions are required to fully develop pore pressures. If the clay content (percent finer than 2 micron size) is greater than 10 percent, the soil is usually considered non-liquefiable, unless it is extremely sensitive.
- Groundshaking must be of sufficient intensity to act as a trigger mechanism. Two important factors that affect the potential for soil liquefaction are duration (as indicated by earthquake magnitude) and intensity (as indicated by peak-ground acceleration).

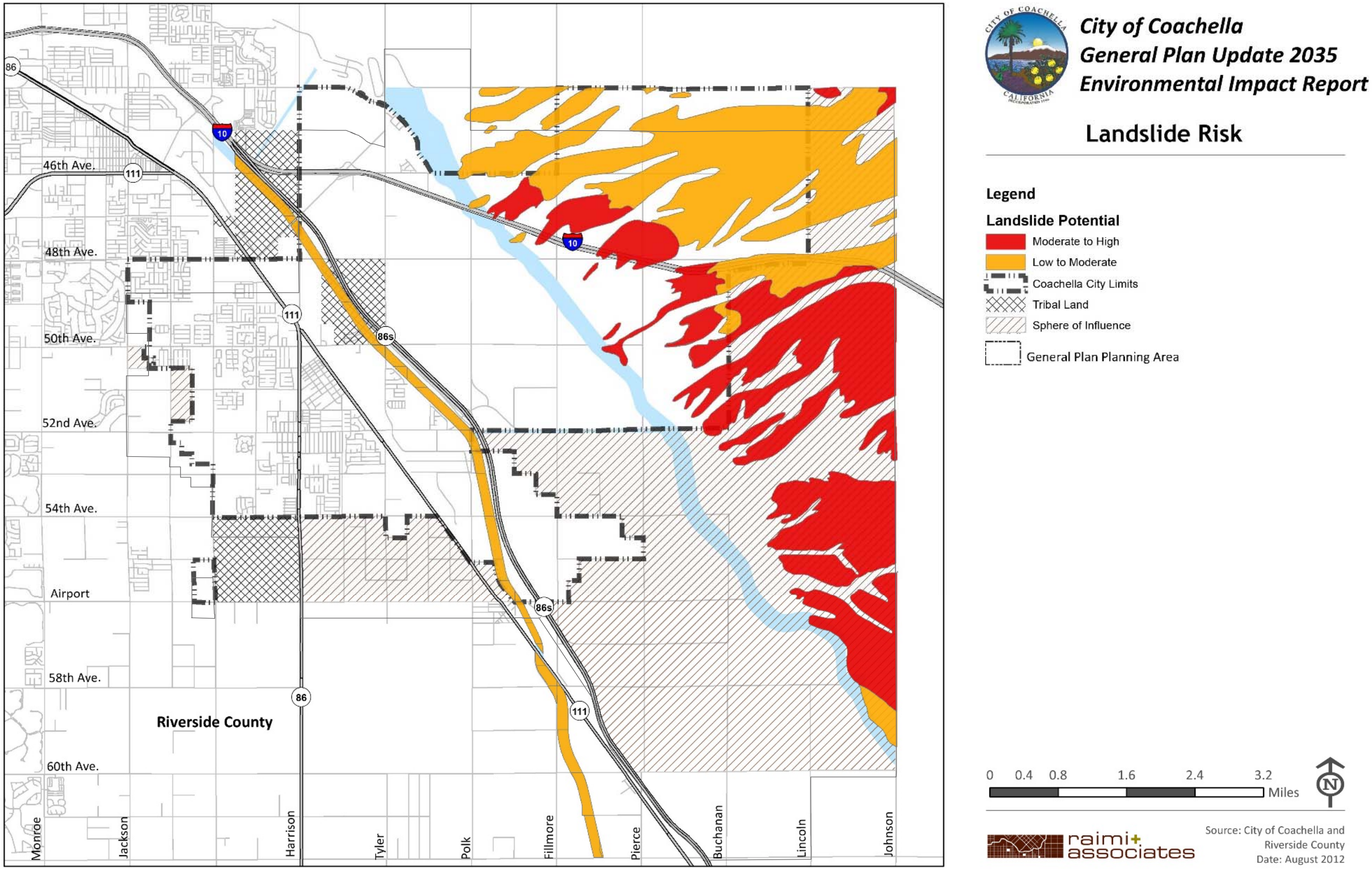
There are two main water bearing aquifers in the Planning Area including a shallow (or semi-perched) water table with groundwater levels ranging from inches to several feet below ground surface due to a restrictive clay layer. The deep ground water aquifer has groundwater levels that are hundreds of feet below the surface. This perched shallow aquifer, in combination with unconsolidated soils and seismic shaking, creates a high potential for liquefaction. Liquefaction probability for the City of Coachella and Sphere of Influence is depicted in **Figure 4.5-5.** The western portion of the Planning Area has the highest potential for liquefaction (mostly high potential, with a smaller linear area of very high potential) (Riverside County, 2008). The eastern portion has a moderate potential for liquefaction (Riverside County, 2008). High and very high liquefaction potential is a hazard for any current or future development.

Landslides and Slope Failure

Slope instability is a condition that can be pre-existing and can pose a negative condition for a project. Landslides often occur along pre-existing zones of weakness within bedrock (i.e. previous failure surfaces). Additionally, landslides have the potential to occur on over-steepened slopes, especially where weak layers, such as thin clay layers, are present and dip out-of-slope. Landslides can also occur on antidip slopes, along other planes of weakness such as faults or joints. Local folding of bedrock or fracturing due to faulting can add to the potential for slope failure. Groundwater is very important in contributing to slope instability and landsliding. In addition, other factors that contribute to slope failure include undercutting by stream action and subsequent erosion as well as the mass movement of slopes caused by seepage or cyclical wetting and drying.

The majority of the Planning Area is relatively level with a low potential for landslides (refer to Figure 4.5-6: Landslide Risk). The State of California Department of Conservation California Geological Survey *Landslide Map Inventory – Southern California* does not include landslide data mapped for the City of Coachella (SCDC, 2008). The U.S. Geological Survey's (USGS) *Landslide Overview Map the Conterminous United States* and *Landslide Incidence and Susceptibility Map* indicates the City of Coachella Planning Area has a low (less than 1.5 percent of area involved) landslide incidence (USGS, 2008).

Figure 4.5-6: Landslide Risk



EARTHQUAKE-INDUCED SETTLEMENT

Settlement of the ground surface can be accelerated and accentuated by earthquakes. During the prolonged ground shaking of an earthquake, settlement can occur as a result of the relatively rapid compaction and settling of subsurface materials (particularly loose, uncompacted, and variable sandy sediments above the water table) due to the rearrangement of soil particles. Settlement can occur uniformly or occur differentially within the same land segment. Areas underlain by artificial fill would be susceptible to this type of settlement.

SOIL TYPES

The majority of soils found in the Planning Area are developed from alluvial fans, valley fill, or lacustrine (lake) basins within the Coachella Valley. The remaining soils were developed over the hilly terrain such as the Mecca Hills and on old terraces such as those found at the base of Santa Rosa Mountains. The soils on alluvial fans and valley fill range from fine sands in dune areas; to gravely, cobbly, or stony sands adjacent to hillsides; and to sandy loams in the central portion of the Planning Area. These soils formed within lacustrine basins in the southern portion of the Planning Area are generally loams that can have a clay, silt, and/or sandy component to their character. Additionally, these soils are situated on hilly terrain and terraces range from sands to loams and can exhibit gravely, cobbly, and/or clayey matrix.

