Appendix Q

Baseline Biology Report

DRAFT

August 2014

Desert Renewable Energy Conservation Plan (DRECP)

Baseline Biology Report

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
AF	acre-feet
BLM	Bureau of Land Management
BMP	best management practice
CCH	Consortium of California Herbaria
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game
CEHC	California Essential Habitat Connectivity Project
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Connectivity Project	California Desert Connectivity Project
CRPR	California Rare Plant Rank
CSLC	California State Lands Commission
DEM	digital elevation model
DOD	Department of Defense
DPR	Department of Parks and Recreation
DPS	distinct population segment
DRECP	Desert Renewable Energy Conservation Plan
DWR	Department of Water Resources
ECOMAP	Ecological Classification and Mapping Task Team
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FMMP	Farmland Mapping and Monitoring Program
GIS	geographic information system
GPS	Global Positioning System
g/L	grams per liter
HR	hydrologic region
I-8	Interstate 8
I-10	Interstate 10
I-15	Interstate 15
I-40	Interstate 40
IID	Imperial Irrigation District
LADWP	Los Angeles Department of Water and Power
LCRMSCP	Lower Colorado River Multiple Species Conservation Plan

ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
LRO	locally rare occurrence
MCAGCC	Marine Corps Air Ground Combat Center
MSL	mean sea level
NECO	Northern and Eastern Colorado
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	National Resources Conservation Service
NVCS	National Vegetation Classification Standard
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
OHV	off-highway vehicle
RA	Recreation Area
SCML	South Coast Missing Linkages
SNWA	Southern Nevada Water Authority
SR	State Route
SSURGO	Soil Survey Geographic [Database]
SWP	State Water Project
TCA	Tortoise Conservation Area
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
WBWG	Western Bat Working Group
WEMO	West Mojave

1 INTRODUCTION

The Desert Renewable Energy Conservation Plan (DRECP) Area (herein referred to as the "Plan Area") encompasses a vast area of southeastern California, covering over 35,000 square miles (Figure 1-1). The Plan Area spans the California deserts (primarily the Mojave and Colorado/Sonoran deserts, and a small portion of the Great Basin Desert) and adjacent areas from Imperial County and eastern San Diego County in the south to Inyo County and eastern Kern County in the north. The Plan Area is bounded by Baja California, Mexico, to the south; Arizona and Nevada to the east; the Sierra Nevada and Tehachapi mountain ranges to the north and northwest; and the Peninsular and Transverse mountain ranges to the west. The California deserts are characterized by unique and diverse physical and biological resources and processes.

The purpose of this baseline biology report is to summarize the environmental and biological setting for the Plan Area in order to establish the foundation for conservation planning under the DRECP. This baseline biology report includes the following sections:

- Introduction, which includes organizational information and definitions.
- Environmental Setting, which addresses ecological classification, climate, geomorphology, and hydrology.
- Physical and Ecological Processes, which covers geological and ecological processes, habitat linkages, and wildlife movement.
- Natural Communities and Biological Setting, which describes natural communities, land covers, and biological diversity.
- Species Considered for Coverage, which addresses 37 species covered under the DRECP, organized by taxon and then in alphabetical order by common name.
- Anthropogenic Land Uses and Influences, which discusses human uses and disturbances, including rural and urban development, transportation corridors and roadways, water conveyance, utilities and infrastructure, grazing, mining, military uses, off-highway vehicle/recreational uses, and non-native and other invasive species.
- Conservation and Management Factors and Issues, which discusses the conservation and management factors and issues related to landscape-level factors, ecological processes, natural communities, and Covered Species.
- References Cited, which lists the documents and resources reviewed and cited in the baseline biology report.

1.1 Definitions

The following provides definitions for terms used in the baseline biology report.

Biological diversity: The variety of organisms considered at all levels, from genetic variants of a single species through arrays of species to arrays of genera, families, and higher taxonomic levels.

Covered Species: Those species addressed in the DRECP for which the applicants will seek permits for Covered Activities under Section 2835 of the Natural Community Conservation Planning Act and/or Section 10 of the federal Endangered Species Act.

DRECP land cover map: The land cover map is used in the DRECP as the baseline natural communities layer for DRECP conservation analyses. This single, comprehensive map was assembled from the best available data to define the land cover types and natural communities in the Plan Area.

Ecosystem function: Biological and physical processes operating at the ecosystem level, such as the cycling of matter, energy, and nutrients that maintain the characteristics and biodiversity of an area.

Environmental gradients: A shift or transition in physical and ecological parameters across a landscape, such as changes in topography, climate, geology, land cover types, and natural communities.

Evapotranspiration: Evaporation and transpiration by vegetation.

Aeolian: Related to, caused by, or carried by wind.

Fluvial: Action related to a river or stream (e.g., alluviation resulting from fluvial processes).

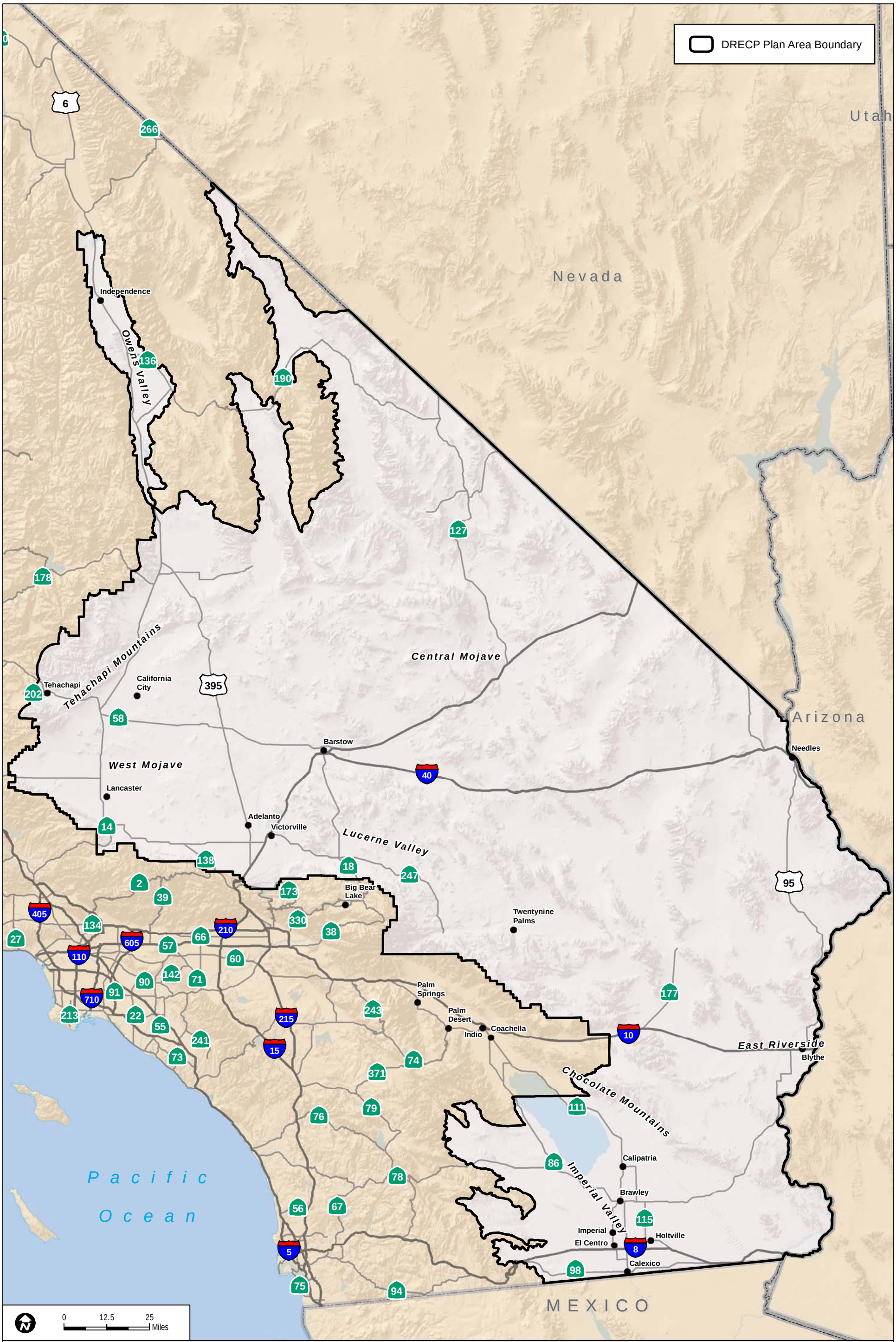
Geomorphology: Landforms and relief patterns of the Earth's surface.

Mass wasting: The downslope movement of rock, regolith (rock and mineral fragments), and soil under the direct influence of gravity, including creep, slides, and debris flows.

Natural communities: Assemblages of vegetation types and the plant and animal species that use those vegetation types as habitat. A natural community is generally characterized by the commonalities in the vegetation types and the natural ecological processes that dominate the community and give it its unique characteristics.

Plan Area: The geographic area of the DRECP, as depicted in Figure 1-1. The Plan Area includes areas proposed for Covered Activities and the area in which all conservation area actions would occur.

Surficial geology: The unconsolidated geological surface materials that lie above bedrock.



Sources: CEC (2010), USGS (2010), ESRI (2010)

FIGURE 1-1

Regional Map

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2 ENVIRONMENTAL SETTING

This section describes the environmental setting of the Plan Area in terms of existing physical conditions.

2.1 Physical Conditions

The physical conditions in the Plan Area include ecoregions, climate, geomorphology, and hydrology, which provide the context for the physical and ecological processes, as well as the biological setting described in Sections 3 and 4, respectively.

2.1.1 Ecoregions

The U.S. Forest Service (USFS) (1997) defined ecological sections and subregions (i.e., ecoregions) within California as part of the USFS National Hierarchical Framework adopted by the USFS Ecological Classification and Mapping Task Team (ECOMAP). The Plan Area is divided into the following ecoregion sections: Colorado Desert, Mojave Desert, Sierra Nevada, Sonoran Desert, and Southern California Mountains and Valleys. These sections are further divided into 33 ecoregion subsections listed in Table 2-1 and shown on Figure 2-1. These ecoregion sections are classified as Level III Ecoregions of the Continental United States by the U.S. Environmental Protection Agency (EPA 2003).

Table 2-1
Ecoregion Sections and Subsections in the Plan Area

Ecoregion Section	Ecoregion Subsection	Acres[1]	Percentage of Plan Area
Colorado Desert	Borrego Valley-West Mesa	707,881	3.1%
	Coachella/Imperial Valleys	878,203	3.9%
	East Mesa-Sand Hill	823,174	3.6%
Mojave Desert	Amargosa Desert-Pahrump Valley	441,180	2.0%
	Buillion Mountains-Bristol Lake	1,185,425	5.2%
	Death Valley	843,862	3.7%
	Funeral Mountains-Greenwater Valley	841,996	3.7%
	High Desert Plains and Hills	3,053,161	13.5%
	Ivanpah Valley	297,786	1.3%
	Kingston Range-Valley Wells	889,442	3.9%
	Lucerne-Johnson Valleys and Hills	1,466,427	6.5%
	Mojave Valley-Granite Mountains	1,983,332	8.8%
	Owens Valley	417,558	1.8%
	Panamint Valley	251,034	1.1%

Table 2-1
Ecoregion Sections and Subsections in the Plan Area

Ecoregion Section	Ecoregion Subsection	Acres[1]	Percentage of Plan Area
	Pinto Basin and Mountains	619,077	2.7%
	Piute Valley-Sacramento Mountains	1,092,891	4.8%
	Providence Mountains-Lanfair Valley	1,429,833	6.3%
	Searles Valley-Owlshead Mountains	842,507	3.7%
	Silurian Valley-Devil's Playground	660,764	2.9%
Sierra Nevada	Eastern Slopes	279,209	1.2%
	Tehachapi-Piute Mountains	222,773	1.0%
Sonoran Desert	Cadiz-Vidal Valleys	1,127,419	5.0%
	Chocolate Mountain and Valleys	911,282	4.0%
	Chuckwalla Valley	502,582	2.2%
	Palen-Riverside Mountains	237,042	1.0%
	Palo Verde Valley and Mesa	274,446	1.2%
Southern California Mountains and Valleys	Desert Slopes	863	0.0%
	Little San Bernardino-Bighorn Mountains	176,538	0.8%
	Northern Transverse Ranges	36,708	0.2%
	San Gabriel Mountains	7,617	0.0%
	San Gorgonio Mountains	45,745	0.2%
	Sierra Pelona-Mint Canyon	26,629	0.1%
	Upper San Gorgonio Mountains	11,235	0.0%

[1] Numbers may not total precisely due to rounding.

2.1.2 Climate

In the desert regions of the Plan Area, the climate is generally characterized by hot, dry summers and mild to cold winters. Rainfall events originate from winter frontal storms off the Pacific Ocean and occasional summer convective monsoons, but these sources are variable in different regions of the desert. Winter storms generally bring widespread, longer duration, low-intensity rainfall, particularly in the western desert regions, whereas summer monsoons generate isolated, short, high-intensity rainfall in the eastern desert regions (Lichvar and McColley 2008). Annual precipitation ranges from approximately 3 inches in the low deserts (such as the Colorado and Sonoran) to approximately 8 inches in the high deserts and desert ranges (such as the Mojave) (USFS 1997).

2.1.2.1 Data Sources

Specific climate information for the Plan Area was primarily obtained from the Western Regional Climate Center (2011) administered by the National Oceanic and Atmospheric Administration (NOAA).

2.1.2.2 Mojave Desert

The Mojave Desert is a "cold" or winter desert, with about 50% to 70% of rainfall occurring during the winter (Redmond 2009). The Northern Mojave Desert has the most extreme variations in temperature (including freezing temperatures as low as 0 degrees Fahrenheit (°F) at the higher elevations and snowfall), precipitation, and potentially evapotranspiration levels, when compared to the other subregions (Randall et al 2010; Webb et al. 2009). The Northern Mojave Desert includes Death Valley, which is the lowest elevation and hottest location in North America; the air temperature here can exceed 130°F in late July and early August at the lowest elevations (Randall et al. 2010). In contrast to the Northern Mojave Desert, the Western Mojave Desert has more predictable winter precipitation than the other subregions, accounting for an estimated 82% to 97% of the annual rainfall (Webb et al. 2009).

Rainfall amounts are also geographically and seasonally variable and are related to topography and elevation. Annual rainfall in valley areas of the Mojave Desert range from about 2 to 5 inches and about 10 to 30 inches in the mountain ranges (Redmond 2009). Monsoonal precipitation from early July to mid-October averages 1.4 inches, with a range of 0.02 to 4.9 inches per season (Randall et al. 2010). Drought and wet periods in the Mojave Desert are related to the El Niño Southern Oscillation (ENSO) cycle, which is a cyclical climatic pattern that typically results in increased winter precipitation in southern and central California.

2.1.2.3 Sonoran Desert

The Sonoran Desert in California is lower in elevation overall and hotter and drier than the Mojave Desert. The California portion of the Sonoran Desert is also called the Colorado Desert, but is referred to as the Sonoran Desert herein. Most of the Sonoran Desert in California is below 1,000 feet mean sea level (MSL), with the low elevation at -275 feet MSL in the Salton Trough (CDFG 2007, Chapter 8). Most of the mountainous regions of the Sonoran Desert in California are below 3,000 feet MSL (CDFG 2007). In contrast to the Mojave Desert, the lower elevations of the Sonoran Desert seldom experience sub-freezing temperatures and frost, but snow may fall occasionally at the higher elevations during very cold winter storms. Rainfall occurs from winter rains, but a substantial portion of the

annual rainfall in the Sonoran Desert in California is from the North American monsoon, which typically occurs from July to late September (Adams and Comrie 1997). Compared with the Mojave Desert, precipitation patterns and temperature regimes across the California Sonoran Desert are less variable. The hottest month is typically July with an average daily high of about 107°F and average daily low of 75°F. The coldest months are typically December and January with an average daily high of 68°F and average daily low of 38°F.

2.1.2.4 Sierra Nevada

The Plan Area includes the southern extent of the Sierra Nevada Range and the eastern portion of the Tehachapi Mountains Range south of State Route (SR) 58 within Kern County. The Plan Area east of the Sierra Nevada and outside the Mojave Desert extends north from the edge of the Northern Mojave Desert around Ridgecrest into the Owens Valley to near Big Pine. Elevations of the southern Sierra Nevada in the Plan Area range from about 5,000 feet above MSL to more than 6,000 feet. The Tehachapi Mountains Range portion ranges from about 4,000 feet to 5,000 feet above MSL. The elevation of the Owens Valley is about 4,000 feet above MSL. Because these mountain ranges are generally in the rain-shadow of the winter storms, they are more arid than west- and north-facing areas. The City of Tehachapi has an annual rainfall of 11.1 inches, with 84% occurring from winter storms in November through April (Western Regional Climate Center 2011). The area also receives about 23 inches of snowfall annually. The average winter and summer temperatures are quite different, with an average daily high of 51°F and average daily low of 30°F in January and an average daily high of 87°F and average daily low of 57°F in July. Annual rainfall at Independence is about 5.8 inches and about 78% of this is from winter storms occurring from November through March; however, rain typically occurs in all months of the year. The Owens Valley also receives about 5 inches of snow annually.

2.1.2.5 Foothills

Vegetation communities at the northern edges of the San Gabriel, San Bernardino and Western Transverse mountain ranges, up to approximately 4,000 feet above MSL are typically chaparral. A representative annual precipitation amount for these areas is about 10 inches of rain and 0.8 inch of snow at Acton in the Western Transverse Ranges (approximately 2,700 feet above MSL) (Western Regional Climate Center 2011). The average daily high at Acton in the coldest month is 58°F in January and the average daily low is 34°F. In July, the hottest month, the average daily high is 96°F and average daily low is 67°F.

2.1.3 Geomorphology

Geomorphology refers to the landforms and relief patterns of the Earth's surface. Although the Plan Area extends into the San Bernardino and Western Transverse mountain ranges and the Sierra Nevada mountain range regions in the north, the vast majority of the Plan Area is in the Mojave and Colorado/Sonoran desert regions of California. Therefore, this discussion focuses on the geomorphology of the desert regions of the Plan Area.

The Mojave Desert is bounded on the west by the Sierra Nevada, San Bernardino, Tehachapi, and San Gabriel mountain ranges, and the Sonoran Desert portion of the Plan Area is bounded on the west by the Peninsular Ranges and on the east by the Colorado River. These large mountain ranges create a rain-shadow effect that is responsible for the development of the arid desert regions. The geomorphology of the Mojave and Sonoran desert regions is dominated by short, isolated mountain ranges within desert plains. Major landforms include mountains, plateaus, alluvial fans, playas, basins, and dunes, as illustrated in Figure 2-2. There are at least 65 named mountain ranges in the Plan Area. Associated with many of these mountain ranges are alluvial fans, which is a fan-shaped landform that forms along the base of a mountain front by the buildup of steam sediments and debris flows (Harden 2004). Large, coalescing alluvial fans contain numerous washes called bajadas. The inter-mountain areas are characterized by numerous playas and basins that form dry lakes, such as Lucerne Dry Lake, El Mirage Dry Lake, Ivanpah Dry Lake, Bristol Dry Lake, and Silurian Dry Lake. There are approximately 16 named dune systems in the Plan Area, including about 12 in the Mojave Desert and southern Great Basin Desert and about 4 in the Sonoran Desert (e.g., Pavlik 1985). Among the largest dunes in the Plan Area are the Algodones Dunes in the Sonoran Desert and the Kelso Dunes in the Mojave Desert. Additional information regarding landforms in the Plan Area is included in Section 3.3.1.

2.1.4 Hydrology

As described in the previous sections, major landforms in the Plan Area include mountains, plateaus, alluvial fans, playas, basins, and dunes. Slope debris (i.e., rockslides and rockfalls), alluvial fans, playas, and basins are primarily formed from the forces of running water. Substantial surface waters and flows are extremely scarce and unpredictable in arid desert climates. Stream channels are typically ephemeral and formed by flash-flood events, especially during the monsoon season in the Sonoran Desert portion of the Plan Area. Typical channel forms in the desert regions include alluvial fans, compound (braided) channels, discontinuous ephemeral channels, and single-thread channels with floodplains (Lichvar and McColley 2008). Anthropogenic modifications to Plan Area hydrology from urbanization and water conveyance and storage are described in Section 6.

The Plan Area spans all or portions of 52 watersheds (see Table 2-2 and Figure 2-3).

Table 2-2
Watersheds in the Plan Area

Watersheds		
Amargosa	East Salton	Mesquite
Amos-Ogilby	Emerson	Mojave
Antelope	Fremont	Owens
Anza-Borrego	Goldstone	Owlshead
Ballarat	Granite	Pahrump
Bessemer	Grapevine	Rice
Bicycle	Hayfield	Route Sixty Six
Broadwell	Homer	Salton Sea
Cadiz	Imperial	Santa Ana River
Chemehuevis	Indian Wells	Santa Clara – Calleguas
Chuckwalla	Ivanpah	Superior
Clark	Johnson	Trona
Colorado	Joshua Tree	Ward
Coso	Kern River	West Salton
Coyote	Lavic	Whitewater
Cuddeback	Leach	Yuma
Dale	Lucerne Lake	—
Deadman	Means	—

Source: DWR 2004.

Major hydrologic features in the Plan Area include the Lower Colorado River, Salton Sea, Owens River, Owens Lake, Mojave River, and Amargosa River. Further, the Plan Area is divided into two major hydrologic regions: the South Lahontan Hydrologic Region and the Colorado River Hydrologic Region. The South Coast and Tulare Lake hydrologic regions account for less than 1% of the Plan Area (Department of Water Resources [DWR] 2003). These major hydrologic features are discussed in Sections 2.1.4.2 through 2.1.4.10.

2.1.4.1 Data Sources

Watershed data for the Plan Area are from the California Interagency Watershed Map of 1999 (Calwater version 2.2.1, updated May 2004), which is the State of California's working definition of watershed boundaries. Calwater 2.2.1 includes the hydrologic unit name, as defined by the State Water Resources Control Board. The hydrologic unit is a subdivision of California's 10 hydrologic regions (HRs) and is used to represent the watershed (DWR 2004).

Descriptions of the South Lahontan and Colorado River HRs in the Plan Area are based on the DWR (2003) document *California's Groundwater Bulletin 118.*

The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface-water drainage system. Point data were used to identify seeps/springs and wells in the Plan Area. Line data were used to delineate intermittent and perennial streams/rivers and canals/ditches in the Plan Area, as well as major flowlines, such as the Amargosa, Colorado, Mojave, and Owens rivers. Polygon data were used to identify waterbodies in the Plan Area, including perennial and intermittent lakes/ponds, reservoirs, playas, swamps/marshes, and ice masses (U.S. Geological Survey [USGS] 2010).

The U.S. Fish and Wildlife Service's (USFWS') Classification of Wetlands and Deepwater Habitats of the United States dataset represents the extent, approximate location, and type of wetlands and deepwater habitats in the conterminous United States. The areal extent of wetlands and surface waters, as defined by Cowardin et al. (1979), is mapped in this dataset and include freshwater emergent wetland, freshwater forested/shrub wetland, lake, riverine, and other wetlands types in the Plan Area.

2.1.4.2 Lower Colorado River

The Lower Colorado River runs along the California–Arizona border from about 10 miles north of Needles to the United States–Mexico border near Yuma, Arizona (Figure 2-3). Prior to human intervention, the Lower Colorado River was an unobstructed dynamic river system characterized by seasonal water fluctuations and high sediment loads associated with upstream snow runoff and erosional processes. High flow periods in May and June exceeded 100,000 cubic feet per second (cfs) and low flow periods in late fall and winter were 5,000 cfs or less (Lower Colorado River Multi-Species Conservation Program Final Habitat Conservation Plan [LCRMSCP] 2004). Annual sediment loads at Yuma averaged more than 10^8 metric tons (LCRMSCP 2004). These large flow fluctuations and sediment transport processes (aggradation and scour) strongly influenced the establishment of vegetation communities associated with the Lower Colorado River, with scour events impeding the development of riparian communities and aggradation facilitating the development of backwaters, marshes, and riparian communities adjacent to the mainstream channel (LCRMSCP 2004).

Recent direct anthropogenic impacts to the Lower Colorado River causing direct impacts to the natural geomorphologic and hydrologic processes of the Lower Colorado River began in 1852 with the first steamboat trade (LCRMSCP 2004). Since that time, many anthropogenic effects have occurred, most of which involved damming and diversion of water for

agricultural and other consumptive uses; these have resulted in the highly modified Lower Colorado River system of today. The construction of Hoover Dam was one of the most significant events on the Lower Colorado River because it substantially altered the downstream system, including altering natural sediment transport and deposition by eliminating large flood events, increased water clarity, decreased water temperatures, introduction of new species, and isolation of downstream native fish populations (LCRMSCP 2004). Another significant series of activities related to flood control was the construction of levees, training structures, jetty construction, bank stabilization, and channel realignment by the Bureau of Reclamation starting in the 1950s. These activities permanently altered the river system by eroding and channelizing the Lower Colorado River and separating it from floodplain areas supporting riparian communities, marshes, and backwaters. The deepening channel resulting from faster flow lowered the groundwater table, which dried up marshes and backwaters and decreased riparian regeneration (LCRMSCP 2004). However, the training structure resulted in the creation of more extensive and permanent marshes than existed naturally (LCRMSCP 2004).

2.1.4.3 Salton Sea

The Salton Sea is located in the Sonoran Desert in southeastern California from Mecca in the north to Westmoreland in the south (Figure 2-3). The modern Salton Sea lies in the lowest portion of the Salton Trough within what was historically Lake Cahuilla, a natural feature that covered a much larger area than the current Salton Sea, estimated to be approximately 100 miles long and 35 miles wide (Patten et al. 2003). Lake Cahuilla was periodically fed by Colorado River floodwaters, with at least four major flood events since 800 A.D., which achieved surface elevations of about 50 feet above MSL. Smaller floods fed Lake Cahuilla several times between 1840 and 1867, and again in 1891 (Patten et al. 2003). Because water was coming from the Colorado River, Cahuilla Lake was primarily freshwater to somewhat brackish. Although Lake Cahuilla was a natural feature subject to period flooding, and thus part of the natural desert landscape in southeastern California, the formation of the modern Salton Sea resulted from a series of man-made events around the turn of the 20th century. In order to provide water for agriculture in the Imperial Valley, water was diverted to the Alamo River via a canal, which was frequently silted and clogged, thus requiring constant dredging (Patten et al. 2003). To increase water delivery, a temporary intake was dug in 1904. Floods in 1904–1905 provided excessive water to the Imperial Valley, which was then diverted to the Salton Sink, which formed the modern lake[1] (Patten et al. 2003). A dam constructed in 1907 stopped the uncontrolled flows, but by this time the Salton Sea surface elevation was about 197 feet below MSL. Although evaporation is about 6 to 8 feet per year, due to inflows from irrigation-effluent ditches, the

[1] The Salton Sea is considered a lake and contributes the majority of the acreage listed in Table 2-3.

surface elevation has been relatively stable and was about 223 feet below MSL in 1995 (Patten et al. 2003).

The current size of the Salton Sea is about 35 miles long and 9 to 15 miles wide and its surface elevation is about 220 feet below MSL (Tompson et al. 2008). It currently has a maximum depth of about 50 feet, and an average depth of about 30 feet (Tompson et al. 2008). Current inflows to the Salton Sea total about 1.35 million acre-feet (AF) and include the Alamo and New rivers from the south, Whitewater River from the north, Salt Creek from the east, San Felipe Creek from the west, agricultural drains, groundwater, spring discharges, and other ephemeral runoff sources (Tompson et al. 2008). The Alamo and New rivers provide more than 80% of the water inflows (Tompson et al. 2008). Water loss from the Salton Sea occurs entirely from surface evaporation and is in dynamic equilibrium with water inflows. The salinity of the Salton Sea is increasing due to the accumulation of salts in the water inflows and currently is at about 46 grams per liter (g/L), which is almost 40% higher than the salinity of seawater (Tompson et al. 2008). There have been recent projections for the decline in the Salton Sea beginning in 2017 after the mitigation water from the Imperial Irrigation District (IID) water transfer ends. The IID water transfer is a result of agreements between IID and several other water districts that are under contract that specify conserved water volumes and transfer schedules for IID along with the price and payment terms (IID 2012). It is anticipated that starting in 2017, the Salton Sea will become much more saline and the miles of shoreline will become exposed as the sea recedes (ACOE and Natural Resources Agency 2011).

2.1.4.4 Mojave River

The Mojave River, along with the Amargosa River, is one of two major waterways in the Mojave Desert (USGS 2010). The Mojave River runs approximately 100 miles from the northern slope of the San Bernardino Mountains at Summit Valley near Cajon Pass, north through Victorville, to the northeast through Barstow, and then east through the Mojave Valley and Camp Cady to a closed basin sink near Baker (Figure 2-3). The Mojave River surface water flows are mostly ephemeral and occur during the winter and spring as a result of stormwater runoff (USGS 2001). Historically, prior to groundwater development, perennial flows in the Mojave River occurred in the narrows in the Victorville area, Camp Cady, and Afton Canyon, and where the water table intersected the river channel at the Helendale and Waterman faults (Izbecki 2004). Recent streamflow data indicate that large flows reach the Mojave Valley less frequently than in the past, probably due to increased groundwater pumping and consequent increased infiltration upstream of the Mojave Valley (Izbecki 2004). The Mojave River aquifer system includes a floodplain aquifer bordering the river itself that is up to 250 feet thick and composed mostly of sand and gravel, and a broader regional aquifer that surrounds the floodplain aquifer, which is composed mostly

of sand, silt, and clay (USGS 2001). Although they exhibit different hydrologic properties, the floodplain aquifer and regional aquifer are connected hydraulically (USGS 2001). Recharge of the water basin along the Mojave River is primarily (up to 80%) from stormflow infiltration from the mountains in January through March, but the water table is being overdrafted by urban uses, which is affecting the hydrology of the system and affecting riparian communities along the river (Smith 2003; USGS 2001).

2.1.4.5 Amargosa River

The Amargosa River is located in the Mojave Desert in southeastern California and southern Nevada (Figure 2-3). It extends from its headwaters at Pahute Mesa in Nevada to its terminus in the Badwater Basin salt pan in Death Valley at 282 feet below MSL (Bureau of Land Management [BLM] 2006; USGS 2001). It enters California about 15 miles north of Death Valley Junction and east of the Funeral Mountains and continues south to about the Dumont Sand Dunes, where it then runs north into Death Valley. The Amargosa River channel is well-defined from Eagle Mountain to Dumont Dunes. The Amargosa River seldom flows because it is situated in a very arid portion of the Mojave Desert, which receives on average less than 6 inches of rain annually. It is mostly fed by ephemeral runoff from several main tributaries, including Forty Mile Wash and Tonapah Wash that originate in Nevada and Carson Slough near Death Valley Junction in California, but springs at several locations provide perennial flows, including thermal springs at Shoshone and Tecopa (BLM 2006; USGS 2001). The surface flows, which extend about 17 miles along the Amargosa River in the Shoshone, Tecopa, and Amargosa Valley areas, are associated with well-developed cottonwood-willow riparian habitat that provides valuable wildlife habitat for species such as the endemic Amargosa vole (*Microtus californicus scirpensis*) (BLM 2006). The region is sparsely populated and land uses along the Amargosa River include rural communities, mining, and agriculture (USGS 2001).

2.1.4.6 Owens River and Owens Lake

The Owens River and Owens Lake are located on the northernmost part of the Plan Area in the Owens Valley. The Owens River receives water from the eastern flank of the Sierra Nevada and western flanks of the Inyo and White mountains. The Owens River flows south and terminates in the highly saline Owens Lake just south of Lone Pine, where it evaporates (Danskin 1998). Since 2000, the Los Angeles Department of Water and Power (LADWP) has been applying water and maintaining large ponds on the Owens Lake playa for dust control purposes. Although prior to the early 1900s the Owens River was used for local ranching and farming activities, the natural hydrological system of the Owens River and Owens Lake was substantially altered in 1913, when LADWP constructed the Owens River–Los Angeles Aqueduct to divert surface water from the Owens River to Los Angeles. Through expansion of surface water diversions, reduction of irrigation on Los Angeles County-owned agricultural

lands in the Mono Basin, and groundwater pumping in the Owens Valley, by 1970 the aqueduct was conveying on average about 482,000 AF/year to Los Angeles (Danskin 1998). Although groundwater levels and associated native vegetation in the Owens Valley were similar in the early 1970s to those recorded between 1912 and 1921, by the late 1970s groundwater levels and native vegetation had substantially declined and there was concern that the extraction of water was degrading the environment in the Owens Valley (Danskin 1998). A consequence of this concern has been intensive study of the Owens Valley hydrologic system and the effect of groundwater extraction on native plant communities to help develop a groundwater management plan for the Owens Valley.

2.1.4.7 Other Streams/Rivers and Waterbodies

In addition to the major rivers in the Plan Area described previously, there are many smaller intermittent and perennial streams/rivers and waterbodies in the Plan Area. Intermittent and, to a lesser degree, perennial streams/rivers, as classified by the NHD (USGS 2010), occur throughout the Plan Area. Canals/ditches also occur throughout the Plan Area, especially south in the Imperial Valley and in the Palo Verde Valley near Blythe. Intermittent and perennial lakes/ponds and reservoirs also occur throughout the Plan Area. Playas are also common in the Plan Area, including the named playas Bristol, Rogers, Cadiz, Danby, Rosamond, and Searles lakes. There are approximately 240 swamps/marshes mapped in the Plan Area, including features at the southern end of the Amargosa River and around the Salton Sea (Figure 2-3; USGS 2010).

2.1.4.8 Springs/Seeps

There are numerous springs/seeps in the Plan Area where groundwater surfaces through cracks and fissures. Higher concentrations of springs/seeps occur in the Sierra Nevada, Northern Transverse Ranges, along the edges of the San Bernardino National Forest, and in a section of the Mojave National Preserve (Figure 2-3; USGS 2010).

2.1.4.9 National Wetlands Inventory Wetlands

There are approximately 606,071 acres of wetlands identified by the National Wetlands Inventory (NWI) in the Plan Area (Table 2-3). Larger wetland areas occur at the Salton Sea and in the northern portion of the Plan Area (Figure 2-3).

Table 2-3
NWI Wetlands in Plan Area

NWI Wetland Category	Acres[1]
Freshwater Emergent Wetland	20,571
Freshwater Forested/Shrub Wetland	17,545

Table 2-3
NWI Wetlands in Plan Area

NWI Wetland Category	Acres[1]
Freshwater Pond	3,121
Lake	537,151
Riverine	18,644
Other	9,039
Total	**606,071**

Source: USFWS National Wetlands Inventory, GIS Database.
[1] Numbers may not total precisely due to rounding.

2.1.4.10 Groundwater Basin Resources

The Plan Area primarily includes two major hydrologic regions: the South Lahontan HR and the Colorado River HR (DWR 2003). The South Lahontan HR generally encompasses the Mojave Desert, Sierra Nevada, and northern flanks of the San Gabriel and San Bernardino mountain ranges. The Colorado River HR encompasses the Sonoran Desert and eastern flank of the Peninsular Range. The following descriptions of the South Lahontan and Colorado River HRs are based on the DWR (2003) document *California's Groundwater Bulletin 118.*

The South Lahontan HR is composed of the 76 groundwater basins/sub-basins that comprise about 55% of the areal coverage of the approximately 21.2-million-acre HR. There are 64 groundwater basins/sub-basins from the South Lahontan HR within the Plan Area (Figure 2-4). The South Lahontan HR is unique in that it includes the highest and lowest elevations in the contiguous United States, with Mount Whitney at more than 14,000 feet above MSL and Badwater Basin in Death Valley at 282 feet below MSL. The South Lahontan HR receives on average 7.9 inches of rain annually and generates annual runoff of approximately 1.3 million AF. Smaller basins contain groundwater within unconfined alluvial aquifers. Aquifers for larger basins and areas near dry lakes may be separated by aquitards that confine groundwater. Depth to groundwater may range from tens or hundreds of feet in smaller basins to thousands of feet in large basins. Groundwater use for agricultural and urban use is concentrated in the southern part of the South Lahontan HR (e.g., the Victorville and Barstow areas); otherwise, there is little groundwater development and little basin-specific information for the HR.

The Colorado River HR is composed of the 64 groundwater basins/sub-basins, which comprise about 26% of the areal coverage of the approximately 13-million-acre HR. There are 58 groundwater basins/sub-basins from the Colorado River HR within the Plan Area (Figure 2-4).

The Colorado River HR receives on average 5.5 inches of rain annually and generates annual runoff of approximately 200,000 AF, which is the most arid HR in California. Smaller basins contain groundwater within unconfined alluvial aquifers. Aquifers for larger basins and areas near dry lakes may be separated by aquitards that confine groundwater. Depth to groundwater may range from tens or hundreds of feet in smaller basins to thousands of feet in larger basins. Water quality in the Colorado River HR is variable.

2.1.5 Topography

Table 2-4 indicates the distribution of elevational ranges in the Plan Area at 500-foot increments (USGS 2007). The majority of the site is at the middle elevation range of approximately 1,500 to 3,500 feet above MSL.

Table 2-4
Distribution of Elevation Ranges in the Plan Area

Elevation Range (feet MSL)	Acres[1]
Less than 0	1,113,214
0–500	1,782,416
500–1,000	2,306,611
1,000–1,500	2,023,211
1,500–2,000	2,255,978
2,000–2,500	3,337,427
2,500–3,000	3,452,561
3,000–3,500	2,534,566
3,500–4,000	1,785,846
4,000–4,500	1,028,194
4,500–5,000	525,208
5,000–5,500	267,900
5,500–6,000	111,403
6,000–6,500	37,862
6,500–7,000	15,415
7,000–7,500	6,727
7,500–8,000	2,159
8,000–8,500	299
8,500–8,700	5
Total	**22,587,002**

Source: USGS 2007.
[1] Numbers may not total precisely due to rounding.

A large portion of the Plan Area is relatively flat as opposed to moderately sloped or steep (Table 2-5; Figure 2-5). The flattest areas of the Plan Area include the Mojave Desert's High Desert Plains and Hills and the Colorado Desert.

Table 2-5
Distribution of Slope Ranges in the Plan Area

Slope (degrees)	Acres[1]	% of Total
0–5	13,616,816	60.3%
5–10	3,693,475	16.4%
10–15	1,484,146	6.6%
15–20	994,398	4.4%
20–25	754,999	3.3%
25–30	581,268	2.6%
30–35	442,050	2.0%
35–40	329,161	1.5%
40–45	237,909	1.1%
45–50	164,847	0.7%
50–100	286,817	1.3%
Above 100	1,117	0.0%
Total	**22,587,002**	**100.0%**

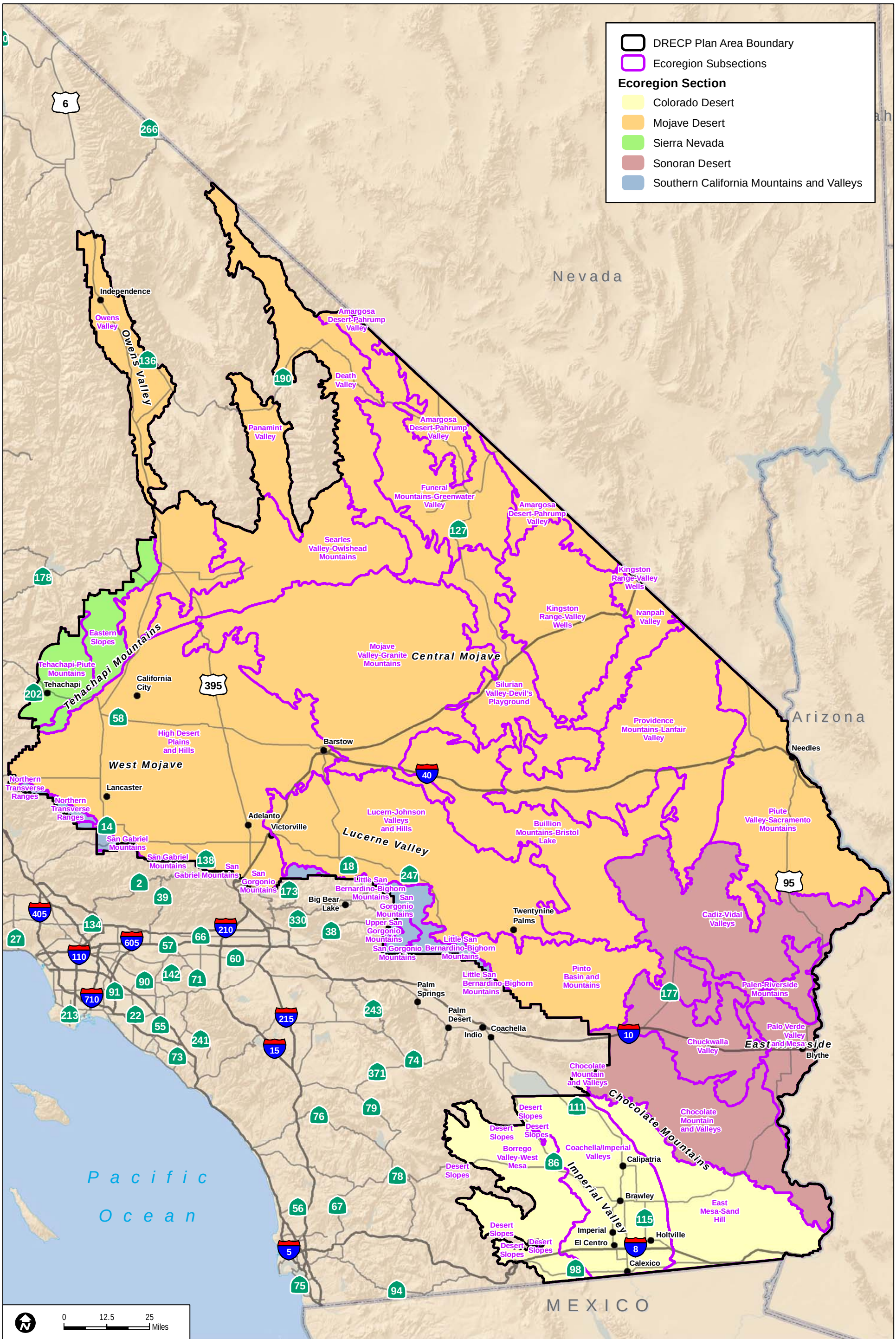
Source: USGS 2007.
[1] Numbers may not total precisely due to rounding.

The Plan Area supports a relatively even distribution of aspects, but notably proportionally very little (1%) of the Plan Area is "flat" (i.e., without aspect) (Table 2-6; Figure 2-6) (USGS 2007).

Table 2-6
Distribution of Aspect in the Plan Area

Aspect	Acres[1]	% of Total
Flat	236,598	1.0%
North	2,772,605	12.3%
Northeast	3,386,458	15.0%
East	3,082,267	13.6%
Southeast	2,813,017	12.5%
South	2,729,629	12.1%
Southwest	2,965,895	13.1%
West	2,489,945	11.0%
Northwest	2,110,587	9.3%
Total	**22,587,002**	**100.0%**

Source: USGS 2007.
[1] Numbers may not total precisely due to rounding.



Sources: CEC (2010), USGS (2010), ESRI (2010), USDA (2010)

FIGURE 2-1

Ecoregions

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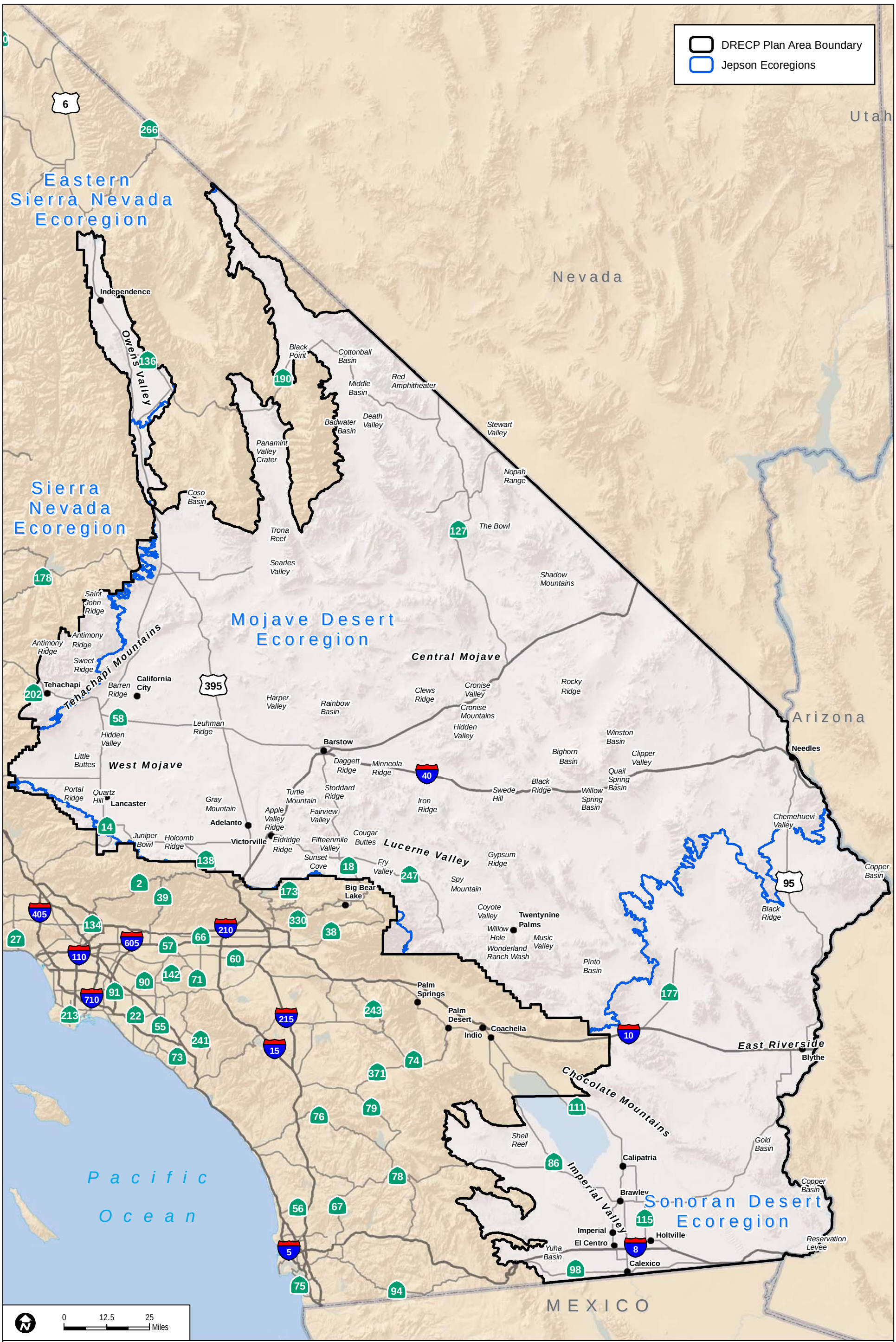

Sources: CEC (2010), USGS (2010), ESRI (2010)

FIGURE 2-2

Physical Geology

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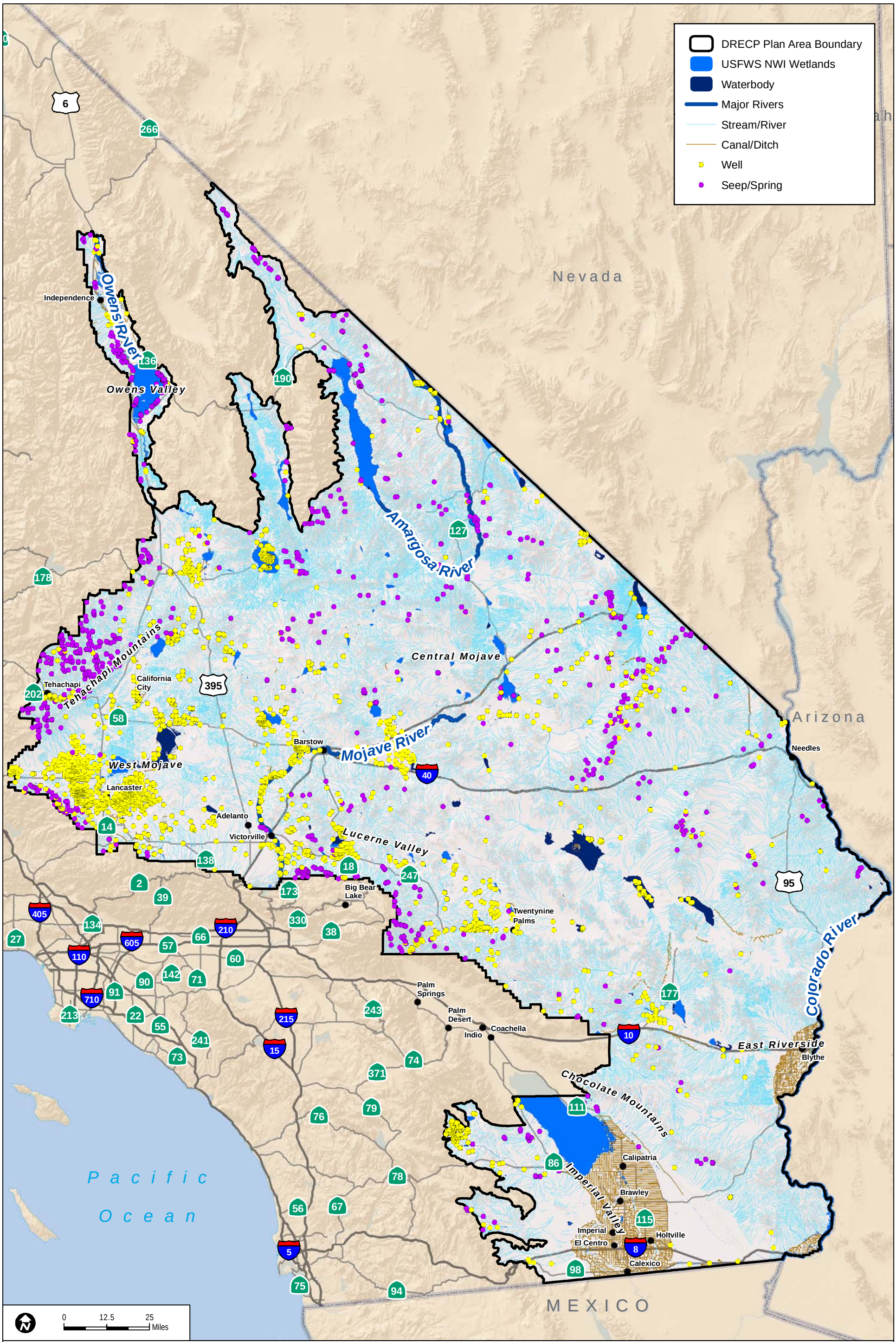

Sources: CEC (2010), USGS (2010), ESRI (2010), USFWS (2011), DWR (2004)