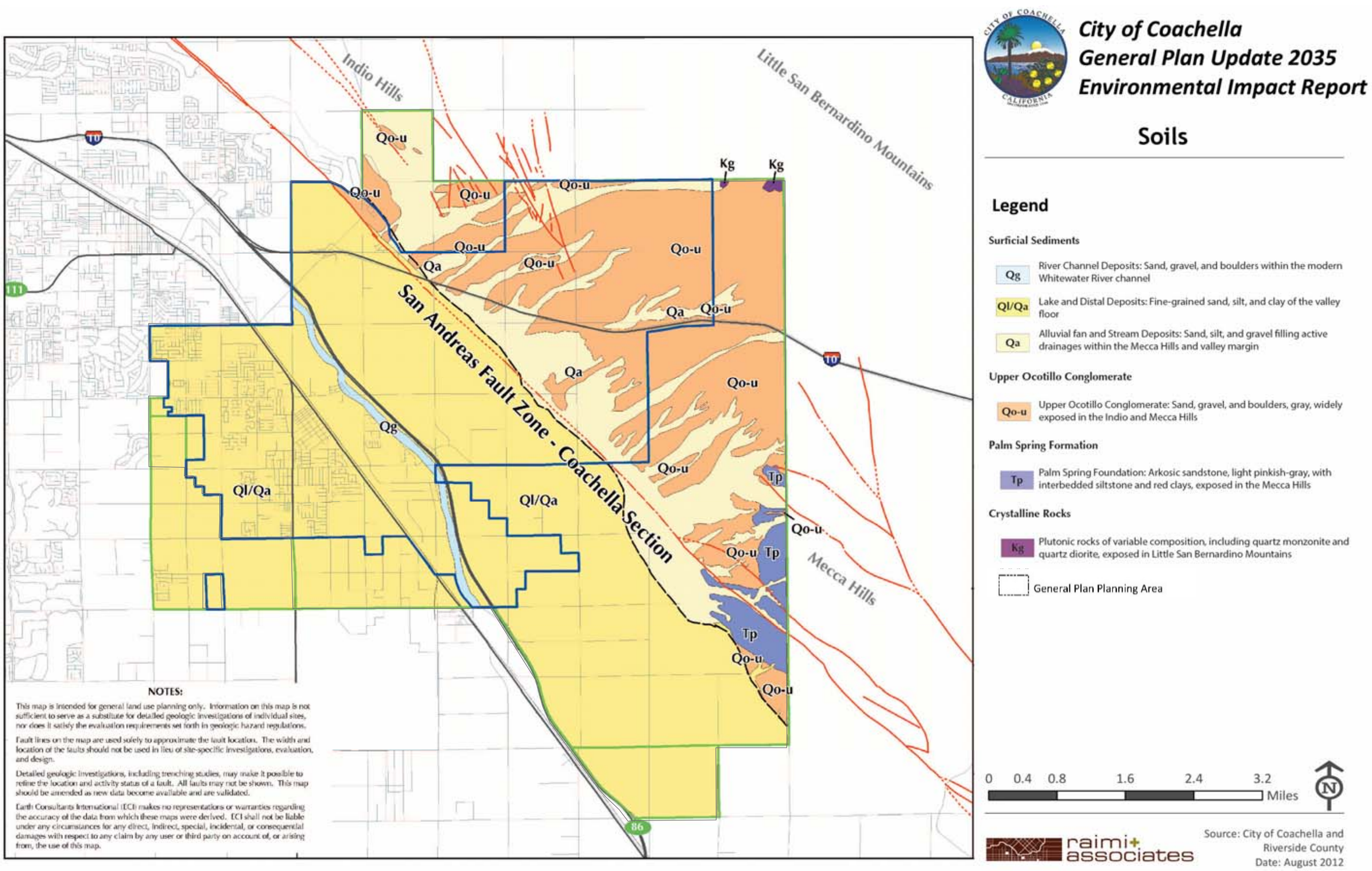
The following information regarding soils is based on *Sheet No. 12 - Soil Survey of Riverside County*, *California, Coachella Valley Area (Indio Quadrangle)* prepared by the United States Department of Agriculture, dated 1978 and the National Resource Conservation Survey, Web Soils Service. Soils within the planning area are characterized from somewhat poorly drained to excessively drained, runoff varies from very slow to rapid, and the hazard of erosion varies from slight to moderate. More specific soil characteristic are demonstrated but their soil types. Table 4.5-2 provides brief descriptions of the soil types within the Planning Area and Figure 4.5-7: Soils Classification shows the distribution of soils in the Planning Area.

Table 4.5-2: Soil Types Present in the City of Coachella and Sphere of Influence

Soil Type	Description
Gilman-Coachella-Indio Association	This soil is nearly level to rolling, somewhat excessively drained find sandy loam, silt loams, loamy fine sand, and very fine sandy loam on alluvial fans.
Carsitas-Myoma-Carrizo Association	This soil is nearly level to moderately steep, somewhat excessively drained or excessively drained sand, fine sand, gravel sand, cobble sand, and stony sand on alluvial fans and valley fill.
Myoma-Indio-Gilman Association	This soil is nearly level to rolling, somewhat excessively drained to moderately drained fine sand in dune areas and loamy fine sand, very fine sandy loam, fine sandy loam on alluvial fans.
Salton-Indio-Gilman-Imperial Association	This soil is nearly level, somewhat poorly drained to well drained silt clay loam, very fine sandy loam, fine sandy loam, and silt loam in lacustrine basins.
Chuckwalla-Badland Association	This soil is nearly gentle sloping to very steep, well drained to excessively drained sand, cobble fine sandy loam, and very gravel sand clay loam in the Indio Hills and terraces.
Badland-Carsitas Association	This soil is nearly level to very step, excessively drained fine sand, sand, gravel sand, and cobble sand in the Indio Hills.
Carsitas Series	This soil series consist of excessively drained soils. Carsitas gravely sand, 0 to 9 percent slopes, is located within the Planning Area north of the Coachella Canal. This soil type is nearly level to moderately sloping on alluvial fans, permeability is rapid, runoff is slow, and the hazard of erosion is moderate.
Coachella Series	This soil series is located throughout the Planning Area and consist mainly of well-drained soils, with slopes ranging from 0 to 5 percent. Permeability is moderately rapid, runoff is medium, and the hazard of erosion is slight.
Gilman Series	This soil series is located throughout the Planning Area and consist mainly of well-drained soils, with slopes ranging from 0 to 5 percent. Permeability is moderate, runoff is very slow, and the hazard of erosion is slight.
Indio Series	This soil series is located throughout the Planning Area and consist mainly of well-drained and moderately well-drained soils that formed in alluvium with slopes range from 0 to 5 percent. Permeability is moderate, runoff is slow, and the hazard of erosion is slight.
Myoma Series	This soil series is located throughout the Planning Area and consist mainly of somewhat excessively drained soils with slopes range from 0 to 15 percent. Permeability is rapid, runoff is very slow, and the hazard of erosion is slight.
Salton Series	This soil series is located throughout the Planning Area and consist of somewhat poorly drained soil with slopes range from 0 to 2 percent. Permeability is slow, runoff is slow, and the hazard of erosion is slight.

SOURCE: Sheet No. 12 –- Soil Survey of Riverside County, California, Coachella Valley Area (Indio Quadrangle) prepared by the United States Department of Agriculture, dated 1978 and the National Resource Conservation Survey, Web Soils Service

Figure 4.5-7: Soils Classification



GEOLOGIC HAZARDS

Potential soil hazards related to existing geologic conditions include: subsidence, landslides, erosion, and collapsible and expansive soils.

Erosion

The potential for natural erosion type hazards is high in areas with a combination of the following conditions: 1) moderately steep to steep slopes (greater than 15 percent), 2) loose to unconsolidated soils and sediments, 3) little or no vegetation cover, and 4) uncontrolled surface water runoff. Changes in any of these conditions can increase erosion potential, as well as cause surface drilling. Additionally, an increase in erosion can increase downstream sediment loads.

Based on soil types present, the hazard of soil erosion within the planning area ranges from slight to moderate (refer to the discussion above regarding soil types). Carsitas/Chuckwalla-Badlands association, located near the eastern boundary of the planning area, is characterized as very steep with numerous deep, steep sided channels having rapid runoff and high erosion potential where soil is left bare. Refer to Figure 4.5-8: Erosion Potential

Collapsible and Expandable Soil

Collapsible soils are low density, silty to very fine-grained, predominately granular soils containing very small pore spaces and voids. When saturated, these soils undergo a rearrangement of their grains and a loss of cementation, resulting in substantial and rapid settlement under relatively low loads. A rise in the groundwater table or an increase in surface water infiltration, combined with the weight of a building or structure, can initiate rapid settlement and cause the foundations and walls of such facilities to crack. Collapsible soils generally are the result of rapid deposition of sediment near the source that has not absorbed enough moisture to form a compact soil. Most collapsible soils are associated with arid and semi-arid environments, such as found in the Planning Area. Collapsible soils are most commonly associated with eolian (wind) deposited sands and silts, alluvial fan materials rimming the valley, and mudflow sediment deposited at the base of slopes during flash floods. Collapsible soils may fail with a minimal amount of increased overburden. Those alluvial soils found in the central planning area, as well as soils rimming the valley should be considered to have a moderate to high potential for collapse (NRCS, 2008).