FIGURE 2-3
Hydrology

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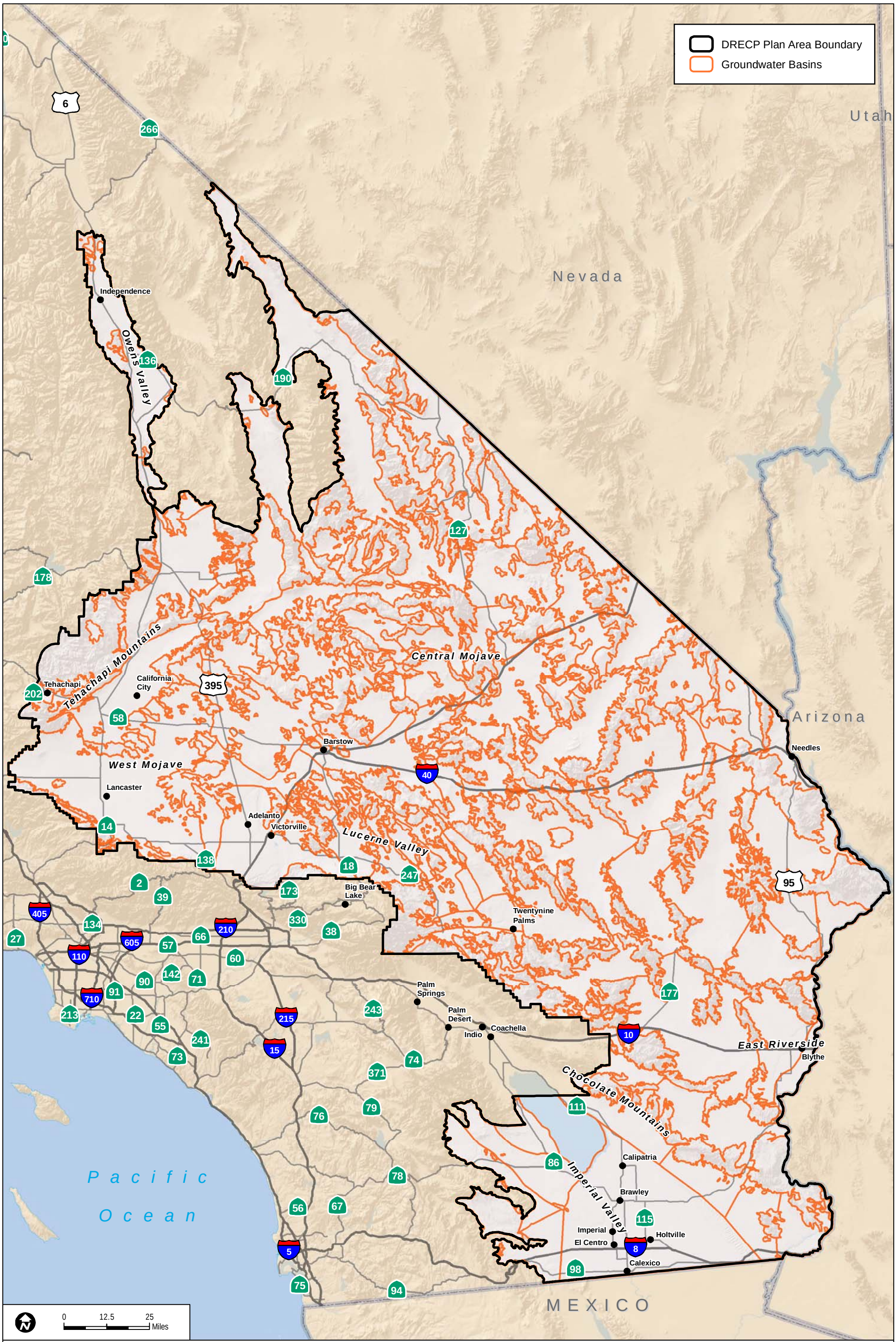

Sources: CEC (2010), USGS (2010), ESRI (2010), CA DWR (2000)

FIGURE 2-4
Groundwater

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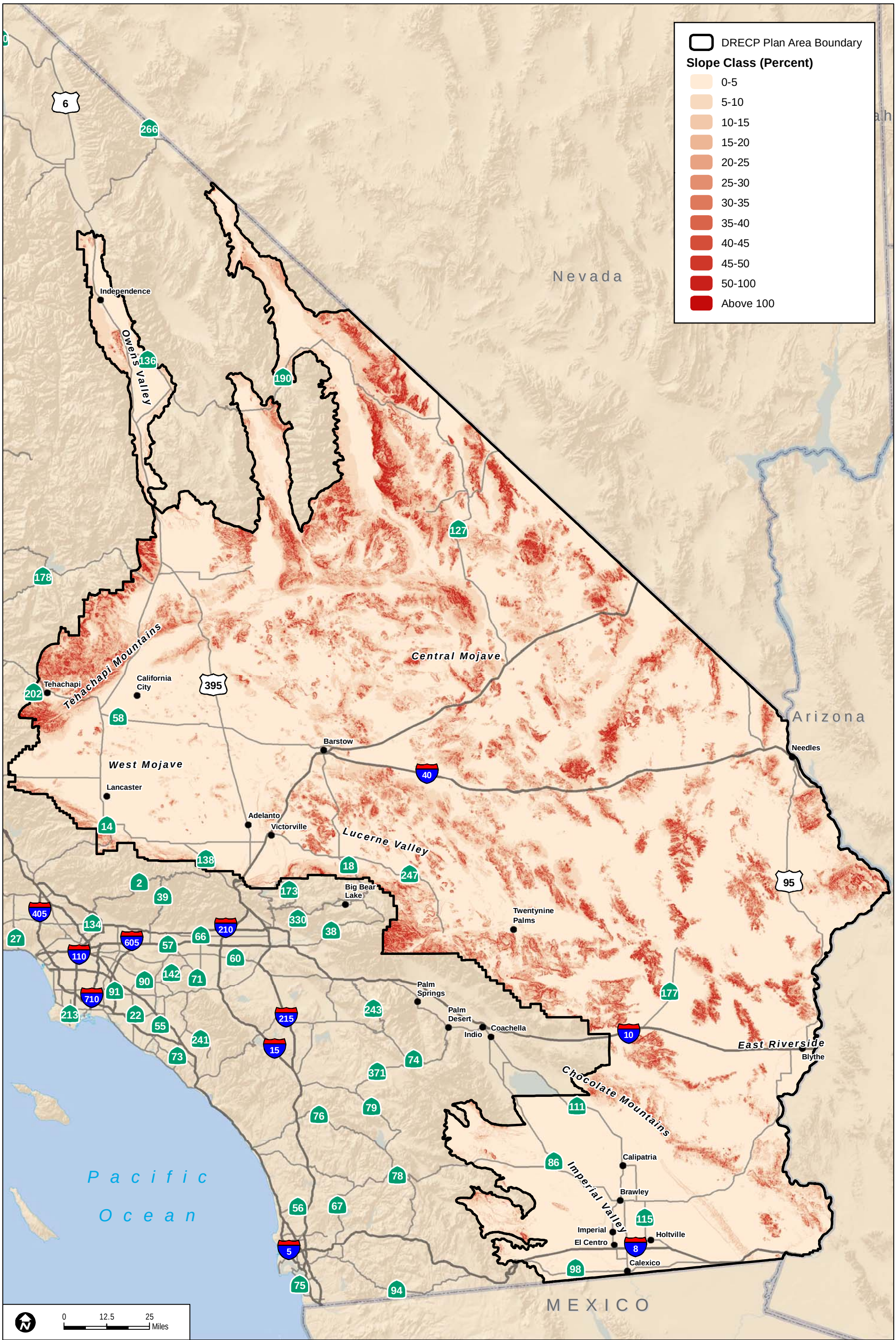

Sources: CEC (2010), USGS (2010), ESRI (2010), USGS (2011)

FIGURE 2-5
Slope

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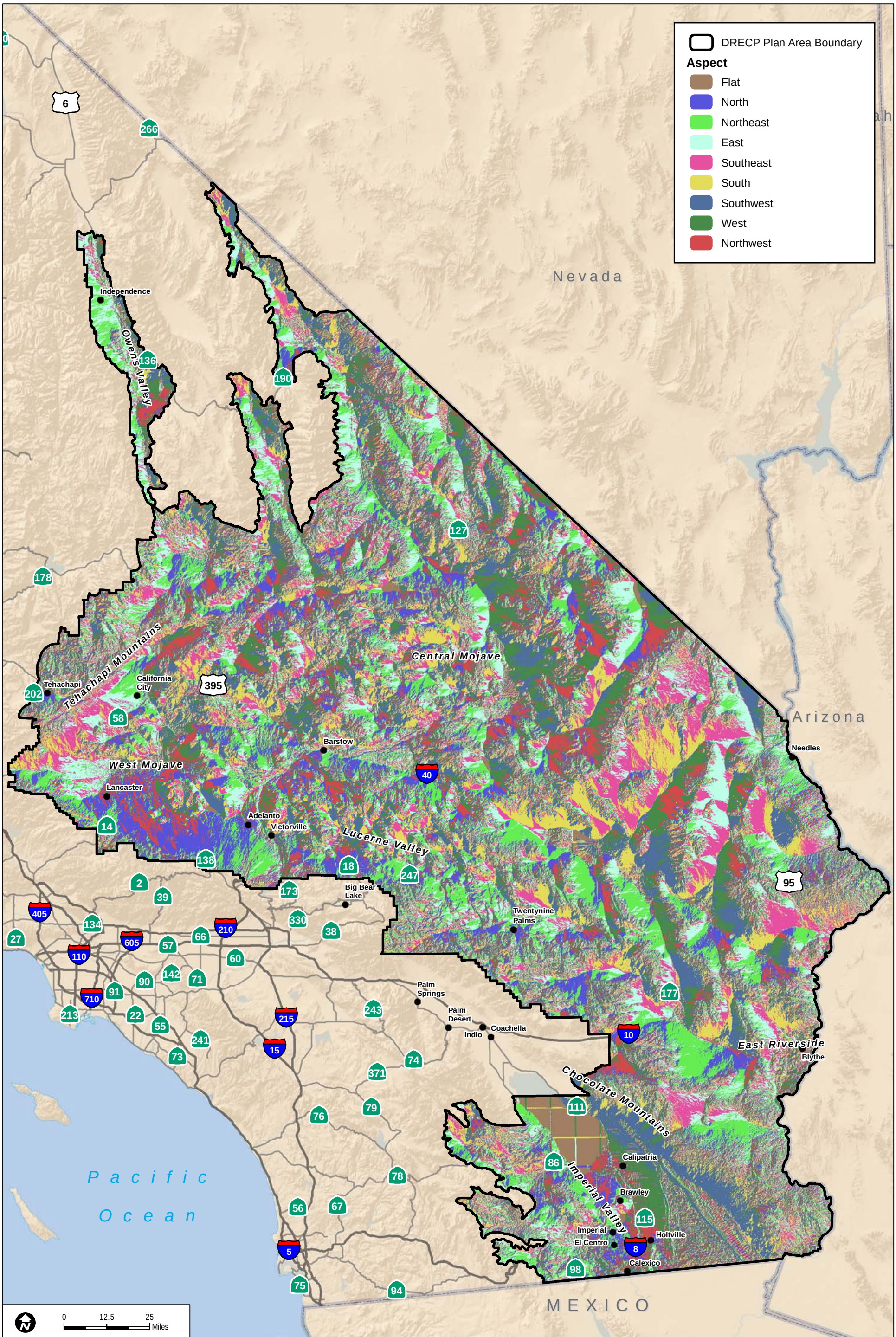

Sources: CEC (2010), USGS (2010), ESRI (2010), USGS (2011)

FIGURE 2-6
Aspect

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3 PHYSICAL AND ECOLOGICAL PROCESSES

This section summarizes the existing setting of the Plan Area in terms of surficial geology and processes, ecological processes, and landscape habitat linkages and wildlife corridors.

3.1 Data Sources

The existing ecological and biological setting description is based on the best available existing data and information, including the use of aerial imagery, geographic information system (GIS) data sources, resource agency documents, and scientific literature.

The descriptions of ecological processes (Section 3.3) and habitat linkages and wildlife corridors (Section 3.4) are based on a review of relevant scientific literature and data for these topics, which are cited in the descriptions and listed in Section 8.

Elevation range, percent slope, and aspect are derived from digital elevation model (DEM) data (USGS 2007). Landform is derived from the Land Facet tool using DEM data. This data layer classifies areas as ridgelines, plains, valleys, or slopes (USGS 2007).

Soil parent material is derived from statewide surficial geology data from the California Department of Conservation (2000). Soil texture comes from the U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database (USDA 2006).

3.2 Surficial Geology and Processes

This section describes the surficial geology of the Plan Area and the physical processes that govern soil transport, deposition, and formation. Desert soil conditions are a driving factor in the hydrology and the type and distribution of biotic resources, including plant and animal communities. Because desert ecosystems are water-limited and non-riparian vegetation communities get most of their water from moisture stored in the soil (Miller et al. 2009), the relationships between soil structure, soil hydrology, precipitation patterns, surface water, and groundwater therefore are critical for maintaining a healthy desert ecosystem. Soil structure reflects surficial geology, which refers to the unconsolidated geological surface materials that lie above bedrock. Surficial geology therefore is an important factor in soil hydrology and hence in the type and distribution of local desert vegetation communities and associated ecological processes, as discussed in detail in Section 3.3. Generally, soil structure strongly affects root distribution, which relates to aboveground plant size/biomass and productivity (Fenstermaker et al. 2009).

Table 3-1 summarizes the surficial geology of the Plan Area by parent material. Surficial geology of the Plan Area is also shown on Figure 3-1.

Table 3-1
Surficial Geology in the Plan Area

Parent Material Geologic Unit Name	**Acres**[1]
Gabbroic	**44,391**
Mesozoic gabbroic rocks	44,391
Granitic	**2,852,464**
Cenozoic (Tertiary) granitic rocks	64,327
Mesozoic granitic rocks	2,493,229
Paleozoic and Permo-Triassic granitic rocks	1,438
Precambrian granitic rocks	197,953
undated granitic rocks	95,518
Granitic and Metamorphic	**109,902**
Granitic and metamorphic rocks, undivided, of pre-Cenozoic age	109,902
Igneous and Metamorphic	**438,190**
Precambrian igneous and metamorphic rock complex	438,190
Metavolcanic	**368,782**
Mesozoic volcanic and metavolcanic rocks; Franciscan volcanic rocks	134,662
Paleozoic metavolcanic rocks	221,906
undivided pre-Cenozoic metavolcanic rocks	12,214
Mixed Rock	**189,630**
Miocene marine	189,630
Sand Dune	**707,177**
Extensive sand dune deposits	707,177
Sedimentary	**14,892,913**
Alluvium (mostly Holocene, some Pleistocene) Quaternary nonmarine and marine	13,683,505
Miocene marine	71
Miocene nonmarine	150,323
Oligocene nonmarine	393
Paleocene marine	923
Pliocene marine	41,786
Plio-Pleistocene nonmarine, Pliocene nonmarine	709,471
Selected large landslide deposits	4,038
Tertiary nonmarine, undivided	302,403

Table 3-1
Surficial Geology in the Plan Area

Parent Material Geologic Unit Name	**Acres**[1]
Sedimentary and Metasedimentary	**1,147,417**
Carboniferous marine	35,068
Cretaceous marine undivided	49,127
Devonian marine	19,885
Jurassic marine	1,021
Limestone of probable Paleozoic or Mesozoic age	18,750
Paleozoic marine, undivided	70,583
Permian marine	10,648
Precambrian rocks, undivided	806,446
Schist of various types and ages (metasedimentary or metavolcanic	89,226
Silurian and/or Ordovician marine	42,924
Triassic marine	3,739
Volcanic	**1,621,158**
Quaternary volcanic flow rocks	143,166
Quaternary pyroclastic rocks and volcanic mudflow deposits	21
Recent (Holocene) pyroclastic rocks & volcanic mudflow deposits	2,019
Recent (Holocene) volcanic flow rocks	58,233
Tertiary intrusive rocks	123,969
Tertiary pyroclastic rocks And volcanic mudflow deposits	204,671
Tertiary volcanic flow rocks	1,089,079
Water	**214,978**
Water	214,978
Grand Total	**22,587,002**

Source: California Department of Conservation 2010.
[1] Numbers may not total precisely due to rounding.

The majority of the Plan Area is composed of alluvium, which is unconsolidated sediment deposited by streams. Alluvium comprises 61% of the Plan Area. Alluvium is more common in the desert regions of the Plan Area. In the more mountainous areas, alluvium makes up a relatively small portion of the Plan Area.

The other most common surficial geological components in the Mojave Desert are granite substrates (coarse-grained intrusive rock consisting mainly of light silicate minerals), which make up 13% of the area, and volcanic/metavolcanic rocks, which make up 9% of the area. There are still several relatively young (i.e., within the last million years) volcanic

features in the Mojave and Sonoran deserts, including the Cima, Amboy-Pigash, and Turtle Mountain features in San Bernardino County, Pinto Basin-Salton Creek in Riverside County, and Obsidian Buttes in Imperial County, as well as several smaller miscellaneous volcanic features in San Bernardino, Inyo, and Imperial counties (Harden 2004). Sand dune and marine and marine depositions make up relatively small portions of the Plan Area, but still account for substantial acreages in the Mojave and Colorado/Sonoran deserts. Sand dune deposits comprise about 2% (306,542 acres) of the Mojave Desert and about 7% (399,825 acres) of the Colorado/Sonoran Desert. About 807 acres of sand dunes occur east of Sierra Nevada. Marine deposits are a relatively small portion of the Plan Area, comprising just over 7% of the Mojave Desert and about 4% to 5% of the Colorado/Sonoran Desert (including the Salton Sea). Mapped sand dunes and sand resources in the Plan Area cover approximately 1,780,794 acres of the Plan Area based on natural community mapping, surficial geology data, and dune complex mapping (California Department of Conservation 2000; Dean 1978; CDFG 2012d).

Miller et al. (2009) identify three fundamental geomorphic processes that shape the surficial geology of desert systems and transportation and deposition of substrates: (1) aeolian (wind transported); (2) fluvial, alluvial, and lacustrine (water-transported); and (3) mass-wasting (gravity-transported). Miller et al. (2009) outlined the relationship between substrate deposit types and depositional process: alluvial fans are formed through fluvial and debris flow processes; aeolian dunes and sheets are formed through aeolian processes; playas and axial valley washes are formed through fluvial, lacustrine, and aeolian processes; hillslope materials are formed through mass-wasting; and wetland deposits are formed through fluvial and aeolian processes. Surficial deposits vary on several factors related to these depositional processes, including particle size, cohesiveness, bulk density, lateral and vertical heterogeneity, and degree of sorting (Miller et al. 2009). These geomorphic processes are common to both the Mojave Desert and Colorado/Sonoran Desert ecoregions of the Plan Area.

3.2.1 Aeolian Processes

Wind systems are particularly important in arid and semiarid environments where sparse vegetation enables wind energy to more directly affect the soil surface (Breshears et al. 2003). The deposition of aeolian sediments is one of the major processes that shape the desert landscape, including desert pavement and dune systems (BLM 2002a; Miller et al. 2009), and therefore is discussed here as well as Section 3.3.2.

Aeolian systems are determined by the interactions of three main factors: sediment supply, sediment availability (i.e., its ability to be transported by the wind), and the transport capacity of the wind (Kocurek and Lancaster 1999). Miller et al. (2009) describe aeolian-

driven soil formation, or pedogenesis, as a process that "proceeds by progressive infiltration of fine-grained aeolian materials (dust), chemical deposition, and weathering within sediment deposits…" (p. 232). This process results in a soil layering or "horizonization" that strongly affects soil permeability and moisture-holding capacity and becomes more pronounced over time. Aeolian processes facilitate the formation of desert pavements, which are closely packed rock surface substrates created through wind and water erosion that generally have very low permeability and moisture available to plants (Miller et al. 2009). Increased runoff from these soils can also promote erosion and the development of surface drainages and dissection of the soil deposits (Miller et al. 2009).

Sand dune systems form where winds are consistently strong enough to lift and carry fine sand grains and where there is little or no vegetation that serves to stabilize the soil (Harden 2004). Sandy alluvium in dry washes and alluvial fans are the sources for these materials and strong winds generally blowing east to west transport the sands to areas where the winds decrease at the mountain front and deposit the sand (Harden 2004). The Algodones Dunes in the Colorado/Sonoran Desert of the southeastern area of the Plan Area, for example, formed from the sandy delta of the Colorado River and currently extend about 43 miles from the southwest portion of the Salton Sea to the Mexican border and reach heights of over 300 feet.

3.2.2 Fluvial, Alluvial, and Lacustrine Processes

As described previously, the majority of the surficial geology of the Mojave and Colorado/Sonoran deserts and east of Sierra Nevada is alluvium that has resulted from fluvial processes and over geological time scales that deposit materials (i.e., alluviation) from the mountains to the alluvial fans at the base of the mountains. Desert fluvial processes generally relate to the drainage system of slopes and channels. Although these processes are generally considered to occur over long periods of time, severe flooding events related to thunderstorms can cause alluvial fan flash flooding and large debris flows that can alter the landscape over very short time periods. Generally, the size of an alluvial fan is proportional to the size of the drainage network for the fan (Harden 2004).

Lacustrine processes are most prominent in desert dry lakes or playas, which generally are low spots in drainage basins that capture sediments and surface water, and which also may be influenced by groundwater; technically such areas are base-level plains in desert drainage basins (Cooke and Warren 1973) (see hydrology discussion in Section 2.1.4). Several prominent playas in the Plan Area are listed in Section 2.1.3 and playas are also discussed in Section 2.1.4 in context of hydrology. Playas are characterized by large flat areas dominated by fine-grained sediments. Due to the fine-grained sediments, playas are relatively impermeable. Surface water is removed by infiltration and evaporation and groundwater is removed by

evaporation and evapotranspiration (evaporation and transpiration by vegetation). During wet periods, surface water may accumulate, facilitating lacustrine sedimentation. Overall, the hydrologic characteristics of a playa are affected by climate, basin floor conditions, soil and vegetation, and water salinity (which affects evaporation rates).

3.2.3 Mass-Wasting Processes

Mass wasting refers to the downslope movement of rock, regolith (rock and mineral fragments), and soil under the direct influence of gravity (Lutgens and Tarbuck 1992). Mass wasting processes include creep, slides, and debris flows. Slides are sudden downslope movements of rocks and sediments. Debris flows are dense, fluid mixtures of rock, sediments, and water. Mass wasting in the many major and smaller mountain ranges in the Plan Area occurs primarily as rock falls and rock slides on the steeper slopes. Intense monsoonal rains and earthquakes are likely primary causes of rockfalls and rockslides on steep, mountain slopes in the Plan Area. Creep, on the other hand, is a slow, continuous downslope movement primarily related to freeze/thaw or wet/dry cycles (Lutgens and Tarbuck 1992; California Department of Conservation 2007).

3.3 Ecological Processes

Sections 2.1 and 3.2 described the existing physical setting of the Plan Area and the physical processes that shape the landscape, including climate, the overall geomorphology of the Plan Area (i.e., mountain ranges, plateaus, valleys, and basins) and the main geomorphic processes affecting surficial geology and hydrology (i.e., aeolian, fluvial, alluvial, lacustrine, and mass wasting). The physical setting and processes influence the existing biological/ecological setting through the ecological processes described in this section. The ecological processes and factors that influence these processes are environmental gradients, substrates, soil biota, carbon and nutrient cycling, and fire. Other ecological processes that are not specifically addressed in this section include population dynamics, structural complexity, evolution, and ecological succession.

3.3.1 Environmental Gradients

Generally, the vegetation types and patterns in the desert regions are directly related to these physical features and processes, which create the various environmental gradients in the Plan Area. A discussion of the natural communities and vegetation types in the Plan Area is provided in Section 4. An environmental gradient is a spatial shift in physical and ecological parameters across a landscape, such as changes in topography, climate, land cover types, or natural communities. Environmental gradients are influenced by factors such as temperature, precipitation, wind, and solar exposure that vary with physical factors

such as elevation, latitude, slope, and aspect. For example, the hotter, drier, and flatter desert lowlands are associated with relatively low plant species richness and diversity and are dominated by low, shrubby species such as creosote (*Larrea tridentata*) and burro-weed (*Ambrosia dumosa*) (Baldwin et al. 2002). As elevation and precipitation increases, vegetation communities include more woody species, such as Joshua tree (*Yucca brevifolia*) and conifers such as pinyon pines (*Pinus* spp.) and junipers (*Juniperus* spp.). The composition of desert vegetation also varies with seasonal precipitation patterns. Most herbaceous annuals germinate and bloom in association with winter rains, but some species respond to ephemeral summer rains (Baldwin et al. 2002). Insolation is defined as incident solar radiation and corresponds to the amount of solar resource available per unit area. It is usually expressed as kilowatt-hours per square foot per day (kwhrs/ft^2-day) and can be summed over an area to give an estimate of the gross energy potential in that area. The Plan Area has very high insolation values ranging from between 7 and 7.5 kilowatt-hours per square meters per day (kwhrs/m^2-day) (CEC 2005).

As described in Section 2.1.5, the Plan Area ranges in elevation from below sea level to approximately 8,700 feet above MSL (Figure 3-2). The majority of the site is at the middle elevation range of approximately 1,500 to 3,500 feet above MSL. A large portion of the Plan Area is relatively flat as opposed to moderately sloped or steep. The Plan Area supports a relatively even distribution of aspects, but notably proportionally very little (1%) of the Plan Area is entirely "flat" (i.e., without aspect).

3.3.2 Substrates

Substrate is also an important factor in local desert vegetation communities and normal soil hydrology, and this factor is critical for maintaining and restoring native communities. Generally, soil structure strongly affects root distribution, which relates to aboveground plant size/biomass and productivity (Fenstermaker et al. 2009). Because desert ecosystems are water-limited, the relationship between precipitation patterns, soil structure, and soil hydrology therefore is critical for maintaining a healthy desert ecosystem. The surficial geology and processes associated with ecological processes in substrates are described in Section 3.2. Key factors in how substrates influence ecological processes include:

- Water infiltration into the upper soil horizon;
- Water storage capacity of lower soil horizons;
- Nutrient availability for plants; and
- Direct effects of aeolian sand deposition on plants and animals.

Several different soil surface textures occur in the Plan Area. The acreage of each soil texture type is listed in Table 3-2. Very gravelly sandy loam (soil composed of sand, silt, and clay), unweathered bedrock, and loamy sand are the most common soil textures in the Plan Area. Figure 3-3 depicts the distribution of the various soil textures in the Plan Area.

Table 3-2
Soil Textures Mapped in the Plan Area

Soil Texture	Acres[1]
clay	301,069
clay loam	64,590
coarse sand	6,372
coarse sandy loam	870,715
cobbly fine sandy loam	86,511
cobbly sand	59,858
extremely gravelly sandy loam	1,605,679
fine sand	831,201
fine sandy loam	479,338
gravelly loam	9,977
gravelly loamy coarse sand	195,042
gravelly sand	47,049
gravelly sandy loam	113,681
loam	16,910
loamy fine sand	732,231
loamy sand	4,533,157
sand	1,160,311
sandy loam	1,051,236
silt loam	1,727
silty clay	223,372
silty clay loam	691,959
unweathered bedrock	4,189,988
very channery loam	21,790
very cobbly fine sandy loam	5,064
very cobbly loamy sand	38,886
very cobbly sandy loam	7,297
very fine sandy loam	210,943
very gravelly coarse sand	388,477
very gravelly fine sandy loam	38,879
very gravelly loam	51
very gravelly loamy fine sand	12,591

Table 3-2
Soil Textures Mapped in the Plan Area

Soil Texture	Acres[1]
very gravelly loamy sand	347,300
very gravelly sandy loam	3,231,473
very gravelly silt loam	455
weathered bedrock	822,033
Not Mapped	187,800
Total	**22,585,015**

Source: USDA 2006.
[1] Numbers may not total precisely due to rounding.

Substrate is also an important factor in local desert vegetation communities and normal soil hydrology, and this factor is critical for maintaining and restoring native communities. Generally, soil structure strongly affects root distribution, which relates to aboveground plant size/biomass and productivity (Fenstermaker et al. 2009). Because desert ecosystems are water-limited, the relationship between precipitation patterns, soil structure, and soil hydrology therefore is critical for maintaining a healthy desert ecosystem.

Baldwin et al. (2002) summarize the general relationships between vegetation communities and general substrate types. Lower elevation bedrock substrates, for example, support plant species such as brickellbush (*Brickellia arguta*), brittlebush (*Encelia farinosa*), hedgehog cactus (*Echinocereus engelmannii*), and arrow-leaf (*Pleurocoronis pluriseta*). Washes support more deep-rooted shrubs that are tolerant of flash-floods, including catclaw (*Senegalia greggii*), desert-willow (*Chilopsis linearis*), white burrobrush (*Ambrosia salsola*), mesquite (*Prosopis glandulosa*), palo verde (*Cercidium* spp.), ironwood (*Olneya tesota*), and smoke tree (*Psorothamnus spinosus*). Playas, salt flat, and basins where water collects may support highly alkaline or saline conditions that are unsuitable for plant growth, but the margins of these features support tolerant plants such as saltbushes (*Atriplex* spp.) and greasewood (*Sarcobatus vermiculatus*).

A critical feature of soil hydrology is the infiltrability of the soil, which is the maximum rate water can infiltrate a given soil under atmospheric conditions (Miller et al. 2009). Sand deposition increases water infiltration, dilutes soil nutrient concentrations, reduces soil surface stability, and restricts the soils' water- and nutrient-holding capacity (Belnap et al. 2008). However, infiltration generally decreases with the increasing age of a soil deposit and degree of soil development. As described in Section 3.2.1, an important characteristic of desert substrates is the formation of desert pavement and accumulation of desert varnish on alluvial piedmonts (i.e., the areas lying at the base of mountains), which occurs progressively over a long time period as the soil is stabilized (i.e., the process of pedogenesis).

Horizonization, which becomes more pronounced with age, strongly affects soil permeability and moisture-holding capacity. The collection of silt and sand in the Av horizon (a distinct, fine-grained soil horizon that forms the topmost mineral layer of soil and has many vesicles or large pores throughout) through aeolian processes, for example, facilitates the formation of desert pavement, which generally has very low permeability (as little as 1%) and moisture available to plants (Miller et al. 2009). The decreased infiltration in older deposits is also related to higher runoff rates, which causes erosion and the formation of surface drainages and deposit dissection (Miller et al. 2009). Generally, in the Eastern Mojave, perennial plant cover decreases with the age of the deposit and formation of desert pavement and varnish (Miller et al. 2009).

While development of the Av horizon can decrease infiltration of the water, development of the underlying B horizon (i.e., subsoil) can also strongly affect soil hydrology. The accumulation of loam, sandy clay loam, and clay loam in the B horizon enhances soil structure and the number of micropores, which increases the retention and water storage capacity of the soil (Belnap et al. 2008; Miller et al. 2009). The finer soils have lower permeability and bind water more tightly to soil particles by capillary force (Miller et al. 2009).

In addition to available moisture related to soils structure, plant species composition is also influenced by the nutrient-rich deposition of fine silt and clay particles that alter soil fertility (Belnap et al. 2008). Aeolian dust contributes to the formation of soils and supplies sediments with essential nutrients, including the following elements: phosphorus, magnesium, sodium, potassium, molybdenum, and calcium (Reynolds et al. 2001).

In addition to aeolian-related soil and vegetation interactions that occur over long time periods of soil development, aeolian processes can have more direct and immediate physical impacts on the ecosystem. Sand deposition that can occur during a single wind event can cause either complete or partial plant burial. Airborne dust that collects and accumulates on leaves and stems of desert plants can cause a reduction in physiological performance that may eventually reduce plant growth and seedling establishment (Belnap et al. 2008). Sand inputs can also affect, either negatively or positively, animal species' ability to burrow into the soil (Belnap et al. 2008). Consequently, areas with active aeolian systems, such as sand dunes, generally include plant and animal species able to adapt to rapid changes in substrate (Belnap et al. 2008).

Although plant and animal community types and distributions are strongly determined by the physical processes discussed above, plant and animals also exert an influence on soil development, structure and hydrologic and chemical properties such as infiltrability, organic material, and chemical nutrients through bioturbation (i.e., the mixing of sediment by the burrowing, feeding, or other activity of living organisms). Bioturbations may occur from

plant rooting and burrowing by insects, rodents, and reptiles. Titus et al. (2002), for example, found that microsites with perennial shrubs in a creosote–burro-weed community in the Mojave Desert and small mammal burrows had higher levels of nutrients, and non-vegetated sites (washes, plant interspaces) had very low levels of nitrogen and phosphorus.

3.3.3 Soil Biota

Soil biota is another important factor in desert ecosystem processes (Belnap et al. 2008). Soil surface biota or biological soil crusts are related to soil stabilization, nutrient cycling, and local hydrology. Biological soils crusts in the Mojave Desert consist primarily of cyanobacteria, which cover most soil surfaces, and soil surfaces at higher elevations also support lichens and mosses (Belnap et al. 2008). Biological soil crusts serve important soil stabilization functions that influence biological resources, including aggregating soil particles and reducing their susceptibility to wind and water erosion; roughing the soil surface, which traps dust and increases capture of mineral nutrients; and enhancing retention of wind- and waterborne organic material and seeds (Belnap et al. 2008). Subsurface soil biota include bacteria, fungi, protozoa, nematodes, and microarthropods (Belnap et al. 2008). An important function of subsurface biota is the breakdown of plant litter and roots, which makes the nutrients of these materials available to other plant and animal organisms (Belnap et al. 2008).

3.3.4 Carbon and Nutrient Cycling

Carbon and nutrients cycling are important factors in desert ecosystems. Carbon cycling in desert systems occurs from dead plant material, with aboveground decomposition likely occurring from abiotic process (e.g., release of gas when soils are wetted) and belowground decomposition occurring from the biotic process of respiration by plant roots and soil organisms (Belnap et al. 2008). Biological crusts can be significant sources of carbon in arid and semi-arid environments, especially in areas between vascular plant species where biological soil crusts can reach 100% cover. In addition, soil organisms, which are sources of carbon for other organisms, are relatively more diverse and abundant in soils with a biological soil than soils without a biological crust.

Nitrogen is made available to plants in the Mojave Desert mainly by prokaryotes (organisms lacking a discrete nucleus separated from the cytoplasm), dominated by the cyanobacterium *Nostoc* (Belnap et al. 2008). Nitrogen fixation is controlled by moisture and temperature in association with physiological activity by the cyanobacterium (Belnap et al. 2008).

Phosphorus, which can be a vegetation-limiting nutrient in deserts, is made available by the weathering of primary material such as apatite (Belnap et al. 2008). Generally, phosphorus is

unavailable for uptake by soil biota and plants because of its relative insolubility (due to its reaction with carbonates, iron oxide, and other compounds), but exudates (fluid that filters from the circulatory system) of cyanobacteria, bacteria, fungi, and plant roots can increase phosphorus availability and uptake by dissolving these compounds (Belnap et al. 2008).

Other important nutrients affecting plant productivity include potassium; calcium; magnesium; sodium; and micronutrients, including copper, iron, zinc, and manganese.

Potassium, which is essential for plants, is fairly evenly distributed throughout the soil profile in desert regions (Belnap et al. 2008). Too much calcium can limit plant growth by forming calcium carbonate to the depth of water infiltration (e.g., in playas) and creating a solid layer of calcrete (or caliche, a calcium-rich hardpan) that inhibits plant roots and water flow (Belnap et al. 2008). Too much calcium can also inhibit the bio-availability of other important nutrients such as phosphorus, magnesium, and micronutrients by reducing their solubility. Magnesium, which can be depleted fairly rapidly from soils, interacts strongly with other cations such as potassium and sodium and plant productivity can be affected by the ratio of magnesium to other cations (positively charged ions) (Belnap et al. 2008). Sodium is beneficial to plant productivity in small amounts, but because it is the most easily leached cation and forms alkaline crusts on the surface, many desert plants have adaptive mechanisms for managing high sodium levels (Belnap et al. 2008).

The micronutrients of copper, iron, zinc, and manganese are also important to plant productivity, but typically have low biologically available concentrations in the Mojave Desert and also react with carbonate compounds that result in low solubility and bio-availability (Belnap et al. 2008).

3.3.5 Fire

Fire has been historically infrequent in the southwestern deserts but has increased in frequency and extent in recent decades, generally as a result of increased fuel provided by the invasion of non-native annual grasses, such as red brome (*Bromus rubens*) and buffelgrass (*Pennisetum ciliare*) (Brooks and Matchett 2006; Abella 2010). Most of the fires recorded from 1911 to 2009 within the Plan Area occurred along its western boundary (CAL FIRE 2009). It has been estimated that between 1980 and 1990, about 38 square kilometers (9,390 acres) of the Mojave Desert burned every year (Pavlik 2008). Brooks and Minnich (2007) indicate that between 1980 and 2001, the Mojave Desert had an annual fire frequency of 2.1 fires per 1,000 square kilometers, the Sonoran Desert had an annual fire frequency of 0.6 fires per 1,000 square kilomenters, and the Colorado Desert had an annual fire frequency of 2.2 fires per 1,000 square kilometers. Within the Plan Area, the largest

acreages burned in the years 1999, 2005, 2006, and 2007 (CAL FIRE 2009), indicating a trend of increased fire sizes/frequency.

Non-native plant invasions may alter the fire regime by changing the frequency, intensity, extent, type, or seasonality of fire (Brooks and Matchett 2006). Repeated fires are typically followed by dominance of bromes (*Bromus* spp., red brome in particular) capable of carrying fire again soon after burning. This can result in a repeated invasive plant/fire regime where increased fire frequency and conversion of native vegetation communities to invaded landscapes develops into a positive feedback loop, setting the stage for even more frequent, intense widespread fires and increased conversion of the native landscape (Brooks and Matchett 2006).

Increased fire in the desert ecosystem has severe consequences because the plant communities and desert species were not exposed to frequent and large-scale fires during their evolutionary history and thus are not fire adapted, as are some other communities such as chaparral (Pavlik 2008). These changes are most evident in the middle elevation shrublands dominated by creosote bush, Joshua tree, and blackbrush (*Coleogyne ramosissima*). Creosote bush, for example, does not stump-sprout like some chaparral species (Pavlik 2008). Fire has also decimated large numbers of Joshua trees in areas of Joshua Tree National Park. Fire readily kills Joshua trees and they rarely resprout. In addition, Joshua trees often require protection in the form of shading by existing vegetation or nurse plants for reproduction, making regeneration of new individuals slow since it takes time for the nurse plants to become established following fire (Abella 2010).

Some desert wildlife species, such as Agassizi's desert tortoise (*Gopherus agassizii*), are also especially vulnerable to fire because they do not have behavioral avoidance responses to severe events (e.g., deep burrow systems and quick escape). On the other hand, the effects of fire may be beneficial in certain cases. Early successional communities may provide habitat favorable for some wildlife species, such as Merriam's kangaroo rat (*Dipodomys merriami*), which forages in open areas. Studies have shown increased abundance of this species after a fire in Sonoran Desert upland habitat (Abella 2010).

Compared to other areas of the Mojave Desert, the middle elevation shrublands are more susceptible to increased fire size following years of high rainfall, which causes an increase in the biomass of non-native annual grasses, especially red brome, that produce continuous fuel-beds. Further, native desert annuals do not typically flourish following fire (i.e., they are not "fire-followers"). At lower elevations, the background cover of native perennial fuels is already very low, which lessens the impact of the ephemeral fuels. At higher elevations, native woody fuels dictate fire regimes so fire size does not vary so much with rainfall (Brooks and Matchett 2006).

Fire functions differently than other forms of disturbance in the desert. Abella (2010) found in the Mojave and Sonoran deserts that perennial cover generally rebounded faster after fire compared to land-clearing disturbances in addition to differences in post-disturbance species composition. Although fire affects soil's physical and chemical properties, soils may still remain more intact following fire compared to land-clearing disturbances in which soils are removed or heavily compacted. In addition, roots and seeds are not necessarily entirely removed by fire, but are often removed after land-clearing disturbances. Thus, the residual propagules may enhance plant reestablishment after fire relative to establishment following other types of disturbance (Abella 2010). However, fires can sterilize soils by killing mycorrhizal fungi (Pavlik 2008).

3.4 Landscape Habitat Linkages and Wildlife Corridors

Natural environments are typically heterogeneous and form a mosaic across a landscape. Terrestrial wildlife species typically occupy favorable patches within a landscape matrix and may move between these patches through less favorable habitats. However, terrestrial wildlife species are more likely to follow pathways between habitat patches that contain elements of their preferred habitat (Rosenberg et al. 1997). Disjunct habitat patches that are used by terrestrial wildlife to negotiate through landscape mosaics have been likened to "stepping-stones," and some researchers (e.g., Bennett 2003) have suggested that in some cases and for some species, stepping-stone habitat is as effective as continuous corridors.

There is a distinction between short-term individual movements, such as foraging within an organism's home range, long-term dispersal (one-time emigration and immigration events between populations), and migration (seasonal or periodic movements). Corridors and habitat linkages may allow for both long- or short-term movements, dispersal, and migration depending on the life history requirements and ability of a particular species to travel through a landscape. Wildlife movement and population connectivity also may be examined at three spatial scales: (1) landscape habitat linkages, (2) wildlife corridors, and (3) wildlife crossings.

Landscape habitat linkages (or simply "linkages") are large open space areas on a landscape scale that contain natural habitat and provide a connection between at least two larger adjacent open spaces or habitat areas. Linkages are defined as providing a large enough area to at least support a natural habitat mosaic and viable populations of smaller terrestrial species, such as rodents, smaller carnivores (e.g., raccoons [*Procyon lotor*], skunks, fox, and weasels [*Mustela* spp.]), passerine birds, amphibians, reptiles, and invertebrates and allowing for gene flow through diffusion of populations over a period of generations, as well as allowing for jump dispersal for some species between neighboring

habitats. Linkages can form large tracts of natural open space and serve both as "live-in" or "resident" habitat and as connections to the larger landscape (e.g., large core habitat areas).

Wildlife corridors are linear landscape elements that provide for species movement and dispersal between two or more habitats, but do not necessarily contain sufficient habitat for all life history requirements of a species, particularly reproduction (Rosenberg et al. 1995, 1997). For this reason, while corridors may provide for dispersal of most species, they may not provide for the diffusion of populations over a longer time scale. The main prerequisite for corridors is that they increase animal movement between habitat patches. The mechanisms related to the efficacy of corridors are varied and species-specific (Soulé and Gilpin 1991; Beier and Loe 1992; Rosenberg et al. 1995; Haddad and Tewksbury 2005).

Wildlife crossings are locations where wildlife must pass through physically constrained environments (e.g., roads, development) during movement within home ranges or during dispersal or migration between core areas of suitable habitat. Such crossing can occur within a landscape habitat linkage or within a wildlife corridor. Development and roads may transect or interrupt an existing natural crossing, creating dangerous or impassable barriers that impede the natural movement of a species and possibly subject it to higher risks of injury and mortality from adverse human interactions, such as increased vehicle collisions at roadways where no safe wildlife passage is provided (Meese et al. 2007).

3.4.1 Data Sources and Methods

Potential landscape-level habitat linkages and wildlife movement corridors in the Plan Area have been identified in the California Desert Connectivity Project (Penrod et al. 2012), the California Essential Habitat Connectivity Project (Caltrans 2010), the South Coast Missing Linkages Project (Beier et al. 2006; South Coast Wildlands 2008), and A Linkage Design for the Joshua Tree–Twentynine Palms Connection (Penrod et al. 2008).

3.4.2 Description of Linkages and Corridors

The California Desert Connectivity Project (Penrod et al. 2012) provides a comprehensive and detailed habitat connectivity analysis for the California deserts. The Connectivity Project included both least-cost corridor habitat permeability models for four focal species (American badger [*Taxidea taxus*], kit fox [*Vulpes macrotis*], bighorn sheep [*Ovis canadensis*], and Agassizi's desert tortoise) and identification of a Desert Linkage Network using "land facet" methods based on the approach described by Beier and Brost (2010). The land facet method is designed to identify "swaths" of habitat of fairly uniform physical conditions that will interact with uncertain climate changes to maintain habitat for species and species' movement (Penrod et al. 2012). Each identified linkage consists of a corridor for each land facet and a corridor for high diversity of land facets and should support movement of species associated with that facet

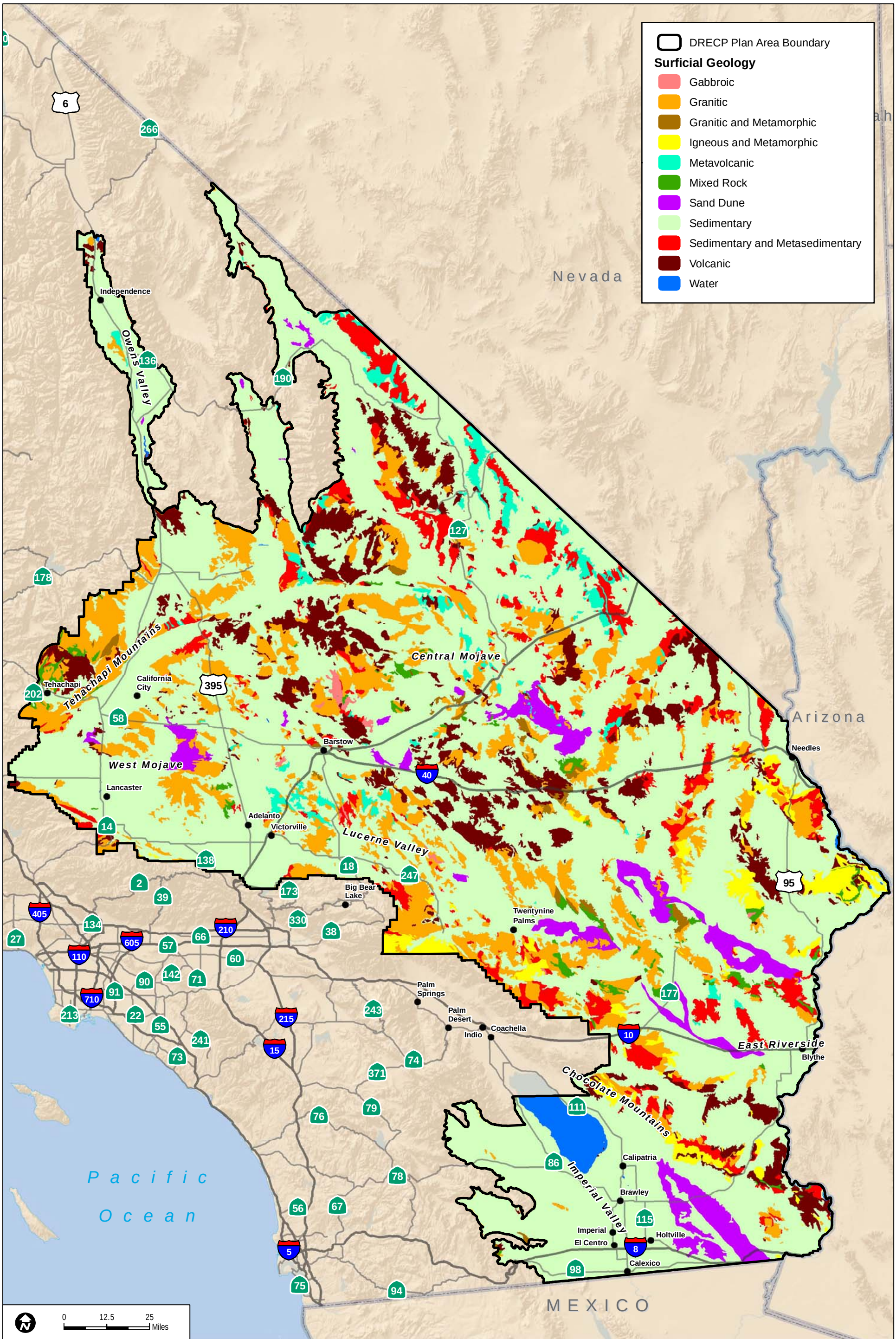
(Penrod et al. 2012). The Connectivity Project identified 23 "crucial" linkage planning areas within the Plan Area that are each defined by a pair of "landscape blocks" that should remain connected. The landscape blocks identified by Penrod et al. (2012) include Sierra Nevada, China Lake North Range, China Lake South Range, Kingston-Mesquite Mountains, Mojave National Preserve, Edwards Air Force Base, Twentynine Palms and Newberry-Rodman, San Gabriel and San Bernardino mountain ranges, Joshua Tree National Park, Stepladder-Turtle Mountains, Whipple Mountains, Palen-McCoy Mountains, Chocolate Mountains, East Mesa, and Picacho. Each of these landscape blocks is linked to another landscape block by one or more linkages that meet certain criteria defined by Penrod et al. (2012). Finally, Penrod et al. (2012) conducted habitat suitability, patch size, and configuration analyses for 44 focal species, including 12 mammals, 8 birds, 9 reptiles, 1 amphibian, 5 lepidoptera (insects), and 9 plants, to evaluate the configuration and extent of potentially suitable habitat in the linkage network. The reader is referred to Penrod et al. (2012) for a detailed discussion of the linkage network identified by the Connectivity Project.

The California Essential Habitat Connectivity Project (CEHC) (Spencer et al. 2010) was coarser in scale than the Connectivity Project or South Coast Missing Linkages (SCML). The CEHC Project did not use focal species to identify areas needing connection; rather, it used indices of environmental integrity and other biological inputs to identify large "Natural Landscape Blocks" and "Essential Connectivity Areas" throughout California. These are particularly useful in identifying important areas to conserve outside of conservation priority areas not already conserved or mapped by other efforts.

The SCML Project (Beier et al. 2006; South Coast Wildlands 2008) preceded the Connectivity Project (Penrod et al. 2012), which expanded the geographic area from California's South Coast Ecoregion across California's deserts, as discussed above. The SCML Project developed several linkage designs that connected portions of the South Coast Ecoregion with the Mojave and Sonoran deserts, and thus several linkage designs prepared for SCML are partly within the Plan Area and should be incorporated. The Connectivity Project was designed to be complementary to SCML, using similar analytical tools, and the SCML information was incorporated into Penrod et al. (2012) and noted as a "previous linkage design."

A Linkage Design for the Joshua Tree–Twentynine Palms Connection (Penrod et al. 2008) identified the Joshua Tree–Twentynine Palms Connection, which lies in an ecological transition zone between the Mojave and Sonoran deserts. This linkage connects Joshua Tree National Park with the Marine Corps Air Ground Combat Center (MCAGCC) at Twentynine Palms. As with the SCML information, this information was incorporated into Penrod et al. (2012) and noted as a previous linkage design.

Figure 3-4 shows identified habitat connectivity areas within the Plan Area based on these various projects.



Sources: CEC (2010), USGS (2010), ESRI (2010), CA Geological Survey (2011)

FIGURE 3-1

Surficial Geology

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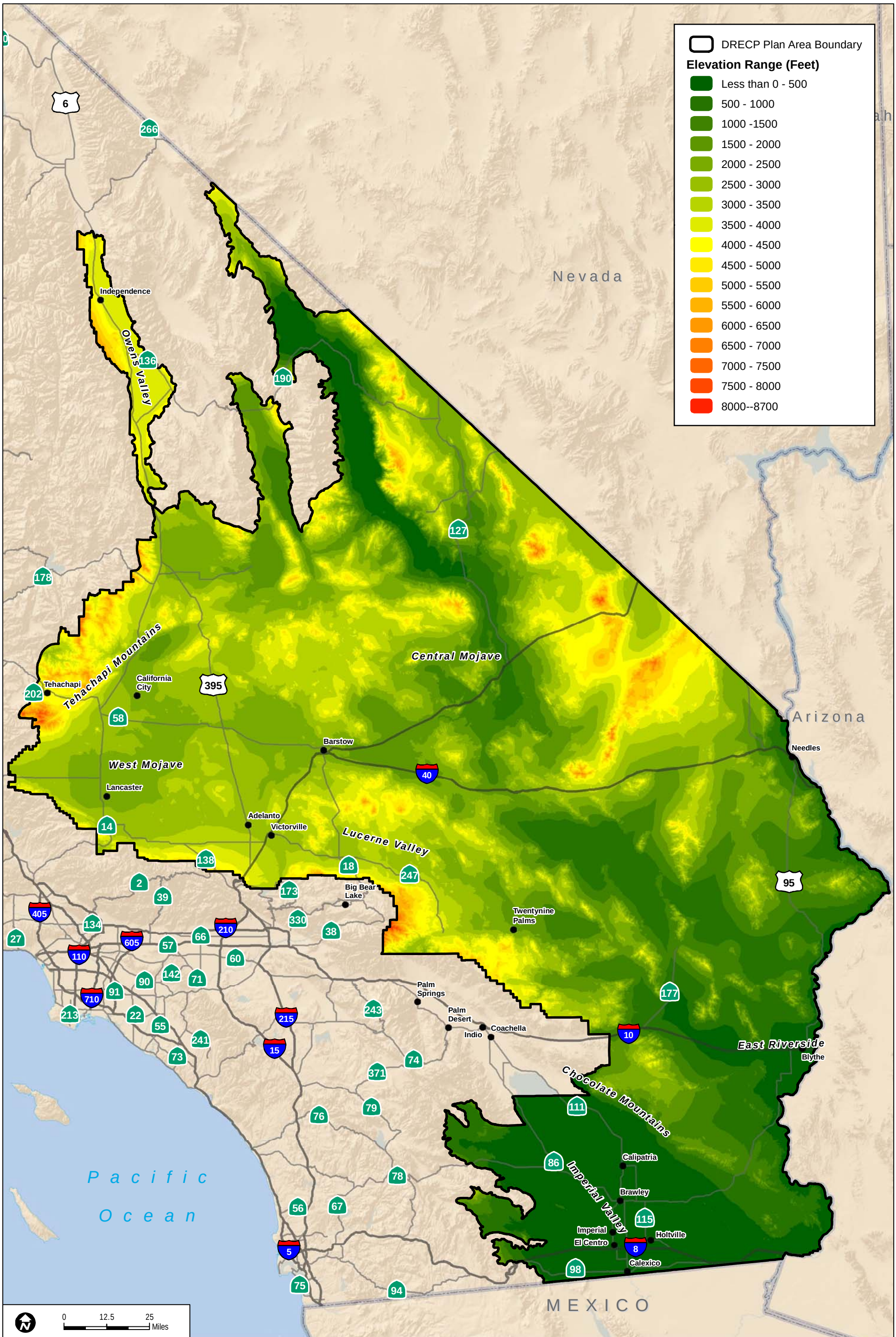
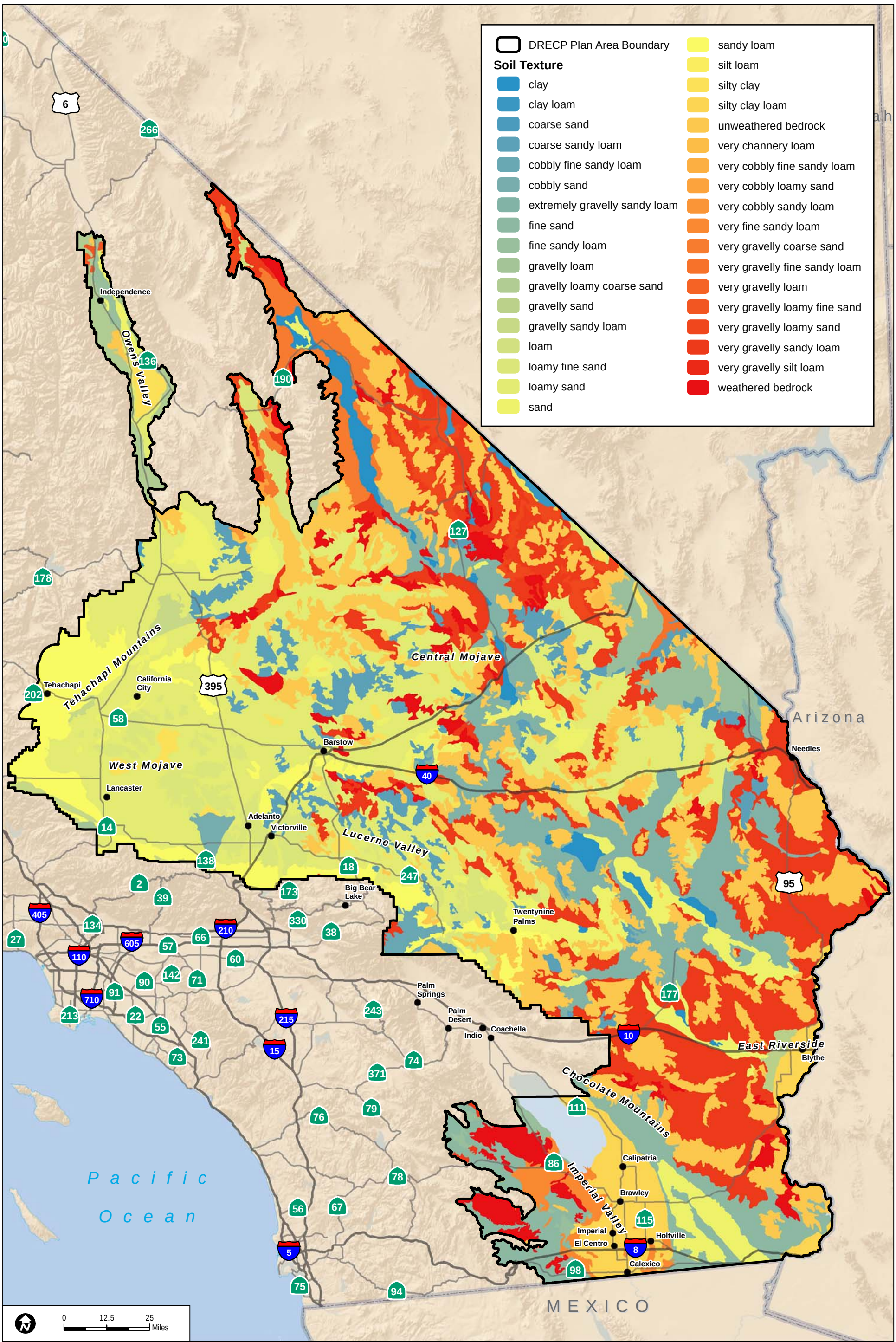


Sources: CEC (2010), USGS (2010), ESRI (2010), CA Geological Survey (2011)

FIGURE 3-2
Topography

INTENTIONALLY LEFT BLANK



Sources: CEC (2010), USGS (2010), ESRI (2010), USDA (2008)

FIGURE 3-3

Soil Textures

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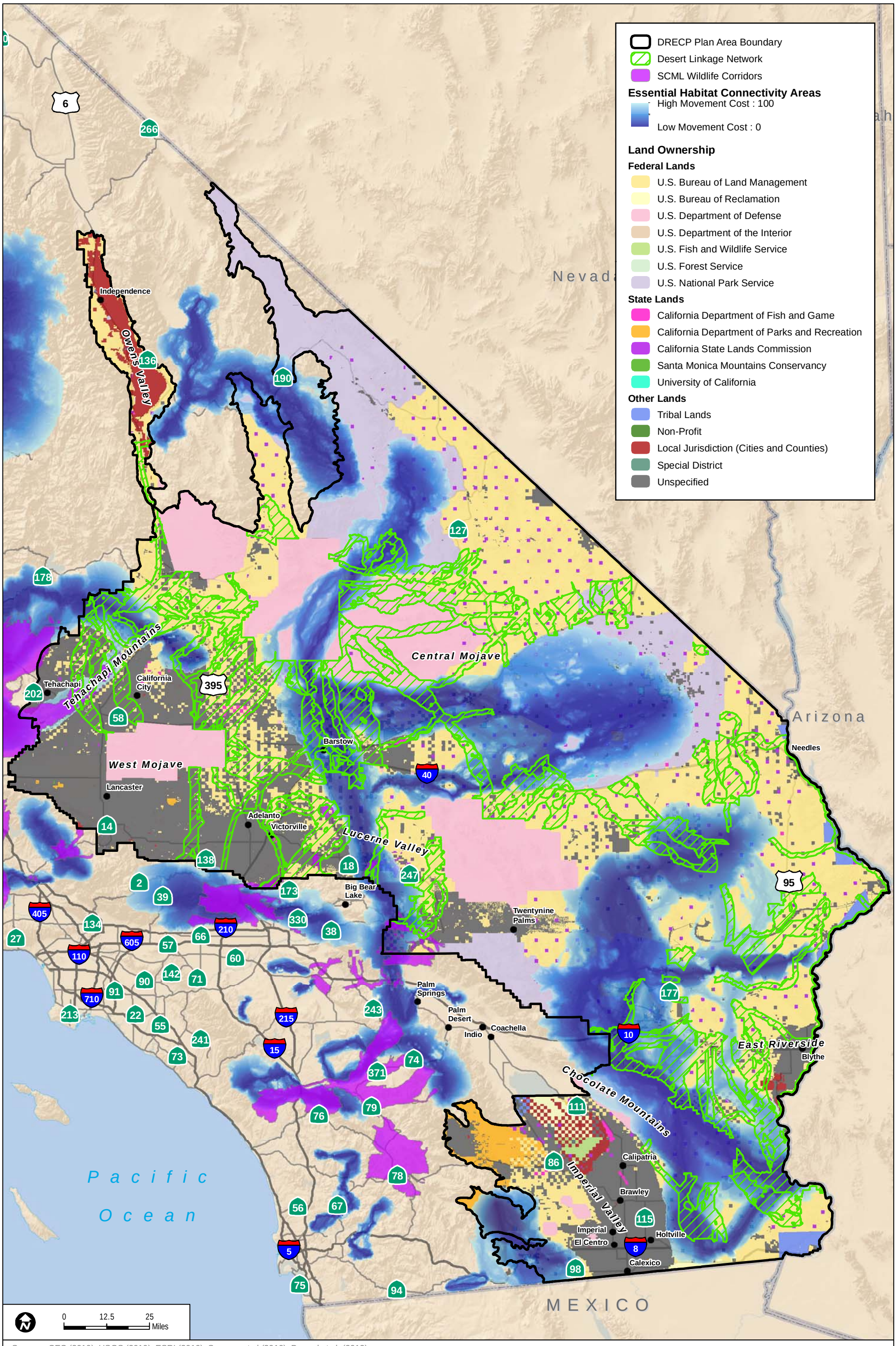

Sources: CEC (2010), USGS (2010), ESRI (2010); Spencer et al (2010); Penrod et al. (2012)

FIGURE 3-4

Habitat Connectivity Areas

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4 NATURAL COMMUNITIES AND BIOLOGICAL SETTING

This section describes the natural communities and floral and faunal diversity associated with these communities in the Plan Area. The mapping of the natural communities, the vegetation types within each community according to the DRECP land cover map is summarized, and the species supported by these communities are described.

4.1 Data Sources

The natural communities and biological diversity description was developed based on the best available existing data and information, including the use of aerial imagery, GIS data sources, resource agency documents, and scientific literature. Citations of specific, individual data sources are given within each section.

4.1.1 Natural Communities

The DRECP land cover map is a detailed map of vegetation types and their associated aggregate natural communities within the Plan Area (see Section 4.2 and Figure 4-1).

The land cover map for the Plan Area represents a composite of the best available natural community and other land cover data for the entire Plan Area. The land cover map is mapped at fine-scale and medium-scale resolution, which can be used to inform many regional and landscape-scale conservation planning decisions. The land cover map incorporates the current National Vegetation Classification Standard (NVCS) compatible land cover mapping classification and hierarchy.

While it is desirable to have current and high-resolution land cover data for conservation planning, regional and landscape-scale analyses can be conducted with the type of mid-scale resolution land cover data comprising the DRECP land cover map, which is developed from the best available data covering the Plan Area. Although a comprehensive alliance-level vegetation type data layer is not available at this time, recent vegetation mapping in the Mojave and Colorado deserts within Inyo, Kern, Los Angeles, San Bernardino, Riverside, and Imperial counties mapped at a finer scale (CDFG 2012a; Aerial Information Systems Inc. 2013) has been incorporated into the Plan Area's land cover map.

The land cover map was developed from multiple sources by combining fine-scale alliance-level mapping conducted in 2011 and 2012 for portions of the Mojave and Colorado deserts within Inyo, Kern, Los Angeles, San Bernardino, Riverside, and Imperial counties with NVCS-based mapping from the Mojave Desert Ecosystem Project and Anza-Borrego Desert State Park portions of the Plan Area (CDFG 2012a; Aerial Information Systems Inc. 2013). Where these data sources were not available, the DRECP land cover map uses

California Gap (2008 CA-GAP) Vegetation (USGS GAP Program, Lennartz et al. 2008) with updates for agricultural and urban areas. These data include the California Farmland Mapping and Monitoring Program (FMMP) (California Department of Conservation 2009) and a current detailed roads dataset (ESRI 2010) that capture newer land cover changes associated with agricultural and rural development.

It is important to have a uniform vegetation classification system throughout the Plan Area that reflects the best available information and allows for incorporation of future mapping. Where the source data was not in the standard NVCS classification scheme, the natural community classes were adapted to the NVCS.

4.1.2 Species

Section 4.3.1 describes the plant and animal species associated with each natural community in the Plan Area. The floral and faunal species richness and diversity discussions in Sections 4.3.2 and 4.3.3 provide an overview of the biological diversity in the Plan Area. The description in this section is not intended to focus on the specific natural history or data related to specific species or groups of species. Information and data related to specific species is provided in Section 5.

4.2 Natural Communities and Land Covers

"Natural communities" are defined as assemblages of vegetation types and the plant and animal species that use those vegetation types as habitat. A natural community is generally characterized by the similarities in the vegetation types and the natural ecological processes that dominate the community and give it its unique characteristics. For example, a shrubland natural community is made of a number of shrub, scrub, and chaparral vegetation types, the associated plant and animal species, the distribution of which is shaped by the patterns of microclimate as determined by precipitation, slope and aspect, and by fire regime. Vegetation types are defined by a vegetation classification scheme based on the plant species growing together with characteristically uniform structures and habitats, consistent species compositions, and recurrence across the landscape (Jennings et al. 2009). The DRECP land cover map uses the NVCS hierarchical classification system and describes natural communities at three levels: General Communities, Natural Communities (NVCS Group level), and Natural Community Alliances (NVCS Alliance level).

The Plan Area has been crosswalked or mapped using the NVCS classification system, as described in Section 4.1.1. This system has been developed to enable the production of uniform information regarding vegetation resources across the nation, based on vegetation

data gathered at varying geographical scales (FGDC 2008). The NVCS uses a hierarchical system of mapping that includes:

- Upper levels that are predominantly physiognomic, based on physical landscape features and vegetation structure:
    1. Formation class;
    2. Formation subclass; and
    3. Formation.
- Middle levels that are physiognomic, biogeographic, and floristic (i.e., based on species identity):
    4. Division;
    5. Macrogroup; and
    6. Group.
- Lower levels that are predominantly floristic:
    7. Alliance; and
    8. Association.

Approximately six-million acres of the Mojave Desert and Colorado/Sonoran Desert within Inyo, Kern, Los Angeles, San Bernardino, Riverside, and Imperial counties have been mapped recently at the fine-grained alliance level (Aerial Information Systems Inc. 2013). The remainder of the Plan Area is described at the group level using a number of different data sources. An alliance is "a floristically defined vegetation type identified by its dominant and/or characteristic species" (Sawyer et al. 2009). The group level is defined as "combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominates), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology, and disturbance regimes" (Sawyer et al. 2009). Floristics play a predominant role in defining alliances in which "diagnostic species, including some from the primary layer, which have moderately similar composition that reflects regional to subregional climate, substrates, hydrology, moisture/nutrient factors, and disturbance regimes" (Sawyer et al. 2009).

Alliances are given a rarity ranking standardized by Natural Heritage methodology (VegCAMP et al. 2013). Under this methodology, natural communities are given a conservation status rank based on a one to five scale, ranging from critically imperiled (G1) to demonstrably secure (G5). Although status is assessed at three distinct geographic scales-global (G), national (N), and state/province (S), the state/province

ranking is used here as it is the most relevant to the DRECP. The scale is as follows (NatureServe 2012):

1 = Critically imperiled

2 = Imperiled

3 = Vulnerable

4 = Apparently secure

5 = Secure.

Using this scale, natural communities with a state ranking of S1 through S3 are considered rare. Furthermore, CDFW identified locally rare occurrences (LROs) of natural communities within the Plan Area in which the community is uncommon in the Plan Area, though it may be more common elsewhere.

Table 4-1 provides a summary of the natural communities in the Plan Area at the general communities, natural community or group, and alliance levels. This section describes the composition and location of the natural communities within each general community and provides descriptions of the natural communities in the Plan Area.

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

GENERAL COMMUNITIES/COMMUNITY TYPE **Natural Community** Alliance[1]	**Rarity Ranking[2]**	**Acres[3]**
CALIFORNIA FOREST AND WOODLAND COMMUNITIES		**149,732**
Californian broadleaf forest and woodland	**—**	**71,969**
Californian broadleaf forest and woodland[4]	—	71,252
Aesculus californica	**S3**	**14**
Quercus chrysolepis tree	S5	52
Quercus lobata	**S3**	**108**
Quercus wislizeni tree	S4	543
Californian montane conifer forest	**—**	**77,764**
Californian montane conifer forest[4]	—	77,604
Pinus sabiniana	S4	160
CHAPARRAL AND COASTAL SCRUB (CISMONTANE SCRUB) COMMUNITIES		**114,086**
Californian mesic chaparral	**—**	**3,896**

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

GENERAL COMMUNITIES/COMMUNITY TYPE Natural Community Alliance[1]	Rarity Ranking[2]	Acres[3]
Californian mesic chaparral[4]	—	2,396
Cercocarpus montanus	S4	1,019
Prunus ilicifolia	**S3**	**92**
Quercus berberidifolia	S4	184
Quercus berberidifolia–Adenostoma fasciculatum	S4	205
Californian pre-montane chaparral	**—**	**1,294**
Californian pre-montane chaparral[4]	—	1,266
Arctostaphylos glandulosa	S4	28
Californian xeric chaparral	**—**	**24,421**
Californian xeric chaparral[4]	—	13,531
Adenostoma fasciculatum	S5	8,852
Arctostaphylos glauca	S4	302
Ceanothus crassifolius	NA	2
Fremontodendron californicum	S4	1,734
Central and south coastal California seral scrub	**—**	**1,374**
Ericameria linearifolia	**S3**	**547**
Eriodictyon (*crassifolium, trichocalyx*)	S4	827
Central and South Coastal Californian coastal sage scrub	**—**	**59,084**
Central and South Coastal Californian coastal sage scrub[4]	—	44
Eriogonum fasciculatum	S5	59,027
Eriogonum wrightii	**S3**	**14**
Western Mojave and Western Sonoran Desert borderland chaparral	**—**	**24,017**
Western Mojave and Western Sonoran Desert borderland chaparral[4]	—	514
Quercus cornelius-mulleri	S4	10,935
Quercus john-tuckeri	S4	12,568
DESERT CONIFER WOODLAND COMMUNITIES		**286,666**
Great Basin Pinyon–Juniper Woodland	**—**	**286,666**
Great Basin Pinyon–Juniper Woodland[4]	—	129,249
Cercocarpus ledifolius	S4	5
Juniperus californica (non-locally rare occurrence (LRO))	S4	81,451
***Juniperus californica* (LRO)**	**S4**	**9,286**
Pinus monophylla	S4	66,675
DESERT OUTCROP AND BADLANDS		**1,877,517**
North American warm desert bedrock cliff and outcrop	**—**	**1,877,517**
North American warm desert bedrock cliff and outcrop[4]	—	1,614,590

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

GENERAL COMMUNITIES/COMMUNITY TYPE Natural Community Alliance[1]	Rarity Ranking[2]	Acres[3]
Atriplex hymenelytra (non-LRO)	S4	84,747
***Atriplex hymenelytra* (LRO)**	**S4**	**185**
Caesalpinia virgata	**S1?**	**52**
Chorizanthe rigida–Geraea canescens	S4	177,775
Peucephyllum schottii	**S3**	**167**
DESERT SCRUB COMMUNITIES		**15,917,296**
Arizonan upland Sonoran desert scrub	**—**	**61,594**
Arizonan upland Sonoran desert scrub[4]	—	19,517
Agave deserti	**S3**	**3,103**
Tetracoccus hallii	**S1**	**25**
Viguiera parishii	S4	38,950
Intermontane deep or well-drained soil scrub	**—**	**117,846**
Intermontane deep or well-drained soil scrub[4]	—	17,414
Ephedra nevadensis (non-LRO)	S4	3,470
***Ephedra nevadensis* (LRO)**	**S4**	**8,335**
Ephedra viridis	S4	12,420
Ericameria teretifolia	S4	8,692
Grayia spinosa	S4	55,012
Krascheninnikovia lanata	**S3**	**7,806**
Lycium cooperi	**S3?**	**1,043**
Purshia tridentata	**S3**	**3,653**
Intermontane seral shrubland	**—**	**75,813**
Intermontane seral shrubland[4]	—	2,350
Encelia (actoni, virginesis)	**S3**	**6,398**
Ericameria cooperi	S4?	2,765
Ericameria nauseosa	S5	64,215
Gutierrezia sarothrae	**S3**	**86**
Inter-mountain dry shrubland and grassland	**—**	**441,101**
Inter-mountain dry shrubland and grassland[4]	—	441,101
Intermountain mountain big sagebrush shrubland and steppe	**—**	**75,727**
Intermountain mountain big sagebrush shrubland and steppe[4]	—	67,828
Artemisia tridentata	S5	556
Inter-Mountain West mesic tall sagebrush shrubland and steppe		7,342
Lower bajada and fan Mojavean–Sonoran desert scrub	**—**	**13,344,238**
Lower bajada and fan Mojavean–Sonoran desert scrub[4]	—	381,133
Ambrosia dumosa	S5	171,803
Atriplex polycarpa	S4	280,865

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

GENERAL COMMUNITIES/COMMUNITY TYPE Natural Community Alliance[1]	Rarity Ranking[2]	Acres[3]
Cylindropuntia bigelovii	**S3**	**3,018**
Encelia farinosa	S4	72,155
Fouquieria splendens	**S3**	**3,132**
Larrea tridentata	S5	468,261
Larrea tridentata–Ambrosia dumosa	S5	3,038,293
Larrea tridentata–Encelia farinosa	S4	381,133
Mojave and Great Basin upper bajada and toeslope	—	**1,438,740**
Mojave and Great Basin upper bajada and toeslope[4]	—	1,085,497
Coleogyne ramosissima (non-LRO)	S4	34,510
***Coleogyne ramosissima* (LRO)**	**S4**	**15,261**
Menodora spinescens	**S3**	**107**
Salazaria mexicana	S4	36,667
Yucca brevifolia	**S3**	**190,457**
Yucca schidigera	S4	76,241
Shadscale–saltbush cool semi-desert scrub	—	**361,909**
Shadscale–saltbush cool semi-desert scrub[4]	—	198,637
Atriplex canescens	S4	37,929
Atriplex confertifolia	S4	125,343
Southern Great Basin semi-desert grassland	—	**328**
Southern Great Basin semi-desert grassland[4]	—	40
Achnatherum speciosum	**S2**	**287**
DUNES AND SAND BASED COMMUNITY		**412,118**
North American warm desert dunes and sand flats	—	**412,118**
North American warm desert dunes and sand flats[4]	—	290,561
Achnatherum hymenoides	**S1**	**617**
Dicoria canescens–Abronia villosa	**S3**	**9,182**
Panicum urvilleanum	**S1**	**729**
Pleuraphis rigida	**S2**	**28,504**
***Prosopis glandulosa* coppice dunes**	**S3?**	**79,490**
Wislizenia refracta	**S2**	**3,036**
GRASSLAND COMMUNITIES		**243,034**
California Annual and Perennial Grassland		**233,560**
California Annual and Perennial Grassland[4]	—	54,547
Brassica nigra and other mustards	—	1,215
Bromus rubens–Schismus (arabicus, barbatus)	—	5,485
California annual & perennial grassland (native component) Mapping Unit (non-LRO)	—	80,329

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

GENERAL COMMUNITIES/COMMUNITY TYPE Natural Community Alliance[1]	Rarity Ranking[2]	Acres[3]
Mediterranean California naturalized annual and perennial grassland	—	86,492
California annual & perennial grassland (native component) Mapping Unit (LRO)	**—**	**5,492**
California annual forb/grass vegetation	**—**	**9,474**
California annual forb/grass vegetation[4]	—	4,855
Amsinckia (menziesii, tessellata)	S4	410
***Eschscholzia (californica)* (LRO)**	**S4**	**4,072**
***Lasthenia californica–Plantago erecta–Vulpia microstachys* (LRO)**	**S4**	**137**
RIPARIAN COMMUNITIES		**1,227,943**
Madrean warm semi-desert wash woodland/scrub	**—**	**919,613**
Madrean Warm Semi-Desert Wash Woodland/Scrub[4]	—	919,613
Mojavean semi-desert wash scrub	**—**	**34,673**
Mojavean semi-desert wash scrub[4]	—	1,417
Ambrosia salsola	S4	18,646
Artemisia tridentata* ssp. *parishii	**S3?**	**450**
Bebbia juncea	**S3?**	**6**
Brickellia incana	**S2?**	**267**
Ephedra californica	**S3**	**4,333**
Ericameria paniculata	**S3**	**1,301**
Lepidospartum squamatum	**S3**	**5,820**
Prunus fasciculata	**S3**	**2,435**
Riverine[5]	**—**	**920**
Sonoran–Coloradan semi-desert wash woodland/scrub	**—**	**196,151**
Sonoran–Coloradan semi-desert wash woodland/scrub[4]	—	1,724
Acacia greggii	S4	22,079
Chilopsis linearis	**S3**	**3,832**
Hyptis emoryi	**S3**	**8,909**
Parkinsonia florida–Olneya tesota	S4	133,672
Pluchea sericea	**S3**	**2,414**
Prosopis glandulosa	**S3**	**10,457**
Psorothamnus spinosus	**S3**	**13,063**
Southwestern North American riparian evergreen and deciduous woodland	**—**	**6,153**

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

GENERAL COMMUNITIES/COMMUNITY TYPE **Natural Community** Alliance[1]	**Rarity Ranking[2]**	**Acres[3]**
Southwestern North American riparian evergreen and deciduous woodland[4]	—	2,191
Alnus rhombifolia	S4	3
Platanus racemosa	**S3**	**143**
Populus fremontii	**S3**	**3,469**
Salix gooddingii	**S3**	**3**
Salix laevigata	**S3**	**334**
Washingtonia filifera	**S2**	**9**
Southwestern North American riparian/wash scrub	**—**	**70,433**
Southwestern North American riparian/wash scrub[4]	—	523
Arundo donax	**—**	13
Baccharis emoryi	**S2?**	**53**
Baccharis salicifolia	S4	222
Baccharis sergiloides	**S3**	**4**
Forestiera pubescens	**S2**	**106**
Salix exigua	S4	228
Salix lasiolepis	S4	62
Sambucus nigra	**S3**	**67**
Southwestern North American introduced riparian scrub	—	58,563
Tamarix spp.	**—**	10,591
WETLAND COMMUNITIES		**1,021,887**
Arid West freshwater emergent marsh	**—**	**3,933**
Arid West freshwater emergent marsh[4]	—	3,782
Typha (angustifolia, domingensis, latifolia)	S5	151
Californian warm temperate marsh/seep	**—**	**424**
Juncus arcticus (var. *balticus, mexicanus*)	S4	424
North American warm desert alkaline scrub and herb playa and wet flat	**—**	**390,559**
North American warm desert alkaline scrub and herb playa and wet flat[4]	—	390,536
Sarcobatus vermiculatus	—	26
Open water[5]	**—**	**215,162**
Playa[5]	**—**	**77,979**
Southwestern North American salt basin and high marsh	**—**	**324,605**
Southwestern North American salt basin and high marsh[4]	—	88,635
Allenrolfea occidentalis	**S3**	**6,727**
Atriplex lentiformis	S4	541

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

GENERAL COMMUNITIES/COMMUNITY TYPE Natural Community Alliance[1]	Rarity Ranking[2]	Acres[3]
Atriplex parryi	**S2?**	**7,022**
Atriplex spinifera	S4	177,040
Distichlis spicata	S4	418
Frankenia salina	**S3**	**120**
Isocoma acradenia	**S2?**	**36**
Southwestern North American alkali marsh/seep vegetation	—	292
Sporobolus airoides	**S2**	**1**
Suaeda moquinii	S4	43,772
Lacustrine[5]	**—**	**9,233**
OTHER LAND COVERS		**1,336,194**
Agriculture	**—**	**732,651**
Developed and Disturbed Areas	**—**	**594,377**
Not Mapped	**—**	**9,167**
	Total	**22,586,483**

1 Only a portion of the Plan Area, approximately six million acres of the Mojave and Colorado Deserts within Inyo, Kern, Los Angeles, San Bernardino, Riverside, and Imperial Counties, have been mapped at the more specific alliance level (Aerial Information Systems Inc. 2013). There are two large-acreage vegetation units, Madrean Warm Semi-Desert Wash Woodland/Scrub and Inter-Mountain Dry Shrubland and Grassland, which are treated as "Natural Communities" for conservation planning purposes. They represent aggregations of finer-scale communities and alliances present in other portions of the Plan Area, in cases where alliance-level data is not yet available.

2 State Rankings: S1 = critically imperiled; S2 = imperiled; S3 = vulnerable; S4 = apparently secure; S5 = secure; ? = inexact numeric rank (NatureServe 2012). LRO = Locally Rare Occurrence. Those in bold typeface are considered rare in the context of the DRECP.

3 Where the group total is not the sum of the alliances a portion of that natural community is undifferentiated at the group level.

4 Where the alliance name is the same as the natural community name, the natural community is undifferentiated and not described at the alliance level.

5 This is a land cover type and not specifically a "natural community."

4.2.1 California Forest and Woodland Communities

The California forest and woodland communities in the Plan Area comprise approximately 0.7% (149,732 acres) of the land cover and is limited to the higher elevations in the Plan Area, where they occur primarily in the Tehachapi Mountains in Kern County and the mountains in southwest San Bernardino County (Figure 4-1). The California forest and woodland communities are found within the Owens River Valley Subarea, Pinto Lucerne Valley and Eastern Slopes Subarea, and West Mojave and Eastern Slopes Subarea (Figure 4-1). Two natural communities occur in the Plan Area: Californian broadleaf forest and woodland and Californian montane conifer forest.

Californian broadleaf forest and woodland includes broadleaf evergreen or winter deciduous trees of the California Mediterranean climate zone. It includes mostly oak trees (*Quercus* spp.), but also includes small stands of buckeye (*Aesculus californica*) and black walnut (*Juglans californica*) (VegCAMP et al. 2013). Within the Plan Area, the following alliances are mapped within Californian broadleaf forest and woodland: *Aesculus californica*, *Quercus chrysolepis* tree, *Quercus lobata*, and *Quercus wislizeni* tree. Of these, *Aesculus californica* and *Quercus lobata* have a state ranking of S3 and are therefore considered rare. Californian broadleaf forest and woodland is mapped primarily in the Tehachapi Mountains in Kern County, but also occurs in the Liebre and Sawmill mountains of Angeles National Forest, the northern San Gabriel Mountains, and along Horsethief Canyon north of San Bernardino National Forest. It also occurs west of Indian Wells Valley in Kern County and in scattered locations along the Owens River Valley.

Californian montane conifer forests are characterized by an evenly distributed presence of bigcone Douglas-fir (*Pseudotsuga macrocarpa*) in the canopy, usually with canyon live oak (*Quercus chrysolepis*) as a co-dominant with up to three times the cover of bigcone Douglas-fir. This community is restricted to sheltered sites, including areas protected from canopy fire and relatively steep and shady lower canyons and slopes (VegCAMP et al. 2013). In the Plan Area, Californian montane conifer forests occur primarily in the Tehachapi Mountains and San Bernardino Mountains, as well as in scattered locations along the southern boundary of the Plan Area between these mountain ranges. In the Plan Area, the *Pinus sabiniana* alliance is mapped within the Californian montane conifer forest natural community. In this alliance, foothill pine (*Pinus sabiniana*) is strongly dominant in the overstory and the understory is largely herbaceous or consists of a mixed shrub/herb layer. Most stands occur on lower slopes (Aerial Information Systems Inc. 2013). Within the Plan Area, this alliance occurs at the northern foothills of Sawmill Mountain east of Pine Canyon, north of Keeler Flats, and in the vicinity of Bleich and Broad canyons. With a state ranking of S3, the *Pinus sabiniana* alliance is considered rare in the Plan Area.

4.2.2 Chaparral and Coastal Scrub Communities (Cismontane Scrub)

The chaparral and coastal scrub communities make up 0.5% of the Plan Area (114,086 acres) (Figure 4-1). There are two scrub natural communities and four chaparral natural communities in the Plan Area (Table 4-1).

Both the central and south coastal California coastal sage scrub and central and south coastal California seral scrub natural communities fall within the California coastal scrub macrogroup, which is characterized by a dominance of drought-deciduous shrubs and sometimes deep-rooted sclerophyllous shrubs (woody plants with small leathery evergreen leaves). Stands of central and south coastal California seral scrub are typically

open and have often recently been disturbed so as to reduce vegetative cover, as in a fire. The following species are dominant or co-dominant: San Joaquin snakeweed (*Gutierrezia californica*), common deerweed (*Acmispon glaber*), silver lupine (*Lupinus albifrons*), narrowleaf goldenbush (*Ericameria linearifolia*), yerba santa (*Eriodictyon* spp.), Mendocino bushmallow (*Malacothamnus fasciculatus*), longstem buckwheat (*Eriogonum elongatum*), naked buckwheat (*Eriogonum nudum*), common sandaster (*Corethrogyne filaginifolia*), and tree poppy (*Dendromecon rigida*) (VegCAMP et al. 2013). Two alliances are recorded within the central and south coastal California seral scrub in the Plan Area: *Ericameria linearifolia* and *Eriodictyon (crassifolium, trichocalyx)*. The *Ericameria linearifolia* alliance has a state ranking of S3 and is considered rare in the Plan Area. Central and south coastal California seral scrub is found east of the Tehachapi Mountains near Mojave and in the southern portion of the Plan Area from Mountain Top Junction east of Highway 138 east to Mojave River Forks Regional Park (Figure 4-1).

Central and south coastal Californian coastal sage scrub includes Eastern Mojave buckwheat (*Eriogonum fasciculatum*), black sage (*Salvia mellifera*), or bastardsage (*Eriogonum wrightii*), but does not have significant cover of the plant species that comprise central and south coastal California seral scrub described above (VegCAMP et al. 2013). This natural community occurs primarily at the base of the Tehachapi Mountains, along the southern boundary of the Plan Area within the West Mojave and Eastern Slopes subarea, in the Apple Valley and Granite Mountains area, and near the Bighorn Mountain and Whitewater River National Recreation Lands. This natural community also occurs in the Fort Irwin area and in scattered locations west to the Plan Area boundary (Figure 4-1). Two south coastal Californian coastal sage scrub alliances are mapped in the Plan Area, *Eriogonum fasciculatum* and *Eriogonum wrightii*, the former being much more common than the latter. The *Eriogonum wrightii* alliance has a state ranking of S3 and is considered rare in the Plan Area.

The California chaparral macrogroup includes three natural communities: Californian mesic chaparral, Californian xeric chaparral, and Californian pre-montane chaparral, with Californian xeric chaparral being the most common in the Plan Area. Californian mesic chaparral occurs on sites with mesic conditions, such as north-facing slopes, concavities, and toeslopes with well-drained soils. It is found throughout Mediterranean California, but is primarily inland from the coastal fog belt. Californian mesic chaparral occurs up to 6,000 feet in Southern California. Dominant plant species include a variety of mixed or single-species, evergreen, sclerophyllous shrubs that resprout following fire (VegCAMP et al. 2013). Although most of this natural community is mapped at the coarser group level, there are four alliances mapped in the Plan Area: *Cercocarpus montanus*, *Prunus ilicifolia*, *Quercus berberidifolia*, and *Quercus berberidifolia–Adenostoma fasciculatum*. In the Plan Area,

Californian mesic chaparral occurs in the Tehachapi Mountains and at the base of the San Gabriel Mountains near Antelope Valley in the western portion of the Plan Area (Figure 4-1).

Californian pre-montane chaparral occurs in areas with colder winters with regular frost and snow or moist conditions, such as north-facing slopes and concavities. Stands of Californian pre-montane chaparral are characterized by sclerophyllous shrublands that are either co-dominated or dominated by Eastwood's manzanita (*Arctostaphylos glandulosa*) or chaparral whitethorn (*Ceanothus leucodermis*). Components of Californian pre-montane chaparral are often composed of both shrubs that can resprout and indicator with obligate seeding. Californian pre-montane chaparral is primarily found in central and southern California mountains from 1,000 to 2,000 meters (3,281 to 6,562 feet) (VegCAMP et al. 2013). Californian pre-montane chaparral is primarily found in the Tehachapi Mountains in the Plan Area (Figure 4-1). Most of the Californian pre-montane chaparral on site is mapped at the group level, but there are 28 acres of the *Arctostaphylos glandulosa* alliance on site.

Californian xeric chaparral consists of a mixture of obligate seeders, facultative seeders, and resprouters that form sclerophyll shrublands dominated by one or more of the following species: chamise (*Adenostoma fasciculatum*), bigberry manzanita (*Arctostaphylos glauca*), hoaryleaf ceanothus (*Ceanothus crassifolius*), or flannelbush (*Fremontodendron* spp.). Drought deciduous black sage (*Salvia mellifera*) may be codominant. Californian xeric chaparral typically occurs on well-drained soils with exposures that receive full sun much of the growing season, such as upper slopes, spur ridges, and convexities. Californian xeric chaparral generally occurs inland from maritime chaparral from sea level up to 6,400 feet in elevation. This natural community ranges from inland northern Baja California, Mexico, southern, central, and northern California through the northern end of the Great Valley and north into Oregon (VegCAMP et al. 2013). In the Plan Area, Californian xeric chaparral occurs along the mountainous areas on the western and southern boundaries of the Plan Area within the West Mojave and Eastern Slopes Subarea and at the foothills of the San Gabriel Mountains in the Pinto Lucerne Valley and Eastern Slopes Subarea (Figure 4-1). Over half of the Californian xeric chaparral in the Plan Area is mapped at the group level, but there are also four alliances mapped on site: *Adenostoma fasciculatum*, *Arctostaphylos glauca*, *Ceanothus crassifolius*, and *Fremontodendron californicum*. *Fremontodendron californicum* is an S2 alliance, which is considered rare in the context of the DRECP.

Western Mojave and western Sonoran Desert borderland chaparral is characterized by two-tiered shrublands. One layer includes a moderately open to intermittent cover of sclerophyll shrubs and another shorter layer includes drought deciduous subshrubs with at least some presence of xerophylls, such as pricklypear (*Opuntia* spp.), cholla (*Cylindropuntia* spp.), and yucca (*Yucca* or *Hesperoyucca* spp.). Many drought deciduous species with desert affinities, such as goldenbush (*Ericameria* spp.) and Acton's brittlebush

(*Encelia actoni*), may also be present. Species considered true Mediterranean California chaparral species, such as chamise (*Adenostoma* spp.), manzanita (*Arctostaphylos* spp.), and many ceanothus species (*Ceanothus* spp.; other than *C. greggii*), are either lower in cover or absent from the stand (VegCAMP et al. 2013). In the Plan Area, western Mojave and western Sonoran Desert borderland chaparral occurs in scattered locations along the southern boundary of the Plan Area from the Tehachapi Mountains in the West Mojave and Eastern Slopes Subarea southeast to the little San Bernardino Mountains in the Pinto Lucerne Valley and Eastern Slopes Subarea (Figure 4-1). There are two alliances mapped in the Plan Area: *Quercus cornelius-mulleri* and *Quercus john-tuckeri*.

4.2.3 Desert Conifer Woodland Communities

The desert conifer woodlands in the Plan Area form approximately 1.3% (286,666 acres) of the land cover and occurs primarily in the Tehachapi Mountains area, along the northwestern boundary of the Plan Area to the San Gabriel Mountains, in the Providence and Bullion mountains, Kingston and Funeral mountains, and the Clark Mountain Range (Figure 4-1). One natural community of this type occurs in the Plan Area: Great Basin Pinyon–Juniper Woodland and there are three alliances within this group: *Cercocarpus ledifolius*, *Juniperus californica*, and *Pinus monophylla*. The *Juniperus californica* within the High Desert Plains and Hills is considered an LRO of this alliance.

Great Basin Pinyon–Juniper Woodland includes more than 1% absolute cover of singleleaf pine (*Pinus monophylla*) that is evenly distributed throughout the stand and the stand may have equal or higher cover of California juniper (*Juniperus californica*), Joshua tree (*Yucca brevifolia*), and/or Tucker oak (*Quercus john-tuckeri*) (VegCamp et al. 2013).

4.2.4 Desert Outcrop and Badlands

Desert outcrop and badlands cover approximately 8.3% (1,877,517 acres) of the total Plan Area. This community includes a single natural community: North American warm desert bedrock cliff and outcrop. Although the majority is mapped at the group level in the Plan Area, this group also includes four alliances: *Atriplex hymenelytra*, *Caesalpinia virgata*, *Chorizanthe rigida–Geraea canescens*, and *Peucephyllum schottii* (Table 4-1). The *Atriplex hymenelytra* alliance in the High Desert Plains and Hills is considered an LRO. *Caesalpinia virgata* has a state ranking of S1?, indicating an inexact numeric rank of S1, and is considered rare in the Plan Area. *Peucephyllum schottii* has a state rank of S3 and is considered rare in the Plan Area.

North American warm desert bedrock cliff and outcrop is characterized by areas in which vegetation is largely absent. Vegetation is not uniformly distributed across a landscape

surface and generally consists of less than 5% cover. There are no evenly spaced trees or shrubs. While North American warm desert bedrock cliff and outcrop is not characterized by herbaceous species most of the time, in years of substantial precipitation, herbaceous annual species may be abundant and evenly distributed (VegCAMP et al. 2013). North American warm desert bedrock cliff and outcrop occurs throughout much of the Plan Area, but is most prevalent in the eastern and southern portions from the Piute Valley south (Figure 4-1).

4.2.5 Desert Scrub Communities

The desert scrub communities make up the majority of the Plan Area (approximately 70.5% or 15,917,296 acres) (Figure 4-1). There are eight desert scrub groups in the Plan Area and one community mapped at the broader macrogroup level—inter-mountain dry shrubland and grassland (Table 4-1).

Inter-mountain dry shrubland and grassland vegetation generally consists of scrubs of the cooler (higher elevation) desert. Most of this macrogroup's diagnostic species are long-lived. Although some of the diagnostic species resprout following fire, some are extremely sensitive to fire. Inter-mountain dry shrubland and grassland is widespread in the higher elevations of the Mojave Desert, but in the western and central Mojave and Sonoran deserts, fires and clearing have resulted in many stands of transitional types that intergrade between seral scrub and more stable persistent stands (VegCAMP et al. 2013). Inter-mountain dry shrubland and grassland vegetation occurs from the Owens River Valley south through the foothills of the Tehachapi Mountains along the northwestern boundary of the Plan Area. It also occurs at the foothills of the San Gabriel Mountains, in the Piute and Old Woman Mountains, and in the Borrego Valley (Figure 4-1).

The intermontane deep or well-drained soil scrub, Mojave and Great Basin upper bajada and toeslope, and Southern Great Basin semi-desert grassland groups are categorized within the Inter-Mountain Dry Shrubland and Grassland vegetation macrogroup. Intermontane deep or well-drained soil scrub includes stands dominated by spiny hopsage (*Grayia spinosa*), winterfat (*Krascheninnikovia lanata*), rough jointfir (*Ephedra nevadensis*), Mormon tea (*E. viridis*), Eastern Mojave buckwheat (*Eriogonum fasciculatum*), water jacket (*Lycium andersonii*), peach thorn (*L. cooperi*), and Mexican bladdersage (*Salazaria mexicana*). Intermontane deep or well-drained soil scrub typically occurs on north-facing slopes at lower elevations, but also occurs in basins and on slopes above 3,500 feet. Intermontane deep or well-drained soil scrub can also be found on the medium-textured soils of basin margins and lower fans, especially in cool air drainages. Intermontane deep or well-drained soil scrub includes many similar vegetation types with subtle differences based on soil texture, chemistry, and disturbance regime. Most of the vegetation types in this natural

community recover rapidly following fire compared to Mojave and Great Basin Upper Bajada and Toeslope (VegCAMP et al. 2013). Intermontane deep or well-drained soil scrub is mapped primarily along the southern edge of the West Mojave and Eastern Slopes in the Plan Area following northwest to the foothills of the Scodie Mountains, the mountainous regions in the northern portion of the Pinto Lucerne Valley and Eastern Slopes Subarea, and from the Calico Mountains in the Mojave and Silurian Valley Subarea (Figure 4-1). The following alliances are mapped within the intermontane deep or well-drained soil scrub group: *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria teretifolia*, *Grayia spinosa*, *Krascheninnikovia lanata*, *Lycium cooperi*, and *Purshia tridentata*. The *Ephedra nevadensis* alliance in the High Desert Plains and Hills is considered an LRO. In addition, the *Krascheninnikovia lanata*, *Lycium cooperi*, and *Purshia tridentata* alliances are considered rare in the Plan Area.

Mojave and Great Basin upper bajada and toeslope are shrublands with shrubs attaining at least 2% cover and evenly distributed. However, indicator species for intermontane deep or well-drained soil scrub, if present, are usually less conspicuous or less dominant than coleogyne (*Coleogyne* spp.), bitterbrush (*Purshia* spp.), menodora (*Menodora* spp.), mountain mahogany (*Cercocarpus* spp.), or yucca (*Yucca* spp.) (VegCAMP et al. 2013). Mojave and Great Basin upper bajada and toeslope is fairly common throughout much of the Plan Area except the southern portion. It is most common in the Kingston and Funeral mountains and Providence and Bullion mountains in the eastern portion of the Plan Area (Figure 4-1). Although more than three-quarters of Mojave and Great Basin upper bajada and toeslope is mapped at the group level, there are five alliances mapped in the Plan Area: *Coleogyne ramosissima*, *Menodora spinescens*, *Salazaria mexicana*, *Yucca brevifolia*, and *Yucca schidigera*. The *Coleogyne ramosissima* alliance is considered an LRO in the High Desert Plains and Hills. In addition, the *Menodora spinescens* and *Yucca brevifolia* alliances are ranked S3 and are considered rare throughout the Plan Area.

Southern Great Basin semi-desert grassland is dominated by perennial grasses while shrubs are not evenly distributed (VegCAMP et al. 2013). Southern Great Basin semi-desert grassland occurs in some scattered locations in the northern portion of the West Mojave and Eastern Slopes Subarea and in the Superior Valley in the Mojave and Silurian Valley Subarea (Figure 4-1). Approximately 40 acres of Southern Great Basin semi-desert grassland are mapped at the group level, but the remaining acreage in the Plan Area (287 acres) is mapped as the *Achnatherum speciosum* alliance, which is ranked as S2 and is considered rare in the Plan Area.

The Mojavean–Sonoran desert scrub macrogroup, which comprises the majority of the scrub communities in the Plan Area, consists of two groups: lower bajada and fan Mojavean–Sonoran desert scrub is much more common than Arizonan upland Sonoran desert scrub. Lower bajada and fan Mojavean–Sonoran desert scrub, at more than 13.3

million acres, is by far the single most common natural community in the Plan Area, comprising 59% of the total area. Lower bajada and fan Mojavean–Sonoran desert scrub occurs on lower slopes, fans, and small sheet flow areas, but does not occur on well-defined washes or arroyos with defined banks and channels. This natural community is dominated or co-dominated by the following small to moderate sized shrubs (or perennial grasses): ragweed (Ambrosia spp.), brittlebush (*Encelia* spp.), creosote bush (*Larrea tridentata*), senna (*Senna* spp.), paloverde (*Parkinsonia* spp.), desert ironwood (*Olneya tesota*), barrel cactus (*Ferocactus* spp.), dalea (*Psorothamnus* spp.), and ratany (*Krameria* spp.). Where yucca, Mexican bladdersage, hopsage, or Mormon's tea are present, they have equal or lower cover. Winters where lower bajada and fan Mojavean-Sonoran desert scrub occurs may experience short frosts, but typically don't experience persistent freezes or snow accumulation (VegCAMP et al. 2013). Lower bajada and fan Mojavean-Sonoran desert scrub is found throughout most of the Plan Area except for the mountainous regions along the border of the West Mojave and Eastern Slopes Subarea and substantial portions of the Owens River Valley, Kingston and Funeral mountains, and Imperial Borrego Valley Subareas (Figure 4-1). The following alliances are mapped within *Ambrosia dumosa* lower bajada and fan Mojavean-Sonoran desert scrub in the Plan Area: *Atriplex polycarpa*, *Cylindropuntia bigelovii*, *Encelia farinosa*, *Fouquieria splendens*, *Larrea tridentata*, *Larrea tridentata–Ambrosia dumosa*, and *Larrea tridentata–Encelia farinosa*. The *Cylindropuntia bigelovii* and *Fouquieria splendens* alliances are ranked S3 and are considered rare in the Plan Area.

Arizonan upland Sonoran desert scrub occurs on rocky or bouldery hills and lower mountains (VegCAMP et al. 2013). Arizonan upland Sonoran desert scrub includes the following alliances in the Plan Area: *Agave deserti*, *Tetracoccus hallii*, and *Viguiera parishii*. The *Agave deserti* and *Tetracoccus hallii* alliances are both considered rare in the Plan Area with state rankings of S3 and S1, respectively. In the Plan Area, Arizonan upland Sonoran desert scrub primarily occurs along the Colorado River and in the southern portion of the Pinto Lucerne Valley and Eastern Slopes Subarea (Figure 4-1).

Intermontane seral shrubland is dominated by relatively small, short-lived plants that colonize uplands following both natural and unnatural disturbance events, such as clearing or fire. Characteristic species include Acton's brittlebush (*Encelia actoni*), Virgin River brittlebush (*E. virginensis*), rubber rabbitbrush (*Ericameria nauseosa*), Cooper's goldenbush (*E. cooperi*), or snakeweed (*Gutierrezia* spp.). In addition, burrobrush (*Ambrosia salsola*), Eastern Mojave buckwheat (*Eriogonum fasciculatum*), Nevada jointfir (*Ephedra nevadensis*), turpentinebroom (*Thamnosma montana*), and horsebrush (*Tetradymia* spp.) may be present (VegCAMP et al. 2013). Intermontane seral shrubland occurs primarily in the mountainous regions along the western boundary of the Plan Area

in the West Mojave and Eastern Slopes and Pinto Lucerne Valley and Eastern Slopes Subareas (Figure 4-1). The following alliances are mapped within the Plan Area: *Encelia (actoni, virginesis)*, *Ericameria cooperi*, *Ericameria nauseosa*, and *Gutierrezia sarothrae*. Both the *Encelia (actoni, virginesis)* and *Gutierrezia sarothrae* alliances are state ranked S3 and are therefore considered rare throughout the Plan Area.

Intermountain mountain big sagebrush shrubland and steppe is a sagebrush community occurring at montane elevations. Intermountain mountain big sagebrush shrubland and steppe typically occurs on flats, ridges, nearly flat ridgetops, and mountain slopes with deep to stony soil. It is composed primarily of mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and related taxa. Antelope bitterbrush (*Purshia tridentata*) may occur as a dominant or co-dominant shrub. Other shrubs include snowberry (*Symphoricarpos* spp.), serviceberry (*Amelanchier* spp.), rubber rabbitbrush (*Ericameria nauseosa*), wild crab apple (*Peraphyllum ramosissimum*), wax currant (*Ribes cereum*), and yellow rabbitbrush (*Chrysothamnus viscidiflorus*) (USNVC 2013). Intermountain mountain big sagebrush shrubland and steppe occurs primarily in the Tehachapi Mountains, but it also occurs in the northernmost portion of the Plan Area in the Owens River Valley, and in the Kingston Range, the Ivanpah Mountains, Providence Mountains, and San Bernardino Mountains (Figure 4-1). *Artemisia tridentata* is the only alliance within this group mapped in the Plan Area. Intermountain mountain big sagebrush shrubland and steppe also includes inter-mountain west mesic tall sagebrush shrubland and steppe, a subtype that was aggregated into this natural community.

Shadscale–saltbush cool semi-desert scrub is dominated or co-dominated by fourwing saltbush (*Atriplex canescens*), shadscale saltbush (*A. confertifolia*), or greasewood (*Sarcobatus vermiculatus*). Shadscale–saltbush cool semi-desert scrub generally occurs in dry lakebeds, low dunes adjacent to lakebeds, rocky uplands, or sandy washes (VegCAMP et al. 2013). Shadscale–saltbush cool semi-desert scrub is scattered throughout much of the Plan Area, but is most concentrated in the Owens River Valley, northeast of the Salton Sea, and the area around Lancaster (Figure 4-1). *Atriplex canescens* and *Atriplex confertifolia* alliances are mapped within the Plan Area (Table 4-1).