Expansive soils generally result from having high percentages of expansive clay minerals, such as montmorillonite. These fine-grained soils can undergo substantial increases and decreases in volume, with an increase and decrease in water content respectively. If not adequately addressed, expansive soils can cause extensive damage to structures and paving. The Planning Area is subject to potential expansive soil hazards in the vicinity of Thermal Airport and along the Southern Pacific Railroad tracks near the study area's southern border (City of Coachella, 1998). The Imperial and Salton soil series are considered to have a low to high expansion potential. These soils generally occur in the southern portion of the Planning Area (NRCS, 2008). Soils derived from weathering of consolidated sedimentary rocks in the Mecca Hills in and around the San Andreas fault zone are also considered to have a moderate expansion potential (NRCS, 2008). However, due to the sporadic nature of clay sedimentary bedrock and fault gouge, the Mecca Hills area could not be assigned an expansive soil classification.[5]

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[5] Ibid.

Figure 4.5-8: Erosion Potential

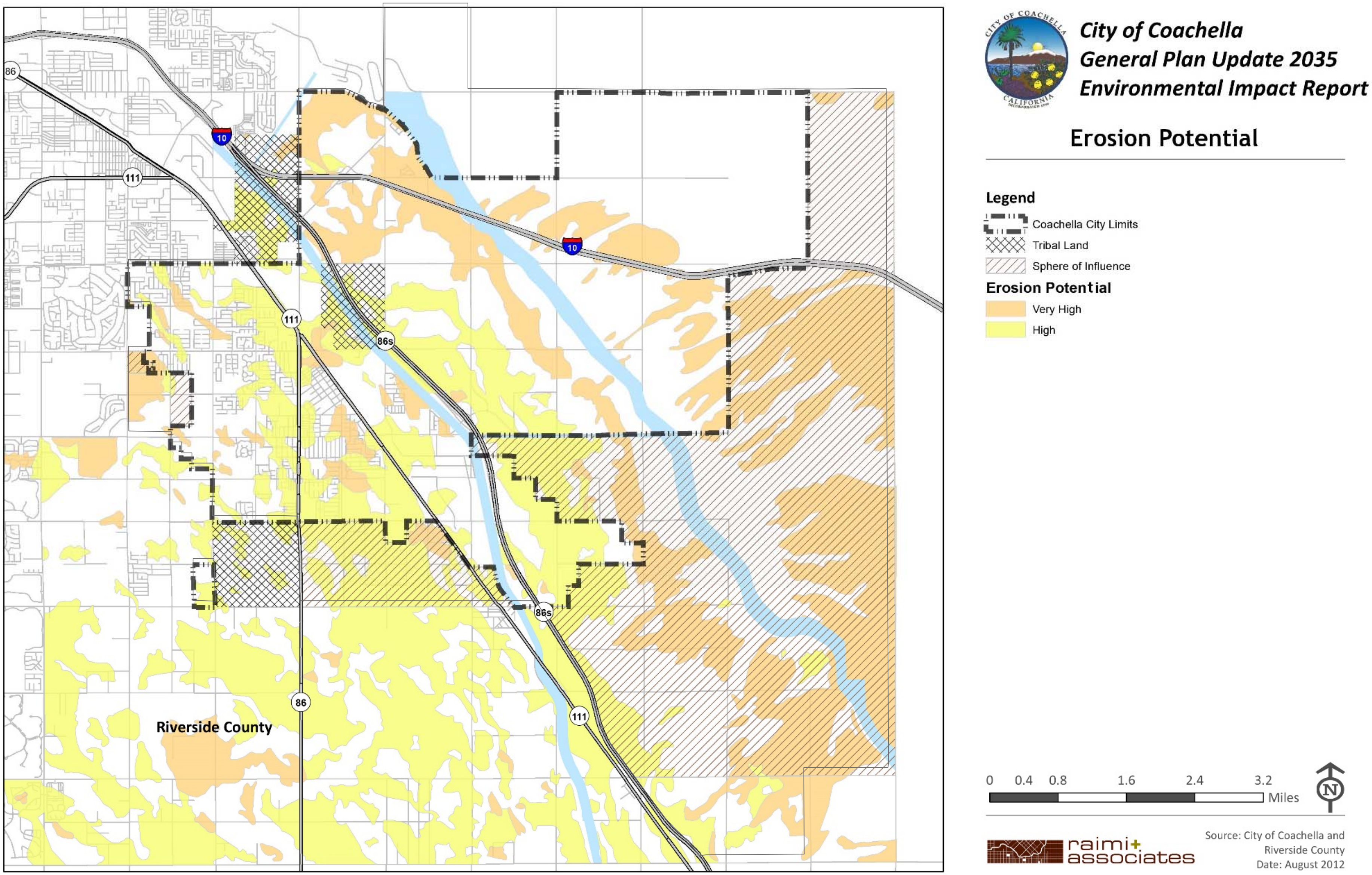
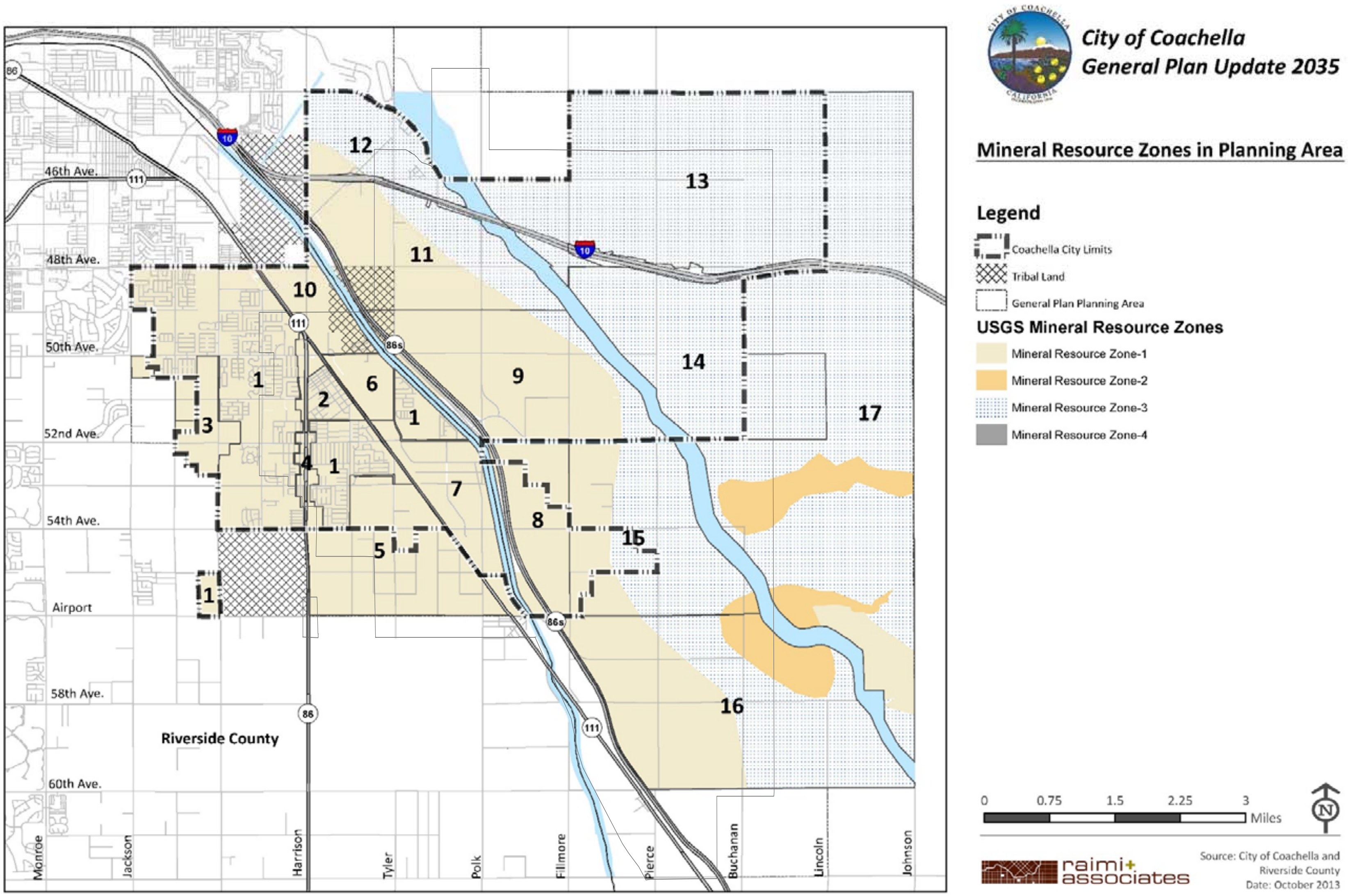


Figure 4.5-9: Mineral Resources



Subsidence

Land subsidence is the gradual, local setting or shrinking of the earth's surface with little or no horizontal motion. Subsidence may also be caused by liquefaction, groundwater withdrawal, oil or gas withdrawal, and hydroconsolidation. During very large earthquakes, it is possible for subsidence or seismically induced settlement to occur in loose granular soils in flat or gently sloped portions of areas as the result of intense ground shaking. Differential settlement, a form of seismic-induced settlement, can occur along areas where the depth to bedrock varies abruptly, such as along the edges of alluvial basins. The entire Planning Area is considered to have active subsidence, and this can be a long-term hazard to existing and future development (Riverside County, 2008).

REGULATORY SETTING

STATE

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code, Chapter 7.5, Section 2621-2699.6) was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This State law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards, such as subsidence or liquefaction. The Act requires the State Geologist to establish regulatory zones, known as "Earthquake Fault Zones," around the surface traces of active faults and to issue appropriate maps. Local agencies must regulate most development projects within these zones. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults. An evaluation and written report of a specific area must be prepared by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (typically 50 feet set backs are required). A section of the Alquist-Priolo-zoned San Andreas Fault extends through the eastern and northeastern portions of the city of Coachella. The California Geological Survey has also zoned other faults in the northern and southeastern portions of the Coachella General Plan area.

California Building Code

The California Building Code (CBC) has been codified in the California Code of Regulations (CCR) as Title 24, Part 2. Title 24 is administered by the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable. The purpose of the CBC is to establish minimum standards to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, and general stability by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction. The CBC is based on the International Building Code. The 2007 CBC is based on the 2006 International Building Code (IBC) published by the International Code Conference. In addition, the CBC contains necessary California amendments which are based on the American Society of Civil Engineers (ASCE) Minimum Design Standards 7-05. ASCE 7-05 provides requirements for general structural design and includes means for determining earthquake loads as well as other loads (flood, snow, wind, etc.) for inclusion into building codes. The provisions of the CBC apply to the construction, alteration, movement, replacement, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout California.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 was developed to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and from other hazards caused by earthquakes. This act requires the State Geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones. Before a development permit may be granted for a site within a Seismic Hazard Zone, a geotechnical investigation of the site must be conducted and appropriate mitigation measures incorporated into the project design. The Planning Area is located in a region that has not yet been mapped under the Seismic Hazards Zonation Program by the California Geological Survey and is currently not shown as an area planned for future evaluation.

LOCAL

City of Coachella Municipal Code

The City of Coachella Municipal Code Chapter 15.08, Uniform Building Code Adopted, adopts the CBC (2001 Edition) with all State and City amendments thereto, as adopted by the State of California, and serves as the City's Building Code. The City's Building Code is the presiding building code for the purposes of regulating the erection, construction, enlargement, alteration, repair, moving, removal demolition, conversion, occupancy, equipment, use, height, area, and maintenance of all buildings or structures in the City, and providing for the issuance of permits and the collection of fees therefore, and providing for penalties for violations thereof. Chapter 15.66, Seismic Hazard Mitigation, includes specific language to promote public safety by identifying buildings that are most susceptible to earthquake damage and requiring certain mitigation measures to protect the lives of persons working and residing in Coachella.

Status of the Unreinforced Masonry Law

In 1986, California enacted a law that required local governments in Seismic Zone 4 to inventory unreinforced masonry (URM) buildings, to establish a URM loss reduction program and report progress to the state by 1990. Each local government was allowed to tailor their program to their own specifications[6]. Since 1994 the City of Coachella has identified 14 URMs but metal detectors found 13 reinforced. The remaining single URM was destroyed in a fire in 1994.

[6] http://www.seismic.ca.gov/pub/CSSC%202006%20URM%20Report%20Final.pdf

ENVIRONMENTAL IMPACTS AND MITIGATION

SIGNIFICANCE CRITERIA

The criteria used to determine the significance of an impact are based on Appendix G of the CEQA Guidelines. For this analysis, implementation of the proposed project may result in significant impacts if it would:

- Expose people or structures to potential substantial adverse effects, including 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; and/or
  - Landslides;
- 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;
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code creating substantial risks to life or property;
- Result in substantial soil erosion or the loss of topsoil; or
- 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.
- Result in the loss of availability of a known mineral resource that would be a value to the region and the residents of the state?
- Result in the loss of availability of locally important mineral resources recovery site delineated on a local general plan, specific plan, or any other land use plan.

FAULT RUPTURE

Impact 4.5-1: Would the Project expose people or structures to potential substantial adverse effects, including 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?

Level of Significance: Less than Significant.

Surface rupture occurs when movement on a fault deep within the earth breaks through to the surface. Fault ruptures usually follow preexisting faults, which are zones of weakness. Ruptures may occur suddenly during an earthquake or slowly in the form of fault creep. Sudden displacements are more damaging to structures because they are accompanied by shaking, while fault creep is the slow rupture of the earth's crust.

Under the proposed CGPU, the City of Coachella anticipates up to an additional 94,000 residents by 2035 (an increase from the current population of 40,000 up to 134,000). To house these new residents, approximately 33,469 dwelling units are expected to be built. Since some portions of the

Planning Area are within the Alquist-Priolo Earthquake Fault Zone, it is critical that new dwelling units are sited appropriately to avoid exposing residents to fault rupture hazards.

Proper enforcement of the Alquist-Priolo Earthquake Fault Zoning Act will significantly reduce potential impacts from fault rupture. The Alquist-Priolo Earthquake Fault Zoning Act requires the State Geologist to establish regulatory zones (known as Earthquake Fault Zones) around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. Local agencies must regulate most development projects within the zones. Projects include all land divisions and most structures for human occupancy. Single family wood-frame and steel-frame dwellings up to two stories not part of a development of four units or more are exempt.

Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings will not be constructed across active faults. An evaluation and written report of a specific site must be prepared by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (generally 50 feet).

The Coachella segment of the San Andreas Fault is believed to be capable of generating a maximum magnitude 7.2 earthquake. Because this segment has not ruptured since about 1680, scientists estimate there is a high probability it will break in a significant earthquake within the next 30 years. If the entire Southern segment (a much larger section of the fault zone that includes the Coachella segment) ruptured, an earthquake of magnitude 8.0 is conceivable. Although the probability of this earthquake occurring is lower, it is not considered unrealistic and the impact to the Coachella region would be considerably more severe. Furthermore, Coachella is located near several other regional active faults – such as the San Jacinto – that have the potential to cause strong ground shaking in the area. The nearby segments of the San Jacinto fault zone could generate at least a magnitude 6.6 earthquake.

It is imperative that the City possess the most accurate and up-to-date data regarding the location of all faults within city boundaries. In this regard, the City of Coachella made a request in May 2008 to the Department of Geological Survey to review and amend the Alquist-Priolo Earthquake Fault Zone for the San Andreas Fault in the City of Coachella and included geotechnical studies to support the request.[7] The Geological Survey responded in June 2008 by agreeing that the studies demonstrated that a modification in the Alquist-Priolo Earthquake Fault Zone for the San Andreas Fault appears warranted, and requested additional site investigation reports.