4.2.6 Dune and Sand-Based Communities

Dune communities make up approximately 1.8% (412,116 acres) of the Plan Area and include one natural community or group: North American warm desert dunes and sand flats with six mapped alliances: *Achnatherum hymenoides*, *Dicoria canescens–Abronia villosa*, *Panicum urvilleanum*, *Pleuraphis rigida*, *Prosopis glandulosa* (coppice dunes), and *Wislizenia refracta*. All of the alliances within this group are considered rare given their state ranking (Table 4-1). North American warm desert dunes and sand flats is

characterized by open dunes, dune aprons, or sand flats in which vegetation is sparse to very open (less than 10% cover) except for annual blooms in favorable years (VegCAMP et al. 2013). This community occurs throughout the Plan Area, with approximately 16 named dune systems, including approximately 12 systems in the Mojave Desert and lower Great Basin Desert and 4 systems in the Sonoran Desert, as well as numerous smaller dunes that are included in the mapping. The largest dune area, which includes the Algodones Dunes, is located in the East Mesa-Sand Hill portion of the Sonoran Desert.

4.2.7 Grassland Community

Grassland communities cover 1.1% (243,033 acres) of the Plan Area and include the macrogroup California annual and perennial grassland and the more specific California annual forb/grass vegetation group (Figure 4-1; Table 4-1).

California annual and perennial grassland consists of grasses and herbs adapted to Mediterranean climates. If shrubs are present they do not exceed more than 10% cover and/or are not evenly distributed (VegCAMP et al. 2013). California annual and perennial grassland is most common in the western portion of the Plan Area, especially along the boundary north of the San Bernardino National Forest (Figure 4-1). The California annual and perennial grassland (native component) Mapping Unit, and the *Brassica nigra* and other mustards, and *Bromus rubens–Schismus* (*arabicus, barbatus*) alliances are mapped within the California annual and perennial grassland in the Plan Area. High-quality stands of the California annual and perennial grassland (native component) Mapping Unit are considered an LRO within the Plan Area. The California annual and perennial grassland macrogroup also includes some areas of Mediterranean California naturalized annual and perennial grassland, a subtype that was aggregated into this macrogroup.

California annual forb/grass vegetation is a group within the broader California annual and perennial grassland macrogroup. Although non-native forbs and grasses may be dominant, native herbs are characteristic and evenly distributed across the herbaceous layer. Cover and composition of native species vary from year to year, but indicators are usually present in sufficient amounts to differentiate from non-native stands. Diagnostic species include fiddleneck (*Amsinckia* spp.), California poppy (*Eschscholzia* spp.), goldfields (*Lasthenia* spp.), dotseed plantain (*Plantago erecta*), and small fescue (*Festuca microstachys*) (VegCAMP et al. 2013). California annual forb/grass vegetation occurs mainly in the western portion of the Plan Area in the West Mojave and Eastern Slopes and Mojave and Silurian Valley Subareas, although there is also a small amount in the Ord Mountains of the Pinto Lucerne Valley and Eastern Slopes Subarea (Figure 4-1). There are three alliances within the California annual forb/grass vegetation group: *Amsinckia* (*menziesii, tessellata*), *Eschscholzia* (*californica*), and *Lasthenia californica–Plantago erecta–Vulpia microstachys*.

Of these, *Eschscholzia* (*californica*), and *Lasthenia californica–Plantago erecta–Vulpia microstachys* are both considered LROs throughout the Plan Area.

4.2.8 Riparian Communities

Riparian communities constitute approximately 5.4% (1,227,943 acres) of the Plan Area and include a riverine category and five groups: Madrean warm semi-desert wash woodland/scrub, Mojavean semi-desert wash scrub, Sonoran–Coloradan semi-desert wash woodland/scrub, Southwestern North American riparian evergreen and deciduous woodland, and Southwestern North American riparian/wash scrub (Figure 4-1; Table 4-1). About 75% of the riparian community is mapped only at the macrogroup level as Madrean warm semi-desert wash woodland/scrub.

Madrean warm semi-desert wash woodland/scrub is mapped in defined desert washes that are distinctly different in plant composition and/or cover compared to adjacent upland communities, in areas that did not receive alliance-level mapping. A conglomerate group has been defined as a natural community for the purposes of the DRECP and is mapped in all of the Plan Area's subareas, but is most common in the Cadiz and Chocolate mountains and Imperial Borrego Valley (Figure 4-1). The washes where this community is found are variable and can range from broad and many-channeled to narrow with a singular or few channels. Washes where Madrean warm semi-desert wash woodland/scrub occurs may be found in hills, across moderate sloping fans, or in relatively flat lower toeslopes or basins. Diagnostic species include jointfir (*Ephedra californica* or *E. trifurca*), California broomsage (*Lepidospartum squamatum*), Mojave rabbitbrush (*Ericameria paniculata*), burrobrush (*Ambrosia salsola*), desert almond (*Prunus fasciculata*), woolly brickellbush (*Brickellia incana*), big sagebrush (*Artemisia tridentata* ssp. *parishii*), catclaw acacia (*Acacia greggii*), desert lavender (*Hyptis emoryi*), honey mesquite (*Prosopis glandulosa*), screwbean mesquite (*P. pubescens*), desert willow (*Chilopsis linearis*), smoketree (*Psorothamnus spinosus*), blue paloverde (*Parkinsonia florida*), and desert ironwood (*Olneya tesota*) (VegCamp et al. 2013).

Mojavean semi-desert wash scrub is one of two groups or communities within the Madrean warm semi-desert wash woodland/scrub macrogroup. This community occurs in many scattered locations throughout the Plan Area, but is most common in the western portion of the Plan Area (Figure 4-1), and is differentiated from the Sonoran–Coloradan semi-desert wash woodland/scrub community by specific alliance. This community is dominated, co-dominated, or contains an even distribution of shrubs including jointfir, California broomsage, Mojave rabbitbrush, burrobrush, desert almond, woolly brickellbush, big sagebrush, and sweetbush (*Bebbia juncea*) (VegCamp et al. 2013). In fact, the following alliances occur within the Plan Area: *Ambrosia salsola*, *Artemisia tridentata*

ssp. *parishii*, *Bebbia juncea*, *Brickellia incana*, *Ephedra californica*, *Ericameria paniculata*, *Lepidospartum squamatum*, and *Prunus fasciculata*. All of these alliances with the exception of *Ambrosia salsola* are considered rare in the Plan Area due to their state ranking.

Sonoran–Coloradan semi-desert wash woodland/scrub is the second group or community within the Madrean warm semi-desert wash woodland/scrub macrogroup. This community occurs primarily in the southern portion of the Plan Area from the Twentynine Palms area southeast to the Palo Verde Valley and in the Imperial Borrego Valley area (Figure 4-1). Microphyll woodlands, as defined in the DRECP, consist of four alliances within this natural community. Sonoran–Coloradan semi-desert wash woodland/scrub is characterized by wash or wetland margin vegetation of warmer desert areas. Diagnostic species include shrubby "trees," such as mesquite (*Prosopis glandulosa* or *P. pubescens*), desert willow, smoke tree, paloverde, desert ironwood (*Olneya tesota*), or tall wash or wetland shrubs, such as arrowweed (*Pluchea sericea*) and desert lavender. Sonoran–Coloradan semi-desert wash woodland/scrub is often found at the edges of springs, river terraces, washes, and other areas that concentrate water (VegCamp et al. 2013). The following alliances occur within this community on site: *Acacia greggii*, *Chilopsis linearis*, *Hyptis emoryi*, *Parkinsonia florida–Olneya tesota*, *Pluchea sericea*, *Prosopis glandulosa*, and *Psorothamnus spinosus*. Of these, *Chilopsis linearis*, *Hyptis emoryi*, *Pluchea sericea*, *Prosopis glandulosa*, and *Psorothamnus spinosus* have state rankings of S3 and are considered rare in the Plan Area.

Southwestern North American riparian evergreen and deciduous woodlands are characterized by riparian winter deciduous, broad-leaved trees, or tall shrubs, including Fremont cottonwood (*Populus fremontii*), California sycamore (*Platanus racemosa*), and/or willows (*Salix* spp.). This natural community occurs primarily in the Tehachapi Mountains and along the Mojave and Colorado rivers within the Plan Area (Figure 4-1). The following alliances occur within this community on site: *Alnus rhombifolia*, *Platanus racemosa*, *Populus fremontii*, *Salix gooddingii*, *Salix laevigata*, and *Washingtonia filifera*. All of these alliances, except for *Alnus rhombifolia*, are considered rare in the Plan Area.

Southwestern North American riparian/wash scrub is characterized by native or non-native riparian shrubs and lacks a significant cover or presence of riparian trees. Generally, native species of baccharis (*Baccharis* spp.), elderberry (*Sambucus* spp.), swampprivet (*Forestiera* spp.), narrowleaf willow (*Salix exigua*) or arroyo willow (*S. lasiolepis*) are dominant or co-dominant. There may be scattered, unevenly distributed *Populus fremontii* and other willow species (*Salix* spp.) or other riparian trees at less than 10% cover (VegCamp et al. 2013). This natural community primarily occurs in the Owens Valley and Imperial Valley, but occurs elsewhere throughout the Plan Area (Figure 4-1). Over 80% of the Southwestern North American riparian/wash scrub on site is mapped at the group

level and is undifferentiated. Southwestern North American riparian/wash scrub also includes some areas of Southwestern North American introduced riparian scrub, a subtype that was aggregated into this group. The following alliances occur within the Southwestern North American riparian/wash scrub on site: *Arundo donax, Baccharis emoryi, Baccharis salicifolia, Baccharis sergiloides, Forestiera pubescens, Salix exigua, Salix lasiolepis, Sambucus nigra,* and *Tamarix* spp. The *Baccharis emoryi*, *Baccharis sergiloides*, *Forestiera pubescens*, and *Sambucus nigra* alliances have state rankings of S2 or S3 and so are considered rare in the Plan Area.

Riverine is mapped in areas of rivers or streams that lack substantial cover of riparian vegetation. This land cover type is primarily mapped along the Mojave and Colorado rivers (Figure 4-1).

4.2.9 Wetland Communities

Wetland communities cover approximately 4.5% (1,021,897 acres) of the Plan Area and include five natural communities: arid west freshwater emergent marsh, Californian warm temperate marsh/seep, North American Warm Desert Alkaline Scrub and Herb Playa and Wet Flat, Southwestern North American alkali marsh/seep vegetation, and Southwestern North American salt basin and high marsh (Table 4-1).

Arid West freshwater emergent marsh is dominated by either common reed (*Phragmites australis*), tall bulrushes (*Schoenoplectus* spp.), or cattails (*Typha* spp.). Within the Plan Area, much of this natural community is mapped at the group level, but a portion is also mapped as the *Typha* (*angustifolia, domingensis, latifolia*) alliance (Table 4-1). Arid West freshwater emergent marsh occurs primarily in the Owens River Valley and the West Mojave and Eastern Slopes Subareas, but also occurs in other subareas (Figure 4-1).

Californian warm temperate marsh/seep is mapped only at the alliance level within the Plan Area. The *Juncus arcticus* (var. *balticus, mexicanus*) alliance is dominated by artic rush (*Juncus arcticus*) and occurs in temporarily to seasonally flooded meadow environments. Although other native and non-native herbs may be present, arctic rush is prevalent throughout the stand (Aerial Information Systems Inc. 2013). This alliance is present in the southern portion of the West Mojave and Eastern Slopes Subarea and near the Paradise Range in the Mojave and Silurian Valley Subarea (Figure 4-1).

North American warm desert alkaline scrub and herb playa and wet flat include dense herbaceous stands that are wet, flooded, or moist throughout the growing season (VegCAMP et al. 2013). This natural community is widespread throughout much of the Plan Area and ranges from Edwards Air Force Base to Death Valley in the northeast to Ivanpah

Valley along the eastern boundary, and southeast to the Chuckwalla Valley. Its southwestern extent in the Plan Area is in the Anza-Borrego Desert State Park (Figure 4-1). There are no alliances mapped within North American warm desert alkaline scrub and herb playa and wet flat (Table 4-1).

Southwestern North American salt basin and high marsh is typically restricted to alkali or salt basins, spring margins, or river terraces with salt or alkali deposits (VegCAMP et al. 2013). Most of this natural community occurs in the West Mojave and Eastern Slopes Subarea, but Southwestern North American salt basin and high marsh is relatively wide ranging in the Plan Area spanning from the Owens Valley to south of Blythe and west of the Salton Sea (Figure 4-1). There are several alliances mapped within this group, including *Allenrolfea occidentalis*, *Atriplex lentiformis*, *Atriplex parryi*, *Atriplex spinifera*, *Distichlis spicata*, *Frankenia salina*, *Isocoma acradenia*, *Sporobolus airoides*, and *Suaeda moquinii*. The *Allenrolfea occidentalis*, *Atriplex parryi*, *Frankenia salina*, *Isocoma acradenia*, and *Sporobolus airoides* alliances are all considered rare in the Plan Area due to their state rankings (Table 4-1). Southwestern North American alkali marsh/seep vegetation is also included as a subtype within Southwestern North American salt basin and high marsh and is dominated by either rushes (*Juncus* spp.) or bulrushes (*Schoenopluctus* or *Bolboschoenus* spp.) (VegCAMP et al. 2013). Southwestern North American alkali marsh/seep vegetation is found in the West Mojave and Eastern Slopes Subarea with the largest area mapped southwest of Rosamond Lake (Figure 4-1).

4.2.10 Other Land Covers

4.2.10.1 Open Water, Playas, and Lacustrine Areas

Open water accounts for approximately 22% (215,162 acres) of the wetlands in the Plan Area, the majority of which is the Salton Sea. Lacustrine consists of lakes or lake-like areas and occurs along the California Aqueduct in the southern portion of the West Mojave and Eastern Slopes Subarea and areas near Ridgecrest in the northern portion of this subarea, as well as locations in between. It is also scattered throughout the Mojave Valley area east of Barstow and occurs in the Pinto Lucerne Valley and Eastern Slopes and Cadiz Valley and Chocolate Mountains Subareas (Figure 4-1). Playas are dry lake beds that may form shallow lakes after heavy rain events; playas are most prevalent in the Owens River Valley and Ward Valley (Figure 4-1).

4.2.10.2 Agriculture

Agricultural areas are mapped over approximately 3.2% (732,651 acres) of the Plan Area and are concentrated in three main regions: the Imperial Valley south of the Salton Sea, the

Palo Verde Valley in the Blythe region, and the Antelope Valley in the western Mojave Desert (Figure 4-1; Table 4-1).

Almost 500,000 acres in Imperial County are in agricultural production (Imperial County Farm Bureau 2011). Field crops account for most of the land in production, including about 166,000 acres of alfalfa; 66,000 acres of Sudangrass for hay; 44,000 acres of wheat; and 34,000 acres of sugar beets (UC Davis 2011a). Major vegetable crops include lettuce, cabbage, carrots, onions, broccoli, cauliflower, sweet corn, bell pepper, chili peppers, cantaloupes, mixed melons, and watermelons (UC Davis 2011a). Imperial County also supports the largest number of feedlot and fed cattle in California (UC Davis 2011a).

The Palo Verde Valley supports about 108,000 acres of agricultural lands, of which about 60% is alfalfa, 11% cotton, 6% wheat and barley, and 5% Sudangrass and Bermuda grass (*Cynodon dactylon*) (Barrows 2007). Agriculture in the Antelope Valley is on a much smaller scale than the Imperial and Palo Verde valleys. The acreage of vegetable crops in the Antelope Valley increased from about 9,090 acres in 1999 to 11,670 acres in 2000, due primarily to the carrot industry (UC Davis 2011a). Other crops include alfalfa, dry onions, carrots, potatoes, peaches, grapes, and nectarines.

4.2.10.3 Developed and Disturbed Areas

Developed and disturbed land is mapped over approximately 2.6% (594,377 acres) of the Plan Area and includes low- to high-intensity urban development and open space associated with developed areas, including uses such as golf courses. Developed areas are concentrated in the western Mojave in the Palmdale/Lancaster area; Victorville, Barstow, and Ridgecrest; and in the Sonoran Desert in the El Centro area of the Imperial Valley and Blythe area (Figure 4-1). Disturbed lands occur primarily in the western Mojave area west and north of Edwards Air Force Base and the Ridgecrest area. Lands mapped as developed and disturbed also include areas of rural development in the west Mojave, Morongo Valley, western Imperial Valley, and Blythe areas.

A small portion of the Plan Area, located largely in the west Mojave, Imperial Valley, and along the eastern edge of the Plan Area, is classified as “unmapped” due to lack of data in the source data for the land cover layer. These areas are primarily characterized by rural development or agricultural land uses.

4.3 Biological Diversity

The tremendous biological diversity of the Plan Area reflects the size and geographic diversity of the Plan Area. The Plan Area includes parts of three floristic provinces in California: (1) the Desert Province consists of the Mojave and Sonoran deserts; (2) the

Great Basin Province east of the Sierra Nevada; and (3) the California Floristic Province (Baldwin et al. 2002). Although these boundaries are distinct geographic divisions, the plant communities and species often exhibit gradual transitions between the provinces (Baldwin et al. 2002). It is often at these transition zones where biological diversity and species richness is particularly high because of mixed transitional plant communities and shared species. As described previously, the Plan Area also has numerous mountain ranges, valleys, and basins, and elevation ranges from less than 200 feet below MSL to more than 7,900 feet above MSL. This topographic diversity, which influences precipitation, runoff, and temperature patterns, supports a large range of environmental gradients that are associated with different plant and animal species assemblages.

4.3.1 Natural Communities and Land Covers

This section discusses plant and wildlife species that are closely associated with the natural communities identified in Section 4.2.

4.3.1.1 California Forest and Woodland Communities

California forest and woodland communities in the Plan Area comprise approximately 0.7% of the land cover and are generally limited to the higher elevations in the Plan Area, where they occur primarily in the Piute Mountains in Kern County and the mountains in southwest San Bernardino County (Figure 4-1). Similar to oak woodlands and forests, conifer forests provide important breeding and foraging habitat for many species that do not occur in lower elevation habitats, such as Cassin's finch (*Carpodacus cassinii*) and Clark's nutcracker (*Nucifraga columbiana*). The relatively high proportion of decadent trees typically found in high elevation conifer forest provide cavity and snag nesting habitat. Conifers also provide a large insect prey base for many bird species, including a variety of warblers. Jeffrey pine (*Pinus jeffreyi*) provides seed for many species, as well as bark and foliage that are food sources for squirrels (Sciuridae) and mule deer (*Odocoileus hemionus*). Coniferous forest is also important transitory habitat for mule deer during migration. Due to the relatively small amount of conifer forest in the Plan Area and its limitation to the western boundaries, the wildlife populations dependent on coniferous habitats probably are relatively small, but include several bird species that are common in coniferous habitats, such as Steller's jay (*Cyanocitta stelleri*), Clark's nutcracker, pinyon jay (*Gymnorhinus cyanocephalus*), and mountain chickadee (*Poecile gambeli*). Small mammals such as chipmunks are also strongly associated with coniferous habitats. Several other small mammals that occur in the coniferous habitats also are common in the woodland and savannah and scrub and chaparral habitats, including deermouse (*Peromyscus* spp.) and woodrats (*Neotoma* spp.). Common reptiles occurring in coniferous habitats include California kingsnake (*Lampropeltis getula californiae*), California mountain kingsnake

(*Lampropeltis zonata*), western rattlesnake (*Crotalus oreganus*), gophersnake (*Pituophis cantifer*), common gartersnake (*Thamnophis sirtalis*), western fence lizard (*Sceloporus occidentalis*), and side-blotched lizard (*Uta stansburiana*), most of which are also common at lower elevations. Uncommon reptiles and amphibians occurring at higher elevations and associated with coniferous forests include southern rubber boa (*Charina umbratica*) and yellow-legged frogs (*Rana* spp.).

Oak woodlands provide important breeding and foraging habitat for a variety of species, particularly birds. Birds characteristic of oak woodlands and forests include acorn woodpecker (*Melanerpes formicivorus*), Nuttall's woodpecker (*Picoides nuttallii*), northern flicker (*Colaptes auratus*), white-breasted nuthatch (*Sitta carolinensis*), western scrub-jay, oak titmouse, band-tailed pigeon (*Patagioenas fasciata*), and Hutton's vireo (*Vireo huttoni*) (Small 1994). Acorns are an important food source for several common bird species, including acorn woodpecker, western scrub-jay, and oak titmouse. Caching of acorns by scrub jays also promotes oak regeneration and recruitment. Understory shrubs and herbaceous vegetation in oak woodlands and forests also provide other food resources for native species, including arthropods, fruits, and seeds. Most of the birds associated with woodlands and forests use the trees for roosting, perching, refuge, or nesting. Nesting cavities and snags in woodlands and savannahs are particularly important for acorn woodpecker, oak titmouse, and western bluebird, as well as the special-status purple martin (*Progne subis*). Large oak trees provide nesting and roosting habitat for several raptors, including golden eagle, red-tailed hawk, red-shouldered hawk (*Buteo lineatus*), and American kestrel. Mammals such as mule deer, gray fox, bobcat, and common raccoon use woodland and forests for cover, refuge, and movement. Gray squirrels (*Sciurus griseus*) rely on woodlands for cover, nesting cavities, and acorns as a food source. The understory of woodlands and savannahs provides herbaceous and leaf-litter cover and food resources for a variety of small species, including various mice and reptile species.

4.3.1.2 Chaparral and Coastal Scrub Communities (Cismontane Scrub)

Chaparral and coastal scrub communities cover 0.5% of the Plan Area. They tend to occur at the mid-elevations of the mountain ranges that bind the desert portions of the Plan Area. The wildlife communities in the coastal scrub and chaparral support species that are more common in cismontane and coastal regions of Southern California and less tolerant of the harsh arid desert conditions.

Year-round resident species that typically only are found in the chaparral and coastal scrub communities include California quail (*Callipepla californica*), California thrasher (*Toxostoma redivivum*), wren-tit (*Chamaea fasciata*), California towhee (*Melozone crissalis*), spotted towhee, rufous-crowned sparrow (*Aimophila ruficeps*), and black-chinned sparrow

(*Spizella atrogularis*). Certain small mammals are also fairly exclusive to coastal scrub and chaparral habitats, including dusky-footed woodrat (*Neotoma fuscipes*), Pacific kangaroo rat (*Dipodomys agilis*), Dulzura kangaroo rat (*Dipodomys simulans*), brush deermouse (*Peromyscus boylii*), California deermouse (*Peromyscus californicus*), California pocket mouse (*Chaetodipus californicus)*, San Diego pocket mouse (*Chaetodipus fallax*), and brush rabbit (*Sylvilagus bachmani*). Common reptiles found in scrub and chaparral habitats include common kingsnake (*Lampropeltis getula*), western rattlesnake, coachwhip, gophersnake, western fence lizard, western whiptail (*Aspidoscelis tigris*), and side-blotched lizard. There are also a number of wildlife species that commonly occur in mesic coastal scrub and chaparral and that are also relatively common and widespread in desert scrub communities, including greater roadrunner, Costa's hummingbird, ash-throated flycatcher, cactus wren, blue-gray gnatcatcher (*Polioptila caerulea*), phainopepla (*Phainopepla nitens*), loggerhead shrike, sage sparrow (*Amphispiza belli*) (only winters in desert), black-tailed jackrabbit, desert cottontail, little pocket mouse (locally in sparse scrub with sandy soils and washes), cactus deermouse, North American deermouse (*Peromyscus maniculatus*), desert woodrat, bobcat (*Lynx rufus*), mountain lion (*Puma concolor*), and gray fox. Ringtail (*Bassariscus astutus*) also occurs throughout the state in riparian scrub, but is uncommon in the deserts and Southern California. Mule deer occur in both coastal scrubs and chaparral and in brushier habitats in the Mojave and Sonoran deserts. Reptiles tend to be more limited in distribution, but species that occur in both mesic coastal scrub and chaparral and the desert communities include common kingsnake, coachwhip, gophersnake, rosy boa, western patch-nosed snake, glossy snake (*Arizona elegans*), side-blotched lizard, and western whiptail.

4.3.1.3 Desert Conifer Woodland Communities

The desert conifer woodland community comprises approximately 1.3% of the Plan Area (Figure 4-1). Wildlife inhabiting pinyon-juniper woodlands also often occur in chaparrals and coastal scrubs and/or desert scrubs, but a few species are closely associated within pinyon-juniper woodlands. Bird species typical of the woodland communities in the Plan Area, but that are also commonly found in other vegetation types include Brewer's sparrow, black-chinned sparrow, western scrub-jay (*Aphelocoma californica*), oak titmouse (*Baeolophus inornatus*), bushtit (*Psaltriparus minimus*), Bewick's wren (*Thryomanes bewickii*), loggerhead shrike, crissal thrasher, gray-headed junco (*Junco hyemalis caniceps*), ladder-backed woodpecker (*Picoides scalaris*), ash-throated flycatcher, Cassin's kingbird, mountain chickadee (at higher elevations), blue-gray gnatcatcher, black-throated gray warbler (*Dendroica nigrescens*), and Scott's oriole (*Icterus parisorum*). Species that are somewhat limited to pinyon-juniper woodland include pinyon jay, which breeds in pinyon, but may forage in shrublands and grassland; juniper titmouse (*Baeolophus ridgwayi*),

which occurs in the north and northeastern portions of the Mojave desert; hepatic tanager (*Piranga flava*), which is a rare summer resident in pinyon-juniper woodland on Clark Mountain, in the Kingston Mountains, the New York Mountains, and the northeastern San Bernardino Mountains; and gray vireo (*Vireo vicinior*), which also require dense stands of chaparral near pinyon-juniper woodlands (Garrett and Dunn 1981; Small 1994).

During the winter months, large numbers of birds forage on the juniper berries, including robins (*Turdus migratorius*), cedar waxwings (*Bombycilla cedrorum*), western bluebirds (*Sialia mexicana*), and evening grosbeaks (*Coccothraustes vespertinus*) (Small 1994). The pinyon pine nuts are important food for the pinyon jay and Clark's nutcracker during the winter (Small 1994).

The CDFG Species of Special Concern pallid San Diego pocket mouse (*Chaetodipus fallax pallidus*) occurs in pinyon-juniper, as well as scrubs and chaparral in the Peninsular Ranges. Other relatively common mammals occurring in pinyon-juniper woodland, as well as other vegetation types, are black-tailed jackrabbit, brush rabbit, desert cottontail, Pacific kangaroo rat, California pocket mouse, dusky-footed woodrat, desert woodrat, as well as several deermouse species. Large mammals include mule deer, mountain lion, and bobcat. As with birds and mammals, the reptiles found in pinyon-juniper woodland are often found in other vegetation types at lower and higher elevations. Snakes expected to occur in pinyon-juniper woodlands include rosy boa, glossy snake, California striped snake (*Coluber lateralis lateralis*), speckled rattlesnake, red diamond rattlesnake (*Crotalus ruber*), and western rattlesnake, among others. Lizards expected to occur include western fence lizard, side-blotched lizard, coast horned lizard (*Phrynosoma blainvillii*), and western whiptail.

4.3.1.4 Desert Outcrop and Badlands Communities

Desert outcrop and badlands communities cover approximately 8.3% of the Plan Area (Figure 4-1). Although these areas are generally unvegetated, they may include areas of sparse shrub cover that provide wildlife habitat.

Several birds are associated with unvegetated and sparsely vegetated areas. The rock wren (*Salpinctes obsoletus*) uses rock outcrops, talus slopes, cliffs, and banks where it gleans spiders, insects, and other small invertebrates from rocks and crevices and also nests under large rocks or in cavities and crevices among the rocks. The canyon wren (*Catherpes mexicanus*) also occurs in rocky canyons. The canyon wren also gleans spiders, insects, and other small invertebrates and nests on rock ledges, shelves, and crevices, usually near water. Cliff swallow (*Petrochelidon pyrrhonota*) builds mud nests on rock overhangs and cliffs, but a source of mud must be nearby; this species is not widespread in the Plan Area.

Some highly mobile birds use secluded rock outcrops and ledges for nesting, including golden eagle, prairie falcon, and common raven (*Corvus corax*).

Of the mammals, several bat species use rock outcrops and crevices for day roosting sites. The bat species most strongly associated with rocky crevices include Yuma myotis (*Myotis yumanensis*), Californian myotis (*Myotis californicus*), long-legged myotis (*Myotis volans*), western pipistrelle (*Pipistrellus hesperus*), spotted bat (*Euderma maculatum*), and pocketed free-tailed bat (*Nyctinomops femorosaccus*), which must drop from a height to gain flying speed. Other bat species that use rock crevices include fringed myotis (*Myotis thysanodes*), western small-footed myotis (*Myotis ciliolabrum*), pallid bat (*Antrozous pallidus*), and Brazilian free-tailed bat (*Tadarida brasiliensis*). Other bat species that use caves, mines, and tunnels that are often associated with unvegetated areas are California leaf-nosed bat (*Macrotus californicus*) and Townsend's big-eared bat (*Corynorhinus townsendii*). The use of roost sites by bats in the Plan Area is not well understood, but several bat species have been recorded in various areas of the Plan Area. Californian myotis has been documented in southern Inyo County, eastern Kern County, and south-central San Bernardino County. The pallid bat and Townsend's big-eared bat have been documented in scattered locations throughout the Plan Area (see Sections 5.4.7 and 5.4.8 for full details). California leaf-nosed bat has been documented in several locations in the southern portion of the Plan Area (see Section 5.4.3). Several other species have been documented in a single area: big brown bat (*Eptesicus focus*) has been documented in northern Riverside County; Yuma myotis has been documented in eastern Los Angeles County; and long-legged myotis has been documented in southern Inyo County.

Several other mammals are strongly associated with unvegetated habitats. Spiny pocket mouse (*Chaetodipus spinatus*) occurs in the Sonoran Desert and canyon mouse (*Peromyscus crinitus)* occurs throughout the Plan Area in rocky habitats. The canyon mouse burrows beneath rocks and in rock crevices. Among other habitats, bighorn sheep occur in scattered locations in steep and rugged rocky terrains associated with the many mountain ranges in the Plan Area. Bighorn sheep use rocky terrains for escape, bedding, and lambing, but move to more open and exposed habitats to forage and access water. The rock squirrel (*Spermophilus variegatus*) is endemic to the Providence Mountains in the Eastern Mojave Desert where it uses rocky areas for burrows and dens.

Reptiles closely associated with rocky areas include chuckwalla (*Sauromalus ater*), Great Basin collared lizard (*Crotaphytus bincinctores*), rosy boa (*Lichanura trivirgata*), and speckled rattlesnake (*Crotalus mitchellii*).

Playas are fairly devoid of vegetation due to highly alkaline soils but do provide unique and important seasonal wetland resources for a variety of migratory and wintering birds. For

example, Searles Dry Lake east of Trona and Koehn Dry Lake northeast of California City have spring-fed wetlands that expand with winter rains that produce highly productive alkali meadows and mudflats (National Audubon Society 2011a). Harper Dry Lake near Barstow also provides wetland habitat for birds (BLM 2007). Thousands of migratory and wintering waterfowl and shorebirds are attracted to these wetland resources, including phalaropes (*Phalaropus* spp.), teal and pintail (*Anas* spp.), eared grebe (*Podiceps nigricollis*), American white pelican (*Pelecanus erythrorhynchos*), herons and egrets (Ardeidae), killdeer (*Charadrius vociferus*), stilts and avocets (Recurvirostridae), white-faced ibis (*Plegadis chihi*), northern harrier, and short-eared owl (National Audubon Society 2011a; BLM 2007). Snowy plover (*Charadrius alexandrinus*) has been documented to nest at Harper Dry Lake and Searles Dry Lake (Garrett and Dunn 1981; National Audubon Society 2011a). Raptors such as peregrine falcon (*Falco peregrinus*), which hunt for waterfowl, also occur in these areas and other predators, such as coyote, are attracted to these resources when large congregations of birds are present.

4.3.1.5 Desert Scrub Communities

Desert scrub communities cover 70.5% of the Plan Area. As shown in Table 4-1, desert scrub consists of several macrogroups and groups.

The wildlife communities in desert scrub are quite diverse, but there are several species of birds, mammals, and reptiles that are distinctly representative of desert scrub. Generally, these species either do not occur outside of the desert scrub or if they do occur elsewhere, the desert is an important stronghold of their range, or an important part of the life cycle (wintering habitat).

Bird species typically considered to be "desert species" and that commonly occur in desert scrub include Gambel's quail (*Callipepla gambelii*), white-winged dove (*Zenaida asiatica*), greater roadrunner (*Geococcyx californianus*), common poorwill (*Phalaenoptilus nuttallii*), Costa's hummingbird (*Calypte costae*), verdin (*Auriparus flaviceps*), cactus wren (*Campylorhynchus brunneicapillus*), black-tailed gnatcatcher (*Polioptila melanura*), LeConte's thrasher (*Toxostoma lecontei*), green-tailed towhee (winter range), Abert's towhee, Brewer's sparrow (*Spizella breweri;* winter range), and black-throated sparrow. Bendire's thrasher (*Toxostoma bendirei*) occurs locally in Joshua tree woodland, as well as desert succulent scrub.

Mammals that are common but generally limited to desert scrub in the Plan Area are almost all rodents. Most of the rodent species are kangaroo rats or pocket mice and several occur throughout the Mojave and Sonoran deserts, including Merriam's kangaroo rat, desert kangaroo rat, little pocket mouse, and long-tailed pocket mouse (*Chaetodipus*

formosus). Other kangaroo rats and pocket mice are less widespread and more locally distributed, including Great Basin pocket mouse (*Perognathus parvus*), desert pocket mouse (Sonoran Desert and locally in Mojave Desert), spiny pocket mouse (primarily Sonoran Desert), chisel-toothed kangaroo rat (Mojave and Great Basin desert areas supporting shadscale), and Panamint kangaroo rat (*Dipodomys panamintinus*) (Mojave and Great Basin deserts). Other common rodents in the desert scrub communities include cactus mouse (*Peromyscus eremicus*), canyon deermouse, grasshopper mouse (*Onychomys torridus*), and desert woodrat (*Neotoma lepida*). The white-throated woodrat (*Neotoma albigula*) occurs throughout the Colorado/Sonoran Deserts. Several squirrel species occupy desert scrub in the Plan Area, but with the exception of the widespread white-tailed antelope squirrel, these species tend to have limited distributions. The round-tailed ground squirrel is also fairly widespread in the Colorado/Sonoran Deserts and Eastern Mojave Desert. The Mohave ground squirrel is limited to the western Mojave Desert in the eastern Kern, northeastern Los Angeles, western San Bernardino, and southwestern Inyo counties. The rock squirrel is limited to the Providence Mountains in the Eastern Mojave Desert. Two lagomorphs are common throughout the scrub communities—black-tailed jackrabbit and desert cottontail. Other "desert" mammal species that occur throughout the Plan Area in the desert scrub communities are Crawford's gray shrew (*Notiosorex crawfordi*) and kit fox.

A variety of reptile species occupy the desert scrub and woodlands in the Plan Area. Most notable among these is the desert tortoise, which occurs throughout most of the undisturbed and less disturbed areas of the Plan Area. Other reptile species commonly occurring in both the Mojave and Colorado/Sonoran deserts include common chuckwalla, desert horned lizard, desert iguana, desert spiny lizard, long-nosed leopard lizard, zebra-tailed lizard, western groundsnake, western shovelnose snake (*Chionactis occipitalis*), and sidewinder. The Great Basin collared lizard occurs in the Mojave Desert and northeastern portion of the Sonoran Desert. Species generally restricted to the Mojave Desert include desert night lizard (*Xantusia vigilis*) and Mojave rattlesnake (*Crotalus scutulatus*). Species mostly limited to the Colorado/Sonoran Deserts include flat-tailed horned lizard (*Phrynosoma mcallii*) and western diamond-backed rattlesnake. The Gila monster (*Heloderma suspectum*) is restricted to a small area in northeastern San Bernardino County. Although some of these species are geographically widespread and common, they occur patchily within their range in specific microhabitats. For example, sidewinders often occur in sandy washes and windblown sand areas where they can burrow under the sand and wait for prey. The chuckwalla, on the other hand, is mostly restricted to the cover of rocky and boulder-strewn habitats. Generally, reptiles can be characterized as species associated either with flatter, open terrain with sandy soils (e.g., desert horned lizard, desert spiny lizard, long-nosed leopard lizard, zebra-tailed lizard, and Mojave rattlesnake) or with rocky

and/or brushy and woody areas (e.g., chuckwalla, Great Basin collared lizard, desert night lizard, and western diamond-backed rattlesnake).

4.3.1.6 Dune Communities

Dune communities comprise approximately 1.8% of the Plan Area. As discussed in Section 2.1.3, the Plan Area supports approximately 16 major dune systems in the Plan Area, including about 12 in the Mojave Desert and Southern Great Basin Desert and about 4 in the Sonoran Desert (Pavlik 1985). As isolated systems with unique habitat conditions (i.e., actively shifting sand), many species occurring in sand dunes are specifically adapted and restricted to dune habitats. In a study of Mojave and Great Basin desert dunes systems, Pavlik (1985, pp. 205–206) made the following observations about dune flora:

> 1) The taxonomic composition of the dune flora differs from that the desert as a whole; 2) dune vegetation has a distinctive life form spectrum that may be related to sand movement; 3) a subset of the flora appears to be edaphically restricted to dunes and patches of sand habitat; and 4) the presence of endemic taxa at several dunes indicates some degree of geographic and ecologic isolation through time.

Pavlik (1985) found that common dune flora included members of Asteraceae, Fabaceae, Chenopodiaceae, and Polemoniaceae and was somewhat deficient in Poaceae. Pavlik also found that approximately 95% of the dune taxa were indigenous. About 68% of sand dune flora recorded by Pavlik (1985) consisted of annuals (50%) and geophytes (18%). The relative abundance of annuals and geophytes compared to perennial shrubs appears to be a response to shifting sand conditions. Pavlik (1985) notes that annual species have higher rates of carbon assimilation, growth, and development that minimizes the exposure time to the harsh dune conditions (i.e., burial, abrasion, and deflation). Geophytes have ephemeral shoots and rhizomes or rootstocks that can support buds near dune surface (Pavlik 1985). Common herbaceous dune plant species include sand verbena (*Abronia villosa*), showy desert-marigold (*Baileya pauciradiata*), desert lily (*Hesperocallis undulata*), basket evening primrose (*Oenothera deltoides* ssp. *deltoides*), and fanleaf crinklemat (*Tiquilia plicata*) (Baldwin et al. 2002).

Similar to plant species, dune wildlife species often are uniquely adapted to the dunes. Fringe-toed lizards (*Uma* spp.) have morphological adaptations to living on fine sands, including velvety skin, fringed toes with projecting point scales, a countersunk lower jaw, earflaps, and camouflage (Stebbins 1985). The three species in the Mojave and Colorado/Sonoran deserts are endemic to different dune systems: the Colorado fringe-toed lizard (*Uma notata*) occurs in the Algodones Dunes in the Sonoran Desert; the Mojave fringe-

toed lizard (*Uma scoparia*) occurs in dunes systems in the Mojave Desert north to the southern end of Death Valley and south to about Parker, Arizona; and the Coachella Valley fringe-toed lizard (*Uma inornata*) occurs in the Coachella Valley west of the Plan Area within the Coachella Valley of the Colorado Desert (outside of the Plan Area) (Stebbins 1985).

Dune systems also support several endemic invertebrate species. As stated in an ISA (2010, p. 15) report:

> The Kelso Dunes alone have 10 described endemic arthropods (eight beetles, a sand-treader cricket, and a Jerusalem cricket); the Algodones Dunes have eight (seven beetles, one sand-treader cricket); and every southern California dune system that has received any level of taxonomic surveys has one or more endemic arthropods (at least 30 or 40 overall).

The CDFG Wildlife Species Matrix (CDFG 2011) includes several invertebrate species documented in the different dune systems, including Kelso Dune glaresis scarab beetle (*Glaresis arenata*), Kelso Jerusalem cricket (*Ammopelmatus kelsoensis*), Kelso giant sand treader cricket (*Macrobaenetes kelsoensis*), Saline Valley snow-front June beetle (*Polyphylla anteronivea*), and brown-tassel trigonoscuta weevil (*Trigonoscuta brunnotesselata*) in the Mojave Desert. Invertebrates in the Sonoran Desert dune systems include Carlson's dune beetle (*Anomala carlsoni*), Hardys' dune beetle (*Anomala hardyorum*), and Andrews' dune scarab beetle (*Pseudocotalpa andrewsi*) (CDFG 2010b).

At least one small mammal—desert kangaroo rat (*Dipodomys deserti*)—is closely associated with dune habitats throughout the Mojave and Sonoran deserts where it digs burrows at the base of perennial shrubs in more stabilized areas of dunes and not in areas of rapidly shifting sand (Hoffmeister 1986).

4.3.1.7 Grassland Community

Grassland vegetation communities cover approximately 1.1% of the Plan Area (Figure 4-1). Additionally, playas also support some grasslands (e.g., saltgrass [*Distichlis spicata]*) and may support large areas of herbaceous cover at times.

Desert grasslands provide important habitat for a wide variety of bird species. The bird community in desert grasslands can be characterized by three foraging types: raptors, insectivores, and granivores. Birds in these groupings may overlap somewhat (i.e., some of the raptors and the granivores also take insect prey), but the ecological niches supporting these groups are fairly distinct. It should be noted that most of the birds occurring in desert grasslands are fairly widespread in the California deserts and not generally restricted to desert grassland habitats.

Common raptors that forage in the desert grasslands include golden eagle (*Aquila chrysaetos)*, ferruginous hawk (*Buteo regalis)*, northern harrier (*Circus cyaneus)*, Swainson's hawk (*Buteo swainsoni)*, red-tailed hawk (*Buteo jamaicensis)*, prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius)*, merlin (*Falco columbarius*), burrowing owl (*Athene cunicularia)*, short-eared owl (*Asio flammeus*), great horned owl (*Bubo virginianus*), and loggerhead shrike (*Lanius ludovicianus)*. The larger species, such as golden eagle, red-tailed hawk, and great horned owl, primarily prey on rodents, lagomorphs, and reptiles, and the smaller species, such as American kestrel, burrowing owl, short-eared owl, and loggerhead shrike, include smaller rodents, reptiles, amphibians, small birds, and larger insects in their diet. Birds occurring in desert grasslands that are primarily insectivores include lesser nighthawk (*Chordeiles acutipennis)*, common nighthawk ([*Chordeiles minor*] limited mostly to Owens Valley), western kingbird (*Tyrannus verticalis)*, Cassin's kingbird (*Tyrannus vociferans*), Say's phoebe (*Sayornis saya)*, horned lark (*Eremophila alpestris),* and western meadowlark (*Sturnella neglecta)*. Most granivorous birds, such as sparrows and finches, also include insects in their diets during the breeding season. This group is characterized by stout beaks adapted to seed eating, and includes vesper sparrow (*Pooecetes gramineus*), savannah sparrow (*Passerculus sandwichensis*), lark sparrow (*Chondestes grammacus*), black-throated sparrow (*Amphispiza bilineata*), and house finch (*Carpodacus mexicanus*).

Similar to birds, mammals occurring in grasslands can be categorized by their primary foraging habitats: herbivores, granivores, omnivores, and carnivores. Further, most mammal species using desert grasslands require other habitats for important aspects of their daily activities for their life history. For example, many of the mammals found in grasslands use shrubs, rocks, and other substrates for cover, refuge, or nesting and burrowing. For this reason, many of the mammals using desert grasslands occur in grassland/shrubland mosaics and shrub steppe vegetation types more frequently than monotypic grasslands.

Common desert grassland herbivores (grazers and browsers) include desert cottontail (*Sylvilagus audubonii)*, black-tailed jackrabbit (*Lepus californicus)*, white-tailed antelope squirrel (*Ammospermophilus leucurus)*, round-tailed ground squirrel (*Xerospermophilus tereticaudus)*, the endemic Mohave ground squirrel (*Xerospermophilus mohavensis)*, and Botta's pocket gopher (*Thomomys bottae)*. These species primarily forage on grasses and forbs, but may also feed on leaves, flowers, fruits, seeds, and the squirrels also eat insects and spiders. As a subterranean species, the pocket gopher feeds mostly on roots, tubers, and bulbs.

The granivores using desert grasslands include kangaroo rats, pocket mice, and other mice. The two kangaroo rats most likely to occur in grassland habitats are Merriam's kangaroo

rat and chisel-toothed kangaroo rat (*Dipodomys microps*) in the Great Basin Desert. However, as a specialist on shadscale (*Atriplex confertifolia*) leaves, the chisel-toothed kangaroo rat also is restricted to areas with a mix of shrubs. Pocket mice are less likely to occur in large, shrubless grassland areas because they primarily forage for seeds under shrubs and, as quadrupeds, are less able to move quickly across large grassland areas compared to the bipedal and highly mobile kangaroo rats.

At least three omnivorous rodents, deermouse, western harvest mouse (*Reithrodontomys megalotis)*, and non-native house mouse (*Mus musculus*), occur in grasslands. The deermouse and western harvest mouse are ubiquitous and the house mouse occurs in association with developed and disturbed areas. These species feed on seeds, fruits, and invertebrates.

Several mammalian carnivores hunt in desert grasslands for lagomorphs, rodents, birds, reptiles, amphibians, and larger invertebrates, including coyote (*Canis latrans)*, kit fox (*Vulpes macrotis*), gray fox (*Urocyon cinereoargenteus)*, and American badger. The carnivorous southern grasshopper mouse (*Onychomys torridus*) also occurs in grasslands, scrub-grassland mosaics, and shrub steppe vegetation types, feeding almost exclusively on arthropods such as scorpions and grasshoppers, crickets, caterpillars, moths, and darkling beetles. Southern grasshopper mouse also occasionally takes small vertebrates and forages for seeds.

Desert grasslands, including grassland/shrubland mosaics and shrub steppe vegetation types, provide habitat for several reptile species, but similar to the mammals, these species occur in other vegetation types that provide cover, prey, and refuge (e.g., rocks, burrows, and debris). Snakes commonly occurring in desert grasslands include night snake (*Hypsiglena torquata)*, California kingsnake, coachwhip (*Coluber flagellum)*, gophersnake, long-nosed snake (*Rhinocheilus lecontei*), western patch-nosed snake (*Salvadora hexalepis)*, western groundsnake (*Sonora semiannulata),* western diamond-backed rattlesnake (*Crotalus atrox*), and northern Mohave rattlesnake (*Crotalus scutulatus scutulatus*). These snakes primarily prey on lizards, small mammals, smaller snakes, nesting birds, and amphibians. Fewer lizards occupy grasslands, but include side-blotched lizard, long-nosed leopard lizard (*Gambelia wislizenii*), western fence lizard, and desert spiny lizard (*Sceloporus magister*).

4.3.1.8 Riparian Communities

Riparian communities comprise approximately 5.4% of the Plan Area and can be associated with springs and areas of surface water, which provide some of the most productive wildlife habitat in the Plan Area (Figure 4-1). These “oases” provide water, cover, shade, and abundant food resources (e.g., insects and other invertebrates) for migrating and resident bird species and provide nesting habitat for birds, including cavity nesters. Some

of the important oases in the Plan Area include the Lower Colorado River system; riparian habitats associated with the Salton Sea in Imperial and Riverside counties; Agua Caliente Springs, Borrego Springs, Bow Willow Springs, and Dos Cabezas Spring in eastern San Diego County; Morongo Valley, Twentynine Palms, Box S Spring, Old Woman Spring, and Sarasota Spring in San Bernardino County; and Amargosa River, Furnace Creek Ranch, and Scotty's Castle in Inyo County (Small 1994).

Many bird species nest in desert riparian habitats in the Plan Area, including southwestern willow flycatcher (*Empidonax traillii extimus*), least Bell's vireo (*Vireo bellii pusillus*), hairy woodpecker (*Picoides villosus*), vermilion flycatcher (*Pyrocephalus rubinus*), Lucy's warbler (*Oreothlypis luciae*), yellow warbler (*Dendroica petechia*), elf owl (*Micrathene whitneyi*) (only along the Colorado River), brown-crested flycatcher (*Myiarchus tyrannulus*), black phoebe (*Sayornis nigricans*), great-tailed grackle (*Quiscalus mexicanus*), yellow-breasted chat (*Icteria virens*), common yellowthroat (*Geothlypis trichas*), summer tanager (*Piranga rubra*), blue grosbeak (*Passerina caerulea*), song sparrow (*Melospiza melodia*), and black-billed magpie (*Pica hudsonia*) (only northern Mojave Desert and Owens Valley). Other species are migrants or winter visitors in desert riparian habitats, including red-naped sapsucker (*Sphyrapicus nuchalis*), belted kingfisher (*Ceryle alcyon)*, tree swallow (*Tachycineta bicolor*), house wren (*Troglodytes aedon*), spotted towhee (*Pipilo maculatus*), vesper sparrow, and lark sparrow.

Bird species occurring in both desert riparian and desert wash include Gila woodpecker (*Melanerpes uropygialis*), ash-throated flycatcher (*Myiarchus cinerascens*), crissal thrasher (*Toxostoma crissale)*, orange-crowned warbler (*Oreothlypis celata*), Gambel's quail, common nighthawk, verdin, green-tailed towhee (*Pipilo chlorurus*), Abert's towhee (*Melozone aberti*), and gilded flicker (*Colaptes chrysoides*).

Many other bird species, as well as reptiles and mammals, that are not desert riparian or desert wash dependent often use these habitats for water and food resources. Reptiles and mammals that commonly occur in sandy soils, such as sidewinder (*Crotalus cerastes*), desert horned lizard (*Phrynosoma platyrhinos*), desert iguana (*Dipsosaurus dorsalis)*, zebra-tailed lizard (*Callisaurus draconoides*), little pocket mouse (*Perognathus longimembris*), and desert pocket mouse (*Chaetodipus penicillatus*) are often found in desert washes.

Common amphibians found in desert riparian and desert wash habitats include Baja California treefrog (*Pseudacris hypochondriaca)* and Woodhouse's toad (*Anaxyrus woodhousii*), red-spotted toad (*Anaxyrus punctatus*), great plains toad (*Bufo cognatus*), Baja California treefrog (*Pseudacris hypochondriaca*), and Rio Grande leopard frog (*Lithobathes berlandieri*) (introduced in Lower Colorado River and Imperial County area). Less common amphibians associated with desert riparian and wash habitats include arroyo toad

(*Anaxyrus californicus*), Sonoran desert toad (*Ollotis alvaria*) (previously called Colorado River toad [*Bufo alvarius*]), Arizona toad (*Anaxyrus microscaphus*), and Couch's spadefoot (*Scaphiopus couchii*). Arroyo toad in the Plan Area is limited to the desert slopes of the Transverse Ranges and currently is only known from the upper Mojave River area. The California range of the Sonoran desert toad is limited to the extreme southeast portion of the Sonoran Desert. This species has not been collected since 1955 and may be extirpated from California (Jennings and Hayes 1994). Couch's spadefoot is known from scattered locations east of the Algodones Dunes and north into San Bernardino County (CaliforniaHerps 2011).

4.3.1.9 Wetland Communities

The wetland community covers approximately 4.5% of the Plan Area and includes alkali and freshwater marshes, as well as open water, playas, and lacustrine areas (Figure 4-1). This community provides important habitat for several taxa, and especially for birds, because they are valuable wetland habitat "islands" in an arid landscape that provide cover for nesting and concentrated food sources that do not occur elsewhere in the region.

Marsh habitats with dense stands of cattail (*Typha* spp.) provide nesting habitat for several bird species in the Plan Area, including least bittern (*Ixobrychus exilis*), clapper rail (*Rallus longirostris*), black rail (*Laterallus jamaicensis*), marsh wren (*Cistothorus palustris*), common yellowthroat, red-winged blackbird (*Agelaius phoeniceus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), redhead (*Aythya americana*), ruddy duck (*Oxyura jamaicensis*), common moorhen (*Gallinula chloropus*), and American coot (*Fulica americana*) (Patten et al. 2003). Marsh habitats also provide foraging and/or resting and loafing habitat for many more avian taxa such as grebes (Podicipedidae); many species of herons, bitterns, and allies; ibises and spoonbills (Threskiornithidae), including white-faced ibis (*Plegadis chihi*); ducks and geese (Anatidae), including uncommon species such as wood duck (*Aix sponsa*); raptors such as northern harrier, and peregrine falcon; rails (Gruiformes) such as Virginia rail (*Rallus limicola*) and sora (*Porzana carolina*); stilts and avocets; sandpipers (Scolopacidae) such as solitary sandpiper (*Tringa solitaria*), western sandpiper (*Calidris mauri*), short-billed dowitcher (*Limnodromus griseus*), long-billed dowitcher (*Limnodromus scolopaceus*), and Wilson's snipe (*Gallinago delicata*); belted kingfisher; and swallows (Hirundinidae) (Garrett and Dunn 1981).

Amphibians expected to use marsh habitats in the Plan Area include Baja California treefrog, American bullfrog (*Lithobates catesbeianus*), Woodhouse's toad, and possibly Sonoran desert toad. The Baja California treefrog and bullfrog are widespread in most aquatic habitats in much of California, including desert areas. Woodhouse's toad occurs along the lower Colorado River, in orchards between Indio and the Salton Sea, and in

irrigated lands in the Imperial Valley (Zeiner et al. 1988). The Colorado River toad is uncommon in the lower Colorado River area and irrigated areas of Imperial County (Zeiner et al. 1988).

At least two mammals may occur in marsh habitat associated with the Colorado River system—Arizona cotton rat (*Sigmodon arizonae*) and muskrat (*Ondatra zibethicus*) (Zeiner et al. 1990). The muskrat also may occur in marshy habitat elsewhere in the Plan Area such as the Salton Sea and at least two locations in southern Inyo County (Zeiner et al. 1990). The muskrat is primarily herbivorous and feeds on aquatic plants such as cattails and bulrush (*Schoenoplectus* spp.), but also preys on small vertebrates such as crayfish (Zeiner et al. 1990).

Marshes also support a variety of aquatic invertebrates that provide food for birds and mammals that nest and forage in the marshes. Carnivorous birds such as bitterns, herons and egrets, and rails prey on many invertebrates, including crayfish, insects, spiders, worms, slugs, and snails. They also take amphibians, small mammals, and reptiles in the vicinity of the marshes. Ducks such as redhead and ruddy duck and gallinues such as common moorhen and American coot are primarily herbivorous, feeding on tubers, foliage and stems, and seeds of aquatic plants, and algae, but also take some insects.

Several pupfish are known from aquatic and marshy habitats in the Mojave Desert, including Amargosa pupfish (*Cyprinodon nevadensis amargosae)*, Saratoga Springs pupfish (*Cyprinodon nevadensis nevadensis*), Shoshone pupfish (*Cyprinodon nevadensis Shoshone)*, which are subspecies of *Cyprinodon nevadensis*; and Cottonball Marsh pupfish (*Cyprinodon salinus milleri*) and Salt Creek pupfish (*Cyprinodon salinus salinus*), which are subspecies of *Cyprinodon salinus* (Moyle 2002).

Amargosa pupfish inhabit freshwater marsh in the Amargosa River in Amargosa Canyon and marshes associated with ditches that drain Tecopa Hot Springs and Tecopa Bore. These broad marshes support algae and emergent cattails and rush (*Juncus* spp.). The Saratoga pupfish only occurs in Saratoga Springs in the southeastern corner of Death Valley. The Shoshone pupfish historically occurred in Shoshone Springs, but is now confined to artificial refuges (Moyle 2002). These pupfish primarily feed on cyanobacteria and algae, but seasonally prey on small invertebrates such as chironomid larvae, ostracods, copepods, and mosquito larvae (Moyle 2002). They occur in areas where the water column velocities are less than 2 centimeters per second (0.79 inches/second) (Moyle 2002). Seasonal water temperatures range from 10 to 38°C (50 and 100°F) and may be close to freezing during severe winters; the maximum water temperature these pupfish can stand is about 42°C (108°F) (Moyle 2002).

In contrast to Amargosa pupfish, the Cottonball Marsh pupfish and Salt Creek pupfish are adapted to much more saline conditions that may be more than two times saltier than seawater at times. Both subspecies occur on the Death Valley floor – Salt Creek pupfish on Salt Creek in the northern part of Death Valley and Cottonball Marsh pupfish in a marsh adjacent to the sink for Salt Creek (Moyle 2002). Occupied pools are bordered by salt-tolerant plants, such as saltgrass (*Distichlis spicata*), and pickleweed (*Salicornia* spp.). The Salt Creek pupfish primarily feeds on algae and cyanobacteria, but the Cottonball Marsh pupfish, and likely the Salt Creek pupfish, also feeds on amphipods, ostracods, and small snails that occur on algal mats (Moyle 2002). Seasonal water temperatures range from near freezing to almost 40°C (104°F). Salt Creek pupfish can tolerate water temperatures to up 38°C (50°F) and survive in short-term exposure to 43°C (109°F) (Moyle 2002). Salt Creek pupfish exhibit opportunistic, explosive population increases when water flows are high, possibly reaching peaks in the millions and measuring densities of 527 fish per square meter (Moyle 2002). The population peaks, followed by die-offs when waters recede, provide an abundant food source for birds such as herons and egrets and common ravens (Moyle 2002).

The desert pupfish (*Cyprinodon macularius*) occurs in small isolated populations around the Salton Sea and Colorado River, in shoreline pools and irrigation drainages with quiet water conditions (Moyle 2002). They have also been introduced into sanctuaries in Anza-Borrego Desert State Park and elsewhere. Desert pupfish are adapted to a wide range of habitat conditions, occurring in fresh water to highly saline conditions twice as salty as sea water and water temperatures ranging from 7°C to 45°C (45°F to 113°F) (Moyle 2002). During the winter, they bury themselves under loose debris and become dormant (Moyle 2002). They are opportunistic omnivores, feeding on algae, ostracods, copepods, aquatic crustaceans, insect larvae, and small snails.

4.3.1.10 Other Land Covers

Agricultural Areas

Agricultural areas are mapped over approximately 3.2% of the Plan Area and are concentrated in three main regions: the Imperial Valley south of the Salton Sea, the Palo Verde Valley in the Blythe region, and the Antelope Valley in the western Mojave Desert (Figure 4-1). Generally, all three areas provide important wintering and migration habitat for many bird species, especially shorebirds.

The agricultural fields in the Imperial Valley attract a large number of birds that visit the Salton Sea during migration and for wintering, as well as birds that are resident year-round. Many of these species forage and rest in the agricultural fields and use the irrigated fields

and associated canals and ditches, and trees associated with agricultural fields provide for cavity nesting. Food sources in these agricultural fields can be abundant, especially when disking or grazing unearths or flushes various terrestrial insects, such as crickets, grubs, and grasshoppers. Waste grain provides food sources for seed-eaters such as blackbirds, goldfinches, and sparrows (Small 1994). The agricultural fields in the Imperial Valley are particularly important habitat for many water birds (including shorebirds), as well as other avian species. In 1999, Shuford et al. (2000) recorded 38,398 individuals of at least 63 bird species over 12 monthly surveys in agricultural fields in the northern Imperial Valley. The three dominant species observed during this study were ring-billed gull (*Larus delawarensis*) (12,092 individuals), cattle egret (*Bubulcus ibis*) (10,862 individuals), and red-winged blackbird (4,034 individuals), accounting for 70% of all the birds counted. Other relatively common species detected (i.e., more than 100 individuals counted), in descending order of abundance, were white-faced ibis, snow/Ross's goose (*Chen* spp.), long-billed curlew (*Numenius americanus*), black-necked stilt (*Himantopus mexicanus*), black tern (*Chlidonias niger*), swallow spp., killdeer, laughing gull (*Leucophaeus atricilla*), western meadowlark, least sandpiper (*Calidris minutilla*), black-bellied plover (*Pluvialis squatarola*), whimbrel (*Numenius phaeopus*), Brewer's blackbird (*Euphagus cyanocephalus*), American pipit (*Anthus rubescens*), Wilson's phalarope (*Phalaropus tricolor*), greater yellowlegs (*Tringa melanoleuca*), tree swallow, horned lark, American kestrel, and yellow-headed blackbird. Fourteen of the 20 most abundant taxa in agricultural fields were shorebirds (Shuford et al. 2000). Agricultural fields with a grass component were the most frequently used, accounting for 39% of all birds, followed by alfalfa fields with 31% and bare fields with 24% of birds. Most of the activity in the fields was feeding (65%), followed by resting (23%), and flying (10%) (Shuford et al. 2000). Periodic burning of fields, such as asparagus, provides particularly valuable habitat for wintering mountain plovers (*Charadrius montanus*), horned larks, and American pipits (Patten et al. 2003).

The canals and drainage ditches in the Imperial Valley also provide extremely important habitat for the burrowing owl, which supports one of the largest breeding populations in California. There were an estimated 5,600 pairs (range 3,405 to 7,775) in Imperial Valley during 1992 and 1993 (Gervais et al. 2008). This estimate dropped to 4,879 pairs in 2007 and 3,557 pairs in 2008. Burrowing owls in this region nest along the soft earthen embankments of canals and ditches and roads in areas surrounded by crops, and about 80% of foraging occurs within about 1,950 feet of the nest burrow (Gervais et al. 2008).

In addition to burrowing owl and American kestrel, other raptors also commonly forage in agricultural fields, including barn owl (*Tyto alba*), great horned owl, and northern harrier, as well less commonly occurring raptors such as merlin, ferruginous hawk, and Swainson's

hawk (Patten et al. 2003). Rodents, including ground squirrels and pocket gophers (*Thomomys bottae*), and large invertebrates may be abundant on agricultural lands and attract foraging raptors.

The Palo Verde Valley supports fewer numbers of birds compared to the Imperial Valley due to the Imperial Valley's proximity to the Salton Sea and substantially more agriculture. However, the close proximity of the Palo Verde Valley to the Colorado River makes this area an important migration route and the adjacent agricultural fields in the area provide important habitat for migrant shorebirds when flooded, including large numbers of mountain plover, whimbrel (numbering up to 10,000 in the spring), and long-billed curlew (National Audubon Society 2011b).

The Antelope Valley in the Western Mojave Desert also supports a substantial amount of agriculture, although on a much smaller scale than the Imperial and Palo Verde valleys. Alfalfa fields in the Antelope Valley are important foraging habitat for the small local breeding population of Swainson's hawk, a state-listed threatened species, because they provide a consistent level of available prey such as ground squirrels, pocket gophers, grasshoppers, and crickets (Woodbridge 1998). The agricultural fields, especially alfalfa, also support mountain plover, and fields that receive effluent from local water treatment facilities can support hundreds of white-faced ibis, long-billed curlew, and other shorebirds in the fall and winter (National Audubon Society 2011c). Ferruginous hawk, mountain bluebird (*Sialia currucoides*), and horned lark also use agricultural fields in the Antelope Valley (Hood 2007).

Although birds are by far the largest vertebrate group to use agricultural lands in the Plan Area, other vertebrate wildlife taxa expected to use agricultural lands include mammals and some amphibians and reptiles. As discussed previously, small mammals such as ground squirrels and pocket gophers may be abundant and reliable prey for raptors in agricultural areas. Coyotes may also hunt for these prey in agricultural areas. Common muskrat and hispid cotton rat (*Sigmodon hispidus*) are common along irrigation and roadside ditches associated with agricultural areas in the Imperial and Palo Verde valleys (Zeiner et al. 1990). The common muskrat feeds mostly on aquatic plants and aquatic invertebrates. The hispid cotton rat feeds on grasses and invertebrates, but also on sugar beets and other crops. The Arizona cotton rat occurs in agricultural areas along the lower Colorado River and feeds on sugar beets, grains, and other crops (Zeiner et al. 1990). Several bat species have geographic ranges that overlap the three main agricultural areas. While most bats primarily forage in natural habitats (e.g., scrubs, chaparral, woodland, forest, desert wash and riparian areas), they also may be attracted to agricultural fields for insect prey, including moths, dragonflies, damselflies, grasshoppers, crickets, mantises, walking sticks, true bugs, beetles, ants, wasps, and bees. Bat species that may occur throughout the Plan Area and that may forage in

agricultural areas include big brown bat, Brazilian free-tailed bat, Californian myotis, pallid bat, spotted bat, Townsend's big-eared bat, and western pipistrelle. Bats that may occur more locally in the Plan Area and forage in agricultural areas include California leaf-nosed bat in the Sonoran and Eastern Mojave deserts; pocketed free-tailed bat and western yellow bat (*Lasiurus xanthinus*) in the Sonoran Desert; and Yuma myotis and western red bat (*Lasiurus blossevillii*) along the Colorado River.

Agricultural operations provide aquatic breeding and foraging habitat for amphibians, and several common and at least two invasive species occur in the Plan Area. Ponds and irrigation ditches provide suitable aquatic breeding habitat and the adjacent fields provide abundant invertebrate prey taken by amphibians, including grasshoppers, crickets, moths, caterpillars, beetles, ants, sow bugs, scorpions, centipedes, and spiders. The native amphibian species that occur in ponds and irrigation ditches in agricultural areas are primarily limited to the Imperial Valley and lower Colorado River, and include Woodhouse's toad, great plains toad, and Couch's spadefoot (lower Colorado River). The non-native Rio Grande leopard frog, which is native to Texas, New Mexico, and Mexico, may have been accidentally introduced in the Yuma area between 1965 and 1971 during fish plants, and has expanded its range into the agricultural areas of the Imperial Valley (CaliforniaHerps 2011). The non-native American bullfrog occurs throughout the Plan Area in suitable habitat.

Agricultural areas support a limited number of reptile species, although some may be attracted to agricultural areas for small rodent prey and larger invertebrates, especially if the agricultural area is adjacent to natural habitat that provides adequate refuge and shade (e.g., rocks, shrubs). Snakes in particular are highly vulnerable to mortality from farm equipment, vehicle collisions, and human control and eradication. Snakes that may sometimes occur in agricultural areas, especially areas with grasses, include California kingsnake, coachwhip, gophersnake, western groundsnake, checkered gartersnake (*Thamnophis marcianus*), and western diamond-backed rattlesnake. The side-blotched lizard is the only lizard expected to commonly use agricultural areas for foraging and refuge (e.g., in rodent burrows), but some other common lizard species that occur in desert scrub and wash habitats may occasionally forage along the habitat boundary between natural habitat and agriculture.

Developed and Disturbed Areas

Developed and disturbed areas are mapped over approximately 2.6% of the Plan Area and include low- to high-intensity urban development and open space associated with developed areas, including uses such as golf courses. Developed and disturbed areas also include rural development and disturbed lands that can support a mix of native desert

species that are adapted to urban and rural settings and several non-native species that have naturalized in these settings. Urban or suburban environments can provide forage, roosting, and nesting opportunities for some of the Covered Species, primarily birds. Some common wildlife in the more highly developed urban setting include at least two very common non-native birds, house sparrow (*Passer domesticus*) and European starling (*Sturnus vulgaris*), and one non-native rodent, the house mouse (Pavlik 2008). Common native birds in developed desert settings include house finch, mourning dove, white-winged dove, Costa's hummingbird, northern mockingbird, Brewer's blackbird, great-tailed grackle, and common raven (Small 1994; Behrends, pers. obs. 1978–1986). In addition to these common urban-adapted species, native bird species that commonly occur in lower density desert urban, rural settings, native plant gardens, and along the edges of golf courses include red-tailed hawk, American kestrel, American roadrunner, Gambel's quail, American robin, western meadowlark, barn owl, screech owl (*Megascops* spp.), western and Cassin's kingbird, verdin, and cactus wren (Weathers 1983; Behrends, pers. obs. 1978–1986). Other wildlife commonly occurring within or near developed areas include coyote, deer mice, Merriam's kangaroo rat, pocket mice, woodrat, round-tailed squirrel, side-blotched lizard, gophersnake, coachwhip, and rattlesnake (P. Behrends, pers. obs. 1978–1986). Water features, primarily associated with golf courses, attract migrating waterfowl (e.g., ducks, geese, grebes, loons) and shorebirds (Weathers 1983; P. Behrends, pers. obs. 1978–1986). Irrigated landscaped areas, such as golf courses and parks, are a magnet for migrating land birds.

4.3.2 Floral Richness and Diversity

The California desert flora includes approximately 2,267 plant taxa (i.e., species, subspecies, and varieties) that are native to California, comprising about 37% of the total flora in California (Baldwin et al. 2002). About 232 taxa (10%) in the California deserts are non-native, which is relatively less than the 15% of California total taxa that are non-native (Baldwin et al. 2002). The Mojave Desert in California has about 1,409 native taxa, compared to 1,363 native taxa in the southern Great Basin Province and 709 native taxa in the Colorado/Sonoran Desert (Baldwin et al. 2002). The higher level of plant diversity in the Mojave and Great Basin deserts compared to the Colorado/Sonoran Desert reflects the greater climatic and elevation diversity of these regions.

4.3.3 Faunal Richness and Diversity

Similar to the vegetation communities and floral richness and diversity, the desert regions of the Plan Area also support a high diversity of animal species.

4.3.3.1 Reptiles and Amphibians

Approximately 70 reptiles and amphibian species have geographic ranges within the Plan Area. The largest group of reptiles is snakes, which comprise about 27 species from the Boidae (boas), Colubridae (egg-laying), Leptotyphlodipae (blind snakes), and Viperidae (vipers) families. The lizards comprise approximately 23 species from several families, including Anguidae (alligator lizards), Phrynosomatidae (e.g., horned, fringe-toed, spiny, sagebrush, and fence lizards), Iguanidae (chuckwalla, desert iguana), Crotophytidae (collared and leopard lizards), and Xantusa (night lizards). There are four tortoises and turtles with ranges in the Plan Area, including desert tortoise, western pond turtle (*Actinemys marmorata*), Sonora mud turtle (*Kinosternon sonoriense*), and spiny softshell (*Apalone [Trionyx] spinera*). There are three gecko species (*Coleonyx* spp. and *Phyllodactylus xanti*) and two skink species (*Eumeces* spp.) with ranges in the Plan Area. Although the Plan Area is arid, about 14 amphibian species occur, including several salamanders (Salamandridae [newts] and Plethodontidae [lungless salamanders], spadefoot toads [Pelobatidae, true toads [Bufonidae], and tree frogs [Hylidae], and true frogs [Ranidae]). A more detailed discussion of the reptile and amphibian species typically occurring in the different natural communities is provided in Section 4.3.1.

4.3.3.2 Birds

Birds comprise a very large component of the faunal richness and diversity, in large part because of the Salton Sea, Colorado River, and adjacent irrigated agricultural fields that attract large numbers of birds during migration and for wintering. Even excluding the Salton Sea and adjacent agricultural lands, the BLM California Desert Checklist of Birds (Foreman and Nicolai 2011) includes almost 300 species representing about 39 separate taxonomic groups (e.g., hawks, kites, and eagles, owls, hummingbirds, woodpeckers, rails, swallows, finches, sparrows, vireos, flycatchers, and other passerines [relating to the bird order Passeriformes]). Of these approximately 300 species, a much smaller number are commonly found in the most arid habitats that make up the vast majority of the Plan Area because most avian nesting and wintering species are limited to areas where food and water or vegetation is readily available. Audubon California has identified 22 Important Bird Areas in the DRECP boundary.[1] A more detailed discussion of the avian species typically occurring in the different natural communities is provided in Section 4.3.1.

[1] Important Bird Areas are sites that provide essential habitat for one or more species of bird and must satisfy certain criteria to qualify.

4.3.3.3 Mammals

The Plan Area is within or intersects with the geographic ranges of about 75 mammal species (Ingles 1965). The largest group of mammals occurring in the Plan Area is rodents (Rodentia), comprising approximately 34 species. The rodent group includes about 12 species of kangaroo rats (*Dipodomys* spp.), kangaroo mice (*Microdipodops* spp.), and pocket mice (*Perognathus* and *Chaetodipus* spp.); about 12 species of "old world rodents" (Muridae), including western harvest mouse, woodrats (*Neotoma* spp.), deer mice (*Peromyscus* spp.), voles (*Microtus* spp.), muskrat; about six squirrel (*Ammospermophilus* spp., *Xerospermophilus* spp., and *Spermophilus* spp.) and four chipmunk species (Sciuridae), and two gopher species (*Thomomys* spp.). Bats (Chiroptera) comprise the second largest group, with approximately 19 species, including species from the Phyllostomidae (leaf-nosed bats), Verspertionidae (evening bats), and Molossidae (free-tailed bats) families. Approximately six shrew species (Insectivora) occur in the Plan Area. Eleven carnivore (Carnivora) species occur in the Plan Area, including mountain lion, bobcat, coyote, kit fox, American black bear (*Ursus americanus*), raccoon, ringtail, weasel, and American badger. Four ungulates occur in the Plan Area, including elk (*Cervus elaphus*), bighorn sheep, pronghorn (*Antilocapra americana*), and mule deer. A more detailed discussion of the mammal species typically occurring in the different natural communities is provided in Section 4.3.1.

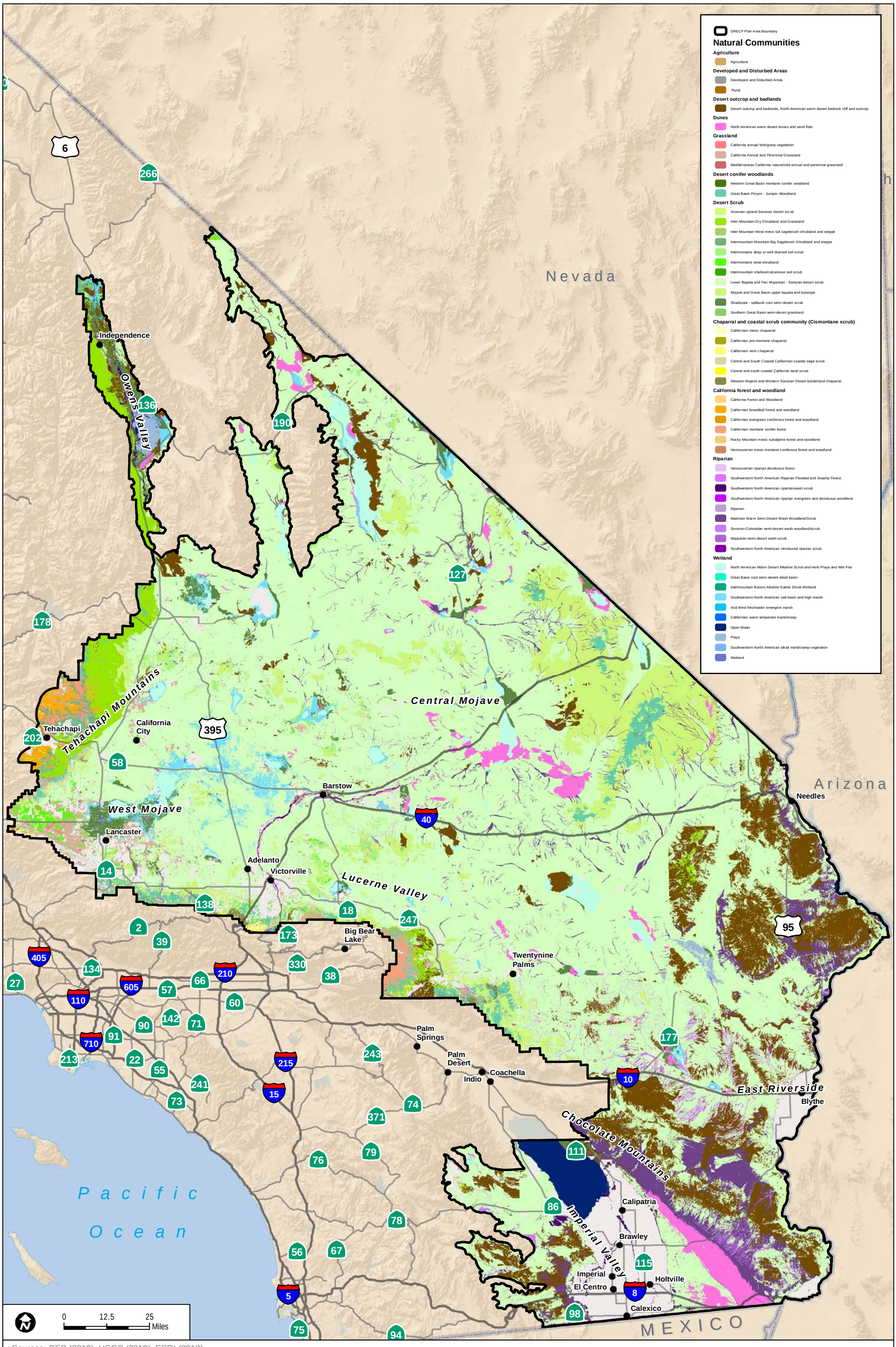
4.3.3.4 Fish

Because fish are limited to aquatic habitats, they are not widespread in the Plan Area. However, approximately 35 taxa are known from the Sonoran Desert and 19 taxa are known from the Mojave Desert (CDFG 2010a). Several of these fish taxa are included on the Special Animals List because of their high level of endemism or because of other threats and environmental stressors. Special-status fish in the Mojave Desert include Amargosa pupfish, Saratoga Springs pupfish, Shoshone pupfish, Cottonball Marsh pupfish, Salt Creek pupfish, Mohave tui chub (*Siphateles bicolor mohavensis*), arroyo chub (*Gila orcutti*), Amargosa Canyon speckled dace (*Rhinichthys osculus* ssp. *1*), and Owens speckled dace (*Rhinichthys osculus* ssp. *2*). Special-status fish known from the Sonoran Desert include desert pupfish, razorback sucker (*Xyrauchen texanus*), and bonytail (*Gila elegans*), the latter two of which are federally and state-listed endangered and occur in the Colorado River.

4.3.3.5 Invertebrates

The total number and diversity of arthropods, including crustaceans (e.g., fairy shrimp), insects, centipedes, millipedes, and arachnids and gastropods (snails and slugs) in the Plan Area is unknown and impossible to estimate because many groups of arthropods and

gastropods have not been studied. However, studies have shown high species richness and endemism levels resulting from microhabitat specialization associated with unique substrates, host plants, and water sources (CDFG 2010a). For example, more than 2,500 invertebrate taxa have been identified at the Deep Canyon Desert Research Center, which is primarily Colorado Desert on alluvial fan and rocky slopes, but also supports montane forest, chaparral, high desert plateau, pinyon-juniper woodland, ephemeral streams, and permanent waterholes (UCR 2005). With respect to endemism, CDFG (2010a) reports that 22 of 29 invertebrate taxa known from the Mojave Desert that are on the Special Animals List are endemic to the Mojave Desert. Similarly, 8 of 15 invertebrate taxa known from the Colorado/Sonoran Desert that are on the Special Animals List are endemic to the Colorado/Sonoran Desert (CDFG 2010a). A more detailed discussion of invertebrates known from the different natural communities is provided in Section 4.3.1.



Sources: CEC (2010), USGS (2010), ESRI (2010)

FIGURE 4-1

Land Cover

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5 SPECIES CONSIDERED FOR COVERAGE

This section provides a brief summary of the regulatory status, general distribution, natural history, threats and reasons for decline, habitat characteristics, and occurrence within the Plan Area for each of the 37 species, subspecies, or varieties proposed for regulatory coverage under the DRECP (i.e., Covered Species) and 2 subspecies identified as Planning Species (i.e., burro deer and desert kit fox). Expanded versions of the species profiles are provided in Appendix B to this report. Appendix C to this report includes a description and graphical depiction of the species' modeled, or estimated, suitable habitat in the Plan Area. This section also provides an overview of the species occurrence database compiled for special-status plant and wildlife species that have been recorded within the Plan Area.

5.1 Reptiles/Amphibians

5.1.1 Agassiz's Desert Tortoise

5.1.1.1 Status and Distribution

Regulatory Status

The Agassiz's desert tortoise (*Gopherus agassizii*) (hereafter simply referred to as desert tortoise) is both a California state- and federally listed threatened species. Critical habitat for desert tortoise was first designated for the Beaver Dam Slope (Utah) population in 1980 (45 FR 55654–55666). The Mojave population critical habitat was designated in 1994 (59 FR 5820–5886). The original recovery plan for the Mojave population of the desert tortoise was completed in 1994 (USFWS 1994). A revised draft recovery plan was completed in 2008 (USFWS 2008c), and a final revised recovery plan was released in 2011 (USFWS 2011e). In 1939, a California state law was enacted to prohibit the purchase or sale of desert tortoise. Fish and Game Code Section 5000 prohibits the purachase, sale, harming, take possession or transportation of any tortoises (Gopherus) or parts there of. The desert tortoise was listed as threatened in 1989.

Natural History

Desert tortoises are herbivores, and wildflowers, grasses, and in some cases, cacti make up the bulk of their diet (USFWS 2010e; Woodbury and Hardy 1948). Some of the more common herbaceous species utilized by the desert tortoise include desert dandelion (*Malacothrix glabrata*), primrose (*Oenothera* spp.), gilia (*Gilia* spp.), showy desert-marigold, and lotus. Additionally, tortoises may eat some grasses, such as Indian rice grass (*Oryzopsis hymenoides*) or galleta grass (*Hilaria rigida*), although the nutritional value may be less. Also, tortoises are known to eat some cacti such as prickly pear (*Opuntia*

mohavensis), beavertail (*Opuntia basilaris*), and various cholla cacti (*Opuntia* spp.). Spring desert annuals and grasses are particularly important in that they supply tortoises with much needed water (USFWS 2010e), which can be stored by desert tortoises for long periods of time (Marlow 1979; Woodbury and Hardy 1948). In Twentynine Palms, California, desert tortoises were found in plant communities with high plant species diversity, such as washes and ecotones between communities (Baxter 1988). Although tortoises were captured more frequently in the diverse wash community—significantly more than expected based on a random distribution—this could be a result of higher visibility to the surveyors in these areas. Nevertheless, their burrows were also significantly closer to ecotones than a set of random points. The use of these high plant diversity areas may therefore be related to increased food availability or possibly the nature of the annual herbs found in these areas.

The desert tortoise breeds in the late summer and fall, before going into brumation for the winter. Males will "joust" to establish loosely defined home ranges, but these can overlap and are not exclusive. Home range size can vary dramatically, from 10 to over 450 acres (USFWS 1994). Females begin breeding at about 15 to 20 years of age, and will store the male's sperm (Gist and Fisher 1993; Turner and Berry 1984). Egg laying occurs in the spring, but occasionally may also take place in the fall. Incubation is typically about 100 days, with the eggs hatching in the late summer and early fall. There is little or no parental care of the nest or the young. The sex of the offspring is determined by the incubation temperature; females being hatched at higher ground temperatures (above 89°F) while males are hatched below this temperature (Spotila et al. 1994). Average clutch size is 4.5 eggs (Turner et al. 1984, 1986).

Tortoise activity is focused on its home range, and is primarily determined by temperature (USFWS 1994). Nevertheless, some relocated tortoises have moved significant distances from their release point, including crossing major highways (Stewart 1991). Duda et al. (1999) found that tortoise home ranges tend to shrink during periods of drought compared to years of high rains. Following winter brumation, tortoises become more active as low temperatures abate in the spring months. During the spring, tortoises are active throughout the day, foraging on the fresh shoots of annual plants. But as the heat continues to increase into the summer months, tortoises are more active in the cooler morning, late afternoon, and evening hours. During the hot daytime temperatures, tortoises retreat to burrows to wait out the high temperatures. Tortoises can be found above ground any time of year if it rains and they are in need of water.

The desert tortoise is a primary consumer; that is, they feed on plants. As such, they compete for vegetation resources with other primary consumers, such as the desert iguana, Gambel's quail, mourning dove (*Zenaida macroura*), pronghorn antelope, and domestic

cattle (*Bos taurus*). Adult tortoises are preyed on by few other animals; however, some may be taken by coyote, badgers, free-roaming dogs, ravens, raptors, and kit fox. Young tortoises are routinely preyed upon by kit fox and common raven.

Desert tortoise burrows supply important shade and thermoregulatory resources for a variety of species, including many species of snakes, insects and spiders, and small mammals.

General Distribution and Populations Trends

The Agassiz's desert tortoise is associated with the Colorado/Sonoran Deserts of California and Mojave Deserts in the southwestern United States. Generally, its range extends north and west from the Colorado River. It extends from the desert areas of California south of the San Joaquin Valley, eastward across the Mojave Desert into southern Nevada, the extreme southwestern corner of Utah (i.e., the Beaver Dam Slope), and the extreme northwestern corner of Arizona, as well as southeast across the Colorado Desert to the Colorado River. The Plan Area supports individuals attributed to Agassiz's desert tortoise or the Mojave population. According to the *Revised Recovery Plan for the Mojave Population of the Desert Tortoise (*Gopherus agassizii*)*, the Mojave population occurs north and west of the Colorado River in the Mojave Desert of California, Nevada, Arizona, southwestern Utah, and the Colorado Desert in California (USFWS 2011e). Historical information for the Mojave population densities or abundance does not exist rangewide to provide a baseline for population trends (USFWS 2011e). Long-term study plots and other studies, however, demonstrated "appreciable declines" at the local level in many areas, and that the identified downward trend of the species in the western portion of the range at the time of the federal listing as threatened in 1990 was valid and is ongoing (USFWS 2011e). Results of studies in other parts of the Mojave population's range also are inconclusive, but suggest that declines are broadly distributed across the desert tortoise's Mojave Desert range (USFWS 2011e). In addition, specific management actions over a 23-year monitoring program have not demonstrated a positive effect on populations, although the life history of the species (i.e., delayed reproductive maturity, low reproductive rates, and relatively high mortality early in life) is such that rapid increases in populations are unlikely to be observed (USFWS 2011e).

Reasons for Decline

The desert tortoise is faced with a multitude of threats and environmental stressors to its survival. Many of these threats are synergistic (Tracy et al. 2004). For a detailed review of these threats and stressors, please see Boarman (2002). Chief among these threats are:

- Predation;
- Habitat loss and fragmentation;

- Disease;
- Other human activities (e.g., agriculture, fire, landfills, grazing, military activities);
- Off-highway vehicle (OHV) use;
- Collecting; and
- Invasive species.

5.1.1.2 Habitat Characteristics

The desert tortoise can be found in a wide variety of habitats, such as alluvial fans, washes, canyons, and saltbush plains (CVAG 2007; Woodbury and Hardy 1948; USFWS 1994). Whereas most tortoises in the Mojave Desert are usually associated with creosote bush scrub on alluvial fans and bajadas (USFWS 2011e), they can also be found in saltbush scrub (Stewart 1991) and even in some man-made structures, such as artillery mounds (Baxter 1988). *Gopherus morafkai* in the Sonoran Desert are associated more with the low rocky slopes of the desert mountains (Schamberger and Turner 1986, Barrett 1990).

The presence of shrubs in tortoise habitat is extremely important. Shrubs not only supply shade for desert tortoises during hot weather (Marlow 1979), but also the roots provide support and protection for tortoise burrows. For instance, near Twentynine Palms, California, 71% of desert tortoise burrows were associated with creosote bush, and desert tortoises avoided the only community without creosote bush (Baxter 1988). However, other investigators found that burrows were not significantly closer to creosote bush than random sites in areas with vegetation representing both Mojave and Sonoran affinities. Burrows were significantly farther from yucca (*Yucca* spp.) than random sites (Lovich and Daniels 2000). In still another case, burrows were associated with Mojave yucca (*Yucca schidigera*) and catclaw even though these species were not particularly abundant (Burge 1978). Wilson et al. (1999) found that most juvenile burrows were associated with shrubs. These studies point out that utilization of shrubs varies with the location of the study site; nevertheless, shrubs provide important resources for the desert tortoise.

Several studies have also shown that edaphic (soil) conditions are important for desert tortoises. Tortoises spend up to 98% of their lives underground (Nagy and Medica 1986). Where soils are so sandy that they cannot support the roof of a burrow, tortoises are unlikely to utilize the area (Baxter 1988). In a multivariate analysis of tortoise abundance criteria, Weinstein et al. (1986) indicated that “soil digability"” is a significant regression variable (i.e., this variable accounted for a significant amount of the variance in habitat use). Conversely, if a caliche horizon (a hardened deposit of calcium carbonate) is present, it may be so hard that tortoises cannot successfully burrow under it. For instance, at the

Twentynine Palms Marine base, Baxter (1988) found that every "tank pit" supported tortoise burrows, most often located just under the hardpan.

5.1.1.3 Occurrence within Plan Area

The historical distribution of the desert tortoise (including both the currently recognized Agassiz's and Morafka's desert tortoise species (Murphy et al. 2007) appears to be mostly the same as today. However, some authors indicate its range may once have been broader at the end of the Pleistocene era, extending as far east as Texas and to coastal Southern California in the west. It is hypothesized that its range contracted to its current size about 8,000 years ago (Moodie and Van Devender 1979; Van Devender and Moodie 1977). Native Americans used the desert tortoise for a variety of purposes, including food, ceremonial uses, medicinal uses, and household (utensil) uses; it also figured prominently in Native American mythology and symbolism (Schneider and Everson 1989). There are 33 historical (i.e., before 1990) occurrence records in the Plan Area (Dudek 2013) (Figure SP-R01 in Appendix B).

There are 1, 642 recent (i.e., since 1990) occurrence records in the Plan Area (Dudek 2013; USFWS 2011d) in the Mojave Desert and Colorado/Sonoran Desert (see Figure SP-R01 in Appendix B). Desert tortoises are mostly absent from the valley floor of the very hot, dry Coachella Valley, including the valley west of the Plan Area, but it does occur on the lower slopes of the surrounding desert mountains (CVAG 2007). Additionally, some studies indicate that the desert tortoise may utilize available local habitat in a non-random fashion, perhaps focusing its activities in high plant diversity and low sand abundance areas (Baxter 1988; Duda et al. 2002; Wilson and Stager 1992).

The *Revised Recovery Plan for the Mojave Population of the Desert Tortoise* (USFWS 2011e) identifies six Recovery Units intended to facilitate an ecosystem approach to land management and desert tortoise recovery (USFWS 2011e). Three of the six recovery units are within the Plan Area (Table 5-1). Tortoise Conservation Areas (TCAs) include desert tortoise habitat within critical habitat, Desert Wildlife Management Areas, Areas of Critical Environmental Concern, Grand Canyon-Parashant National Monument, Desert National Wildlife Refuge, National Park Service lands, Red Cliffs Desert Reserve, and other conservation areas or easements managed for desert tortoises (USFWS 2011e). Linkage habitat are important areas identified by Recovery Implementation Teams, such as important genetic linkages identified by Hagerty et al. 2010 (cited in USFWS 2011e) that are important to maintaining the species' distribution throughout its range (USFWS 2011e). High-priority habitat is high priority for management.

Table 5-1
Desert Tortoise Recovery Units in the Plan Area

Recovery Unit	Reserve	Acreage
Colorado Desert	High Priority Habitat	393,424
	Linkage	469,055
	TCA	3,130,878
	Colorado Desert Total	*3,993,356*
Eastern Mojave	Linkage	784,034
	TCA	2,095,675
	Eastern Mojave Total	*2,879,709*
Western Mojave	Linkage	1,207,516
	TCA	2,325,522
	Western Mojave Total	*3,533,038*
	Grand Total	**10,406,103**

There are 12,642,923 acres[1] of modeled suitable habitat for Agassiz's desert tortoise in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.1.2 Flat-Tailed Horned Lizard

5.1.2.1 Status and Distribution

Regulatory Status

The flat-tailed horned lizard (*Phrynosoma mcallii*) is a California Species of Special Concern and is both a Bureau of Land Management (BLM) and U.S. Forest Service (USFS) sensitive species. The species has been proposed for listing by the USFWS on four separate occasions (1993, 2001, 2005, 2010). On March 15, 2011, the USFWS published a proposed rule determining that the flat-tailed horned lizard does not require protection under the federal Endangered Species Act (ESA) (76 FR 14210–14268). A Flat-tailed Horned Lizard Rangewide management Strategy (Flat-tailed Horned Lizard ICC 2003) has also been developed.

[1] All acreages reported for suitable habitat for the proposed Covered Species are approximations.

Natural History

Flat-tailed horned lizard feed almost exclusively on harvester ants, but opportunistically eat small beetles, caterpillars, and termites (Flat-tailed Horned Lizard ICC 2003). The percentage of ants in their diet is greater than other horned lizard species and in one study was found to be 97% of the prey items found in flat-tailed horned lizard stomachs (Flat-tailed Horned Lizard ICC 2003).

Mating usually occurs in May and June, but may start in April when adult flat-tailed horned lizards emerge from hibernation. Clutch size and number is dictated by the abundance of resources, and during a typical year females will lay one clutch of 4 to 6 eggs. With favorable conditions the females lay two clutches per season. The first clutch emerges in July and the second emerges around September. Reproduction may be at least doubled in wet years as opposed to dry years (Grant 2005). In dry conditions only the late season clutch will be produced (Young and Young 2000). Females travel outside of their home range to excavate a deep (80 to 100 centimeters [32 to 39 inches]) burrow where the eggs are deposited just below the level where the sand becomes visibly moist (Young and Young 2000). Hatchlings emerge from July through October. Flat-tailed horned lizards typically reach sexual maturity within their second year (Flat-tailed Horned Lizard ICC 2003) but may breed in their first year (Barrows and Allen 2009). Their typical life span is 4 years, but they have been documented to live up to 6 years (Flat-tailed Horned Lizard ICC 2003). This species has a relatively low mean longevity and extremely low reproductive rates relative to other Phrynosomatids. This combination renders this species extremely vulnerable to local extinctions over fairly quick time periods if habitats are fragmented or compromised with anthropogenic structures and activity (Barrows, pers. comm. 2012; Barrows and Allen 2009).

Flat-tailed horned lizards are most active in the spring and fall, when they are active on the surface most hours of the day. During this period they are also active on the surface through the night (Flat-tailed Horned Lizard ICC 2003). During the increased summer temperatures their activity pattern shifts to two periods, morning and evening (Flat-tailed Horned Lizard ICC 2003). The optimum air temperature range for active flat-tailed horned lizards appears to be 35.2^{0}C to 40.2^{0}C (95.4 ^{0}F to 104.4^{0}F). They seek refuge in burrows or under the sand when daytime surface temperatures exceed 41.0^{0}C (105.8^{0}F) (Wright and Grant 2003; Wone and Beauchamp 2003).

Adult flat-tailed horned lizard are obligatory hibernators, spending most of the winter months (mid-October to mid-February) in burrows 5 to 10 centimeters (2 to 4 inches) below the surface (Flat-tailed Horned Lizard ICC 2003). Juvenile activity is also reduced during the winter, but they are occasionally seen foraging on warm winter days. It is

thought that due to their smaller size they are not able to maintain a sufficient amount of fat reserves to remain in hibernation through the winter (Muth and Fisher 1992).

Home ranges for flat-tailed horned lizards can vary by population, sex, size of the individual, climatic conditions, or density of lizards, but typically are in the range of 1 to 10 acres, but can much larger at times. In some populations it is thought that flat-tailed horned lizard do not permanently maintain distinct home ranges, but rather shift their spatial use area over time (Flat-tailed Horned Lizard ICC 2003). Home ranges appear to vary in relation to resource conditions and sex. On study site near Yuma, Arizona, Young and Young (2000) found that mean home range sizes for males was 6.2 acres during a dry year and significantly larger at 25.1 acres during a wet year. In contrast, mean female home ranges were 3.2 acres in a dry year and relatively the same at 4.7 acres in a wet year. This study also observed a wide variation in movement patterns among individuals, with a few home ranges estimated at greater than 85 acres.

Of their known natural predators round-tailed ground squirrel and the loggerhead shrike were highlighted as major predators (76 FR 14210–14268). Other native predators include kestrels and roadrunners. These predators occur naturally though recent scientific literature suggests that the populations of some of these predators are now higher as a result of manmade changes to the landscape, resulting in increased predation of flat-tailed horned lizards localized near developed areas (76 FR 14210–14268). In addition, feral dogs and cats can prey on flat-tailed horned lizard. Recent studies have found a clear negative impact on flat-tailed horned lizard presence to at least 450 meters (1,476 feet) away from disturbance (Young and Young 2005). Flat-tailed horned lizard has a relatively low mean longevity and extremely low reproductive rates relative to other Phrynosomatids. This combination renders this species extremely vulnerable to local extinctions over fairly quick time periods if habitats are fragmented or compromised with anthropogenic structures and activity.

General Distribution and Populations Trends

The northern range limit of the flat-tailed horned lizard is in the Coachella Valley and extends southeast to the Imperial and Borrego valleys and into Baja California, Mexico. The western limit of the species' range is Anza-Borrego Desert State Park in eastern San Diego County, and to the east they are found in Glamis and Ogilby northwest of Yuma, Arizona, and then into the lower Colorado subdivision of the Sonoran Desert in Arizona (Jones and Lovich 2009).

There are three regionally descriptive populations of flat-tailed horned lizard in California: Coachella Valley; the west side of the Salton Sea/Imperial Valley; and the east side of the

Imperial Valley (NatureServe 2011; 76 FR 14210–14268). The population in the Coachella Valley is divided into two segments by Interstate (I-) 10. The two populations within the Imperial Valley are divided by I-8 and the Coachella Canal into four segments (Algodones Dunes, East Mesa, West Mesa/Anza Borrego, and Yuha) (Wright and Grant 2003). Approximately 50% of the flat-tailed horned lizard historical range in California has been lost due to urban and agricultural development (Flat-tailed Horned Lizard ICC 2003). Most of this habitat conversion has occurred in the Imperial Valley between the Salton Sea and the U.S.–Mexico border. However, the USFWS determined that current threats to the species identified in the 1993 proposed rule for listing the species as endangered are not as significant as formerly believed and available data do not indicate the species is likely to become endangered in the foreseeable future throughout all or a significant portion of its range (76 FR 14210–14268).

Reasons for Decline

The major identified threats to this species are habitat fragmentation and population isolation, agricultural development, urbanization, OHV use, highways, canals, railroads, military activities, utilities, predation, mining and mineral material extraction, geothermal power development, oil and gas development, wind turbines, landfills, exotic plants, fire, pesticide use, land disposal, cattle grazing, and other ground disturbance activities (Flat-tailed Horned Lizard ICC 2003; 76 FR 14210–14268). Unregulated border patrol activities and related infrastructure development are also threats (Barrows and Allen 2009; Barrows, pers. comm. 2012). On March 15, 2011 the USFWS published the proposed rule for their determination that the flat-tailed horned lizard does not require protection under the federal ESA (76 FR 14210–14268). The proposed rule included an evaluation of potential current threats, including agricultural and urban development, energy generation facilities, invasive plants, OHV use, military training, overutilization (e.g., collecting), and disease and predation. Generally, the USFWS concluded that while some level of threat to flat-tailed lizard and its habitat still exists from these factors, the level of threat is not substantial and does not justify listing of the species (76 FR 14210–14268). Nonetheless, these factors should still be considered threats to consider in the DRECP.

In a study examining boundary processes between natural and anthropogenic desert landscape the flat-tailed horned lizard demonstrated an unambiguous negative response to the anthropogenic habitat edges (Barrows et al. 2006). This effect was likely a result of road avoidance or road associated mortalities and predation from birds that may occur more often or be more abundant along habitat edges given the greater availability of resources in suburban areas (Barrows et al. 2006).

5.1.2.2 Habitat Characteristics

Flat-tailed horned lizards occupy the hottest and most barren areas of the Sonoran Desert. Suitable habitat is characterized as stabilized sand dunes that fall within the creosote-white bursage series of Sonoran Desert Scrub community (Turner and Brown 1982; Jones and Lovich 2009). They also occur in loose, active sand dunes, although often at the dune periphery or in more stable regions within the active dune habitat. Historically they have been found in extremely active dune hummock habitats in the western Coachella Valley where they have now been extirpated. They tend to occur at higher densities in aeolian habitats that are more stable than those preferred by fringe-toed lizards (*Uma* spp.), but there is substantial overlap in the habitat occupied by these lizards (Barrows, pers. comm. 2012).

Flat-tailed horned lizard is primarily associated with fine, moderately active aeolian sands (Barrows and Allen 2010). Barrows et al. (2008) included six soil classifications in the model used to identify potential distributions of flat-tailed lizard: Myoma fine sand 5–15% slope (MaD), Myoma fine sand 0–5% slope (MaB), Coachella fine sand 0–2% slope (CpA), Coachella fine sandy loam 0–2% slope (CsA), Niland sand 2–5% slope (NaB) (Soil Conservation Service 1980, cited in Barrows et al. 2008), and a previously mapped region of ephemeral surface sand availability (Barrows and Allen 2007a, cited in Barrows et al. 2008).

Flat-tailed horned lizards occur at elevations from below sea level to about 250 meters (820 feet) above MSL (AGFD 2003). They are found where the substrate is composed of fine sands or silica. They are also found in areas that lack windblown sands such as the saltbush flats north of the Salton Sea, and the badlands in the Yuha Basin and Borrego Valley (Flat-tailed Horned Lizard ICC 2003). Flat-tailed horned lizards do not normally occur in habitats characterized as rocky mountainous areas, new alluvial areas with sloping terrain, major dune systems, marshes and tamarisk-arrow weed thickets, and agricultural and developed areas (Turner et al. 1980).

5.1.2.3 Occurrence within Plan Area

The flat-tailed horned lizard has one of the most restricted ranges of all North American horned lizards (Stebbins 1985). The historical range of the flat-tailed horned lizard in California was approximately 1.8 to 2.2 million acres, primarily in Imperial County, but also in central Riverside and eastern San Diego counties (Flat-Tailed Horned Lizard ICC 2003). The historical western boundary was formed by Fish Creek, Vallecito, and the Santa Rosa mountains. In addition, another valley of habitat stretches to the west beyond Ocotillo and Coyote Wells where I-8 meets State Route (SR-) 92. The southern extent stretched into the Yuha Basin, ending at the Sierra Juarez and Coyote mountains. The eastern extent of the flat-tailed horned lizard range extended to the Algodones Dunes and is limited by the Chocolate

and Cargo Muchacho mountains (Hodges 1997). There are 216 historical (i.e., before 1990) occurrences of flat-tailed horned lizard in the Plan Area and an additional 29 occurrences of unknown observation date (CDFG 2012b; Dudek 2011) (see Figure SP-R02 in Appendix B).

About 50% of the flat-tailed horned lizard historical range in California has been lost due to urban and agricultural development (Flat-Tailed Horned Lizard ICC 2003). There are 1,794 recent (i.e., since 1990) occurrences of flat-tailed horned lizard in the southern portion of the Plan Area (CDFG 2012b; Dudek 2011) (see Figure SP-R02 in Appendix B). The current known range for flat-tailed horned lizard begins near the confluence of the San Gorgonio and Whitewater rivers in Riverside County, and extends south and east through the Coachella Valley into Imperial County. Flat-tailed horned lizard are found on both sides of the Salton Sea, extending west into Borrego Valley with small extensions into the lower portions of the Coyote Creek Watershed, around Clark Dry Lake, north of the Fish Creek Mountains and southwest along San Felipe Creek. They are found on the Carrizo Wash east of Bow Willow, and may be found within the Carrizo Badlands. Their range extends east across East Mesa and the Algodones Dunes to Pilot Knob Mesa. Though their range extends into Arizona, the California population is separated by the Chocolate Mountains, Cargo Muchacho Mountains, and the agricultural development near Yuma, Arizona (Turner et al. 1980; Wright and Grant 2003; NatureServe 2011).

The model generated 624,072 acres of modeled suitable habitat for flat-tailed horned lizard in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.1.3 Mojave Fringe-Toed Lizard

5.1.3.1 Status and Distribution

Regulatory Status

The Mojave fringe-toed lizard (*Uma scoparia*) is a California Species of Special Concern and a BLM sensitive species (CDFG 2012b). In 2006, a petition was filed to list the northern populations associated with the Amargosa River as a distinct population segment (DPS) under the federal ESA. On October 4, 2011, the USFWS published its 12-month finding, concluding that the Amargosa River population does not constitute a DPS and is not a listable entity (76 FR 61321–61330).