To address the issue of fault rupture in the City, the CGPU proposes a comprehensive policy program to provide mechanisms for identifying and avoiding threats from fault rupture. The CGPU would govern how development is designed and constructed to proactively address the potential fault rupture hazard and prevent the creation of significant fault rupture related hazards. As mentioned in the regulatory section above, several regulations already exist to help prevent the inadvertent siting of structures in areas prone to fault rupture. The CGPU takes this regulatory framework further help with additional

[7] City of Coachella letter from Tim Brown, City Manager, City of Coachella to William A. Bryant, California Geological Survey, May 19, 2008.

policies to help prevent fault related hazards. These policies, found in the Safety Element, are as follows:

- **1.1 Development plan review.** Review all plans for new development to be certain new structures are designed in accordance with the most recent California Building Code adopted by City Council, including the provisions regarding seismic loads, lateral forces and grading.
- **1.2 Earthquake-resistant new buildings.** Require all new habitable buildings and structures to be designed and built to be seismically resistant and not built across the trace of an active fault.
- **1.4 Strengthened infrastructure.** Promote the strengthening of infrastructure and utilities to make them more earthquake resistant by encouraging the City's utility service providers to identify, evaluate and replace or strengthen, as needed, those sections of their distribution network that are located in areas susceptible to fault rupture, liquefaction or slope instability. This also includes encouraging the City's utility service providers to identify and replace or strengthen those sections of their distribution network in the General Plan area that are the oldest, and therefore more likely to be weathered or corroded.
- **8.1 Local Hazard Mitigation Plan**: Maintain and update on a regular basis, as mandated by FEMA, a Local Hazard Mitigation Plan. Incorporate an assessment of climate change-related hazards in all future Local Hazard Mitigation Plan updates.
- **8.2 Emergency response organization**: Maintain and update the emergency response organization consisting of representatives from all City departments, the Riverside County Fire and Sheriff Departments, local quasi-governmental agencies, private businesses, citizens, and other community partners involved in emergency relief and/or community-wide emergency-response services.
- **8.6 Emergency exercises**: Participate in regional and local emergency exercises, such as the Great California ShakeOut, an annual statewide earthquake drill.
- **8.10 Earthquake-preparedness educational programs**: Conduct educational programs for residents and businesses regarding measures to take before, during, and after an emergency, and involve the public in the awareness of City emergency response plans, resources, risk reduction and mitigation measures.

Through these policies and the regulations of the Alquist-Priolo Act and the California Building Code, the City would be able to identify and avoid potential future threats that might arise through the construction of new structures in the vicinity of a fault or fault zone. All future development must be consistent with the CGPU, including these policies. Thus, these policies will ensure that future development that might be at threat of fault rupture could not be constructed without the appropriate seismic upgrades or within the vicinity of a fault trace. Thus, impacts would be less than significant.

Mitigation Measures

No mitigation measures are necessary.

SEISMIC GROUND SHAKING

Impact 4.5-2: Would the Project expose people or structures to potential substantial adverse effects, including risk of loss, injury or death involving strong Seismic Ground Shaking?

Level of Significance: Less than Significant.

Ground movement during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and type of geologic material. Areas underlain by bedrock typically experience less severe ground shaking than those underlain by loose, unconsolidated materials. Areas most susceptible to intense ground shaking are those located closest to the earthquake-generating fault, and areas underlain by thick, loosely unconsolidated and saturated sediments. Potential ground shaking risk is displayed on Figure 4.5-4: Ground Shaking Risk, which identifies the entirety of the Planning Area as above-average likelihood, with the greatest risks (>300%) found along the fault zones and in the potential fault areas.

The interaction between earthquake-induced ground motion and human-made structures is complex; some of the governing factors include the structure's height, construction quality, stiffness, architectural design, condition and age. New advances are reflected in the most recent building codes, thus, newer structures built to these codes are theoretically stronger and more likely to survive an earthquake. However, the main purpose of building codes is to prevent structures from collapsing; significant damage that might cause a structure to be uninhabitable following a large earthquake is possible and permissible. Building codes are also not retroactive; consequently there are older building types still in existence that do not perform well when shaken. Fortunately, the Planning Area does not have issues with older, unreinforced masonry buildings (sometimes referred to as 'soft housing'). According to the 2000, 2003 and 2006 reports by the Seismic Safety Commission on the "Status of the Unreinforced Masonry Building Law," the City of Coachella's initial survey indicated that there were 14 unreinforced masonry (URM) buildings in the City. However, a review of these buildings using metal detectors later showed that thirteen of these are reinforced. The one true URM in the city was reported as destroyed in a fire in 1994.

Construction regulations and guidelines are currently in place for new structures, to prevent collapse from ground shaking. These regulations ensure that structures are built with proper reinforcement to a level and engineering standard that is most recent, to prevent structure failure. Regulations regarding seismic ground shaking and building regulations can be found on page 4.5-19 of this section. Additionally, the CGPU provides additional policies for development to comply with in order to reinforce the importance of safe structure construction and reduce impacts from seismic ground shaking. Routine implementation of City of Coachella's policy requiring adherence to the Uniform Building Code for this seismic area will reduce the potential for nearly all impacts related to ground shaking for newly constructed buildings to a less than significant level. In particular, Section 15.08.030, Amendments to the California Building Code - Building Code Section 3403.5, includes requirements for new construction in Coachella that are more stringent than the standard California Building Code (CBC). Additionally, Chapter 15.66, Seismic Hazard Mitigation, identifies those buildings in the City that are most susceptible to earthquake damage and to require certain mitigation measures to protect the lives of persons working and residing in Coachella. Several proposed policies from the Safety Element of the General Plan Update 2035 were crafted specifically to address safety concerns pertaining to seismic groundshaking, and provide direction for decision makers to ensure minimal threats from seismic groundshaking. These policies are listed below:

1.3 **Strengthened and seismically retrofitted older structures.** Promote the strengthening of older structures to make them more resistant to seismic shaking. This includes encouraging owners of potentially hazardous buildings, such as pre-1952 wood-frame structures, concrete tilt-ups, pre-1971 reinforced masonry, soft-story, multi-family residential buildings and manufactured homes, to assess the seismic vulnerability of their structures and conduct seismic retrofitting as necessary to improve the buildings' resistance to seismic shaking.

1.5 **Seismically damaged buildings.** Prohibit any additions or reconstruction of structures damaged by seismic hazards, unless the structure is re-located to a safer area, or it can be demonstrated the proposed project and its occupants can be protected from future, recurrent damage by implementing mitigation measures not present in the original, damaged structure.

2.7 **Damaged buildings.** Prohibit any additions or reconstruction of habitable structures destroyed or damaged by geologic hazards unless the structure is relocated to a safer area or the applicant proves that the remedial measures proposed will mitigate the unsafe geological conditions so the proposed project and its occupants can be protected from future, recurrent damage.

Together, the regulations governing new buildings and the proposed policies provide a comprehensive framework for ensuring new construction anticipated under the CGPU would be built to withstand groundshaking, identify existing structures that may be at risk, and encourage older structures to be rehabilitated or moved to a safer area. Determination of projects vulnerability to seismic groundshaking will be determined through development application review stage, when proposed projects would be evaluated against the CGPU for consistency with these policies. Projects not consistent with these policies could not be approved by the City. Thus, impacts would be less than significant.

Mitigation Measures

No mitigation measures are necessary.

GROUND FAILURE AND LIQUEFACTION

Impact 4.5-3: Would the Project expose people or structures to potential substantial adverse effects, including risk of loss, injury or death involving seismic-related ground failure, including liquefaction?

Level of Significance: Less than significant.

Throughout the Planning Area there is a high potential for liquefaction from seismic events. Liquefaction is a hazard associated with intense ground shaking. During seismic events, the earth accelerates and soils can destabilize, particularly when sufficient water is present in the soil. The destabilized soil and water can mix, resulting in liquefaction. Liquefaction is generally associated with shallow groundwater conditions and the presence of loose and sandy soils or alluvial deposits. Liquefaction probability for the Planning Area is depicted in Figure 4.5-5: Liquefaction Risk. The western portion of the Planning Area has the highest potential for liquefaction (mostly high potential, with a smaller linear area of very high potential) (Riverside County, 2008). The eastern portion has a moderate potential for liquefaction (Riverside County, 2008). High and very high liquefaction potential is a hazard for any current or future development.

Completely avoiding all areas susceptible to earthquake-induced liquefaction or settlement is generally not feasible. However, through engineering based solutions such as reinforced pad design and properly engineered and compacted soil, liquefaction issues can be largely eliminated. The City of Coachella along with state and federal agencies have restrictions and requirements for development design and location that lead to reduced impacts from seismic-related ground failure. Through the development review process of proposed structures in the Planning Area, a site-by-site analysis is required to determine if structures are allowable, or to assess building design and check that proposed structures meet existing regulations or applicable codes. The CGPU also provides policies that would be applied during the development permit review process to ensure structures are following regulations prior to development and are in compliance with any applicable design or engineering standards. During this phase, the City would require special studies within these zones for new construction, as well as for significant redevelopment, and require implementation of the engineering recommendations for mitigation. This approach is covered under the Safety Element of the CGPU, as listed below.

1.6 **Liquefaction assessment studies.** Require liquefaction assessment studies be conducted for all projects proposed in areas identified as potentially susceptible to liquefaction (Plate 1-3, Technical Background Report). These studies need to be conducted in accordance with the provisions in the Seismic Hazards Mapping Act and the most recent version of the California Geological Survey's Special Publication 117: Guidelines for Evaluating and Mitigating Seismic Hazards in California.

1.7 **Liquefaction mitigation.** In areas where geotechnical testing shows the sediments are susceptible to liquefaction, require the implementation of mitigation measures as a condition of approval. Liquefaction mitigation measures shall be applied to all habitable structures, bridges, roadways, major utility lines and park improvements to be built in these areas.

2.8 **Critical facility siting.** Regulate the location of new essential or critical facilities in areas that could be affected by geologic hazards by comparing, during the project feasibility stage, the location of the proposed facilities with the mapped areas in the Technical Background Report identified as susceptible to natural hazards.

In accordance with the state-mandated Seismic Hazards Mapping Act (SHMA), all projects within a State-delineated Seismic Hazard Zone for liquefaction must be evaluated by a Certified Engineering Geologist and/or Registered Civil Engineer (this is typically a civil engineer with training and experience in soil engineering). Further, the Seismic Hazards Mapping Act specifies that the lead agency may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils. It is these regulations that will restrict development from occurring in areas subject to liquefaction, or require site-specific designs that eliminate rises associated with liquefaction, and reduce risks to structures from failures from liquefaction. Along with the existing regulatory framework, additional CGPU policies will provide decision makers with additional regulatory tools to apply additional hazard-avoidance standards on proposed projects within the Planning Area. Projects that do not meet regulations set out by the current law, government codes, and CGPU policies would not be permitted to build. Also, if a geologic report concludes liquefaction impacts cannot be reduced to less than significant with mitigation as necessary, development would not be permitted. Compliance with SHMA and General Plan policies would reduce impacts from liquefaction to less than significant.

Mitigation Measures:

No mitigation measures are necessary.

LANDSLIDES

Impact 4.5-4: Would the Project expose people or structures to potential substantial adverse effects, including risk of loss, injury or death involving landslides?

Level of Significance: Less than significant.

Slope instability would be a potential hazard as development encroaches into the hills in the Northeastern part of the Planning Area. The geologic unit forming most of the hills is generally resistant to large-scale landsliding, so future slope failures are more likely to consist of surficial failures and erosion of sandy geologic materials, as shown on Figure 4.5-6: Landslide Risk. Such failures typically occur during exceptional and/or prolonged rainfall, and may manifest as mud or debris flows. Larger slope failures could occur in the small portion of the hills underlain by the Palm Spring Formation due to the presence of clay beds and deformation by the San Andreas Fault. Cut slopes in this area will most likely need remedial grading to meet minimum engineering requirements. The U.S. Geological Survey's Landslide Overview Map the Conterminous United States and Landslide Incidence and Susceptibility Map indicates the Planning Area has a low (less than 1.5 percent of area involved) landslide incidence (USGS, 2008). Another relatively minor risk for Coachella related to debris flow is rockfall. Portions of the Mecca Hills in the southeastern most section of the General Plan Area are underlain by bedrock assigned to the Palm Spring Formation. Faults, joints and fractures have formed several wedges of rock that are precariously attached to the slope faces; strong shaking during an earthquake is likely to topple these rocks posing a rockfall hazard to areas adjacent to and below these slopes.

Though there is a relatively low probability of landslides in the Planning Area, there are regulations to assess development risks from geological hazards such as landslides. These regulations set compliance standards and review protocol for structures within the Planning Area. Proposed projects in the Planning Area are required, by law, to meet applicable regulations prior to obtaining a permit for development. In addition to existing regulations, the CGPU Land Use + Community Character Element and Safety Elements propose multiple policies that address the potential hazard associated with landslides, as follows:

Land Use + Community Character Element

2.15 **Steep slopes.** Limit development and grading in areas with slopes greater than 20 percent and limit the density and intensity of development in areas with slopes of between 10 and 19 percent.

Safety Element

2.3 **Slope failure mitigation.** Minimize grading and modifications to the natural topography to prevent potential for man-induced slope failures. Where deemed necessary, erect protective devices such as barriers, rock fences, retaining structures or catchment areas.

2.4 **Field inspections.** Conduct routine field inspections during grading and construction to ensure safety practices are being followed and the site is being graded; and new structures are being built in accordance with the most recent California Building Code adopted by the City, in agreement with the approved plans and specifications.

2.5 **Slope failure map updates.** Maintain an updated map of slope failures in the General Plan area to identify slopes where debris flows, surficial mass wasting events, and rockfalls have occurred, especially during wet winters.

The regulatory framework outlined on page 4.5-19 of this section summarize standards and development restrictions for land or structures at risk of impact from landslides. During the development permit review stage of a project within the Planning Area, these regulations, along with CGPU policies, would limit the siting of buildings in hazardous areas and enact additional safety precautions relative to construction and design activities. Permits for projects within the Planning Area that would place structures at risk of landslides would be withheld if the proposed project fails to meet criteria set by the existing regulations. Following compliance with the current regulatory framework and proposed General Plan policies, impacts would be less than significant in this regard.

Mitigation Measures:

No mitigation measures necessary.

SUBSIDENCE

Impact 4.5-5: Would the Project be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

Level of Significance: Less than Significant.

Land subsidence is the gradual, local setting or shrinking of the earth's surface with little or no horizontal motion. Subsidence may also be caused by liquefaction, groundwater withdrawal, oil or gas withdrawal, and hydroconsolidation. During very large earthquakes, it is possible for subsidence or seismically induced settlement to occur in loose granular soils in flat or gently sloped portions of areas as the result of intense ground shaking. Differential settlement, a form of seismic-induced settlement, can occur along areas where the depth to bedrock varies abruptly, such as along the edges of alluvial basins. The entire Planning Area is considered to have active subsidence, and this can be a long-term hazard to existing and future development (Riverside County, 2008).

The results of studies evaluating the potential for regional subsidence within the Planning Area are unclear. Significant subsidence has been documented in other parts of the valley (Palm Desert, Indian Wells and La Quinta), where the subsidence and associated ground fissuring have been attributed to groundwater withdrawal. Requiring geological and geotechnical investigations in areas with potential for earthquake-induced liquefaction, landsliding or settlement as part of the environmental and development review process will reduce impacts significantly. As such, the CGPU proposes a series of policies aimed at limiting development in high risk areas and requiring site-specific studies to determine individual risk and develop appropriate design strategies. These policies are as follows:

2.15 **Steep slopes.** Limit development and grading in areas with slopes greater than 20 percent and limit the density and intensity of development in areas with slopes of between 10 and 19 percent.

2.1 **Geotechnical investigations.** Require all development proposals in the City to conduct, as a condition of approval, geotechnical and engineering geological investigations, prepared by state-certified professionals (geotechnical engineers and engineering geologists, as appropriate) following the most recent guidelines of the California Geological Survey and similar organizations, that address, as a minimum, the site-specific geologic hazards identified in the Technical Background Report. This includes the hazard of slope failure in, and adjacent to, hillside areas.

2.9 **Groundwater resources protection.** Develop partnerships with the Coachella Valley Water District and adjacent communities to manage the groundwater resources of the region, prevent over-drafting of the aquifers and prevent regional subsidence due to excessive water extraction.

The policies will be used as regulatory framework in the development review stages of project permitting in the Planning Area. Decision makers will have the CGPU and policies to ensure responsible development occurs with minimal impact from unstable soil within the Planning Area. All future development must be consistent with the CGPU in order to receive approval to build. Projects not consistent with the policies of the CGPU would not be approved by the City. Thus, potential impacts are less than significant.

Mitigation Measures

No mitigation measures necessary.