Natural History

The Mojave fringe-toed lizard is best described as an opportunistic omnivore. They feed primarily on sand-dwelling insects, but will also feed on the flowers, leaves, and seeds of

annual plants (Jarvis 2009). Juvenile Mojave fringe-toed lizards feed primarily on arthropods including ants, beetles, and scorpions. As they become adults, their diet shifts to include a more herbivorous diet (Jones and Lovich 2009). As is seen in many reptiles that live in arid environments, these lizards obtain most of their water from the insects and plants that they ingest (76 FR 61321–61330).

Sexual maturity is reached when individuals reach 65 to 70 millimeters (2.5 to 2.75 inches, snout-vent length, usually two summers after hatching [Jennings and Hayes 1994]). Mating typically occurs between April and late June (76 FR 61321–61330). Reproductive activity is highly dependent on the availability of sand-dwelling plants that grow in response to winter (October–March) rainfall (76 FR 61321–61330). Clutch size ranges from two to five eggs, but average two or three eggs (Miller and Stebbins 1964). During years with low rainfall females produce smaller clutch sizes, or none at all. Conversely, they may have multiple clutches in years with abundant rainfall (76 FR 61321–61330).

Mojave fringe-toed lizards are most active from late spring through early fall, when they are active during the hotter periods of the day. According to Jones and Lovich (2009), their optimum body temperature is 37.3°C (99°F), and they are rarely active when air temperatures are below 38°C (100°F) or above 49°C (120°F). They seek refuge in burrows or under the sand when daytime surface temperatures start to exceed 49°C (120°F).

Home ranges for Mojave fringe-toed lizards vary greatly between sexes with adult males typically holding large (0.10 hectare or 0.3 acre) home ranges that are on average three times that of females. Both sexes display territorial behavior, although only males are known to defend their home ranges aggressively (Jones and Lovich 2009).

Dispersal of Mojave fringe-toed lizards is unlikely in the absence of nearby areas of windblown sands (76 FR 61321–61330). Within areas of active sand transport, sand dunes are highly dynamic and continually moving; in some cases, moving several meters per year. Movement between populations is poorly studied, although is likely limited by the natural movement of sands. No specimen of Mojave fringe-toed lizard has been captured more than approximately 150 feet from windblown sand deposits (76 FR 61321–61330).

Natural known predators of Mojave fringe-toed lizard include snakes, long-nosed leopard lizard, greater roadrunner, burrowing owl, loggerhead shrike, hawks, American badger, and coyote (Jones and Lovich 2009). Mojave fringe-toed lizard often uses burrows to escape predation. Burrowing rodents common in their habitat areas are round-tailed ground squirrel, white-tailed antelope squirrel, and various species of kangaroo rats and pocket mouse (Fromer et al. 1983). In addition to predator avoidance, Mojave fringe-toed lizard use these rodent burrows for thermal protection under very high ambient temperatures.

Lizard species known to occur in habitats with similar characteristics as those preferred by the Mojave fringe-toed lizard include desert iguana, desert horned lizard, long-nosed leopard lizard, side-blotched lizard, ornate tree lizard (*Urosaurus ornatus*), and zebra-tailed lizard. Of these species, only zebra-tailed lizard appears to be a potential competitor for food resources with Mojave fringe-toed lizard. These species are both insectivorous, approximately the same adult size, and likely select prey of similar size. Foraging behavior in the two species is similar, although not well documented (Fromer et al. 1983).

General Distribution and Populations Trends

The Mojave fringe-toed lizard is restricted to deposits of loose sand; as a result, its distribution is discontinuous throughout its range (Fromer et al. 1983). The species is endemic to the Mojave and Sonoran deserts of Southern California and western Arizona. Within these regions, they are known to occur at more than 35 sand dune complexes in California and one in Arizona (Jarvis 2009).

The Mojave fringe-toed lizard is known to occur at more than 35 sand dune complexes in California and one in Arizona, all of which are naturally occurring within the species' historical range (76 FR 61321–61330; Norris 1958). Hollingsworth and Beaman (2001) state that although there is no published data suggesting a decline in population sizes of the Mojave fringe-toed lizard, enough urban development in the Mojave exists to cause concern that populations will be adversely affected. BLM (2002a) states that there is no information about population trends. However, a more recent paper by Murphy et al. (2006) documents the extirpation of the species at four sites where they were previously reported (i.e., Harper and El Mirage dry lakes, Piute Butte, and Lovejoy Buttes). While Murphy et al. (2006) indicate some extirpations, they do not directly assess populations, which would require a more comprehensive assessment of population changes over time.

Reasons for Decline

The loose windblown sand habitat that Mojave fringe-toed lizards rely on requires protection from direct and indirect disturbances (Barrows 1996). Direct disturbances to loose windblown sand habitat can include the use of off-road vehicles, the infestation and stabilization of dune sands by invasive exotic species (e.g., Sahara mustard), and urban development. Direct disturbances to Mojave fringe-toed lizards include increases in local predators (e.g., common raven). Indirect disturbances can include development of sand source areas, sand transport areas, and the use of sand barriers (e.g., sand fences) to control sand movement. It has been stated that this species is highly vulnerable to off-road vehicle activity and the establishment of windbreaks that affect how windblown sand is deposited (Stebbins 2003). The decline of the closely related Coachella Valley fringe-toed

lizard is primarily attributed to habitat loss caused by urban development; disruption of the natural movement of sand caused by roads, windbreaks, and other man-made alterations; and OHV use, which causes direct impacts to the species' habitat (Weaver 1981; Beatley 1994).

5.1.3.2 Habitat Characteristics

The Mojave fringe-toed lizard is only found in and immediately around areas of the Mojave Desert that contain deposits of aeolian, or fine windblown sands (Jones and Lovich 2009). These sands are typically associated with dunes, washes, hillsides, margins of dry lakes, and sandy hummocks between elevations of 90 and 910 meters (295 and 2,986 feet) (76 FR 61321–61330; Norris 1958; Stebbins 2003). Sand dune ecosystems, including their source sand and sand corridors, are necessary for the long-term survivorship of aeolian sand specialists (Barrows 1996). Though sparsely vegetated, vegetation may include blue palo verde, honey mesquite, creosote bush, white bursage, indigo bush, sandpaper plant (*Petalonyx thurberi*), saltbush, and numerous species of annuals (76 FR 61321–61330; Jarvis 2009).

5.1.3.3 Occurrence within Plan Area

The Mojave fringe-toed lizard is endemic to the Mojave and Sonoran deserts of Southern California and western Arizona. Historically, this species was known to occur throughout the windblown sand areas in the following counties within the Plan Area: southern Inyo, San Bernardino, northern Los Angeles, and eastern Riverside. Within these counties, this species was known to occur within the present and historical river drainages and associated sand fields of the Mojave, Amargosa, and Colorado rivers (Jarvis 2009). Outside of the Plan Area, they were known from La Paz County in Arizona (Jones and Lovich 2009). Norris (1958) indicates that many of the major dune complexes are the result of reworking previous Pluvial beach sands, and that fringing dunes adjacent to river systems may have been more continuous than the time of writing. Most date from the recent, while several others date from the Pleistocene. There are 18 historical (i.e., pre-1990) occurrences for Mojave fringe-toed lizard contained in the California Natural Diversity Database (CNDDB) and an additional 30 records with an unknown date of observation (CDFW 2013; Dudek 2013). These records are widely scattered throughout the Plan Area, generally in a region bounded on the west by the Palmdale area, on the northeast by the Black Mountains, on the east by the Turtle Mountains, and on the south by the Ford-Palen dunes area

There are 115 recent (i.e., since 1990) occurrences recorded in the Plan Area (Dudek 2013). Since 2006, Mojave fringe-toed lizards have been found in locations within the Amargosa River drainage that did not have any historical occurrence records. As

described above, this species is currently found within more than 35 named and unnamed sand dune complexes within the three major river drainages in the Plan Area: the Amargosa, Mojave, and Colorado rivers. Norris (1958) described 31 dune complexes. However, a more recent paper by Murphy et al. (2006) documents the extirpation of the species at four sites where they were previously reported (i.e., Harper and El Mirage dry lakes, Piute Butte, and Lovejoy Buttes). Figure SP-R03 in Appendix B shows the species' range and occurrences in the Plan Area.

The model generated 278,723 acres of modeled suitable habitat for Mojave fringe-toed lizard in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.1.4 Tehachapi Slender Salamander

5.1.4.1 Status and Distribution

Regulatory Status

The Tehachapi slender salamander (*Batrachoseps stebbinsi*) is state listed as threatened in California and is a BLM sensitive species. The USFWS published its 12-month finding for the species in October 2011 to determine whether it should be federally listed as threatened and concluded that a listing as threatened was not warranted (76 FR 62900–62926).

Natural History

Although the Tehachapi slender salamander's specific feeding habits are unknown, related species feed on small arthropods, such as spiders and mites, insects (especially collembolans, coleopterans, and hymenopterans), earthworms, and snails (Cunningham 1960; Adams 1968). The Tehachapi slender salamander primarily forages under surface objects, such as pieces of bark or flat talus rocks, in moist areas or in leaf litter. *Batrachoseps* are generally sit-and-wait predators (CaliforniaHerps 2011); they search or wait for small insects and other invertebrates under surface objects (USFS 2006). Salamanders may enter termite tunnels and earthworm burrows when foraging (Morey 2005). They may compete with juvenile salamanders of other species where their ranges overlap (Morey 2005).

Reproduction by *Batrachoseps* species is terrestrial (Hansen and Wake 2005). Eggs are laid in moist places under surface objects and neonates hatch fully formed (USFS 2006; CaliforniaHerps 2011). The breeding season of the Tehachapi slender salamander is suspected to be from about November to February, with peak activity in November and December, but the timing of reproduction is likely climate related. The Tehachapi slender

salamander probably lays eggs during the rainy periods of winter and early spring (Morey 2005). Breeding activity may extend into May at higher elevation and at sites with moist conditions. Clutch size remains unknown, although related salamanders lay eggs in clusters of 4 to 21 (Stebbins 1954; USFS 2006). Although nest sites have not been directly observed, eggs are likely deposited deep within the rock talus and litter matrix typical of Tehachapi slender salamander microhabitat (Hansen and Wake 2005). Tehachapi slender salamanders may build communal nests, which have been reported for the sympatric black-bellied salamander (Jockusch and Mahoney 1997).

The Tehachapi slender salamander is not thought to be territorial (USFS 2006), although females of related species are often found in the immediate vicinity of egg clusters (Morey 2005). Tehachapi slender salamander home ranges are suspected to be approximately 0.5 acre (USFS 2006), with individuals moving no more than about 164 feet in their lifetime (Hansen and Wake, pers. comm. 2008). The area of Tehachapi slender salamander surface activity probably covers its area of underground activity (Morey 2005). In similar slender salamander species, up to 15 individual territories have been located within a 1,076-square-foot area (Hansen and Wake, pers. comm. 2008).

The activity patterns of the Tehachapi slender salamander are largely dependent upon precipitation patterns, which are erratic in both timing and amount within the species' range (Hansen and Wake 2005). Surface activity closely relates to the onset of the rainy season, which generally occurs around November or December (Hansen and Wake 2005). At lower elevations this rainy season may be rather brief (2 to 3 months) (Hansen and Wake 2005). Due to the relative dryness of its habitat, the Tehachapi slender salamander may have a shorter activity period than other slender salamanders (CaliforniaHerps 2011). During the moist period (November to May) the Tehachapi slender salamander can be found nocturnally active on the surface, although periods of surface activity vary from year to year (Morey 2005). March and April generally marks the salamander's peak surface activity, although it can extend into May in wet years or at higher elevations (e.g., upper reaches of Pastoria and Tejon Creek drainages, Tehachapi Mountains) (Hanson and Wake, pers. comm. 2008). During drier periods, salamanders retreat underground to moist seepages (Morey 2005). In years of below-average rainfall or consecutive years of drought, salamanders may not appear under surface cover at all, but rather retreat to subterranean refugia (Morey 2005; Hansen and Wake 2005).

All known Tehachapi slender salamander localities overlap the range of the yellow-blotched salamander (*Ensatina eschscholtzii croceater*) (Hansen and Wake 2005). Both species occupy similar habitats, but yellow-blotched salamanders have a more extensive distribution. In some areas where yellow-blotched salamanders are abundant, Tehachapi

slender salamanders do not occur; conversely, where Tehachapi slender salamanders are locally abundant there are few yellow-blotched salamanders.

Primary predators of the Tehachapi slender salamander are most likely small snakes such as the ring-necked snake (*Diadophis punctatus*) (Hansen and Wake 2005). Other potential predators of both adults and juveniles include beetle larvae and other predatory arthropods, diurnal birds (especially birds that forage through leaf litter), and small mammals (Morey 2005).

General Distribution and Populations Trends

The Tehachapi slender salamander is endemic to California and is reported to occur only in Kern County, although Morey (2005) indicates that the species could extend south into Los Angeles County. The CNDDB includes occurrences for elevations ranging from 1,610 feet in the Caliente Creek area to 5,575 feet in the Tehachapi Mountains (CDFG 2012b).

According to the USFWS 12-month review, there are two populations of the Tehachapi slender salamander that represent two DPSs of a single species: the Tehachapi Mountains DPS and the Caliente Canyon DPS, which together constitute the entire range of the species (76 FR 62900–62926).

Population trends of the Tehachapi slender salamander are unknown. However, all documented occurrences are considered to be extant, although individual populations are small and localized (Hammerson 2009). No ecological or population studies have been conducted that would provide specific information about population status and trends.

Reasons for Decline

Tehachapi slender salamander populations are restricted to seasonally shaded, north-facing slopes of canyons located in otherwise arid to semi-arid terrain where talus occurs. The small and localized nature of these populations, which occur at a limited number of sites, makes them highly susceptible to habitat disturbance caused by development. The USFWS analyzed the threat to Tehachapi slender salamander posed by proposed development in the 12-Month Finding (76 FR 62900–62926). The only known potential development-related threats to the species are the proposed Tejon Mountain Village residential and commercial development in the Tehachapi Mountains. The USFWS found that under a worst-case scenario only 2.8% of suitable habitat for the species would be impacted by the Tejon Mountain Village development and concluded that this level of impact would not threaten the Tehachapi Mountains DPS (76 FR 62900–62926).

Within the Plan Area, identified threats at two of the recent (2007, 2009) documented sites include possible erosion from the paved road at the site south of Caliente Creek Road (CDFG 2012b). The CNDDB (CDFG 2012b) indicates that the area of the Tollgate Canyon/Stevenson Creek site is proposed for wind energy development (CDFG 2012b). However, the USFWS 12-Month Finding does not identify wind energy development as a potential threat at this site (76 FR 62900–62926). The sites at Silver Creek, Indian Creek, and the unnamed canyon south of Indian Creek are on private lands. Based on site photographs, the Silver Creek and Indian Creek sites appear to be in fair to good condition because grazing occurs at the sites, but there are no signs of other activities, such as buildings, roads, or mining (76 FR 62900–62926). The site at the unnamed canyon south of Indian Creek appears to be in good condition based on site photographs. This site is on BLM land and there is no evidence of grazing nor is it within a BLM grazing allotment (76 FR 62900–62926). No other threats were identified for these new sites.

Tehachapi slender salamander habitat is also potentially threatened by feral pig (*Sus scrofa*) (Hansen and Wake, pers. comm. 2008), road construction, mining, and cattle grazing, as well as flood control projects (Hansen and Stafford 1994; Jennings 1996). Hansen and Wake (pers. comm. 2008) considered feral pigs to be the main threat to Tehachapi slender salamander in the Tehachapi Mountains.

The USFWS analyzed the potential effects of climate change on the Tehachapi slender salamander in the 12-Month Finding (76 FR 62900–62926). Based on the climate models, temperatures in the Tehachapi Mountains are expected to increase, but the effect of climate change on precipitation is less certain. There is a high level of uncertainty as to how these changes will affect Tehachapi slender salamander (76 FR 62900–62926). While any specific effects on the species remains speculative, the USFWS concluded that some loss of habitat may occur in more exposed canyon areas, but that habitat will remain in the most shaded, lower portions of the canyons and that the species may also be able to shift within canyons in response to climate change (76 FR 62900–62926).

5.1.4.2 Habitat Characteristics

The Tehachapi slender salamander inhabits moist canyons and ravines in oak and mixed woodlands (CaliforniaHerps 2011). Vegetation in occupied habitat includes foothill pine (*Pinus sabiniana*), canyon live oak (Quercus *chrysolepis*), interior live oak (*Quercus wislizeni*), blue oak (*Quercus douglasii*), Fremont cottonwood (*Populus fremontii*), western sycamore (*Platanus racemosa*), and California buckeye (*Aesculus californica*) (Evelyn, pers. comm. 2012; Hansen and Wake 2005). At higher elevation sites, Tehachapi slender salamander has also been found with white fir (*Abies concolor*) (Evelyn, pers. comm. 2012). In more exposed areas of Caliente Creek, habitat includes California juniper (*Juniperus californica*), yucca

(*Yucca* spp.), bush lupine (*Lupinus* spp.), and buckwheat (*Eriogonum* spp.). In the lower elevation Caliente Creek areas, the species is restricted to the lower margins of north-facing slopes and side canyons among granitic or limestone talus and scattered rocks (Hansen and Wake 2005). The species also occurs on north-facing slopes in the Tehachapi Mountains within talus piles and fallen wood (Hansen and Wake, pers. comm. 2008; Hansen and Wake 2005). The understory forb miner's lettuce (*Claytonia perfoliata*) is commonly found at occupied sites (Brame and Murray 1968).

During the moist periods of fall, winter, and spring precipitation, individuals seek cover under surface objects, especially rock talus (Brame and Murray 1968). Other substrates that may be used for cover include rocks, logs, bark, and other debris in moist areas (CaliforniaHerps 2011), but they are primarily associated with talus (Hansen and Wake, pers. comm. 2008; Hansen and Wake 2005).

Specific habitat requirements for breeding or egg laying for this species are not well documented. Similar species lay their eggs underground or on moist substrates underneath or within surface objects, especially pieces of bark (Stebbins 1972).

It is unknown how or whether juvenile Tehachapi slender salamander habitat differs from that of adults. Juveniles are rarely found, which may indicate that hatching occurs in the spring, as surface activity declines, and that juveniles may remain underground (Hansen and Wake 2005).

5.1.4.3 Occurrence within Plan Area

The Plan Area includes the eastern portion of the Tehachapi slender salamander's geographic range. There is one historical (i.e., pre-1990) occurrence of the Tehachapi slender salamander in the Plan Area; a record from 1957 on private land from the Tehachapi Pass area near SR 58 (Dudek 2013). It was initially reported by Brame and Murray (1968) that the site was covered by a road, but as of 2008, the site was not covered by a road and remained in good condition, consisting of foothill pine (*Pinus sabiniana*), interior live oak (*Quercus wislizeni*), and California buckeye (*Aesculus californica*), as well as blue oak (*Quercus douglasii*) in open areas (CDFW 2013).

There are five recent (i.e., since 1990) records for the species in the Plan Area: (1) a 2007 occurrence located in talus on the south side of Caliente Creek Road near the mouth of Big Last Chance Canyon (this site could also be considered historical because it was first reported by Brame and Murray (1968)); (2) a 2009 occurrence located between Tollgate Canyon and Stevenson Creek about 7 miles north–northeast of SR 58; (3) a 2011 occurrence located in Silver Creek; (4) a 2011 occurrence located in Indian Creek; and (5) a 2011

occurrence in an unnamed canyon south of Indian Creek. The 2007 and 2009 occurrences are on BLM lands (CDFW 2013) and the three most recent occurrences are on private land (76 FR 62900–62926; Dudek 2013). The three 2011 occurrences described in the USFWS 12-Month Finding extend the range of the Tehachapi slender salamander approximately 7 miles to the southeast of Caliente Canyon, but these are still considered to be part of the Caliente Canyon DPS (76 FR 62900–62926) (see Figure SP-A02 in Appendix B).

The model generated 47,883 acres of modeled suitable habitat for Tehachapi slender salamander in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2 Birds

5.2.1 Bendire's Thrasher

5.2.1.1 Status and Distribution

Regulatory Status

Bendire's thrasher (*Toxostoma bendirei*) is a California Species of Special Concern. This species is also designated a BLM sensitive species and USFWS Bird of Conservation Concern.

Natural History

Bendire's thrashers mainly consume insects and other arthropods; however, they may also consume seeds and berries (Ambrose 1963). The only quantitative study on the stomach contents of this species found ants, termites, and Lepidoptera larvae to dominate (Ambrose 1963). Anecdotal reports of birds foraging or carrying prey to the nest suggest that grasshoppers, beetles, caterpillars, and other larvae or pupae that it obtains near or on the ground dominate the diet (Woodbury 1939; Engels 1940; Bent 1948).

Typically, Bendire's thrashers forage on the ground but may also search vegetation for insects and pick fruit (Engels 1940; Ambrose 1963). This species uses its bill to peck, probe, and hammer in the ground (Engels 1940). They may occasionally use their bill to dig, but may not be efficient in this use (Ambrose 1963).

In California, territorial behavior begins when the species returns to the breeding grounds beginning in mid-March through mid-June (England and Laudenslayer 1989a, 1989b). In Arizona, this species may return to breeding sites in small unmated flocks as early as the beginning of February (earliest date February 9; see Brown 1901). There is no additional

information on how pair formation begins, where it occurs, or the process of nest construction in this species (England and Laudenslayer 1993).

Nests have been reported with eggs in early March (Arizona; Brown 1901) and late March (California; England and Laudenslayer 1993) suggesting nest building begins shortly after arriving to the breeding grounds. Clutches are typically three to four eggs (Brown 1901). Historical data reviewed by England and Laudenslayer (1993) suggest, although is not definitive, the breeding begins earlier in the southeast and advances across to the northwest of their breeding range. Bendire's thrashers have been known to produce a second clutch in a season (England and Laudenslayer 1989a, 1989b). Only one record exists for the occurrence of a third brood in a season (Gilman 1915).

Bendire's thrashers typically breed in dry scrub and cacti of desert areas. Nests may be low in a tree, shrub, or cactus clumps and usually 2 to 4 feet off the ground; occasionally 12 feet high (Baicich and Harrison 1997). The most common nest host plants include cholla, juniper, mesquite, Joshua trees and other yuccas (England and Laudenslayer 1993; Darling 1970).

There is no information on the specific territoriality behavior of this species. Overall, this species is migratory in the northern portion of their range and a permanent resident in the southern portion. In the northern portion of their range, dispersal may begin directly after breeding (England and Laudenslayer 1993).

Young in post-breeding flocks have been observed to be mixed with curve-billed and Crissal thrashers (*T. crissale*) (Scott 1888). In general, Bendire's thrashers may be observed in pairs or immediately after breeding in small flocks. However, they are usually inconspicuous except when singing (England and Laudenslayer 1993).

General Distribution and Populations Trends

The exact distribution of this species is poorly understood due to its secretive behavior, migratory movements, and lack of research (England and Laudenslayer 1993). In general, this species is found in the southwestern U.S. deserts ranging from southeastern California, southernmost Nevada, southernmost Utah, southern Colorado south through New Mexico, and throughout the Sonora desert. In Mexico, the species distribution is believed to be in Sonora with wintering to Tiburon Island and northern Sinaloa (Blake 1953). The species appears to be mostly confined to the Mojave Desert (Unitt et al. 2004), and northwestern Mexico deserts (England and Laudenslayer 1993).

Bendire's thrasher is known to breed from southeastern California, southern Nevada, southern Utah, south-central Colorado, western and throughout New Mexico (Darling 1970), south to central Sonora, and throughout Arizona (Miller et al. 1957; Phillips et al.

1964; England and Laudenslayer 1989a, 1989b; AOU 1998). Within New Mexico and California, breeding appears irregular leaving many suitable sites unoccupied (England and Laudenslayer 1993).

In winter, Bendire's thrasher leaves the northern areas of its breeding range (England and Laudenslayer 1993). Bendire's thrashers that breed in California are thought to winter in southern Arizona, southwestern New Mexico, and Sonora, Mexico (England and Laudenslayer 1989a, 1989b). One record also exists for the species detection as far south as southern Sinaloa, Mexico (Bent 1948).

Information is lacking on the exact population status and trends of Bendire's thrashers. Unfortunately, population trends cannot be reliably estimated for this species from the North American Breeding Bird Survey (see *Regional Credibility* in Sauer et al. 2008). Records from the Breeding Bird Survey counts (from Arizona, California, Colorado, Nevada, New Mexico, and Utah) are infrequent for this species, and no significant trends could be detected for the period from 1965 to 1979 (Robbins et al. 1986; England and Laudenslayer 1993).

Declines over 37 years (1966–2003) are estimated at 34.5% (BirdLife International 2013). It is suggested that population may have declined in areas of Arizona between 1940 and 1960 (Ambrose 1963). Unfortunately, the historical and most current field investigations (England and Laudenslayer 1989a, 1989b) were inadequate to determine the population status or trends of the species in California.

Remsen (1978) suggested the total California population was under 200 pairs. Due to these concerns, the species was listed on the California Department of Fish and Game Birds Species of Special Concern (Remsen 1978). As such, there is concern for the status of this species due to their disjunct distribution, seemingly isolated populations, and unknown population sizes. However, in New Mexico, one report suggests the range of the species may have expanded into areas with junipers due to overgrazing (Darling 1970).

Reasons for Decline

Although more research needs to be conducted, Remsen (1978) suggests the Bendire's thrasher is threatened by habitat destruction/alteration (specifically with the harvesting of Joshua trees and yucca), overgrazing, and off-road vehicle use in their breeding habitats. This species may also be threatened by loss of breeding habitat to urban and agricultural development as well as military operations (Shuford and Gardali 2008). However, without any existing quantitative information regarding population densities, most of the information on threats comes from anecdotal descriptions of the species (England and Laudenslayer 1989a, 1989b).

Ambrose (1963) suggests that possible competition with curve-billed thrashers for an exhausted food supply was contributing to the population's decline. Curve-billed thrashers are sympatric throughout parts of this species range (Tweit 1996; Engels 1940; Ambrose 1963; Tomoff 1974). However, Engels (1940) suggested that the means of ecological separation of these species cannot be concluded.

5.2.1.2 Habitat Characteristics

Bendire's thrashers typically breed in open grasslands, shrubland, or woodland with scattered trees and shrubs (England and Laudenslayer Jr. 1993). The vegetation within occupied areas may vary depending on the elevation which ranges from 0 to 5,900 feet (England and Laudenslayer Jr. 1993). At high elevations the species may be associated with sagebrush (*Artemisia* sp.) and some junipers (*Juniperus* sp.). At lower elevations it is associated with deserts and grasslands, such as the Mojave desert scrub. Characteristic plant species within areas where it occurs include Joshua trees (*Yucca brevifolia*), Spanish Bayonet (*Y. baccata*), Mojave Yucca (*Y. schidigera*), cholla cactus (*Opuntia* spp.) and/or other succulents, palo verde (*Cercidium* spp.), mesquite (*Prosopis* spp.), catclaw (*Acacia* spp.), desert-thorn (*Lycium* spp.), and agave (*Agave* spp.) (England and Laudenslayer Jr. 1989a, 1989b, 1993).

Bendire's thrashers may occasionally use vegetation around human habitation and agriculture when the habitat structure resembles natural habitat and curve-billed thrashers are absent (Gilman 1915a; Phillips et al. 1964; Rosenberg et al. 1991).

5.2.1.3 Occurrence within Plan Area

Overall, there are approximately 62 historical (i.e., pre-1990) Bendire's thrasher occurrence records in the Plan Area (CDFW 2013; Dudek 2013). These occurrences are located in eastern Kern County, throughout San Bernardino County, and central Riverside County (see Figure SP-B03 in Appendix B) with the majority of occurrences detected in San Bernardino County.

Within the Plan Area, most occurrences have historically occurred within or near the Mojave National Preserve and between Victorville and Joshua Tree National Park (Appendix B Figure SP-B03) with approximately 36 records near or within the Mojave National Preserve in eastern San Bernardino (Appendix B Figure SP-B03). Nineteen additional records are documented between Victorville and south to Joshua Tree National Park. Historically, this species was considered to breed primarily in the Mojave Desert (Grinnell and Miller 1944; Garrett and Dunn 1981), was considered common in summer in areas of northeastern San Bernardino County, and considered a sparse summer resident in the Joshua Tree National Monument-Yucca Valley area (McCaskie 1974; Remsen 1978).

Currently, there are approximately 11 recent (i.e., since 1990) Bendire's thrasher occurrences in the Plan Area in the following locations: Mojave National Preserve, east of Barstow, in and near Lucerne Valley, within or near Yucca Valley, near the junction of I-8 and SR-177, and near Lake Havasu City (CDFW 2013; Dudek 2013; Appendix B Figure SP-B03).

In general, the species current distribution is similar to its historical distribution. Although plenty of undisturbed habitat exists, the reasons for the species rarity in California are not clear (Unitt et al. 2004). It has been estimated that the population may be fewer than 200 pairs throughout California (Remsen 1978). However, the exact distribution and population status of this species is unknown.

The model generated 2,216,932 acres of modeled suitable habitat for Bendire's thrasher in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.2 Burrowing Owl

5.2.2.1 Status and Distribution

Regulatory Status

The burrowing owl (*Athene cunicularia*) is a California Species of Special Concern. In 2003, a petition to list the burrowing owl as threatened or endangered under the California ESA (Center for Biological Diversity et al. 2003) was rejected by the California Fish and Game Commission (Miller 2007). The species' populations across much of the state remain tenuous, however, and another petition could be submitted, that could potentially change the burrowing owl's status during the planning and implementation of the DRECP. The burrowing owl is also designated as a BLM sensitive species and USFWS Bird of Conservation Concern.

Natural History

Burrowing owls are opportunistic predators that will prey on arthropods, small mammals, birds, amphibians, and reptiles (Karalus and Eckert 1987; Gervais et al. 2008; Poulin et al. 2011). Burrowing owls typically forage in habitats characterized by low-growing, sparse vegetation (Poulin et al. 2011) Feeding on insects during the day, especially during the summer, and small mammals at night. Thomsen (1971) found that crickets and meadow voles were found to be the most common food items. Nocturnal foraging can occur up to several kilometers away from the burrow, and burrowing owls concentrate their hunting on grassland areas, crop fields, and structurally similar habitats with an abundance of small mammals (Haug and Oliphant 1990). The majority of the burrowing owl diet can be made

up of rodents or large insects depending on the region in which they are found and the time of year (Rosenburg et al. 2007; Haug and Oliphant 1990).

Burrowing owls reach sexual maturity within 1 year of age (Poulin et al. 2011). Nesting in California generally runs from February through August, with peak activity from March to July (Zeiner et al. 1990; Thomsen 1971; Gervais et al. 2008). Nesting sites always have available perching sites, such as fences, or raised rodent mounds (Johnsgard 1988). Non-nest satellite burrows are typically employed to escape from approaching predators (especially raptors and ravens), to spread out pre-fledged nestlings (in case terrestrial predators invade an owl family's burrows and consume the young in it), and to relocate from parasite-infested nesting and roosting burrows (Dechant et al. 2012). Burrowing owls are primarily monogamous and typically breed once per year (Poulin et al. 2011). Normally, one clutch of 6–12 eggs is produced per year, with 7–9 eggs in a typical clutch (Poulin et al. 2011), although in rare instances two broods may be raised in a season (Gervais and Rosenberg 1999); the largest clutch recorded was 14 eggs, all of which hatched. During incubation and brooding, the female stays in the burrow almost continuously while the male does the provisioning. Young burrowing owls fledge at about 44 days. As they mature they join the adults in foraging flights at dusk (Rosenberg et al. 1998).

California supports year-round resident burrowing owls and over-wintering migrants (Gervais et al. 2008). Many owls remain resident throughout the year in their breeding locales (especially in central and Southern California) while some apparently migrate or disperse in the fall (Haug et al. 1993; Poulin et al. 2011; Coulombe 1971; Barclay 2007). Owls breeding in northern California locales and at higher elevations are believed to move south during the winter (Grinnell and Miller 1944; Haug et al. 1993; Zeiner et al. 1990). Other researchers report that burrowing owls may "wander" during the winter months, occasionally appearing and disappearing from their breeding grounds (McCaskie et al. 1988; Martin 1973). Further discussion on the distinction in the behavior of burrowing owls as migration, seasonal wandering, or permanent residency at a locale is included in the full species profile in Appendix B. Further discussion on the nature of owl migration and dispersal in California is also included in Appendix B.

Burrowing owls exhibit high site-fidelity and sometimes reuse burrows year after year, although dispersal distances may be considerable and variable depending on location and the age of the owls. Distances of approximately 53–150 kilometers (33–93 miles) have been observed in California for adult and natal dispersal, respectively (Gervais et al. 2008) but are usually much shorter. Sizes of burrowing owl territories and home ranges also vary. For example, at the Oakland Airport in California estimated breeding territories ranged from about 0.04 to 1.1 hectares (0.1–2.8 acres) (Thomsen 1971). Male ranges can be quite large, with estimated ranges as large as 3 kilometers^2 (740 acres) (Haug and Oliphant 1987).

In California, burrowing owls most commonly live in burrows created by ground squirrels (Gervais et al. 2008). Therefore, the suitability and quality of burrowing owl habitat in the Plan Area is closely and positively related to the occurrence and population health of ground squirrels. Burrowing owls on the Great Plains depend mainly on prairie dogs (*Cynomys* spp.) for suitable burrows. In Great Basin sagebrush steppe, where ground squirrels do not occur, burrowing owls may depend on badgers for nest burrow excavation, although this species is a major predator of burrowing owls (Green and Anthony 1997). Burrowing owls prefer grazed areas where livestock have reduced vegetation height (Wedgwood 1976). Green and Anthony (1989) found that nests lined with livestock dung were less prone to predation and had increased insect prey presence (Smith 2004), but uncertainty remains in the effect of grazing on burrowing owls and their habitat (Klute et al. 2003). In addition to badgers, native mammalian and avian predators include coyotes (*Canis latrans*), Swainson's hawks (*Buteo swainsoni),* ferruginous hawks (*B. regalis*), merlins (*Falco columbarius*), prairie falcons (*F. mexicanus*), peregrine falcons (*F. peregrinus*), great horned owls (*Bubo virginianus*), red-tailed hawks (*B. jamaicensis*), Cooper's hawks (*Accipiter cooperii*), and crows (*Corvus brachyrhynchos*) (Poulin et al. 2011). Non-native species, especially domestic dogs (*Canis familiaris*) and cats (*Felis domesticus*) are known predators of adult and young burrowing owls. Cannibalism has also been reported.

General Distribution and Populations Trends

Western burrowing owl is found in non-mountainous western North America, from the Great Plains grasslands in southern portions of the western Canadian provinces south through the U.S. into Mexico (Poulin et al. 2011). Other subspecies occur in arid, open habitats in Florida, the Caribbean Basin, and South America (Poulin et al 2011; Clark 1997) (Figure SP-B04 in Appendix B).

In California, the burrowing owl's range extends throughout the lowlands from the northern Central Valley to the U.S.–Mexico border, with about two-thirds of the population occupying the Imperial Valley, near the Salton Sea (Wilkerson and Siegel 2010). The species' distribution and abundance vary considerably throughout its range (DeSante et al. 2007; Wilkerson and Siegel 2010). Breeding burrowing owls are generally absent from the coast north of Sonoma County and from high mountain areas, such as the Sierra Nevada and the Transverse Ranges extending east from Santa Barbara County to San Bernardino County (Gervais et al. 2008).

Recently published survey results based on a random sample of 860 5 kilometer^2 blocks in California in 2006–2007 yielded an estimate for the breeding-season population of burrowing owls of 9,187 pairs (±2,346 pairs) (Wilkerson and Siegel 2010). When comparing these results to 1993 results for the same survey areas using the same methods, the results indicate a

population decline of approximately 10.9%, although the difference is not statistically significant. (The relatively large margin of error weakens the power of the test to show statistical differences.) Many regions in the Plan Area were not systematically surveyed prior to 2006–2007 (except for the Imperial Valley agricultural complex). Within the Plan Area, agricultural development supports the highest densities of burrowing owls known in the world. However, a survey by Bloom Biological for the Imperial Irrigation District from 2007 to 2008 indicated a decline in the size of the Imperial Valley agricultural population (Bloom 2009). Population surveys were conducted by the Imperial Irrigation District in the summer of 2012 (Lovecchio, pers. comm. 2012). This will help to determine if the decline recorded in 2007–2008 is in fact a longer-term trend.

There were no surveys for burrowing owls prior to 2007 in the West Mohave Desert. Once surveyed, the results yielded an estimate of 560 (±268) pairs of burrowing owls. Due to the survey's focus on a portion of the agricultural valleys, and the subsequent extrapolation of agricultural survey results to non-agricultural desert scrub areas of the West Mojave Desert, this number may constitute either a gross over-estimate or a gross under-estimate of the true number of burrowing owls in the region (Wilkerson and Siegel 2010). Just west of the Plan Area, 53 burrowing owls were found in the Coachella Valley during the 2006–2007 surveys. However, other areas in central-western Kern County (and Rosedale west of the Plan Area) were estimated to have lost at least 95 breeding pairs, since 1993, apparently related to expanding urban development on the west side of Bakersfield (Wilkerson and Siegel 2010).

Reasons for Decline

The most immediate threats to the burrowing owl are the conversion of grassland habitat to urban other than livestock grazing and the loss of agricultural hay, grass, and alfalfa lands to development or conversion to unsuitable crops like cotton, vineyards, orchards, corn, and sugarcane (Gervais et al. 2008, Wilkerson and Siegel 2010). Vehicle collisions may also be a significant cause of mortality in the Plan Area (BLM 2005).

Associated with the habitat loss and degradation is the decline of fossorial species across much of the owl's historical range that create suitable nest sites for burrowing owls, such as ground squirrels (Gervais et al. 2008) and badgers, marmots (*Marmota* spp.), skunks (*Mephitis* spp., *Spilogale putorius*), kangaroo rats (*Dipodomys spectabilis*), and desert tortoises (Gervais et al. 2008; Poulin et al. 2011). Eradication programs that have decimated rodent populations have, in turn, decreased the abundance of key prey available for burrowing owls. Because the burrowing owl depends on other animals to dig its burrows, loss of fossorial species limits the extent of burrowing owl habitat across much of the Plan Area (Poulin et al. 2011).

Direct causes of mortality in burrowing owls include: predation by hawks, owls, badgers, coyotes, foxes, domestic dogs and cats, and others (Poulin et al. 2011); vehicular collisions; wind turbines; barbed wire fences; shooting; road maintenance; tilling, pesticide application and other agricultural practices; and disease and parasites (Gervais et al. 2008; Poulin et al. 2011

5.2.2.2 Habitat Characteristics

Throughout their range, western burrowing owls require habitats with three basic attributes: open, well-drained terrain; short, sparse vegetation generally lacking trees; and underground burrows or burrow-like structures (e.g., culverts) (Klute et al. 2003; Gervais et al. 2008). Burrowing owls occupy grasslands, deserts, sagebrush scrub, agricultural areas (including pastures and untilled margins of cropland), earthen levees and berms, a variety of habitats on coastal uplands (especially by over-wintering migrants) (CDFG 2012b), and urban vacant lots, as well as the margins of airports, golf courses, residential developments, and roads (CVAG et al. 2007; Gervais et al. 2008). Burrowing owls occur on relatively flat expanses with level to gentle topography (CDFG 2012b).Several habitat characteristics may explain the species' distribution within the Plan Area: vegetation density, availability of suitable prey, availability of burrows or suitable soil, and disturbance (primarily from humans) (BLM 2005). However, Unitt (2004) notes that sites with suitable characteristics for burrowing owls may not support populations due to "high sensitivity to habitat fragmentation, proliferation of terrestrial predators, and high mortality from collisions with cars". During the breeding season, burrowing owls may need enough permanent cover and taller vegetation within their foraging range to provide them with sufficient prey, which includes large insects and small mammals (Poulin et al 2011; Wellicome 1997). Paired males are known to line the burrow entrance and tunnel with dried mammal dung for several possible reasons including the prevention of nest predation and increasing insect presence near the nest as a source of convenient prey (Smith 2004). This behavior is obviously prominent in habitat that is regularly grazed by cows, horses or bison (Smith 2004). Few desert areas have too much plant cover for burrowing owls; and those areas that do have high cover (e.g., palm oases), are unoccupied (e.g., Barrows 1989). Dense vegetation may not exclude burrowing owls directly, but rather indirectly through increased predation or competition with other species, or lowered hunting success for preferred prey (BLM 2005). When vegetation height is greater than 5 centimeters (2 inches), owls may prefer habitat with elevated perches to increase their horizontal visibility to detect both predators and prey (Green and Anthony 1989).

Human alteration of the landscape can inadvertently or intentionally create suitable habitat, but can also make potential habitat unsuitable by way of "habitat loss, associated prey reduction, and human disturbance" (Lincer and Bloom 2007) and various pesticides

are known to adversely affect burrowing owls, directly or indirectly (James and Fox 1987; Haug and Oliphant 1987). Agriculture and surface irrigation systems (i.e., earthen canals and ditches) can create habitat by providing bankside burrow sites and prey in the adjacent fields (Gervais et al. 2008; Poulin et al. 2011), while urban development and the associated excessive noise or disturbance can result in habitat loss and indirect adverse effects (BLM 2005).

5.2.2.3 Occurrence within Plan Area

Grinnell and Miller (1944) described a range in California that included most of the lowlands, although "mostly rare or wanting in coastal counties north of Marin County" with "Numbers in favorable localities large; originally common, even 'abundant'." They regarded the species as "becoming scarce in settled parts of the State" due to "roadside shooting, anti-'vermin' campaigns, elimination of ground squirrels—hence of nesting places for these owls." The increase in abundance of burrowing owls in some agricultural environments, such as the Imperial Valley, likely began when the native desert ecosystem in this region was converted to large areas of irrigated agriculture (DeSante et al. 2004). The time period for this shift was in the early twentieth-century as van Rossem (1911) considered the species "abundant everywhere in suitable locations" in the Imperial Valley.

The overall range of the burrowing owl in California has not drastically changed from that described by Grinnell and Miller (1944), but the species has disappeared or greatly declined as a breeding bird in many areas that were once occupied (DeSante et al. 2007; Gervais et al. 2008; Wilkerson and Siegel 2010). By one recent estimate (Miller 2007), the burrowing owl has functionally disappeared as a breeding species from 22% of its former range and continues to decline in an additional 23% of its range.

A statewide survey conducted from 1991 to 1993 found that populations had disappeared from the central coast (Marin, San Francisco, Santa Cruz, Napa, and coastal San Luis Obispo counties), Ventura County, and the Coachella Valley in Riverside County, and were nearly extirpated from Sonoma, Santa Barbara, Orange, coastal Monterey, and San Mateo counties, where only small, remnant populations remained (DeSante et al. 2007).

The most current information on the burrowing owl's breeding distribution in California comes from systematic surveys conducted in 2006–2007 across the species' mainland breeding range in the state (Wilkerson and Siegel 2010). Compared with the surveys in the early 1990s, this survey found 10.9% fewer pairs, but the overall change was not statistically significant. About 69% of California's population was found to be concentrated in agricultural areas of the Imperial Valley; secondary centers of abundance were identified in the southern Central Valley (~12% of the state total), middle Central Valley (~6% of the

state total), western Mojave Desert (~6% of the state total), and Palo Verde Valley near Blythe in eastern Riverside County (~2% of the state total); approximately 5% of the state's population was scattered elsewhere. Figure SP-B04 in Appendix B shows the range and occurrence records for burrowing owl in the Plan Area.

The model generated 6,496,668 acres of modeled suitable habitat for burrowing owl in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.3 California Black Rail

5.2.3.1 Status and Distribution

Regulatory Status

The California black rail (*Laterallus jamaicensis coturniculus*) is a California fully protected species and is also state listed as threatened in the California. The species is also a BLM sensitive species and USFWS Bird of Conservation Concern. A recent molecular genetic analysis (Girard et al. 2010) indicates that birds within and south of the Plan Area may qualify as a separate DPS under the federal ESA. No listing petition has ever been filed for this species (USFWS 2011a), but this new information may result in reappraisal of the status of the species in the Lower Colorado River/Salton Trough region.

Natural History

California black rails forage in the same habitats that they use for breeding. They prey on small (<1 centimeter [.39 inch]) invertebrates, chiefly insects, gleaned from marsh vegetation and mudflats; they also eat small seeds (Eddleman et al. 1994). Analysis of seven incidentally taken rails from an Arizona site found that the birds' diet included various beetles, grasshoppers, ants, earwigs, spiders, and other miscellaneous arthropods, as well as snails, bulrush, and cattail seeds. Bulrush and cattail seeds appear to be an important component of their diet during the winter months when insect prey availability is low (Flores and Eddleman 1991, as cited in Eddleman et al. 1994).

The black rail reproductive cycle begins with pair formation. Associated behavior has not been observed but may involve calls by both sexes, which have been recorded from late February into July on sites along the Lower Colorado River (Eddleman et al. 1994). Multiple broods may be raised; nest records from Arizona indicate that the peak of egg-laying for the first brood of the season is May 1 (Eddleman et al. 1994). One study of black rail nesting along the Lower Colorado River determined that located nests had a mean clutch size of 4.8 eggs (Flores and Eddleman 1993). Nests were in clumps of vegetation elevated an average

of 6.4 centimeters (2.52 inches) above the mud substrate. Incubation began at varying dates from March 30 to June 25, lasting from 17 to 20 days. Both sexes incubated the eggs. The birds aggressively defended the nests by scolding, raising their wings, and running toward researchers. Both young and parents abandoned the nest within 24 hours after the last egg in each clutch had hatched. Newborn hatchlings, although fairly precocious, are small and downy; it appears likely a period of parental care is needed, but there are no data on the subject (Eddleman et al. 1994). One female was recaptured 18 days after nest abandonment with an egg in her oviduct, suggesting that multiple brooding may occur (Flores and Eddleman 1993).

Repking and Ohmart (1977) reported California black rail densities of 1.14 to 1.58 calling birds per hectare (0.46 to 0.64 calling birds per acre) in spring, and 0.73 birds per hectare (0.29 birds per acre) in winter, on the lower Colorado River. In Arizona, black rails used home ranges averaging 0.4 ±0.2 hectare (0.98 ±0.49 acre) and rarely overlapped (Flores 1991, as cited in Harvey et al. 1999).

Movement of rails is primarily by running along the ground, often using trails made by voles (*Microtus* spp.). Rails can also swim short distances. Flight, which exposes them to aerial predators, is uncommon (Eddleman et al. 1994).

California black rails are believed to be nonmigratory, but their occurrence at many small locations indicates that dispersal movements occur (Eddleman et al. 1994). However, there is no documentation of the timing or manner of such movements.

Black rail predators have not yet been identified in the Lower Colorado River/Salton Trough region. Elsewhere, documented avian predators include great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), northern harrier, ring-billed gull, great horned owl, and short-eared owl (Eddleman et al. 1994). Known mammalian predators include rats (*Rattus* spp.), red fox (*Vulpes vulpes*), and domestic cats (*Felis domesticus*). Nest predators likely include a variety of other mammals and reptiles as well (Eddleman et al. 1994).

General Distribution and Populations Trends

The California black rail occurs in California, Arizona, Baja California, and the Colorado River delta in Sonora. Figure SP-B05 in Appendix B shows the distribution of California black rail in the Plan Area. The subspecies appears to be composed of three clearly distinct populations. The coastal population is most numerous and inhabits tidal marshes mainly in the northern San Francisco Bay area, with smaller occurrences at sites from Bodega Bay to northwest Baja California. The intermediate-sized Central Valley population occurs at interior wetlands of Butte, Nevada, Placer, San Joaquin, and Yuba counties. The much

smaller Lower Colorado/Salton Trough population primarily occurs at the following locations: (1) from Laguna Dam to Martinez Lake, Arizona; (2) around the Bill Williams River delta; (3) in the Colorado River delta area; and (4) in the Imperial Valley and adjacent Salton Sea (Eddleman et al. 1994; Patten et al. 2003, Hinojosa-Huerta, et al. 2004, Conway and Sulzman 2007, and Girard et al. 2010).

Comprehensive surveys of California black rail distribution and status were performed for the Lower Colorado River/Salton Trough region in 1973–1974 (Repking and Ohmart 1977), 1988-1989 (Evens et al. 1991), and in 2000–2001 (results included in Conway and Sulzman 2007). Repking and Ohmart (1977) found 106 birds in 1973 and 100 in 1974. Evens et al. (1991) found 75 birds in 1989. Conway and Sulzman (2007), in the most comprehensive survey effort of this region to date, report 136 birds in 2000–2001 surveys, including 100 along the Lower Colorado River, mostly in marshes between Laguna Dam north to Ferguson and Martinez Lakes, 21 black rails at three marshes along the All-American Canal. Of the 100 black rails detected along the Lower Colorado River, 38 were in the Plan Area in California (Conway et al. 2002, as cited in Corman and Wise-Gervaise 2005).

The 1991 study (Evens et al. 1991) reported that "subpopulations were small and isolated" and that "[t]he causes of this downward trend—all related to habitat loss or degradation—are pervasive and ongoing" . Conway and Sulzman (2007, p. 996) delivered a similar conclusion: "Our data suggest that degradation and elimination of suitable emergent marshes over the past 25 to 30 years has caused significant reduction in black rail distribution in Southern California and Arizona."

Reasons for Decline

Human impacts on black rails include shooting and trapping, contaminants, collisions, effects of research, and habitat impairment. Shooting and trapping effects in modern times are likely very minor due to the small size of the bird (Eddleman et al. 1994). Contaminant effects, such as from exposure to pesticides, are virtually unknown, but slightly elevated selenium levels were found in Lower Colorado River birds and eggs analyzed in 1988 (Flores and Eddleman 1991, as cited in Eddleman et al. 1994). The habitat requirement for shallow wetlands makes California black rails especially vulnerable to manipulations of water levels in what are now heavily managed to entirely human-created environments. Research effects include potential disturbance of nesting birds during surveys, and more severe effects, such as mortality, nest failure, or exposure to predation, may occur in association with mist netting, radio tracking, or other invasive research techniques.

Specifically, addressing the Lower Colorado River/Salton Trough populations, Conway and Sulzman (2007) identify degradation and loss of suitable emergent marsh habitat as the

principal threat to the species. They also note declines in habitat suitability due to the spread of tamarisk.

5.2.3.2 Habitat Characteristics

Suitable California black rail habitat generally includes salt marshes, freshwater marshes, and wet meadows. Most or all southwestern U.S. populations, especially in the southern part of the state, are nonmigratory, and these habitat types serve for breeding, foraging, and overwintering.

During the most recent comprehensive survey of California black rail occurrence in the southwestern U.S., Conway and Sulzman (2007) found all sites with black rail detections in riparian marsh habitat. At many sites, upland habitat (chiefly Mojave or Sonoran desert lowland vegetation) or open water were present within 50 meters (164 feet) of the detection site. Vegetation was compared between sites with and without black rails. Species positively correlated with black rails were common threesquare (*Schoenoplectus pungens*), arrowweed (*Pluchea sericea*), Fremont cottonwood (*Populus fremontii*), and seepwillow (*Baccharis salicifolia*). These plants, in turn, are strongly associated with shallow water or moist soil near the upland/wetland interface. Similar results were reported from prior surveys in the region, with Evens et al. (1991) reporting the species most frequent at occupied sites as common threesquare, cattails (*Typha angustifolia* and *T. domingensis*), California bulrush (*Scirpus californicus*), and native tree/shrub communities. Tamarisk presence was also positively associated with black rails but the species was infrequent where tamarisk cover was 67% or greater (Conway and Sulzman 2007). Conway and Sulzman (2007) concurred with previous authors in further concluding that black rail was positively associated with sites that have very shallow standing water (less than 3 centimeters (1.18 inches) deep) and very low daily water level fluctuations.

5.2.3.3 Occurrence within Plan Area

The California black rail occurs in California, Arizona, Baja California Norte, and the Colorado River delta in Sonora.