EXPANSIVE SOILS

Impact 4.5-6: Would the Project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code creating substantial risks to life or property?

Level of Significance: Less than significant.

Expansive soils generally result from having high percentages of expansive clay minerals, such as montmorillonite. These fine-grained soils can undergo substantial increases and decreases in volume, with an increase and decrease in water content respectively. If not adequately addressed, expansive soils can cause extensive damage to structures and paving. The Planning Area is subject to potential expansive soil hazards in the vicinity of Thermal Airport and along the Southern Pacific Railroad tracks near the study area's southern border (City of Coachella, 1998). The Imperial and Salton soil series are considered to have a low to high expansion potential. These soils generally occur in the southern portion of the Planning Area, as shown by Figure 4.5-7: Soils Classification. Soils derived from weathering of consolidated sedimentary rocks in the Mecca Hills in and around the San Andreas fault zone are also considered to have a moderate expansion potential (NRCS, 2008). However, due to the sporadic nature of clay sedimentary bedrock and fault gouge, the Mecca Hills area could not be assigned an expansive soil classification.

The California Building Standards Code contains minimum requirements for construction on expansive soils. Development in the Planning Area would need to comply with California's Building Standard Codes to ensure structures are sound and engineered to reduce impacts from expansive soils. These codes outline minimum criteria for the structure and maintenance of buildings to provide stable buildings that can handle, or reduce impacts from, geological hazards. In addition the CGPU has supporting policies to ensure development has conducted site-specific reports to be required for future development projects by the following General Plan policy from the Safety Element:

2.1 **Geotechnical investigations.** Require all development proposals in the City to conduct, as a condition of approval, geotechnical and engineering geological investigations, prepared by state-certified professionals (geotechnical engineers and engineering geologists, as appropriate) following the most recent guidelines of the California Geological Survey and similar organizations, that address, as a minimum, the site-specific geologic hazards identified in the Technical Background Report. This includes the hazard of slope failure in, and adjacent to, hillside areas.

Development within the Planning Area would need to meet California's Building Standard Codes in order to obtain permits for construction, as well as comply with maintenance codes enforced through code enforcement. Developments that meet the current regulations and standards of the building code would be safe enough to reduce impacts from geological hazards, and would not place people or structures at risk from the negative impacts of expansive soils. Additionally, prior to approval of development projects, geotechnical investigation reports are required for projects to determine if the development site is subject to expansive soils and other geological hazards. These reports would identify the extent of the expansive soils and provide design requirements to reduce the impact of expansive soils on the proposed improvements, such as structural mitigation or ground improvements. By requiring investigation and mitigation techniques prior to project approval, current building codes and the policies of the CGPU would ensure that developments are taking precautionary measures to reduce impacts to structures from expansive soils and the unstable soils thus, existing regulatory requirements and the proposed CGPU policy would ensure that impacts are less than significant.

Mitigation Measures:

No mitigation measures are necessary.

EROSION

Impact 4.5-7: Would the Project result in substantial soil erosion or the loss of topsoil?

Level of Significance: Less than significant.

Based on soil types present, the hazard of soil erosion within the Planning Area ranges from slight to moderate. The Upper Ocotillo Conglomerate (Qo-u) located near the eastern boundary of the Planning Area, is characterized as very steep with numerous deep, steep sided channels having rapid runoff and high erosion potential where soil is left bare. The areas of primary erosion concern are illustrated on Figure 4.5-8: Erosion Potential. Construction in these erosion-prone areas will require some removal and re-compaction of the near surface soils, based on soil engineering testing.

In the Coachella General Plan area, the unconsolidated sediments in the canyon bottoms and valley floor, as well as the granular semi-consolidated sediments forming the hills, are generally the most susceptible to erosion. In particular, the hills north and northwest of the Mecca Hills are underlain by softer sediments assigned to the Ocotillo Formation. Because much of the runoff travels through the area in natural washes and gullies, and by sheet flow, sedimentation is locally a hazard. Natural erosion processes are often accelerated by man's activities, including the removal of protective vegetation, modification of natural drainage patterns and construction of slopes that may be more susceptible to erosion than the natural slope conditions. Development also reduces the surface area available for infiltration, leading to increased flooding, erosion and downstream sedimentation.

Careful land management in hillside areas can reduce the risk of economic and social losses from slope failures. This generally includes land use zoning to restrict development in unstable areas, grading codes for earthwork construction, geologic and soil engineering investigation and review, construction of drainage structures, and if warranted, placement of warning systems. The City of Coachella requires that plans be developed for both temporary and permanent erosion control in new projects. Construction must comply with the project specific Storm Water Pollution Prevention Plan (SWPPP) and Best Management Practices, which are part of the site's grading plans that specify erosion control measures (refer to Section 4.7, Hydrology and Water Quality for additional information on requirements and Section 4.11, Air Quality for additional information on regulations pertaining to dust control).

In addition to the existing regulatory requirements, the proposed policies from the Land Use + Community Character, Safety, and Sustainability + Natural Environment Element CGPU also propose several policies that would address potential erosion impacts, as follows:

Land Use + Community Character Element

2.15 Steep slopes. Limit development and grading in areas with slopes greater than 20 percent and limit the density and intensity of development in areas with slopes of between 10 and 19 percent.

Safety Element

2.1 Geotechnical investigations. Require all development proposals in the City to conduct, as a condition of approval, geotechnical and engineering geological investigations, prepared by state-certified professionals (geotechnical engineers and engineering geologists, as appropriate) following the most recent guidelines of the California Geological Survey and similar organizations, that address, as a minimum, the site-specific geologic hazards identified in the Technical Background Report. This includes the hazard of slope failure in, and adjacent to, hillside areas.

2.2 **Mitigated geologic hazards.** Require all new developments to mitigate the geologic hazards that have the potential to have an impact on habitable structures and other improvements.

2.6 Learn from past mistakes. Monitor the losses caused by geologic hazards to existing development and require studies to specifically address these issues, including implementation of measures designed to mitigate these hazards in all future developments in the General Plan area.

Sustainability + Natural Environment

7.1 Pollution prevention. Limit the amount and concentration of pollutants released into the City's waterways.

7.3 Soil erosion. Require the prevention of water-born soil erosion from sites, especially those **undergoing** grading and mining activities.

7.4 Water quality. Ensure water quality in the City's waterways meets applicable state and federal standards.

The current City regulation and requirements for development within the Planning Area address impacts from loss of topsoil. The requirements must be met in order for a project to obtain permits for development. The CGPU policies provide additional regulatory direction that would be applied during the development permit review of project in the Planning Area. Only projects in compliance with existing regulations, including the SWPPP and CGPU policies would be granted development permits. Together, the framework of stormwater control regulations, air quality regulations, and proposed CGPU policies would limit the erosion potential associated with the proposed project. Impacts would be less than significant.

Mitigation Measures

No additional mitigation measures necessary.

SEPTIC TANKS/WASTEWATER

Impact 4.5-8: 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?

Level of Significance: Less than significant.

Some soils that are particularly shallow or rocky may be inadequate for onsite treatment of wastewater via a septic system. Soils must be sufficiently deep and absorbent so as to allow the percolation of sewage into the soil without daylighting to the surface, where people could come into contact with pathogens. Additionally, in some cases, septic systems could result in localized impacts such as liquefaction or slope instability.

Most soil types within the gently sloped or flatter portions of the Planning Area are of sufficient thickness to preclude effluent from being introduced directly into fractured rock or to daylight to the ground surface. The soils of the Mecca Hills are considered to have a moderate to high susceptibility to slope instability and groundwater quality impacts from effluent disposal.

The City currently requires proposed septic systems to follow the standards of the Riverside County Environmental Health Department for onsite wastewater disposal systems. When applications are submitted to the City, the Engineering Department evaluates each proposal for feasibility. Development proposals that are not feasible would not receive applicable permits, thus preventing projects having negative environmental impact from faulty septic tanks or wastewater.

In addition to current development requirements the proposed CGPU policy from the Safety Element, which follows below, would require onsite testing for project specific improvements, including septic systems.

2.1 **Geotechnical investigations.** Require all development proposals in the City to conduct, as a condition of approval, geotechnical and engineering geological investigations, prepared by state-certified professionals (geotechnical engineers and engineering geologists, as appropriate) following the most recent guidelines of the California Geological Survey and similar organizations, that address, as a minimum, the site-specific geologic hazards identified in the Technical Background Report. This includes the hazard of slope failure in, and adjacent to, hillside areas.