Grinnell and Miller (1944, pp. 130–131) were not aware of any occurrence of black rails in the Lower Colorado River/Salton Trough area, and the first report from the region was for an occurrence at Calipatria in the Imperial Valley (Laughlin 1947). It is thus possible that the rail was rare or absent from the Plan Area prior to construction of Colorado River dams, water diversions, and formation of the Salton Sea in 1905 (Patten et al. 2003). Extensive breeding season surveys were conducted in the area by Evens et al. (1991), at 906 stations in the Lower Colorado River and Salton Trough. They had 116 detections, with 65% of

detections on the Lower Colorado River, 15% in seeps along the All American Canal, 12% at the Salton Sea, 7% at seeps along the Coachella Canal, and 1% at Finney Lake in the Imperial Valley. Overall, there are approximately 11 historical (i.e., pre-1990) California black rail occurrence records in the Plan Area (CDFW 2013; Dudek 2013). These occurrences are located in Imperial County, east of the Salton Sea (Figure SP-B05).

Extensive surveys in the southwestern U.S. in 2000 and 2001 largely confirmed the distribution found earlier, but found far fewer birds despite a greater survey effort, with populations at all sites stable or declining; most individuals were also in Arizona (Conway and Sulzman 2007). Currently, there are approximately 39 recent (i.e., since 1990) California black rail occurrences in the Plan Area. Recent occurrences of black rail in the Plan Area are primarily along the Lower Colorado River from the Laguna Diversion Dam upstream to about the head of Ferguson Lake (CDFW 2013; Figure SP-B05 in Appendix B), although two more isolated occurrences extend the species' range along the river upstream to near Parker.

Other occurrences in the southeastern portion of the Plan Area include an isolated riparian marsh on the north side of the Salton Sea at the Dos Palmas Preserve Area of Critical Environmental Concern on BLM lands, which is supported by seepage from the Coachella Canal; a marsh on the New River near Seeley; marshes at the mouth of the river where it enters the Salton Sea; and marshes supported by seepage from the All American Canal southeast of El Centro (Conway and Sulzman 2007).

In the northern portion of the Plan Area the species has been recorded at Little Lake (Inyo County 1964). In the southwestern portion of the Plan Area, the species was discovered as a suspected breeder at a Carrizo Marsh in Anza Borrego Desert State Park (San Diego County) in 1974 and 1976, but the marhs habitat was destroyed in September 1976 by tropical storm Kathleen and replaced by tamarisk (*Tamarix* spp.); there are no subsequent records for black rail in this area since 1976 (Unitt et al. 2004). Single detections at Big Morongo Preserve in May 1983 and November 1984 suggest an attempt to establish there; the potential is substantial for small, undetected populations at other locations in the Plan Area (Campbell, pers. comm. 2012) (see Figure SP-B05 in Appendix B).

The model generated 669,447 acres of modeled suitable habitat for California black rail in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.4 California Condor

5.2.4.1 Status and Distribution

Regulatory Status

The California condor (*Gymnogyps californianus*) is state and federally listed as endangered and is also a California fully protected species. Critical habitat was originally designated for the California condor on September 24, 1976 (41 FR 41914–41916), and revised the following year on September 22, 1977 (42 FR 47840–47845). The latest version of the recovery plan for the California condor was completed in 1996 (USFWS 1996). A Spotlight Species Action Plan 2010–2014 has been completed by the USFWS (2009f). The 5-year review was completed in June 2013 (USFWS 2013a).

Natural History

California condors are obligate scavengers, feeding only on the carcasses of dead animals, primarily medium- to large-sized mammals, but also occasionally on reptiles and birds (Koford 1953; Wilbur 1978). Condor food items within interior California in prehistoric times probably included mule deer (*Odocoileus hemionus*), tule elk (*Cervus elaphus nannodes*), pronghorn antelope (*Antilocapra americana*), and smaller mammals. Along the Pacific shore, the diet also included whales, sea lions, and other marine species (Koford 1953; USFWS 1996). Koford (1953) estimated that 95% of the California condor diet consisted of cattle, domestic sheep, ground squirrels (*Spermophilus beecheyi*), mule deer, and horses. Recently, condors have been found to feed primarily on domestic animals (e.g., cattle), hunter-killed mule deer (*Odocoileus hemionus*) and wild pigs, shot or poisoned coyotes (*Canis latrans*), and ground squirrels (*Spermophilus* spp.).

Condors locate carcasses by eyesight, not olfaction, and may rely on watching other scavengers, especially turkey vultures (*Cathartes aura*), golden eagles, and common ravens, to locate much of their food.

Most California condor foraging occurs in open terrain of foothill grassland and oak savanna habitats, and occasionally open scrub habitat. In the central coastal portion of the state, coastal plains and beaches are also suitable foraging habitat.

As large scavengers, California condors are evolutionarily adapted for feeding on the carcasses of deer, elk, whales, mastodons, and other large animals more prevalent in the Pleistocene (Emslie 1988). As such, the availability of large dead prey was often unpredictable, leading condors to develop a wide-ranging search behavior. Foraging flights occurred, and continue to occur, over vast areas encompassing hundreds of linear miles of

travel each day (Meretsky and Snyder 1992). Condors tend to forage within 50 to 70 kilometers (km) (31 to 44 miles) of nests, but may travel up to 180 km (112 miles) in search of food. Core foraging areas for nesting birds range from about 2,500 to 2,800 km^2 (965 to 1,081 $miles^2$) (Meretsky and Snyder 1992). Non-breeding birds may have foraging ranges of 5,000 km^2 (1,930 $miles^2$) (USFWS 1996). Like most scavenging birds, California condors are opportunistic. As such, individual birds may be expected to take advantage of local abundance of food almost anywhere within their normal range. Foraging behavior shifts may result from seasonal changes in climatic conditions (e.g., fog, thermal activity, wind intensities, rain) and from changes in food availability (Wilbur 1978).

Condors reach sexual maturity at the age of 5 to 8 years, and a captive male has successfully bred at age 5 (USFWS 1996). Pairs form in late fall and early winter, and remain together year-round and for multiple years. Nest prospecting generally occurs in January or February, several weeks before egg laying (Snyder and Schmitt 2002).

Clutch size is one egg, and a second clutch may be laid if the first fails early in the nesting season. First eggs are laid between the last week of January and the first week of April. The incubation period lasts an average of 57 days, ranging from 53 to 60 days. Both sexes incubate, with shifts lasting several days in length. Chicks hatch from the last week of March through the first week of June. Chick brooding is nearly constant for the first 2 weeks after hatching, after which it declines and ceases during the day at about 1 month of age. Chicks are known to leave the nest cavity and scramble around on foot before taking their first flight. Fledging flights take place when chicks are 5.2 to 6 months old (early September to mid-November). Young are fully dependent on adults for about 6 months after fledging, and partial dependency continues for another 6 months (Snyder and Schmitt 2002). It was formerly thought that pairs nested only every other year because of the long period of parental care, but this pattern seems to relate to timing of successful fledging the previous year; if a nestling fledges early in the year (e.g., late summer–early fall), the pair may attempt nesting the following year (USFWS 1996).

California condors are not migratory, though they are known to travel long distances during foraging flights as described above. One California condor traveled 141 miles (225 kilometers) in a single day, from the northeast corner of Tulare County south through the Sierra Nevada and Tehachapi Mountains to a roost just north of the Santa Barbara nesting area (Snyder and Snyder 2000). Telemetry data and

Global Positioning System (GPS) devices on some birds have documented other long-distance flights, including flights from southern Utah to Flaming Gorge, Wyoming (over 400 miles (643 kilometers) and from Sierra de San Pedro Martir in Baja California to Imperial County, California (approximately 155 miles (250 kilometers) (USFWS, unpubl. GPS

telemetry data).Studies conducted during the 1980s, as summarized by Meretsky and Snyder (1992), showed that the last California condors remaining in the wild prior to 1987 comprised a single population of birds occupying an area of approximately 2 million hectacres (4,942,000 acres). Insofar as could be determined, every California condor in the wild used the entire area and was capable of soaring between any two points within the area in a single day.

California condors use topography and associated thermal weather patterns for flight. Condors usually take advantage of uplift created by thermal cells or topographic relief features for soaring flight. Consequently, most foraging flights tend to occur in mountainous areas where winds deflected by hills provide uplift (Snyder and Schmitt 2002).

Extended flight is achieved by soaring, either gliding in uplifts along topographic features or circling for altitude in thermals, then losing altitude in long glides. Typical flight speed averages about 31 miles per hour (mph), but can reach 43 mph in long extended flights, depending on wind conditions. Condors' high wing-loading (weight-to-wing area ratio; 7.7 kilograms/meters^2).

A recent analysis of GPS data for the period of 2004 through 2009 shows that condor ranges in the Southern California population are becoming increasingly multimodal, with 2009 use concentrated in the Hopper Mountain and Bitter Creek NWRs, Wind Wolves Preserve, and Tejon Ranch, the latter of which exhibits recolonization for foraging purposes (Johnson et al. 2010). These recent GPS movement data indicate that condors are re-establishing foraging ranges that are consistent with their ranges prior to extirpation/removal from the wild in 1987 (Johnson et al. 2010).

Because condors reside at the top of the food web (tertiary consumers), adults are mostly free from predation. However, nests and eggs are subject to predation by other birds of prey. Nests that are not adequately isolated may also be subject to predation by bears, coyotes, foxes, and other mammalian predators.

General Distribution and Populations Trends

Knowledge of the prehistoric and historical range of the California condor comes from fossil records, Native American feather regalia, and written records. Archaeological evidence suggests that during the Pleistocene era condors existed on both coasts of North America, but primarily occupied the west coast (Snyder and Snyder 2000; D'Elia and Haig 2013). Fossil evidence from New Mexico, Arizona, Utah, a single site in New York, sections of northern Mexico, and southern Canada support this hypothesis (Hansel-Kuehn 2003). By 1800, California condors were restricted to their west coast range, which stretched from

British Columbia, Canada, to Baja California, Mexico, with small inland populations in regions such as the Grand Canyon (Snyder and Snyder 2000, D'Elia and Haig 2013). Condors were in the Pacific Northwest until the beginning of the 20th century and found in the southern segment (Baja California) until the 1930s (Koford 1953; Wilbur 1973). By the middle of the 20th century, condors were confined to a small region in Southern California. From the late 1970s to 1987 when the last few condors were trapped for captive breeding purposes, condors foraged primarily in the foothills bordering the southern San Joaquin Valley and valleys in San Luis Obispo, Santa Barbara, Kern, and Tulare counties.

Currently, the condor is found in three disjunct populations: a reintroduced population in both southern and central–coastal California, a reintroduced population in the Grand Canyon area of Arizona, and a reintroduced population in Baja, California, Mexico.

Studies from the 1930s to 1950 gave a population estimate of 60 to 100 condors (Koford 1953), though other evidence and further analysis suggests a more likely population size in 1950 of 150 individuals (Snyder and Johnson 1985). Using Koford's estimate of population size (1953), Miller et al. (1965) estimated only 42 birds were left in the wild in the early 1960s. In 1978, the wild population was estimated at 30 individuals (Wilbur 1978). Comprehensive counts of California condors began in 1982, with the advent of photo-censusing efforts allowing reliable identification of individuals (Snyder and Johnson 1985). This effort confirmed that the wild population declined from an estimate of 21 individuals in 1982, to 19 individuals in 1983, 15 individuals in 1984, and 9 individuals in 1985. The decline in the wild during this period resulted partly from the removal of birds for captive breeding purposes. By the end of 1986, all but two wild California condors had been taken into captivity. On April 19, 1987, the last wild California condor was captured and taken to the San Diego Wild Animal Park. At that time, there were 27 individuals in the global population.

Beginning in 1992, captive condors began to be released back into the wild, with increasing numbers being released in succeeding years. As of August 31, 2013, there were 424 California condors in the world population, including 201 in captivity and 223 in the wild (USFWS 2013b). The wild population includes 123 in central and Southern California, of which approximately 56 (not including 6 young still in the nest) currently inhabit Southern California and have the potential to visit portions of the Plan Area. The remaining wild population includes 30 birds in Baja California and 70 in Arizona. Due to a combination of captive breeding and release, and wild nest reproduction, this population is steadily increasing and is expected to continue to increase, barring stochastic catastrophes.

Reasons for Decline

Because California condors are characterized by high survival rates and low reproductive rates, low rates of adult mortality are important for population stability (Meretsky et al. 2000; Snyder and Schmitt 2002; Walters et al. 2008). Condors have a clutch size of one egg, a normal nest success rate of 40%–50%, and an age of first breeding from about 5 to 8 years (USFWS 1996). They may nest in successive years if nestlings successfully fledge early in the year, but they usually skip years (USFWS 1996).

The decline of the condor population during the early 1900s has not been definitively linked to any particular cause; however, it was likely the result of high mortality rates due to direct persecution, collection of specimens, and secondary poisoning from varmint control efforts and 1,1,1-trichloro-2,2-bis (pchloro-phenylethane (DDT) (Snyder and Snyder 2005; D'Elia and Haig 2013). Lead poisoning may have been a contributing factor, but was not recognized as such until after 1980, at which time it became identified as a major cause of mortality that resulted in the recent decline (Janssen et al. 1986; Bloom et al. 1989; Pattee et al. 1990; Cade 2007; Grantham 2007b), particularly since the development of lead ammunition that fragments upon impact in living tissue. In both California and Arizona, many reintroduced birds have been exposed to high levels of lead (Fry 2003, 2004; Cade 2007; Grantham 2007b; Hall et al. 2007; Hunt et al. 2007; Sullivan et al. 2007; Woods et al. 2007). Other recent documented sources of mortality include predation, powerline collision, micro-trash, fire, and shooting (USFWS 2013a).

The latest version of the Condor Recovery Plan (USFWS 1996) suggests that habitat loss is not an important factor in the recovery of the condor. Similarly, Snyder (2007) did not identify habitat loss as a limiting factor for wild California condors. Although historical condor habitat, especially foraging areas, has been modified, condors are opportunistic scavengers and have switched from natural carrion to feeding on domestic livestock carrion with the conversion of native grasslands to pasture (Wilbur 1972; Studer 1983). In addition, current condor populations may be too low to be affected by low habitat availability (Snyder and Schmitt 2002). However, as the wild condor population increases and expands its current foraging range, and potentially nesting site distribution, secure foraging habitat availability and safe food sources could become limiting factors for recovery of the species. Providing foraging habitat for the condor is one of the recovery objectives for the species (USFWS 1996).

5.2.4.2 Habitat Characteristics

California condors were historically found in habitat with requisite populations of ungulates and other large vertebrates (Koford 1953; Snyder and Snyder 2000; Grantham 2007a). California condors are primarily a cavity nesting species and typically nest in cavities located

on steep rock formations or in the burned-out hollows of old-growth conifers (coast redwood (*Sequoia sempervirens*) and giant sequoia trees (*Sequoiadendron giganteum*)) (Koford 1953; Snyder et al. 1986). Less typical nest sites include cliff ledges, cupped broken tops of oldgrowth conifers, and in several instances, nests of other species (Snyder et al. 1986; USFWS 1996). Key characteristics of a suitable nest site are that it is in a location at least partially sheltered from the weather and in a location easily approachable from the air, such as on a cliff, steep slope, or tall tree (Snyder et al. 1986).

5.2.4.3 Occurrence within Plan Area

Currently, the condor is found in two disjunct populations within the United States: a reintroduced population in both Southern and central-coastal California and a reintroduced population in the Grand Canyon area of Arizona. In California, condors were reduced by the middle of the 20th Century to only occur in a wishbone-shaped area encompassing 10 counties north of Los Angeles, California, including San Benito, Monterey, San Luis Obispo, Santa Barbara, Kern, Ventura, Tulare, Fresno, Kings, and Los Angeles counties (Wilbur 1978). Historical sightings in the Plan Area were primarily in the northwestern portion of the Plan Area in the area around Tehachapi. Some historical sightings were east of the Piute Mountains, south and east of Bright Star and along the western edge of Red Rock Canyon. Farther south, there is a historical occurrence along the southwestern boundary of the Plan Area northeast of Acton and one southwest of Lancaster (Figure SP-B06).

By 1987, the last individuals were trapped out of the wild for captive breeding. Since 1992, releases of captive-bred individuals have occurred in parts of California; Arizona; and Baja California, Mexico (San Pedro Martir Mountains). The California condor occurs principally along the western edges of the Plan Area, specifically within the Tehachapi Mountains east of I-5, and portions of the Los Padres National Forest west of I-5 (USFWS 2010b). GPS tracking data from the USFWS for 2003–2013 show 264 records for the Plan Area. Most records are in and around Tehachapi. There are also records north of Highway 14 and west of Red Rock Canyon. Along the southwestern boundary of the Plan Area, there are records from the Northern Transverse Ranges, west and south of Quartz Hill, and east of Solidad Canyon. It should be noted that as a rapidly expanding cumulative database, additional GPS records for the western edge of the Plan Area are expected. At this time, nesting has not been documented in the Plan Area; condor use of the Plan Area is currently limited to foraging and temporary roosting.

5.2.5 Gila Woodpecker

5.2.5.1 Status and Distribution

Regulatory Status

The Gila woodpecker (*Melanerpes uropygialis*) is state listed as endangered in California. This species is also designated as a BLM sensitive species and a USFWS Bird of Conservation Concern.

Natural History

Gila woodpeckers are omnivorous. They forage primarily on large trees, columnar cacti, and mistletoe (*Phoradendron californicum*), gleaning insects and eating flowers or fruit; though they will occasionally ground-feed when food is easily visible (Edwards and Schnell 2000). Seasonal patterns include feeding on saguaro and other cacti during the summer, when flowers and fruit are present, and mistletoe during the winter, when mistletoe berries are present (Edwards and Schnell 2000). Where saguaro are less common, such as the Lower Colorado River Valley, Gila woodpeckers feed primarily on insects (beetles, moths, butterflies, ants, and cicadas) (Anderson et al. 1982). In southeast California, the species has been observed as a nest predator, eating eggs of Lucy's warbler, yellow warbler, and Bell's vireo (Edwards and Schnell 2000).

The breeding season throughout the Gila woodpecker's range generally begins in April and lasts through August (Anderson et al. 1982; Edwards and Schnell 2000). Fledgling occurs when nestlings are approximately 4 weeks of age (Kaufman 1996) and Gila woodpeckers will occasionally lay multiple clutches per breeding season (Phillips et al. 1964; Inouye et al. 1981). Along the Lower Colorado River, fledglings appear during April (Anderson et al. 1982) and family groups with first brood offspring may remain together as adults attending to second nests (Rosenberg et al. 1991), with second broods fledgling at the end of June (Edwards and Schnell 2000). Clutch size is commonly three to five eggs (Terres 1991). For 84 egg sets stored at the Western Foundation for Vertebrate Zoology, clutch sized ranged from two to seven eggs (mean 3.74 ± 0.87 SD) (Edwards and Schnell 2000). Both the male and female assist in incubation (Hensley 1959) and actively deliver food to young (Edwards and Schnell 2000).

Gila woodpeckers are largely permanent local residents (Edwards and Schnell 2000). Some move short distances seasonally and, when not nesting, will move locally to concentrated food sources (Kaufman 1996).

Gila woodpecker territory size is habitat-dependent. A wash at Organ Pipe National Monument contained three territories averaging 4.6 hectares (approximately 11.3 acres) (Hensley 1954). Two territories in an "open desert area" averaged 9.9 hectares (approximately 24.4 acres) in extent (Edwards and Schnell 2000), while in a mature cottonwood stand in Grant County, New Mexico, Brenowitz (1978) observed six breeding pairs spaced 120 meters (approximately 394 feet) apart (SE ± 7 feet). Pairs defended an area up to 40 to 50 meters (approximately 131 to 164 feet) from their nest from gilded flickers (*Colaptes chrysoides*), European starlings, and other Gila woodpeckers during the pre-nesting period of breeding season.

Gila woodpeckers act aggressively toward numerous species, as noted in Spatial Behavior, but also provide cavities for many secondary cavity-nesters, such as the non-native European starling, which they may compete with for nest cavities (Brenowitz 1978; Kerpez and Smith 1990). According to Brush et al (1983), in southwestern Arizona, three pairs of European starlings usurped cavities that Gila woodpeckers had used the year before (Brush et al. 1983); however, the woodpeckers excavated new cavities and bred successfully. Brenowitz (1978) observed that Gila woodpeckers were territorial toward species that overlapped with them in nest-cavity use (European starlings, gilded flickers, conspecifics) but not toward species that used different nest sites. Aggression has also been documented toward brown-crested flycatcher (*Myiarchus tyrannulus*) (Brush et. al. 1983), bronzed cowbird (*Molothrus aeneus*), Bendire's thrasher, and curve-billed thrasher (*Toxostoma curvirostre*) by Gilman (1915), as well as toward cactus wren, house finch, and white-winged dove by Martindale and Lamm (1984). Steenbergh and Lowe (1977) noted that Gila woodpeckers, along with several other bird species, are potentially important disseminators of saguaro cactus seeds.

General Distribution and Populations Trends

The Gila woodpecker's distribution ranges from near sea level in the Colorado River Valley up to 4,000 feet elevation in desert canyons and foothills (Bent 1939). The Gila woodpecker is predominantly a permanent resident across its range in areas of southeast California, southern Nevada (Alcorn 1988), central Arizona north to Mogollon Rim (Edwards and Schnell 2000), and extreme southwestern New Mexico (Hubbard 1978). It also ranges south in Mexico through Baja California, excluding northwestern Baja California Norte (Wilbur 1987) and western Mexico from the U.S.–Mexico border south to Central Mexico (Howell and Webb 1995; AOU 1998).

Recently, Gila woodpecker populations have declined significantly in southeast California (Rosenberg et al. 1991; Kaufman 1996), possibly due to the clearing of woodlands in the Colorado River Valley and Imperial Valley and nest-site competition with European

starlings (Garrett and Dunn 1981). Rosenberg et al. (1991) indicated that although the species was formerly more common and widespread in the Lower Colorado River Valley, it had become restricted to relatively few areas where some tall trees were retained in native habitats. For a more detailed discuss of the species' population in the Plan Area, refer to the species profile in Appendix B.

Reasons for Decline

Threats and environmental stressors to Gila woodpeckers in the Plan Area include habitat loss and potentially nest site competition, particularly with European starlings. In the southwestern United States, human development and the spread of invasive species have fragmented and degraded riparian woodland and desert habitat, adversely affecting Gila woodpecker populations.

Water diversions, vegetation clearing for agriculture or development, grazing, recreation, wood cutting, and other human-induced disturbances have altered and fragmented riparian communities in the southwestern United States (Szaro 1989). For a more detailed discussion on the impacts of these threats on the Gila woodpecker, refer to the full species profile in Appendix B.

5.2.5.2 Habitat Characteristics

For breeding habitat, Gila woodpeckers require cacti or trees with large trunks that are used for nesting sites. Suitable habitats include riparian woodlands, uplands with concentrations of large columnar cacti, old-growth xeric-riparian wash woodlands, and urban or suburban residential areas (Rosenberg et al. 1987; Edwards and Schnell 2000). Dominant canopy species in suitable habitat in the Plan Area include Fremont cottonwood and Goodding's willow (*Salix gooddingii*) in riparian woodlands; blue palo verde (*Parkinsonia florida*) and ironwood in xeric-riparian woodlands; giant saguaro (*Carnegia gigantea*) in saguaro scrub communities; and various palms, eucalyptus (*Eucalyptus* spp.), and Athel tamarisk (*Tamarix aphylla*) in human-altered environments (Edwards and Schnell 2000). Rosenberg et al. (1991, 1987) found that Gila woodpeckers preferred large patches of woody riparian vegetation for nesting (greater than 49 acres), but others have documented the species in various habitat types, such as desert washes (McCreedy 2008) and residential areas (Mills et al. 1989).

5.2.5.3 Occurrence within Plan Area

The Gila woodpecker is an uncommon to fairly common resident in Southern California along the Colorado River, and locally near Brawley in Imperial County (Garrett and Dunn 1981). Historically in southeastern California, van Rossem (1933) and Grinnell and Miller

(1944) thought this species was spreading north in the Imperial Valley from the Colorado River Delta. More recently, it has declined in the Plan Area (Garrett and Dunn 1981; Rosenberg et al. 1991; Kaufman 1996). The Plan Area includes 38 historical (i.e., pre-1990) CNDDB records, all of which are along the Lower Colorado River between the area where it intersects the California state line and the Mexican border (CDFW 2013) (see Figure SP-B08 in Appendix B).

The CNDDB contains 20 recent (i.e., since 1990) occurrence locations for the Gila woodpecker in the Plan Area (CDFW 2013). All but three occur on public land (e.g., BLM, USFWS, Bureau of Reclamation, or Imperial County); one is on private land; and two occur on land of undocumented ownership (CDFW 2013). All the recent documented occurrences in the CNDDB are along or in close proximity to the Colorado River and within the Imperial Valley. There are also 31 recent occurrences in that mostly occur on private lands south of the Salton Sea, and one on public lands in the Lower Colorado River area (Dudek 2013; see Figure SP-B08 in Appendix B).

The model generated 1,485,338 acres of habitat for Gila woodpecker in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.6 Golden Eagle

5.2.6.1 Status and Distribution

Regulatory Status

The golden eagle (*Aquila chrysaetos)* is federally protected under the Bald Eagle and Golden Eagle Protection Act and Migratory Bird Treaty Act. The golden eagle is also fully protected in California, a USFWS Bird of Conservation Concern and a CDFG Watch List species.

Natural History

Golden eagles in the Plan Area are mostly resident (Polite and Pratt 1990). Dixon (1937) estimated an average home range size of about 93 kilometers^2 (36 miles^2) in Southern California, but home range can vary substantially with habitat conditions and prey availability. In the western U.S., on average, eagles forage over home ranges ranging from about 22 to 33 kilometers^2 (8.5 to 12.7 miles^2) during the breeding season (Kochert et al. 2002). Resident pairs maintain home ranges year-round with shifts in intensity of use from the breeding season to winter (Dunstan et al. 1978; Marzluff et al. 1997). Both residents and migratory individuals show fidelity to wintering areas (Kochert et al. 2002). Though limited dispersal data exist, three radio tagged resident breeders in California all moved to

new territories within 8 kilometers after leaving their original ones (Kochert et al. 2002). Some migrants may temporarily move into areas used by resident birds during the winter.

Golden eagles attain adult plumage in their fifth summer (Kochert et al. 2002). In healthy populations, many adults are prevented from obtaining a breeding territory until a vacancy arises through the death of an established pair member (Haller 1996). These unmated adults ("floaters") form a reserve of potential breeders that buffer the breeding population against loss (Hunt 1998). High mortality, particularly among the older age categories, may reduce or eliminate the floater buffer and cause the overall population to decline. Mated pairs may use the same nest each year, or use alternate nests in successive yearswithin their territories (Terres 1991). Pairs rarely re-nest when the first clutch is destroyed (Watson 1997) and there are no records of pairs producing more than one brood per year. Golden eagles prefer to locate their nests on cliffs or in trees near forest edges or in small stands near open fields (Bruce et al. 1982; Hunt et al. 1998). Breeding densities are directly related to territorial spacing and foraging requirements for the species. The breeding cycleextends from late January through August, with peak activity in February through June. Eggs are laid from early February to mid-May (February and March in most of California). Clutch size varies from one to four eggs, but two is the most common size (Brown 1976; Johnsgard 1990). Incubation lasts 43–45 days (Kochert et al. 2002), and the fledging period is 72–84 days (Johnsgard 1990). The young usually remain dependent on their parents for as long as eleven weeks after fledging. Golden eagles typically forage in open habitats including grasslands and shrublands. They feed mainly on leporids (hares and rabbits) and sciurids (ground squirrels, prairie dogs, marmots), but they also take birds, fish, and reptiles, and frequently feed on carrion (Kochert et al. 2002). Hunting strategies are variable and include attack glides from soaring flight, low-level glides over open hilly terrain ("contour hunting"), and attacks from a perch (Kochert et al. 2002; Polite and Pratt 1990). Golden eagles often pirate food from other raptors. Hunting in mated pairs is also documented (Kochert et al. 2002).

Golden eagles are a top avian predator in the scrubland, grassland, and woodland ecosystems that make up much of the Plan Area. They may directly compete with ferruginous hawks (*Buteo regalis*) and other hawks for mammal prey, and with California condors (*Gymnogyps californianus*), turkey vultures (*Cathartes aura*) and ravens (*Corvus corax*) for carrion. Territorial interactions with other golden eagles may result in some fatalities.

General Distribution and Populations Trends

The golden eagle is predominately a western North American species, ranging from northern Alaska though the western states and Great Plains to Mexico, with some breeding and wintering locations in eastern North America. Within California, the golden eagle is a

year-round resident generally inhabiting mountainous and hilly terrain throughout the open areas of the state. Descriptions of the species' physical characteristics, behavior, and distribution are provided in a variety of field guides (e.g., Peterson 1990; Sibley 2000; National Geographic 2002).

The golden eagle is relatively common in some areas of its range. Local threats or declines do not currently pose a major conservation problem from a global perspective (NatureServe 2011). This species was once a common resident throughout the open areas of California. Numbers are now reduced near human population centers; nesting populations in San Diego County, decreased from an estimated 85 pairs in 1900 to 40 occupied territories in 1999 due to extensive residential development (Kochert et al. 2002).

Reasons for Decline

Golden eagle declines, where they have occurred, are attributed primarily to habitat degradation and human-induced disturbances and mortality (Kochert et al. 2002). Golden eagles are particularly sensitive to human activity near nests, especially during incubation and before the young can thermoregulate (at approximately 3 weeks or age). Golden eagles may be secondarily poisoned by consuming prey that has itself been poisoned by chemicals used to protect crops or kill rodents (Kochert et al. 2002). Additional mortality agents are poaching, electrocution from distribution and utility lines, wire strikes, wind turbine strikes, and lead poisoning (Remsen 1978; Thelander 1974). In a study of the causes of fatalities in 61 golden eagles radio-tagged and recovered in the Diablo Range from January 1994 to December 1997, 37% were killed by wind turbine strikes, 16% by electrocution, and 5% by lead poisoning (Hunt et al. 1998); additional poisoning deaths were suspected in undiagnosed fatalities not involving trauma. The pervasiveness of lead in the environment in the remains of gun-killed animals may impact golden eagle populations. Evidence of elevated blood-lead levels (greater than 0.20 parts per million), likely from ingested hunter ammunition, was detected in 36% of 162 eagles from Southern California from 1985 to 1986 (Harlow and Bloom 1989; Pattee et al. 1990). More than 270 eagles were electrocuted in North America during 1986-1996 (Harness and Wilson 2001); ieagles are most susceptible to electrocution when landing on power poles where parallel wires are close together (Kochert et al. 2002). Vehicle collisions have also been documented as a cause of mortality (Phillips 1986). Studies have documented heat stress as a significant mortality factor for nestlings (Mosher and White 1976), and an inverse correlation exists between nesting success and the number of days with temperatures greater than 32°C (89.6°F) (Steenhof et al. 1997).

5.2.6.2 Habitat Characteristics

Golden eagles use nearly all terrestrial habitats of the western states, occurring primarily in mountainous canyon land, rimrock terrain of open desert and grassland areas (Kochert et al. 2002). In central California, they prefer open grasslands and oak savanna, with lesser numbers in oak woodland and open shrublands (Hunt et al. 1998) but can also be found in desert grasslands and chaparral habitats (Millsap 1981). Cliffs and large trees are used for nesting. Eagles favor cliff ledges with overhangs in areas where extreme solar radiation or high rates of precipitation threaten chick survival (Hunt, pers. comm. 2012). Preferred territory sites include those that have a favorable nest site, a dependable food supply, and broad expanses of open country for foraging (see Foraging Requirements). Hilly or mountainous country where takeoff and soaring are supported by updrafts is generally preferred to flat habitats (Johnsgard 1990). Deeply cut canyons rising to open mountain slopes and crags are ideal habitat (Kochert et al. 2002). Extensive croplands are generally avoided (Hunt, pers. comm. 2012). Golden eagles nest from 200 feet to over 9,000 feet above mean sea level (AMSL).

5.2.6.3 Occurrence within Plan Area

The golden eagle is an uncommon permanent resident and migrant throughout the Plan Area, ranging from sea level up to 3,500 meters (11,480 feet) (Grinnell and Miller 1944). There are 327 historical (i.e., prior to 1990) occurrences for golden eagle in the Plan Area and an additional 12 occurrences with an unknown observation date (CDFW 2013; Dudek 2013). There are golden eagle historical occurrences throughout the Plan Area, but with concentrations in the west Mojave, the region between Victorville and Barstow east on I-15, the Mojave National Preserve, and the eastern portion of Joshua Tree National Park (see Figure SP-B09 in Appendix B).

There are 625 recent (i.e., since 1990) documented occurrences for golden eagle within the Plan Area (CDFW 2013; Dudek 2013) (Figure SP-B09). Golden eagles have occupied nearly every mountain range in the Plan Area; territory occupancy is variable from year to year, productivity is generally low, and most territories contain several alternate nests (La Pré, pers. comm. 2011). The BLM identified “Key Raptor Areas” for golden eagles encompassing the Granite, El Paso, Newberry, and Red mountains, Stoddard Ridge, and Daggett Ridge (Raptor Research Foundation 1989).Other important occupied habitat in the Clark Mountain Range, Tehachapi Mountains, southern Sierra Nevada, and Calico Mountains. Golden eagles may be less abundant in southeastern Imperial County (La Pré, pers. comm. 2011) Many documented occurrences and nests exist to the southwest of the Plan Area in western Riverside and San Diego counties (CDFW 2013).

The model generated 11,219,198 acres of habitat for golden eagle in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.7 Greater Sandhill Crane

5.2.7.1 Status and Distribution

Regulatory Status

The greater sandhill crane (*Grus canadensis tabida*) is state listed as threatened and a fully protected species in California. It is also a BLM sensitive species.

Natural History

Sandhill cranes forage primarily in open, shallow freshwater wetland habitats and agricultural fields, such as irrigated pasture and harvested croplands with waste grain (Tacha et al. 1992). They are omnivorous, eating a variety of small animals and plant material that they glean from the surface or subsurface (Tacha et al. 1992). In addition, their diet varies widely depending on season and location; they are therefore able to adapt to changes in habitat and food availability to some extent. Typical native plant materials include tubers and seeds of aquatic plants. For overwintering birds, waste grain is a very important component of the diet. A wide variety of animal prey items is taken, including large invertebrates and small vertebrates such as mice, frogs, fish, and birds (summarized in Stone 2009).

In the Plan Area, overwintering greater sandhill cranes predominantly forage in agricultural fields and irrigated pastures. Overwintering cranes near Brawley have been observed foraging in irrigated pastures of ryegrass, alfalfa, and Bermuda grass, as well as feeding on spilled grain along railroad tracks near a grain unloading facility north of Keystone (Kalin 2005). Alfalfa and milo fields were readily used along the Colorado River (Rosenberg et al. 1991), as well as corn fields grown for waterbird forage at Cibola National Wildlife Refuge (NWR) (Oldham, pers. comm. 2012). Overwintering cranes in the Plan Area are heavily dependent for foraging throughout the winter on agricultural fields that are close to safe shallow-water wetlands for roosting at night. Sandhill cranes form pair bonds that last for life, and do not breed until they reach 2 to 7 years of age (Tacha et al. 1992). Each pair maintains a breeding territory, and both male and female build a large nest of plant material typically placed in shallow water or dry land at the margin of a wetland (Tacha et al. 1992). They produce a single clutch, almost always of two eggs, and eggs are incubated for about 30 days (Tacha et al. 1992). The chicks are ready to leave the nest soon after hatching and begin feeding after about 1 day. Both parents assist in feeding the chicks. If food is limited only one chick may survive, but if the food supply is adequate, both chicks

may survive. Soon after their first flight, young birds depart with their parents on the southward migration to their wintering grounds, and remain with their parents throughout the winter until they are 9 or 10 months old (Tacha et al. 1992).

For the species as a whole, overwintering sandhill cranes typically arrive in Southern California during October and depart from February through March (Schram 2006, p. 389). Spring migration for the Lower Colorado River Valley population may begin as early as the first week of February (Pacific Flyway Council 1995; Kruse et al. 2011). Cranes depart northward and at least some stage at Lund in Nevada, where they spend a few weeks before continuing north to the breeding grounds by mid-March (Pacific Flyway Council 1995). In fall, move to pre-migratory staging areas in Ruby and Lamoille Valleys in Elko County, Nevada, and assemble before heading south at the end of October along the White River to their wintering grounds (Pacific Flyway Council 1995). The majority of the population overwinters at the Cibola NWR on the Arizona side of the Colorado River, with several hundred birds along the California side of the valley and in the Imperial Valley (Kruse et al. 2011). The migration route of the Lower Colorado River Valley population is one of the shortest among the migratory sandhill cranes.

Most of the foraging and roosting sites for greater sandhill crane are on private lands used for farming and by duck clubs, and the cranes are subject to disturbance from farm activities and hunting. Collision with power lines that traverse the agricultural areas is a potential cause of injury or death for cranes flying between foraging areas. Losses to predators are rare because the birds forage in groups in open areas where visibility is good.

General Distribution and Populations Trends

Greater sandhill crane formerly occupied a much larger breeding range than it does now, ranging across the western and mid-continent from the southern portions of the western and central provinces of Canada (British Columbia, Alberta, Saskatchewan, and Manitoba) to as far south as northern California, Nevada, and Arizona, and northwestern New Mexico in the west and northern Illinois and southern Ontario, Canada in the midwest (Rhymer et al. 2001). Its Hunting and habitat loss beginning in the 1930s greatly reduced the population size and range, but has expanded in recent years. Because of interbreeding with lesser sandhill crane, the northern limits of the population are difficult to define, but the current breeding range of the greater sandhill crane now generally includes contiguous areas of Canada from British Columbia in the west to Wisconsin, Michigan and southern Ontario in the east (Rhymer et al. 2001; Tacha et al. 1992). Disjunct breeding populations occur in four areas of the western U.S.: (1) the nexus of northeastern California, southeastern Oregon and northwestern Nevada; (2) northeastern Nevada; (3) along the border region of Idaho and Wyoming north to southern Montana and south to northern Utah; and (4) northwestern

Colorado (Rhymer et al. 2001; Tacha et al. 1992). Sandhill cranes winter in the southern United States and northern Mexico (Tacha et al. 1991). Wintering locations in California include the lower Colorado River and Salton Sea area, and Imperial Valley and the Central Valley (Patton et al. 2003; Rosenberg et al. 1991 Tacha et al. 1991) (Figure SP-B10). Sandhill cranes also historically wintered abundantly at the Colorado River delta at the head of the Gulf of California in Mexico, about 80 kilometers (50 miles) south of Yuma, Arizona, and was still wintering in Sonora, Mexico in moderate numbers in recent years (Russell and Monson 1998 p. 87, as cited by Campbell, pers. comm. 2012).

The Lower Colorado River Valley population is currently the least numerous of the migratory crane populations (Kruse et al. 2011). Aerial surveys of the major overwintering concentrations of the Lower Colorado River Valley populations (lesser and greater) have been conducted since 1998 (at two sites in Arizona and the Sonny Bono Salton Sea NWR and Gila River), and suggest that the overall numbers are increasing at a rate of about 3% per year, from an However, the relative numbers of greater and lesser sandhill cranes across time is poorly known, casting uncertainty on trends for the greater sandhill crane population here.estimated 1,900 in 1998 to 2,415 counted in 2011 (Kruse et al. 2011).

Reasons for Decline

The most significant current threat to the greater sandhill crane subspecies appears to be habitat loss and degradation, especially on the wintering grounds in California and Florida, the nesting areas in the Midwest, and migration stopovers, especially the Platte River (Meine and Archibald 1996).

Several specific habitat issues of concern for the Lower Colorado River Valley population winter grounds have been identified: (1) a shortage of good roosting sites near foraging areas with grain fields; (2) lack of management and control over agricultural crops that provide winter foraging; (3) destruction of roost sites by past and proposed dredging and channelization projects along the Lower Colorado River: and (4) conversion of croplands from grain to crops that do not provide good foraging for cranes, such as alfalfa and cotton (Pacific Flyway Council 1995). In addition, potential impacts of water transfers and fallowing of agricultural areas in both Imperial Valley and lower Colorado River Valley could have critical impacts on winter grounds (Campbell, pers. comm. 2012).

5.2.7.2 Habitat Characteristics

Greater sandhill cranes are found primarily in open freshwater wetlands, including shallow marshes and wet meadows (Tacha et al. 1992; Meine and Archibald 1996). They nest in moist areas at the margins of extensive wet meadows and marshes (Tacha et al. 1992).

Migrating and wintering greater sandhill cranes often forage in agricultural fields, especially stubble or disked fields where grain crops have been harvested (Tacha et al. 1992). Overwintering birds in the Plan Area use irrigated pastures and croplands, grain fields, and dairy farms (Meine and Archibald 1996). Migrating and wintering birds typically use roost sites in shallow wetlands near foraging areas.

5.2.7.3 Occurrence within Plan Area

Sandhill cranes are winter visitors to the Plan Area and have never been documented to breed in Southern California. Greater sandhill cranes that overwinter in the Plan Area belong to two populations: the Central Valley population and the Lower Colorado River Valley population (Meine and Archibald 1996). The Central Valley population breeds in northeastern California and adjacent south–central and southeastern Oregon, and at scattered sites in southern British Columbia and on Vancouver Island. This population mainly overwinters in the Central Valley and perhaps in the Imperial Valley. The Lower Colorado River Valley population breeds mainly in northeast Nevada and portions of adjacent states and winters in the Lower Colorado River Valley and the Imperial Valley.

Historically, the Lower Colorado River Valley population wintered south along the Colorado River Valley from eastern Nevada as far south as the delta in the Gulf of California (Kruse et al. 2011). Wintering greater sandhill cranes occurred "sparingly" south to the Imperial Valley, and lesser sandhill cranes also overwintered in Southern California, including the Colorado River Valley, the Imperial Valley, and the south end of the Salton Sea (Grinnell and Miller 1944).

Garrett and Dunn (1981) also stated that both greater and lesser sandhill crane subspecies overwintered in Southern California and noted that the relative abundance of the two forms is imperfectly known. They described greater sandhill crane as a regular winter visitor, with overwintering birds known from several scattered locations in the Plan Area: in the fields between Brawley and El Centro in Imperial County, in fields along the Colorado River north of Blythe and in the Cibola area in Riverside County, and in small numbers in the Needles/Topock area in San Bernardino County. Detailed historical counts of wintering sandhill cranes in the lower Colorado River in California are provided in Appendix C of the Pacific Flyway Council's 1995 Management Plan.

There are no historical records for the greater sandhill crane in the CNDDB for the Plan Area (CDFGW 2013; Dudek 2013).

The current overwintering distribution in the Plan Area is similar to that described by Garrett and Dunn (1981), with several regularly used winter locations in both the Imperial

Valley south of the Salton Sea and along the Colorado River. Patten et al. (2003) indicate that historically the great majority of wintering sandhill cranes in the Imperial Valley were lesser sandhill cranes and most wintering along the Colorado River were the greater subspecies, but both subspecies are known in both areas and recent relative numbers are unclear. Patten et al. (2003) also cite five records for the species at or near the north end of the Salton Sea; three in winter and one each in fall and spring.

There are no recent (i.e., since 1990) occurrence records in the CNDDB (CDFW 2013; Dudek 2013) for greater sandhill crane, but there are 16 recent occurrence records contained in the eBird database for the Plan Area for the species (the database does not include subspecies information) (Dudek 2013). These observations are primarily located south of the Salton Sea and along the lower Colorado River, with one 2011 (January) observation from Silver Lake (in Galileo Park) in California City in the western Mojave Desert (Figure SP-B10) (Dudek 2013). This small number of database occurrences, however, does not clarify the common use of the Salton Sea, Imperial Valley and lower Colorado River areas by large numbers of greater sandhill cranes in overwintering congregations. Recently, approximately 250 to 300 overwintering greater sandhill cranes were estimated to forage in privately owned grain fields south of Brawley in the Imperial Valley (Cooper 2004; Schram 2006). A recent local report describes an overwintering group of about 400 cranes foraging during the day near the intersection of Keystone and Dogwood, and roosting at night at private duck clubs in the nearby Mesquite Lake area (Kalin 2005), and this area is known to be a reliable site for overwintering sandhill cranes (Schram 2006). Several hundred sandhill cranes currently winter in Unit 1 of the Sonny Bono Salton Sea National Wildlife Refuge (NWR) (Kruse et al. 2011). Along the lower Colorado River, sandhill cranes have been observed west of the River south Earp and just north of Blythe.

Away from the Colorado River and Salton Sea/Imperial Valley area, in addition the 2011 California City observation noted above, there are 16 records in the Plan Area published in *North American Birds* magazine for the period from 1981 through 2005 (Campbell, pers. comm. 2012). Half are in the Owens Valley, from Bishop south to Owens Lake, with the others at Desert Center (2 records), Harper Dry Lake (2), Ridgecrest (2), Death Valley (1), and near Lancaster (1). Seasonally they extend from September 11 to May 20, with 10 records in fall, 2 in winter, and 3 in spring (Campbell, pers. comm. 2012).

The model generated 638,431 acres of modeled suitable overwintering habitat for greater sandhill crane in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.8 Least Bell's Vireo

5.2.8.1 Status and Distribution

Regulatory Status

The least Bell's vireo (*Vireo bellii pusillus*) is state and federally listed as endangered. A federal draft recovery plan for least Bell's vireo was completed in 1998. Critical habitat was designated for the least Bell's vireo in 1994 (59 FR 4845–4867). Bell's Vireo is also listed as a Bird of Conservation Concern by the USFWS within the Mojave Desert Bird Conservation Regions (USFWS 2008a).

Natural History

Individuals may forage in woodlands or scrub habitat near nesting habitat, concentrated in lower to mid-canopies, especially when actively nesting (Kus et al. 2010; USFWS 1998d). Least Bell's vireo has shown preferences for black willow (*Salix gooddingii*) relative to its cover in territories (Miner 1989; Kus et al. 2010). Least Bell's vireos also forage in upland vegetation adjacent to riparian corridors particularly late in the season (Gray and Greaves 1984; Salata 1983). During the winter, least Bell's vireo utilize willow riparian habitat, arroyo scrub vegetation, and hedgerows in coastal drainages (Kus et al. 2010). Breeding least Bell's vireos begin arriving on their breeding grounds in late March and begin nesting in early April (Kus 2002a). Individuals may remain on the breeding grounds into early October, but nesting is typically finished by the end of July (Kus 1999). Most pairs are monogamous during the breeding season (Kus et al. 2010). Reproduction is significantly affected by brown-headed cowbird nest parasitism. In addition to nest loss to parasitism, some nests fail due to other causes, including precipitation damage to nest or supporting vegetation or effects from human or animal activity, dessication of supporting host plant, infertile or otherwise inviable eggs (Kus et al. 2010), and nest predation by a range of species including western-scrub jays (*Aphelocoma californica*), snakes, Cooper's hawk (*Accipiter cooperii*) and raccoons (*Procyon lotor*)(USFWS 1998d; Kus et al. 2010). Little is known about the migratory routes of this species. Most individuals of the subspecies have left the United States by early October. During spring migration, adults return to their breeding grounds in mid-March to mid-April (Brown 1993; Kus et al. 2010). In California, males arrive on breeding areas 1 to 2 weeks before females (Kus et al. 2010). The species' migratory behavior is poorly known, although it is thought to be chiefly a nocturnal migrant (Brown 1993). Home range and movement during the breeding season is limited to areas within dense riparian corridors. Territories are often linear in nature, following the stream course. For breeding, this species is dependent on dense riparian corridors, typically along watercourses. Scrub habitats adjacent to these watercourses are also

important to the success of the species because they provide foraging opportunities as well as protection for nesting habitat.

Brown-headed cowbirds have decimated Bell's vireo populations throughout its breeding range through nest parasitism, and this is true for both subspecies. Dense riparian breeding habitat that is surrounded by agricultural lands or developed areas could facilitate brown-headed cowbird abundance and lower the breeding success of riparian nesting species such as the least Bell's vireo.

In California, more than one-third of least Bell's vireo nests from the late 1920s through the 1980s contained cowbird eggs (Goldwasser et al. 1980**Error! Bookmark not defined.**). Since widespread implementation of cowbird trapping over the last 25 years, parasitism rates have dropped substantially and Bell's vireo nesting success has increased dramatically (Griffith and Griffith 2000; Kus 1999; Kus and Whitfield 2005).

Cowbirds typically parasitize vireo nests during the egg-laying period and female cowbirds often remove or destroy vireo eggs. Adult Bell's vireos will attack female cowbirds to defend their nests (Mumford 1952; Budnik et al. 2002; Sharp and Kus 2004). In some instances, Bell's vireo will abandon nests parasitized by cowbirds. A study in California showed that vireos continued to incubate three of three videotaped nests in which cowbirds laid eggs (Sharp and Kus 2004).

General Distribution and Populations Trends

Bell's vireo is a migratory species that breeds in North America. Least Bell's vireo breeds in central and southern California, and northwestern Baja California. In California, breeding takes place through coastal Santa Barbara County to San Diego County, San Bernardino, Riverside, and Inyo counties (USFWS 2006a). A few isolated least Bell's vireo have been observed in Kern, San Benito, Monterey, and Stanislaus counties since the species was listed but these counties have not supported any sustained populations.

In California, the historic range of least Bell's vireo has severely contracted. Historically, the breeding range of the least Bell's vireo subspecies was widespread throughout California, including the Sacramento and San Joaquin valleys (Grinnell and Miller 1944), Sierra Nevada foothills, and in the Coast Ranges from Santa Clara County south to approximately San Fernando, Baja California, Mexico (USFWS 1998d). Populations were also known from the Owens Valley, Death Valley, and at scattered oases in the Mojave Desert (Kus et al. 2010; USFWS 1998d). At the time of listing in 1986, over 99% of the least Bell's vireo population was found south of Santa Barbara County (USFWS 2006a).

The least Bell's vireo subspecies overwinters primarily along southern Baja California (Kus 2002a).

Breeding habitat for all subspecies of Bell's vireo generally consists of dense, low, shrubby vegetation, (early successional stages) in riparian areas, and mesquite brushlands, often near water in arid regions (Kus et al. 2010). Bell's vireo winter in both riparian and upland vegetation but in habitats more widely distributed away from water. Least Bell's vireo winters in willow riparian habitat, arroyo scrub vegetation and hedgerows in coastal drainages.

Least Bell's vireo was described as common or abundant in the late 1800s and early 1900s (USFWS 1998d). However, by the late 1900s, large tracts of mesquite woodlands were completely removed by wood harvest and groundwater overdraft (Johnson and Carothers 1982; Johnson et al. 1997). In California, the precipitous decline in numbers has been due to loss and degradation of riparian habitat, and the expansion in range of the brown-headed cowbird (USFWS 1998d).

By 1986, the least Bell's vireo population had declined to an estimated 300 pairs, with the majority occurring in San Diego County (USFWS 1998d; Kus 2002a). In 2008, the statewide population in California numbered approximately 3,000 territorial males (USFWS 2006a).

The USFWS records show a tenfold increase in the least Bell's vireo population since its listing under the federal ESA in 1986, from 291 to 2,968 known territories, with "tremendous" growth of the vireo populations in specific areas in San Diego and Riverside counties and lower but still significant growth in Orange, Ventura, San Bernardino, and Los Angeles counties (USFWS 2006a). However, there have been significant declines in least Bell's vireo populations in Santa Barbara County since its original listing, while Kern, Monterey, San Benito, and Stanislaus counties have not supported any sustained populations (USFWS 2006a).

Reasons for Decline

Historic loss of riparian habitat associated with agricultural practices, urbanization, and exotic plant invasion has contributed to decline of the species (USFWS 2006a). Loss of breeding habitat due to water source alteration (e.g., flood control and channelization), urbanization, and livestock grazing also threatens the species. In addition, nest parasitism by the brown-headed cowbird has greatly reduced nest success throughout most of its breeding range and has been suggested as a primary cause for decline throughout California. A recent study found that vireo productivity increased by one young for each 30% decrease in nest parasitism (Kus and Whitfield 2005). An increase in cowbird abundance is propagated by particular land-use practices (e.g., residential development,

agriculture, grazing) on lands adjacent to breeding habitats (Kus 1999; NatureServe 2011). In urbanized areas, where habitat is fragmented and breeding habitat lacks buffers, nest predation may also increase due to meso-predator release and the addition of non-native predators such as domestic or feral cats (USFWS 2006a). The exotic Argentine ant (*Linepithema humile*) also has been noted as a nest predator (Peterson et al. 2004).