Additionally, the CGPU includes a water quality focused policy in the Sustainability + Natural Environment Element, as follows:

7.1 **Pollution prevention.** Limit the amount and concentration of pollutants released into the City's waterways.

7.4 **Water quality.** Ensure water quality in the City's waterways meets applicable state and federal standards.

The current septic tank regulations serve as a baseline impact reduction technique for development. The regulations, in concert with NPDES requirements, would also address environmental impacts by prohibiting the installation of septic systems in areas that would be likely to have soils inadequate for absorption of effluent.While most of the Planning Area has soils adequate for septic systems, there are a few areas in the Planning Area that might not. The framework of regulations, standard City practices, and the proposed CGPU policies would restrict the placement of new septic systems in inappropriate areas of the Planning Area. Thus, impacts would be less than significant.

Mitigation Measures:

No mitigation measures necessary.

MINERAL RESOURCES

Impact 4.5-9: Would the Project result in loss of availability of a known mineral resource that would be a value to the region and the residents of the state?

Level of Significance: Less than significant.

Existing or potential mineral resource in the Planning Area include sand and gravel, clay, oil and gas and geothermal, according to the City of Coachella General Plan 2020 EIR. Based on maps from the United States Geological Survey, land within the City boundaries is classified as MRZ 1- areas where available geological information indicates that little likelihood exists for presence of significant mineral resources. Subarea 17 of the Planning Area contains portions that are zoned MRZ 2a (PCC) – Areas where geologic data indicate that significant measured or indicated mineral resources are present. It is in the MRZ 2a (PCC) area that two permitted mining operations occur. The Coronet Concrete – Palm Desert Rock Sand Mine, and Coachella Valley Aggregates – Fargo Canyon Mine. Subarea 17 CGPU Land Use Designation is Open Space and mining activity is a permitted use. Thus, no loss of mineral availability is expected. For this reason, there is no potential impact on mineral resources in the Planning Area.

Current state regulation protects sensitive mineral resources, and prohibits the removal of mineral resources in California as an environmental impact reduction and resource preservation strategy. The mining of mineral resources in the Planning Area is prohibited or limited under existing regulations. Additionally, the CGPU provides policies that provide additional measures to protect mineral resources. The following are from the Sustainability and Natural Environment Element

GOAL 8. MINERAL AREAS. MINERAL RESOURCES READILY AVAILABLE TO SUPPORT COMMUNITY NEEDS.

Policies

8.1 **Mining operations.** Permit development of mineral resources for efficient production only where extraction activities are compatible with existing or proposed adjacent land uses.

8.2 **Resource conservation areas.** Ensure the availability of mineral resource areas for future production.

8.3 **Open space and mining.** Provide for resource extraction activities, such as mining, as an allowed use in those areas with an Open Space General Plan Designation.

8.4 **Recycling.** Encourage the reuse and recycling of existing aggregate, concrete and asphalt materials for new residential, commercial, and industrial developments.

8.5 **Compatibility of uses.** Restrict mining and mineral extraction activities to those areas not adjacent to or containing sensitive receptors, important farmland, important habitat or other incompatible uses.

The current regulatory framework protecting mineral resources prevents negative environmental impact from loss of mineral resources. The proposed Land Use Plan of the CGPU was designed to reflect the potential mineral resources and largely designates land as Open Space to protect these resources. Furthermore, the CGPU proposes a suite of policies that would protect mineral resources and prevent land use incompatibility impacts from mining. As such, impacts would be less than significant. Along with the policies in the CGPU regarding mineral resources, operations within the Planning Area would be restricted under current regulation and CGPU policies. The combined regulations ensure mineral use is in compliance with any applicable land uses and encourage resource recycling and proper land use compatibility planning. In addition to minerals being located in Open Space lands under the CGPU Land Use map, the current regulatory framework and supportive policies will reduce any potential impacts on mineral resources that would value the region or state to a level of less than significant.

Mitigation Measures:

No mitigation measures necessary.

LOCAL MINERAL RESOURCES

Impact 4.5-10: Would the Project result in loss of availability of locally important mineral resources recovery site delineated on a local general plan, specific plan, or any other land use plan.

Level of Significance: Less than significant.

Existing or potential mineral resource in the Planning Area include sand and gravel, clay, oil and gas and geothermal, according to the City of Coachella General Plan 2020 EIR. Based on maps from the United States Geological Survey, land within the City boundaries is classified as MRZ 1- areas where available geological information indicates that little likelihood exists for presence of significant mineral resources. Subarea 17 of the Planning Area contains portions that are zoned MRZ 2a (PCC) – Areas where geologic data indicate that significant measured or indicated mineral resources are present. It is in the MRZ 2a (PCC) area that 2 permitted mining operations occur. The Coronet Concrete – Palm Desert Rock Sand Mine, and Coachella Valley Aggregates – Fargo Canyon Mine.

Current state law regulates the removal and use of mineral resources in the Planning Area, and it in place to preserve and protect minerals of local or state importance. In addition to mining regulations the CGPU is the guiding document for the City of Coachella, and as such, has supporting policies provided to protect mineral resources. The following are from the Sustainability and Natural Environment Element:

GOAL 8. MINERAL AREAS. MINERAL RESOURCES READILY AVAILABLE TO SUPPORT COMMUNITY NEEDS.

Policies

8.1 **Mining operations.** Permit development of mineral resources for efficient production only where extraction activities are compatible with existing or proposed adjacent land uses.

8.2 **Resource conservation areas.** Ensure the availability of mineral resource areas for future production.

8.3 **Open space and mining.** Provide for resource extraction activities, such as mining, as an allowed use in those areas with an Open Space General Plan Designation.

8.4 **Recycling.** Encourage the reuse and recycling of existing aggregate, concrete and asphalt materials for new residential, commercial, and industrial developments.

8.5 **Compatibility of uses.** Restrict mining and mineral extraction activities to those areas not adjacent to or containing sensitive receptors, important farmland, important habitat or other incompatible uses.

The current regulatory framework protecting mineral resources prevents negative environmental impact from loss of mineral resources. The proposed Land Use Plan of the CGPU was designed to reflect the potential mineral resources and largely designates land as Open Space to protect these resources. Furthermore, the CGPU proposes a suite of policies that would protect mineral resources and prevent land use incompatibility impacts from mining. As such, impacts would be less than significant. Along with the policies in the CGPU regarding mineral resources, operations within the Planning Area would be restricted under current regulation and CGPU policies. The combined regulations ensure mineral use is in compliance with any applicable land uses and encourage resource recycling and proper land use compatibility planning. In addition to minerals being located in Open Space lands under the CGPU Land Use map, the current regulatory framework and supportive policies will reduce any potential impacts on mineral resources that would value the region or state to a level of less than significant.

Mitigation Measures:

No mitigation measures necessary.

CUMULATIVE IMPACTS

Unsafe seismic, geologic, and soil conditions exist throughout southern California and the Coachella Valley and new development in such areas could result in potentially significant impacts. Cumulative impacts address geological impacts to the Coachella Valley and are considered at full build-out of the CGPU. The increased exposure of people and structures to such geologic hazards resulting from development under the CGPU would be limited to the Planning Area. These potential impacts would be evaluated on a project-by-project basis in accordance with CEQA, the CBC, the Municipal Code, NPDES requirements, and the requirements of the policies of the proposed CGPU. If a specific site were determined to create a significant impact that could not be feasibly mitigated, the site would not be approved for development. The combination of existing regulations, and proposed policies of the CGPU would ensure that structures built within the Planning Area will have minimal impact on soil and will be minimally impacted from geological hazards identified within the Planning Area. Additionally, the size and scope of the development projected under the CGPU would not have a cumulative impact on the region, as any potential geological hazards that could ever potential to be created by the CGPU would be largely limited to the land within the Planning Area.

The extensive regulatory framework and CGPU policies reduce any potential impacts to less than significant levels. Therefore, implementation of the CGPU would not result in cumulatively considerable impacts related to seismic and geologic hazards.

SIGNIFICANT AND UNAVOIDABLE IMPACTS

After compliance with applicable regulations and the proposed CGPU policies, the implementation of the proposed CGPU would not result in any significant unavoidable impacts related to geologic, soil, and seismic hazards.

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