Other threats to this species' habitat include urban and suburban development on floodplains, the presence of large areas of invasive plants such as tamarisk and giant reed (*Arundo donax*), and OHV activity (Wildlife Action Plan Team 2006). Also, flood control projects and grazing have destroyed much of the western nesting habitat (NatureServe 2011).

5.2.8.2 Habitat Characteristics

Bell's vireo is a neotropical migrant that breeds in the summer in riparian scrub. Both subspecies are largely associated with early successional cottonwood-willow and are known to nest in riparian woodlands dominated by willow (Kus et al. 2008) and Fremont cottonwood (*Populus fremontii*) (Kus 2002a). Suitable willow woodlands are typically dense with well-defined vegetative strata or layers. The most critical structural component of nesting habitat in California is a dense shrub layer 2 to 10 feet aboveground (Goldwasser 1981; Franzreb 1989; Brown 1993). Bell's vireo is usually found along drainages or elsewhere near water, including ponded surface water or where moist soil conditions occur (Rosenberg et al. 1991), especially in arid environments (Szaro and Jakle 1982). Kus and Miner (1998) also stated the importance to least Bell's vireo of non-riparian habitats within and adjacent to floodplains for foraging and other activities. In arid environments, surface water appears to be an important element in Bell's vireo habitat (Kus et al. 2010).

5.2.8.3 Occurrence within Plan Area

There are four historical occurrences (i.e., pre-1990) of least Bell's vireo in Inyo County in the northern portion of the Plan Areaand in the southern portion of the Plan Area in and west of Joshua Tree National Park (Dudek 2013).

There are also three historical occurrences for Bell's vireo where the species occurrence in the database is not identified to subspecies (Dudek 2013). These observations were in the Shadow Valley area west of the Mesquite Mountains, near Shoshone, and near Furnace Creek (see Figure SP-B01 in Appendix B).

There are 129 recent occurrence records of least Bell's vireo in the Plan Area in the following areas: near Lancaster and Palmdale, north of Hesperia, north of Victorville, southwest of Yucca Valley, along Carrizo Creek in Anza-Borrego Desert State Park, and along Owens River (CDFW 2013d; Dudek 2013e) (see Figure SP-B02 in Appendix B).

There are 10 recent occurrences for Bell's vireo that are not identified to subspecies in the following areas: two occurrences west of Pearsonville in the southern Sierra foothills, two occurrences in the Amargosa River area, one occurrence south of the Salton Sea, and five occurrences in the Morongo Valley area (Dudek 2013; see Figures SP-B01 and SP-B02 in Appendix B).

The model generated 298,231 acres for least Bell's vireo in the Plan Area. Appendix C includes figures showing the modeled suitable habitat in the Plan Area.

5.2.9 Mountain Plover

5.2.9.1 Status and Distribution

Regulatory Status

Mountain plover (*Charadrius montanus*) is a California Species of Special Concern. It is also a USFWS Bird of Conservation Concern and BLM sensitive species. The proposed federal listing of the mountain plover as a threatened species was withdrawn on May 12, 2011 (76 FR 27756–27799).

Natural History

Mountain plovers feed on ground-dwelling or flying invertebrates found on the ground (76 FR 27756–27799). Their diet primarily consists of beetles, crickets, and ants, though mountain plover diets are diverse and differ greatly by location (76 FR 27756–27799; McGaugh 2006). Mountain plovers feed opportunistically as they encounter prey (76 FR 27756–27799). Foraging behavior consists of short runs and stops in which prey are captured with a lunge at the end of a short, quick run (76 FR 27756–27799; McGaugh 2006). On wintering grounds, mountain plovers also forage by probing into cracks of dried loamy soils (Knopf and Wunder 2006).

Mountain plovers forage in large areas of dry, disturbed ground or areas of short (less than 2 centimeters [0.79 inch]) vegetation with patches of bare ground. Prey is more abundant on prairie dog towns than adjoining habitats (Knopf and Wunder 2006).

Mountain plovers return north to their breeding sites in the western Great Plains and Rocky Mountain states in spring. Males defend territories shortly after arrival at the breeding grounds (76 FR 27756–27799). Generally monogamous, mountain plovers form pairs and begin courtship on arrival at the breeding grounds as well. In Colorado, mountain plovers lay eggs between late April and mid-June in a simple ground scrape nest (76 FR 27756–27799). Mountain plovers incubate for 29 days on average, and young fledge at

approximately 33 to 34 days (76 FR 27756–27799; Knopf and Wunder 2006). Mountain plovers can breed their first spring (76 FR 27756–27799).

In late summer and early fall, mountain plovers migrate south across the southern Great Plains to Texas, New Mexico, and Mexico. Several then travel west to California. In California, fall migrants generally arrive in the north by mid-September and in the south by mid-October (Knopf and Wunder 2006). During spring migration in early March, mountain plovers travel quickly from their wintering sites to their breeding sites, arriving in eastern Colorado by mid-March and in Montana by mid-April (76 FR 27756–27799). In California, wintering mountain plover movement patterns are highly variable with some birds moving more than 34 miles in one week (76 FR 27756–27799).

Most egg and chick losses are to predators (County of Riverside 2003). Birds, mammals, and reptiles, including prairie falcon and kit fox, are known to predate mountain plover eggs and/or chicks (McGaugh 2006).

Mountain plovers favor plowed or recently harvested agricultural fields and habitats that have been burned because these disturbances create the necessary sparse conditions (BLM 2002a, p. N-8; 76 FR 27756–27799). Mountain plovers prefer areas with abundant mammalian burrows (BLM 2002a, p. N-8). They tend to be associated with giant kangaroo rat (*Dipodomys ingens*) colonies, especially when wet years produce tall vegetation elsewhere (76 FR 27756–27799).

General Distribution and Populations Trends

Mountain plover occurs from Canada (AB, SK) south through the United States (AZ, CA, CO, KS, MT, ND (extirpated), NE, NM, NN, OK, SD (extirpated), TX, UT, and WY) and into Mexico. In California, where most birds winter, the mountain plover is known in the following counties: Colusa, Fresno, Imperial, Kern, Los Angeles, Merced, San Benito, San Luis Obispo, Solano, Stanislaus, Tulare, and Yolo (NatureServe 2011; Knopf and Wunder 2006).

From 2004 to 2007, the International Union for the Conservation of Nature (IUCN) listed mountain plover as ‘‘vulnerable,’’ a higher level of concern than ‘‘near threatened.’’ However, higher rangewide population estimates have emerged prompting IUCN to change its rating accordingly.

From 1966 to 1993, Breeding Bird Survey data indicate a decline rate of 3.7% per year. Although the Breeding Bird Survey survey routes are not distributed evenly within the species’ habitat, the decline rate indicates reduction in the population during that 25-year period by approximately two-thirds (Knopf and Wunder 2006). Until 2006, a rangewide

mountain plover population estimate provided by the U.S. Shorebird Conservation Plan was increased from 9,000 to 12,500 (76 FR 27756–27799).

Although wintering mountain plover populations in California appear to have experienced a significant decline over previous decades, more recent wintering numbers, from 2000 onward, have not shown a similar trend. In 2007, 4,500 mountain plover were recorded in the Imperial Valley, which exceeded statewide survey counts of mountain plover from 1994, and 1998 through 2002. A statewide survey over 5 days in January 2011 recorded 1,235 mountain plover, which is considerably fewer than found in previous statewide surveys or recent Imperial Valley surveys. In late 2010, unusually wet conditions due to heavy rains may have influenced the relatively low number of mountain plover in California (76 FR 27756–27799).

Reasons for Decline

Mountain plovers are threatened by loss and degradation of breeding and wintering habitat, predation, severe weather conditions during nesting/fledging, and direct persecution by humans (McGaugh 2006).

Habitat loss and degradation appear to be the main factors contributing to mountain plover population declines (Hunting and Edson 2008). The reduction of short-grass prairie by conversion to agriculture and the elimination of important grazers, such as bison (*Bison bison*), which kept the habitat sparsely vegetated, began in the 1800s (McGaugh 2006). Currently, loss of traditional wintering sites on grasslands and suitable agricultural cropland to urban development, vineyards, or other incompatible land uses could continue to reduce suitable wintering habitat for mountain plover (Hunting and Edson 2008). In addition to allowing higher vegetation structure that is unsuitable for mountain plover, incompatible agricultural practices can directly kill plovers from farm equipment or expose plovers to pesticides (McGaugh 2006).

Predation is the main source of egg and chick loss. Mountain plovers are susceptible to a variety of predators, such as birds, mammals, and reptiles (County of Riverside 2003; McGaugh 2006). Reduced populations of fossorial mammals could impact mountain plover populations since they attract invertebrates used for forage (Hunting and Edson 2008).

Mountain plover is also susceptible to extreme weather conditions. At the Pawnee National Grassland in Colorado, hail and flooding caused almost complete reproductive failure (McGaugh 2006). Climatic conditions also influence vegetation structure with wetter years possibly supporting fewer wintering mountain plover (76 FR 27756–27799).

Because mountain plovers tend to be unwary and form tight flocks, they have historically been susceptible to hunters (e.g., in the late 1800s) (McGaugh 2006; Knopf and Wunder 2006). However, shootings in more recent years have not been documented, and hunting is not a current conservation concern (Knopf and Wunder 2006). Although very tolerant of machinery, such as off-road vehicles, tractors, and military aircraft, mountain plovers will flee nest sites or roost areas when approached by humans on foot, leaving eggs susceptible to overheating due to solar radiation (Knopf and Wunder 2006).

5.2.9.2 Habitat Characteristics

Although mountain plover is categorized as a shorebird, it is not actually associated with margins of freshwater or marine estuaries, and despite its name, mountain plovers do not actually nest in the mountains (76 FR 27756–27799; McGaugh 2006). Suitable breeding habitat for mountain plover includes disturbed prairie or semidesert habitats at high elevations, from 2,000 to 8,500 feet (76 FR 27756–27799; McGaugh 2006; Knopf and Wunder 2006). This species occupies open, flat lands or sparsely vegetated areas, including xeric shrublands, short-grass prairie, and barren agricultural fields. Grassland habitats where mountain plover is found often have a history of disturbance by burrowing rodents, such as prairie dogs, native herbivores, or domestic livestock (76 FR 27756–27799).

Mountain plover breeding sites require short vegetation with some bare ground. Breeding habitats for mountain plover include short- and mixed-grass prairie, prairie dog colonies, agricultural lands, and semidesert areas (76 FR 27756–27799). Typical disturbances in grasslands include disturbances from prairie dogs, cattle grazing, fire, or farming. Although these forms of disturbance are usually required in grassland habitats, breeding sites in semidesert environments may persist without these forms of disturbance (76 FR 27756–27799).

Mountain plover wintering habitats are similar to those used for breeding. In California, mountain plovers primarily winter on fallow and cultivated agricultural fields, but also use grasslands and grazed pastures (76 FR 27756–27799). Alkali playa is an important habitat type in composition, structure, and location (County of Riverside 2003). In the Imperial Valley, where there is the largest known concentration of wintering plovers, preferred foraging habitats include harvested alfalfa fields that have been grazed by domestic sheep and Bermuda grass fields that have been burned post-harvest (Knopf and Wunder 2006). During migration, mountain plovers likely use habitats similar to their breeding and wintering habitats (76 FR 27756–27799). Mountain plovers prefer areas with heavy, saline/alkaline, clay soils (BLM 2002a, p. N-8).

5.2.9.3 Occurrence within Plan Area

Mountain plover occurs from Canada (AB, SK) south through the United States (AZ, CA, CO, KS, MT, ND (extirpated), NE, NM, NN, OK, SD (extirpated), TX, UT, and WY) and into Mexico. In California, the historical wintering range for mountain plover included low elevation interior valleys and plains. The range extended from the southern Sacramento Valley and the inner San Francisco Bay area south to the southern coastal slope and east to the Imperial Valley. According to sources from 1944 and 1957, in the southern deserts, mountain plover historically occurred near Indio in Riverside County, at Brawley and Pilot Hill in Imperial County, and Needles in San Bernardino County (Hunting and Edson 2008).

There are 11 historical (i.e., pre-1990) occurrence records for mountain plover in the Plan Area (CDFW 2013; Dudek 2013). The majority of these occurrences are located east of Lancaster and north of Palmdale, in the southwest corner of Edwards Air Force Base, in the Harper Lake area, and at the southern end of the Salton Sea (see Figure SP-B11 in Appendix B).

In California, mountain plovers continue to occupy the same broad regions in which they have historically occurred, although they no longer winter on the Channel Islands or the eastern fringes of the San Francisco Bay area (Hunting and Edson 2008). In the southern desert region, mountain plovers winter in the Antelope Valley; western Mojave Desert, near Harper Dry Lake; the Imperial Valley; and near Blythe in the Lower Colorado River Valley (Hunting and Edson 2008).

Within the Plan Area, there are 61 recent (i.e., since 1990) documented occurrences south of or along the eastern edge of the Salton Sea, near Palmdale, west of Lancaster, and in the Harper Lake area (see Figure SP-B11 in Appendix B; CDFW 2013; Dudek 2013).

The model generated 718,451 acres of modeled suitable wintering habitat for mountain plover in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.10 Swainson's Hawk

5.2.10.1 Status and Distribution

Regulatory Status

Swainson's hawk (*Buteo swainsoni*) is state listed as threatened in California and is a USFWS Bird of Conservation Concern.

Natural History

In North America, breeding Swainson's hawks prey chiefly upon small rodents such as young ground squirrels, pocket gophers, deer mice, and voles. Voles are especially important to Central California hawks. Their breeding season diet also includes birds, snakes, and insects (especially grasshoppers and crickets) (Snyder and Wiley 1976; Fitzner 1980; Bednarz 1988; Estep 1989). Non-breeding birds in North America and wintering birds in South America feed almost exclusively on insects, especially grasshoppers (Snyder and Wiley 1976; Johnson et al. 1987; Sarasola and Negro 2005).

Swainson's hawks arrive on the breeding grounds in March-April (March in Central California) (Table 2) and begin a week-long nest building phase 1 to 2 weeks after arrival (Fitzner 1980). The egg-laying through fledging period lasts about 73 days per nest, but can last 110 days for the local population (Olendorff 1973). Adjacent pairs can be out of sync by 25 days (Woodbridge 1987). Typical clutch size is 2 or 3 eggs (Olendorff 1973; Fitzner 1980; Bechard 1983; Bednarz and Hoffman 1986) and typically about 2 young are fledged per successful nest (range of 1.62 to 2.18) (Bechard et al. 2010. A study of rural and urban nest sites central California found 1.65 and 1.64 young fledged per successful nest site, respectively (England et al. 1995). The number of fledglings can average less than 1 during years of low prey availability (i.e., not all nests are successful) (Bechard 1983). Young generally fledge mid-July to mid-August at an average age of 43 days (Olendorff 1973, Fitzner 1980, Woodbridge 1987). Migratory movements occur annually between North American breeding grounds and wintering areas primarily located in South America, although some Swainson's hawks use wintering grounds in California and Mexico (Fuller et al. 1998, Bechard et al. 2010;, Wheeler 2003, Bradbury unpublished data). Immature birds and post-breeding adults begin forming migration flocks in August and September, and begin the fall migration in September. Birds migrating to South America leave North America by October and arrive in Argentina in November (Bechard et al. 2010;). The return migration begins late-February and early March in Argentina (Bechard et al. 2010;), with birds arriving in California from early March (Central Valley) through April (other California populations). Fuller et al. (1998) tracked 27 Swainson's hawks on their 1996 and 1997 southbound migrations and recorded a mean cumulative travel distance of over 13,500 kilometers (8,370 miles).

Local movements of California hawks are primarily confined to home ranges, which vary greatly in size (from 69 to 8,718 ha) among populations (Bechard et al. 2010). Smaller home ranges (e.g., less than 1,000 hectares) tend to occur areas with suitable foraging habitat such as alfalfa, fallow fields and dry pastures, while large home ranges (e.g., greater than 2,500 hectares) tend to occur in areas less suitable foraging habitat, such as mature grains and row crops, vineyards, and orchards (Bechard et al. 2010). Natal

dispersal also varies greatly among populations (refer to Appendix B for a more detailed discussion on natal dispersal).

Predator–prey relationships are critical for Swainson's hawk. Conversion of suitable nesting and foraging habitat in some locations in North America, and especially Central California (Risebrough et al. 1989), has led to the loss of nesting opportunities and reduction of prey populations due to conversion of native grassland to cropland. Where agricultural conversion has been to crop types not suitable for foraging and alternative nesting opportunities have not been created, Swainson's hawk populations have dexlined (Bloom 1980; Bechard et al. 2010). Swainson's hawks occasionally lose nestlings or fledglings to great horned owl predation (Fitzner 1978; Littlefield et al. 1984; Woodbridge 1991), and Swainson's hawks themselves have preyed on burrowing owl fledglings (Clayton and Schmutz 1999). Interspecific competition and territoriality occurs between Swainson's hawk and sympatric buteos (e.g., red-tailed hawks) over control of nest sites, although Swainson's hawks appear to dominate in most such encounters (Janes 1984).

General Distribution and Populations Trends

Swainson's hawks breed in the grasslands, shrub-steppe, desert, and agricultural areas of the Columbia Basin, Great Basin, Great Plains, American Southwest, and the Central Valley of California (Bechard et al. 2010) (Figure SP-B12). In California, approximately 94% of the breeding pairs now occur in the Central Valley (CDFG 2007) with most found between Modesto and Sacramento (Bloom 1980). Smaller California breeding populations are also found in the Great Basin in the extreme northeastern California portion of the state, in the Owens River Valley, and in nearby Fish Lake Valley on the Nevada border. Remnant (or recolonizing) populations in Southern California are found in the western Mojave Desert in the Antelope Valley and in the eastern Mohave Desert in the Mojave National Preserve. In California, Swainson's hawk is vulnerable to extirpation due to its very restricted range (primarily the Central Valley), few populations, steep population declines, and loss of habitat. Bloom (1980) concluded that the California Swainson's hawk population had declined 90% since 1900 when Sharp (1902) considered the species abundant. Much of this decline occurred in Southern California, where the species was once considered abundant in coastal valleys (Sharp 1902) but is now completely absent. Based on its large decline, Swainson's hawk was listed as a state-threatened species in 1983. Later inventories estimated populations of 800 hawks in 1988 and 1,000 hawks in 1994 (CDFG 2007b). The CDFG initiated an inventory of Swainson's hawk breeding pairs in California in 2005 and 2006 (CDFG 2007b). Based on a randomized sampling, the CDFG estimated a breeding population of 1,912 pairs (95% confidence interval; range 1,471 to 2,353 pairs) in 2005 and 2,251 breeding pairs (95% confidence interval; range 1,811 to 2,690 pairs) in 2006. The combined estimate for 2005–2006 is 2,081 pairs (95% confidence interval;

range 1,770 to 2,393 pairs). Approximately 94% of the breeding pairs now occur in the Central Valley.

Reasons for Decline

The decline of Swainson's hawks in California has been attributed to riparian habitat loss and agricultural and urban development in the Central Valley (Bloom 1980; England et al. 1995), urbanization in the coastal valleys and plains (Bloom 1980), and a contracting range of Joshua trees and riparian habitats in the Mojave Desert (Bloom 1980). It was estimated that by the mid-1980s, approximately 93% of riparian habitat in the San Joaquin Valley and 73% of riparian habitat in the Sacramento Valley had been lost since the 1850s (CDFG 1994). Chronic and acute pesticide poisoning also affects the Swainson's hawk (Goldstein et al. 1996; Risebrough et al. 1989). Pesticide use on South American wintering grounds threatens all North American populations. South American birds have died from ingesting pesticides targeting grasshoppers (Woodbridge et al. 1995; Goldstein et al. 1996). Goldstein et al. (1996) estimated that 4,100 Swainson's hawks died in 1 year, 1996, from acute pesticide poisoning in Argentina.

Wildfires, lowering of water tables, and flood control also continue to threaten riparian and woodland nesting habitat in California. Off-road vehicle activity and shooting can also disrupt nesting, although the latter is not as important a factor as it once was. Intraspecific competition or aggression with other raptors and common ravens (*Corvus corax*) has been suggested as a stressor elsewhere in the western United States (Janes 1987; Littlefield et al. 1984).

5.2.10.2 Habitat Characteristics

Swainson's hawks are primarily a grassland bird but they are also found in sparse shrubland and small, open woodlands (Bechard et al. 2010). In Central California Swainson's hawks are primarily associated with grain and hay croplands that mimic native grasslands with respect to prey density and availability (Estep 1989; Babcock 1995). They generally nest in isolated trees, narrow bands of vegetation, or along riparian corridors in grassland, shrubland, and agricultural landscapes. Within the DRECP area, Joshua trees (*Yucca brevifolia*) and non-native ornamental trees or trees planted as windbreaks also function as nest sites (CEC and CDFG 2010).

Most Swainson's hawks winter in the pampas (grasslands) of South America, but there they have adapted to agricultural lands, as they have on their North American breeding grounds (Woodbridge et al. 1995a). Foraging habitat includes dry land and irrigated pasture, alfalfa, fallow fields, low-growing row or field crops, new orchards, and cereal grain crops. In the Plan Area, in addition to alfalfa fields in the Antelope Valley, Swainson's hawks may also

forage in grasslands, Joshua tree woodlands, and other desert scrub habitats that support a suitable prey base.

5.2.10.3 Occurrence within Plan Area

Historically, Swainson's hawks were much more common in the Southern California deserts than they are today (Sharp 1902, Bloom 1980). Bloom (1980) estimated that the Mojave/Colorado Deserts population has declined by 95% in the previous century. Current nesting territories in Southern California may represent recolonizations (Woodbridge 1998). There are four historical (i.e., pre-1990) occurrence records in the Plan Area and an additional three records with an unknown observation date (CDFW 2013; Dudek 2013). The four historical occurrences with known observation dates include a 1927 occurrence east of Lancaster and south of E. K8, and 1979 and 1982 occurrences in the eastern portion of the Mojave National Preserve (Figure SP-B12). The latter three historical nest territories in the Lanfair Valley within the Mojave National Preserve had last reported activity in the early 1980s. The occurrences with no observation date in the Dudek (2013) dataset include a site along E. Avenue I east of Lancaster, a site along E. Avenue J east of Lancaster (both of which are north of the 1997 occurrence east of Lancaster), and a site north of Fremont Wash and east of State Highway 395 (Figure SP-B12).

There are 52 recent (i.e., since 1990) occurrences for Swainson's hawk in the Plan Area (CDFW 2013; Dudek 2013) (Figure SP-B12). Most breeding pairs within the DRECP area are located in the western Mojave along the base of the San Gabriel and Tehachapi Mountains and in the Antelope Valley. Approximately ten pairs nest over a relatively wide area in the Antelope Valley (Bloom 2011). Several pairs nest in the upper Owens River Valley, just north (outside) of the DRECP area. However, an isolated Owens River Valley nesting territory (active in 2003) does occur inside the DRECP area at Haiwee Reservoir (Bloom 2011). Scattered recent occurrences are located in the Fremont Valley, the Ridgecrest/China Lake Naval Air Weapons Station, and near Haiwee Reservoir. There is a single occurrence south of the Salton Sea from 2003 (see Figure SP-B12 in Appendix B).

The model generated 1,615,796 acres of modeled suitable habitat for the Swainson's hawk in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.11 Tricolored Blackbird

5.2.11.1 Status and Distribution

Regulatory Status

The tricolored blackbird (*Agelaius tricolor*) is a California Species of Special Concern and also a BLM sensitive species and USFWS Bird of Conservation Concern. This species was previously federally designated as a Category 2 Candidate Species in 1991 (56 FR 58804–58836).

Natural History

Tricolored blackbirds forage primarily in artificial habitat with ideal foraging conditions created in shallow flooded fields. Preferred foraging habitat includes crops, annual grasslands, cattle feedlots, and dairies (Beedy and Hamilton 1999). Foods delivered to tricolored blackbird nestlings include beetles and weevils, grasshoppers, caddis fly larvae, moth and butterfly larvae, and dragonfly larvae (Orians 1961a; Crase and DeHaven 1977; Skorupa et al. 1980; Beedy and Hamilton 1999). Breeding-season foraging studies in Merced County showed that animal matter makes up about 91% of the food volume of nestlings and fledglings, 56% of the food volume of adult females, and 28% of the food volume of adult males (Skorupa et al. 1980).

Adults may continue to consume plant foods throughout the nesting cycle, but they also forage on insects and other animal foods. Immediately before and during nesting, adult tricolored blackbirds are often attracted to the vicinity of dairies, where they take high-energy items from livestock feed. In winter, tricolored blackbird often associates with other blackbird species (*Agelaius* spp.; *Euphagus* spp.), but flocks as large as 15,000 individuals (almost all tricolored blackbirds) may congregate at one location and disperse to foraging sites (Beedy and Hamilton 1999).

Tricolored blackbird is closely related to red-winged blackbird, but the two species differ substantially in their breeding ecology. Red-winged blackbird pairs defend individual territories, while tricolored blackbirds are among the most colonial of North American passerine birds (Bent 1958; Orians 1961a, 1961b, 1980; Orians and Collier 1963; Payne 1969; Beedy and Hamilton 1999). As many as 20,000 or 30,000 tricolored blackbird nests have been recorded in cattail marshes of 4 hectares (9 acres) or less (Neff 1937; DeHaven et al. 1975a), and individual nests may be built less than 0.5 meter (1.5 feet) apart (Neff 1937). The tricolored blackbird colonial breeding system may have adapted to exploit a rapidly changing environment where the locations of secure nesting habitat and rich insect food

supplies were ephemeral and likely to change each year (Orians 1961a; Orians and Collier 1963; Collier 1968; Payne 1969).

During the breeding season, tricolored blackbird exhibits itinerant breeding, commonly moving to different breeding sites each season (Hamilton 1998). In the northern Central Valley and northeastern California, individuals move after their first nesting attempts, whether successful or unsuccessful (Beedy and Hamilton 1997). Banding studies indicate that significant movement into the Sacramento Valley occurs during the post-breeding period (DeHaven et al. 1975b). During winter, virtually the entire population withdraws from Washington, Oregon (although a few remain), Nevada, and Baja California, and wintering populations shift extensively within their breeding range in California (Beedy and Hamilton 1999). For a more detailed discussion of the wintering locations of tricolored blackbird populations in California, refer to the species profile in Appendix B.

Tricolored blackbird occupies a unique niche in the Central Valley/coastal marshland ecosystems. In areas where the number of tricolored blackbirds is high, they are both aggressively and passively dominant to—and often displace—sympatric marsh nesting species, including red-winged blackbird and yellow-headed blackbird (Orians and Collier 1963; Payne 1969).

Nest predation is a major cause of nesting failure at some tricolored blackbird colonies. Historical accounts documented the destruction of nesting colonies by a diversity of avian, mammalian, and reptilian predators. Recently, especially in permanent freshwater marshes of the Central Valley, entire colonies (>50,000 nests) have been lost to black-crowned night-heron (*Nycticorax nycticorax*), common raven, coyote, and other predators (Beedy and Hayworth 1992; Beedy and Hamilton 1999).

General Distribution and Populations Trends

Tricolored blackbird is largely endemic to California, and more than 90% of the population occurs in the state (Churchwell et al. 2005). Population surveys and banding studies of tricolored blackbird in the Central Valley from 1969 through 1972 concluded that their geographic range and major breeding areas were unchanged since the mid-1930s (DeHaven et al. 1975b).

In any given year, more than 75% of the breeding population can be found in the Central Valley (Hamilton 2000), increasingly concentrated in the San Joaquin Valley. This trend appears to be continuing; the latest statewide survey found 88% of the 2011 breeding population concentrated in large colonies in Merced, Kern, and Tulare counties (Kyle and Kelsey 2011). Much smaller colonies are found in southern coastal counties and west of the

desert in Southern California (Beedy and Hamilton 1999). The species also breeds in marshes of the Klamath Basin in Siskiyou and Modoc counties, and Honey Lake Basin in Lassen County. Small breeding populations also exist at scattered sites in Oregon, Washington, Nevada, and the western coast of Baja California (Beedy and Hamilton 1999). During winter, virtually the entire population of the species withdraws from Washington, Oregon (although a few remain), Nevada, and Baja California, and wintering populations shift extensively within their breeding range in California (Beedy and Hamilton 1999).

The USFWS, CDFW, and Audubon California cosponsored intensive tricolored blackbird surveys (carried out by volunteers in suitable habitats throughout California) in 1994, 1997, 1999, 2000, 2004, 2008, and 2011 (Hamilton et al. 1995; Beedy and Hamilton 1997; Hamilton 2000; Green and Edson 2004; Churchwell et al. 2005; Kyle and Kelsey 2011). The results of the Audubon California 2011 statewide survey (Kyle and Kelsey 2011) show a dramatic drop in the species population numbers throughout the state: in all, slightly fewer than 260,000 birds were observed compared to 395,000 in the 2008 survey, a 33% decrease in the population. For a more detailed discussion of the tricolored blackbird surveys, refer to the species profile in Appendix B.

Reasons for Decline

The greatest threats to this species are the loss and degradation of habitat as a result of human activities (Beedy and Hamilton 1999). One of the main causes for population decline has been the near elimination of native cattail wetland complexes throughout central California by agricultural expansion and conversion of wetlands (Kyle and Kelsey 2011). Tricolored blackbird subsequently exploited the croplands that replaced their native habitat. Because of the increasing importance of agricultural fields to the species and the use of Triticale (a hybrid of wheat and rye grown as silage on dairies) as nesting habitat, tricolored blackbirds are at high risk when farmers need to cut their silage in the middle of the tricolored blackbird breeding effort. Entire colonies of up to tens of thousands of nests have been destroyed by harvesting and plowing of agricultural lands (Beedy and Hamilton 1999).

In addition to direct loss and alteration of habitat, other factors also threaten tricolored blackbird populations (Beedy and Hamilton 1999). These factors include predation of fledglings and adults by black-crowned night herons and ravens (Hamilton 2004). In addition, the application of herbicides and pesticides may affect the nesting success of colonies in agricultural areas (Beedy and Hamilton 1999). Various poisons and contaminants have caused mass mortality, including poisoning by strychnine, selenium, and spraying with mosquito abatement oil (Beedy and Hayworth 1992; Beedy and Hamilton 1999; Beedy 2008).

5.2.11.2 Habitat Characteristics

Breeding tricolored blackbirds form large colonies, typically in freshwater wetlands dominated by cattails or bulrushes and thorny vegetation such as Himalayan blackberry (*Rubus armeniacus,* formerly *R. discolor*) (Churchwell et al. 2005). They may also nest in willows, thistles (*Cirsium* and *Centaurea* spp.), and nettles (*Urtica* spp.) (Beedy and Hamilton 1999). They forage away from their breeding grounds in rice fields, lightly grazed pasture, dairies, or alfalfa fields. With the conversion of wetlands to arable land, tricolored blackbirds began exploiting the rich agricultural fields created by the transition to farming. Recently, the species has been using dairies, which contain many of the necessary characteristics for breeding. As a result, the expanding dairy industry in the San Joaquin Valley has led to a shift in distribution and the concentration of species into mega-colonies of tens of thousands of birds. In 2008, 50% of breeding tricolors in California were observed nesting in silage fields (Kelsey 2008).

Tricolored blackbirds have three basic requirements for selecting their breeding colony sites: open, fresh water; a protected nesting site, provided by flooded, thorny, or spiny vegetation; and a suitable foraging space providing adequate insect prey within a few miles of the nesting colony (Hamilton et al. 1995; Beedy and Hamilton 1997, 1999; Churchwell et al. 2005). Almost 93% of the 252 breeding colonies reported by Neff (1937) were in freshwater marshes dominated by cattail and bulrush species. In contrast, only 53% of the colonies reported during the 1970s were in cattails and bulrushes (DeHaven et al. 1975a).

Ideal foraging conditions for tricolored blackbird is created when shallow flood irrigation, mowing, or grazing keeps the vegetation at an optimal height (<15 cm [<5.9 inches]) (Tricolored Blackbird Working Group 2007). Preferred foraging habitats include agricultural crops such as rice, alfalfa, irrigated pastures, and ripening or cut grain fields (e.g., oats, wheat, silage, and rice), as well as annual grasslands, cattle feedlots, and dairies. Tricolored blackbird also forages in remnant native habitats, including wet and dry vernal pools and other seasonal wetlands, riparian scrub habitats, and open marsh borders (Tricolored Blackbird Working Group 2007).

5.2.11.3 Occurrence within Plan Area

Tricolored blackbird is endemic to the west coast of North America and primarily to California. The tricolored blackbird historical breeding range in California included the Sacramento and San Joaquin valleys, lowlands of the Sierra Nevada south to Kern County, the coast region from Sonoma County to the border of Mexico, and sporadically on the Modoc Plateau (Dawson 1923; Neff 1937; Grinnell and Miller 1944).

Tricolored blackbird was described as locally common in the coastal area of Southern California and also bred on the western edge of the desert in Antelope Valley (Garrett and Dun 1981). Birds were resident year-round, dispersing only short distances from the breeding colonies (Garrett and Dun 1981).

There are four historical (i.e., pre-1990) occurrences recorded in the Plan Area and an additional four records with an unknown observation date (CDFW 2013; Dudek 2013). These occurrences are located in the Harper Lake area, Palmdale/Lancaster area, and in the southwestern portion of Edwards Air Force Base (see Figure SP-B14 in Appendix B).

Tricolored blackbirds breed in lowland areas in the western and central portions of the Plan Area. Breeding colonies occur in eastern Kern County from Ridgecrest along the base of the Tehachapi Mountains to Antelope Valley, around Palmdale and Lancaster in northeast Los Angeles County, and east of Barstow in San Bernardino County. There are 471 recent (i.e., since 1990) occurrences for the Plan Area (CDFW 2013; Dudek 2013). These occurrences generally are located in the Lancaster/Palmdale area; in the southwestern portion of Edward Air Force Base; just north of SR 138; along SR 158 in the Tehachapi Mountain range foothills; west and south of Red Rock Canyon State Park; along the Trona Road cutoff north of SR 395; in the southern portion of the China Lake Naval Air Weapons Station north of Ridgecrest; and along the Mojave River east of Barstow (see Figure SP-B14 in Appendix B).

The model generated 277,915 acres of modeled suitable habitat for tricolored blackbird in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.12 Western Yellow-Billed Cuckoo

5.2.12.1 Status and Distribution

Regulatory Status

The western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) is state listed as endangered in California and is also a BLM sensitive species, a USFWS Bird of Conservation Concern, and is a USFS sensitive species. In 2001, the USFWS completed a 12-month review of a petition for listing the western yellow-billed cuckoo under the federal ESA. The USFWS concluded that a listing was warranted but precluded at the time by higher priority listing actions, at which time the subspecies was added to the candidate list (66 FR 38611–38626). The most recent annual review of candidate species by the USFWS on October 26, 2010 includes the species yellow-billed cuckoo (*Coccyzus americanus*), with a western U.S. DPS (76 FR 66370-66439) (i.e., the review does not refer to the western yellow-billed

cuckoo subspecies even though California lists the subspecies *C. a. occidentalis* as Endangered). The USFWS continues to find that the western U.S. DPS warrants listing, but that such listing was precluded at the time of 2011 review. The USFWS states that they are working on a proposed listing rule that they expect to publish before making the next annual resubmitted petition 12-month finding (76 FR 66370-66439).

Natural History

Yellow-billed cuckoos generally forage for lepidopteran larvae (caterpillars) and other large insects such as katydids by gleaning (Hughes 1999; Laymon 1998). They will also occasionally prey on small lizards, frogs, eggs, and young birds (Gaines 1999; Laymon 1998). Foraging occurs extensively in cottonwood riparian habitat (Hughes 1999).

In the western United States, nests are typically constructed in willows, Fremont cottonwood, mesquite, hackberry (*Celtis* spp.), soapberry (*Sapindus saponaria*), alder (*Alnus* spp.), or cultivated fruit trees on horizontal branches or vertical forks of the large tree or shrub (Hughes 1999). Nests are generally placed between 1 and 6 meters (3 and 20 feet) above the ground and concealed by foliage, especially from above (Hughes 1999). Nest sites in arid regions are restricted to relatively humid river bottoms, ponds, swampy areas, and damp thickets (Hughes 1999). Both the male and female build the nest from twigs (approximately 15 centimeters [6 inches] long) likely collected within 10 meters (33 feet) of the nest site (Hughes 1999).

The western yellow-billed cuckoo has a short breeding season, lasting only about 4 months from time of arrival on breeding grounds in the spring to fall migration. Western yellow-billed cuckoos typically lay a single clutch per season of two or three eggs (average is just over two eggs, and up to four eggs per clutch is known) in mid-June to mid-July, and incubation occurs over 9 to 11 days (Hughes 1999; Johnson et al. 2008). Development of the young is very rapid, with fledging occurring in 6 to 9 days; the entire breeding cycle may be only 17 days from egg laying to fledging of the young (Hughes 1999). Fledglings are dependent upon parents for up to 3 weeks following fledging (Johnson et al. 2008). Females often switch mates between broods within years and usually select a new mate in subsequent years. They can also be communal nesters with 2 females laying eggs in a nest and tending the young. Nests often have a helper male that tends the young (Laymon, pers. comm. 2012).

The western yellow-billed cuckoo is a long-distance migrant, although details of its migration patterns are not well known (Hughes 1999). It is a relatively late spring migrant, arriving on the breeding grounds starting mid- to late May, but more commonly in June, and leaving from late August to early September (Franzreb and Laymon 1993; Gaines

1999). The migratory route of the western yellow-billed cuckoo is not well known because few specimens collected on wintering grounds have been ascribed to the western or eastern subspecies. The western yellow-billed cuckoo likely moves down the Pacific Slope of Mexico and Central America to northwestern South America (Hughes 1999).

Western yellow-billed cuckoos may have variable breeding territory sizes, with territories reported to be as small as 10 acres on the Colorado River (Laymon and Halterman 1989), but with a range of 20 to 100 acres on the South Fork Kern River (Laymon 1998). Recent data from radio telemetry studies on the Colorado, San Pedro, and Rio Grande rivers have shown larger home ranges. Cuckoos on the Rio Grande in New Mexico used an average of 204 acres (Sechrist et al. 2009), while cuckoos on the San Pedro River in Arizona, averaged about 125 acres (Halterman 2009). On the Colorado River in Arizona and California, cuckoos home ranges averaged about 95 acres (McNeil et al. 2010; McNeil et al. 2011a, 2011b). Whether western yellow-billed cuckoos are "territorial" in the sense of defending a spatially defined area is uncertain, although individuals have been observed to aggressively supplant each other (Hughes 1999).

Dispersal and the degree to which the western yellow-billed cuckoo shows site fidelity is largely unknown. The absence of pairs on known breeding sites in some years and presence of breeding birds on previously vacant sites demonstrates that breeding may not occur in the same location every year (Gaines and Laymon 1984).

General Distribution and Populations Trends

The western yellow-billed cuckoo's historical geographic range is southwestern British Columbia, western Washington, northern Utah, central Colorado, western Texas, south and west to California, and southern Baja California, Sinaloa, and Chihuahua in Mexico (Hughes 1999). The western yellow-billed cuckoo is rare and local in the southwestern United States. It breeds along the major river valleys in southern and western New Mexico, and central and southern Arizona. In California, the western yellow-billed cuckoo's breeding distribution is now thought to be restricted to isolated sites in the Sacramento, Amargosa, Kern, Santa Ana, and Colorado River valleys (Laymon and Halterman 1987). During surveys in 1999 and 2000 western yellow-billed cuckoos were not found on the Amargosa and Santa Ana rivers (Laymon, pers. comm. 2012).

Western yellow-billed cuckoo was once considered common to numerous in the Sacramento Valley, along the southern coast of California from Ventura to Los Angeles counties, and in Kern County in the late 1800s, but it was considered only fairly common by the 1920s (Gaines 1974; Gaines and Laymon 1984). The numbers of yellow-billed cuckoos in California and other western areas had declined markedly into the 1980s with loss of

riparian habitats (Laymon and Halterman 1987). Surveys in 1986 and 1987 showed a decline from 123 to 163 pairs in 1977 to 30 to 33 pairs in 1987, or a 73% to 82% decline over this 10-year period (Laymon 1998). The most recent statewide surveys in 1999 and 2000, including the Sacramento, Kern, and Lower Colorado rivers (1999 only), as well as other areas with smaller amounts of habitat, documented 41 to 45 pairs and 49 unmated birds in 1999, and 61 to 67 pairs and 61 to 68 unmated birds in 2000 on the Sacramento and Kern rivers (Halterman et al. 2003). Although the number of detected pairs was higher in 1999-2000 compared to 1986-1987, there were still substantially fewer pairs than detected in 1977.

The western yellow-billed cuckoo suffered substantial range reductions in the twentieth century due to loss of riparian habitat (Laymon and Halterman 1987). The species was extirpated north of Sacramento Valley by the 1950s (Gaines and Laymon 1984). Surveys throughout California in 1986–1987 found that only three areas in the state supported more than approximately five breeding pairs on a regular basis, including the Sacramento River between Colusa and Red Bluff, the South Fork of the Kern River, and the lower Colorado River (Johnson et al. 2008). In the 1999-2000 surveys, the Sacramento and Kern rivers were the only remaining areas with more than 1,000 hectares (2,470 acres) each of prime suitable habitat (i.e., high canopy cover, extensive understory, and structural diversity) (Halterman et al. 2003).

Within the Plan Area, the majority of CNDDB records are from the Colorado River (CDFW 2013). Once considered abundant throughout the lower Colorado River, a dramatic decline of the species was noted during surveys in the 1970s and 1980s. The lower Colorado River and its tributaries supported an estimated 180–240 pairs in 1976–77. This population declined by an estimated 80% to 90% by 1986. In 1998, no pairs could be identified west of the Colorado River in the parts of California that had been occupied in 1976–77. Along the lower Colorado River and its major tributaries, losses have been greatest at lower elevations below 900 meters (3,000 feet) (Johnson et al. 2008).

Reasons for Decline

The western yellow-billed cuckoo is sensitive to habitat fragmentation and degradation of riparian woodlands due to agricultural and residential development (Hughes 1999), and major declines among western populations reflect local extinctions and low colonization rates (Laymon and Halterman 1989). Groundwater pumping and the replacement of native riparian habitats by invasive non-native plants, especially tamarisk, have substantially reduced the area and quality of available breeding habitats for yellow-billed cuckoo (75 FR 69222–69294). Even where habitat is not degraded, the species has been extirpated from breeding areas occupied by four or fewer pairs (Laymon and Halterman 1987), possibly

due to the inherent instability of small populations (Laymon and Halterman 1989). The extensive surveys in 1999 and 2000 found that large breeding populations in California only remain on the Sacramento and Kern rivers where there is still substantial prime habitat (Halterman et al. 2003).

Pesticides may affect behavior of western yellow-billed cuckoo by loss of balance or may cause death by direct contact (Hughes 1999). Pesticides may contaminate preferred prey items, particularly lepidopteran larvae. In addition, some prey species, such as frogs, occur in pesticide-laden runoff adjoining agricultural land (Laymon and Halterman 1987). The western yellow-billed cuckoo also has shown pesticide effects on reproduction due to eggshell thinning (Gaines and Laymon 1984; Laymon and Halterman 1987). Of the 33 known occurrences in the Plan Area, agriculture (and associated access roads) adjacent to occupied habitat was reported to be a threat to five of the sites (CDFW 2013).

Climate change may be a stressor on yellow-billed cuckoos. For a more detailed discussion of the potential effects of climate change on yellow-billed cuckoos, refer to the species profile in Appendix B.

5.2.12.2 Habitat Characteristics

This discussion is limited to breeding habitat requirements for western yellow-billed cuckoo in California. Breeding habitat primarily consists of large blocks, or contiguous areas, of riparian habitat, particularly cottonwood–willow riparian woodlands (66 FR 38611–38626). From a survey conducted from northern Kern and Inyo counties south in 1986 and from southern Kern and Mono counties north in 1987, Laymon and Halterman (1989) proposed that optimum habitat patches for the western yellow-billed cuckoo are greater than 200 acres in size and wider than 1,950 feet; sites 101 to 200 acres in size and wider than 650 feet were suitable; sites 50 to 100 acres in size and 325 to 650 feet were marginal; and sites smaller than these dimensions were unsuitable. Western yellow-billed cuckoo prefers dense riparian thickets with dense low-level foliage near slow-moving water sources. Nests are constructed in willows on horizontal branches in trees, shrubs, and vines, but cottonwoods are used extensively for foraging, and humid lowland forests are used during migration (Hughes 1999).

5.2.12.3 Occurrence within Plan Area

The CNDDB contains 28 historical (i.e., pre-1990) occurrence records dating from 1917 to 1986. Of the known occurrences, 24 are from 2 years: 1977 (13), and 1986 (11). Single known occurrences are from 1917, 1945, 1964, 1978, and 1983. Of the historical known occurrences in the Plan Area, 23 are from the Lower Colorado River, with 14 known

occurrences from Imperial County, ranging from the Palo Verde area to the U.S.–Mexico border; 6 from eastern Riverside County in the Blythe area; and 2 from San Bernardino County in the Needles area. Five of the historical known occurrences are from the Amargosa River, Tecopa, China Ranch, and Independence areas in Inyo County, and 2 are from the Mojave River in the Upper Narrows and Hodge areas in San Bernardino County. Of the 28 historical occurences, the majority are on ppublic land.

In the Sacramento Valley, the south coast (including Ventura and Los Angeles counties), and Kern County, yellow-billed cuckoos were considered common to numerous in the late 1800s, but only fairly common by the 1920s (Hughes 1999). By the 1950s, the subspecies had been extirpated north of Sacramento Valley (Hughes 1999). The species may also no longer breed in the Amargosa and Santa Ana rivers (Laymon, pers. comm. 2012).

The CNDDB contains nine recent (i.e., since 1990) occurrences for the Plan Area: a 1991 known occurrence in the Alabama Hills near Lone Pine, a 1998 known occurrence from the Laguna Dam area of the Colorado River in Imperial County, a 2009 occurrence north of the Cibola NWR, a 2009 occurrence in the Imperial NWR area, and 3 2009 occurrences along the Colorado River in the Palo Verde Ecological Reserve in Riverside County (CDFW 2013; see Figure SP-B15 in Appendix B).

The model generated 174,654 acres of modeled suitable habitat for western yellow-billed cuckoo in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.13 Willow Flycatcher

There are four currently recognized subspecies of willow flycatcher (*Empidonax traillii*), three of which occur in California (*E. t. brewsteri*, *E. t. adastus*, and *E. t. extimus*) (USFWS 2002). Only the southwestern willow flycatcher subspecies (*E. t. extimus*) breeds in the Plan Area, and it is the primary focus of this account, including the discussions of natural history, distribution, reasons for decline and population trends, and habitat characteristics. The other two subspecies occur in the Plan Area only briefly during migration, and they are addressed in this account where relevant.

5.2.13.1 Status and Distribution

Regulatory Status

The willow flycatcher is state listed as endangered and the southern willow flycatcher subspecies is also federally listed as endangered. Critical habitat was designated on October 19, 2005 (70 FR 60886–61009) for southwestern willow flycatcher. The U.S. Fish

and Wildlife Service (USFWS) proposed revised critical habitat on August 15, 2011 (76 FR 50542-50629), but the 2005 designation is still in place pending issuance of a final rule. There is a Final Recovery Plan (USFWS 2002) for southwestern willow flycatcher.

Natural History

Southwestern willow flycatchers are insectivorous and forage at the edges or internal openings of their territory, above the canopy or over open water. Their diet consists mainly of bees, wasps, flies, leaf hoppers, and beetles (Durst et al. 2008b), which they catch in the air, glean from vegetation, or occasionally pick, catch, or seize from the ground (Sedgwick 2000). Presumably, the diets of migrating *E. t. adastus* and *E. t. brewsteri* are similar.

Southwestern willow flycatcher males and females become reproductively viable during their second year. This subspecies is predominantly monogamous although reports of polygyny are not uncommon (Sedgwick 2000). Males arrive at the breeding sites between early May and early June (USFWS 2002). Females arrive 1 to 2 weeks after males and inhabit the territory of a male (Finch and Stoleson 2000). Nest building begins approximately 2 weeks after pair formation. Females build an open cup nest measuring 8 centimeters high by 8 centimeters wide (3.1 by 3.1 inches) with little to no assistance from the male. The female incubates the eggs for an average of 12 to 13 days. The nestlings fledge between 12 and 15 days after hatching (Sogge et al. 2010). Southwestern willow flycatcher will typically renest following an unsuccessful attempt and less frequently may renest following a successful attempt.

During their northbound and southbound migrations, other subspecies of willow flycatcher pass through areas occupied by nesting southwestern willow flycatchers. In Southern California, peak numbers of northbound *E. t. brewsteri* migrate the first couple weeks of June through occupied *extimus* breeding territories (Finch and Stoleson 2000). Therefore, for the purpose of focused surveys for southwestern willow flycatcher, willow flycatchers occurring within the southwestern willow flycatcher breeding range can only be assumed to be southwestern willow flycatcher if detected between June 15 and July 20, when *E. t. brewsteri* have passed north to their breeding grounds (USFWS 2002). Willow flycatchers in the southwest migrate along riparian corridors (Finch and Stoleson 2000); because all three subspecies in California seasonally occur both north and south of the Plan Area, any riparian habitat within the Plan Area might represent important migration habitat for willow flycatchers. Finch and Kelley (1999) found that while migrating along the Rio Grande, willow flycatchers (including *E. t. extimus*) preferred habitats dominated by willows over other riparian species.

Wintering locations for southwestern willow flycatcher are becoming better understood. Paxton et al. (2011a) combined information from mitochondrial DNA sequences and morphological characteristics from museum specimens collected for willow flycatchers from across their winter range and found that the Pacific lowlands of Costa Rica appear to be a key winter location for southwestern willow flycatcher, although Central American countries may also be important for the subspecies. Willow flycatchers will travel between 3,200 and 8,000 kilometers (2,000 and 5,000 miles) round-trip from their wintering sites to their breeding sites. During migration, willow flycatchers use a greater variety of habitats, including some with non-riparian vegetation (Finch and Stoleson 2000).

As is common for passerine bird species, southwestern willow flycatcher juveniles, eggs, and (less often) adults, are preyed upon by other birds, mammals, and reptiles. Predation is often the main factor responsible for nest failure (Sogge et al. 2010). Brown-headed cowbirds, which are obligate brood parasites, parasitize the nests of several native passerine species, including southwestern willow flycatcher, and therefore also contribute to the overall nest failure for this subspecies. Despite evidence for parasitism, brown-headed cowbirds are not considered a primary threat to the success of the southwestern willow flycatcher (Sogge et al. 2010). This subspecies may be able to coexist with cowbirds as a stable population in the absence of other threats (USFWS 2002). Brown-headed cowbirds appear to be more of a threat at small, isolated nesting sites (Sogge et al. 2010).

Refer to Appendix B for more information regarding the natural history of willow flycatcher.

General Distribution and Populations Trends

The willow flycatcher occurs throughout the United States with the exception of the extreme northeast and the southeast. In California, breeding populations of *E. t. adastus* and *E. t. brewsteri* are separated by the crest of the Sierra Nevada, while the historical range of *E. t. extimus* includes riparian habitats in the southern one-third of California, southern Nevada, Arizona, New Mexico, western Texas and northern Mexico (Sogge et al. 2010; (USFWS 2002; see Figure SP-B13 in Appendix B), and, again, this is the only subspecies breeding in the Plan Area. The current range of *E. t. extimus* is similar to its historical range, the main difference being a reduction in the distribution and amount of existing suitable habitat within its historical range. This subspecies' breeding range extends as far north as the Santa Ynez River, Kern River, and the town of Independence on the Owens River (Craig and Williams 1998). Outside of California, historical breeding has occurred in southern Nevada, southern Utah, Arizona, New Mexico, and southwestern Colorado (Paxton 2000; Sogge et al. 2010).

From the mid-1900s to the 1980s, populations of southwestern willow flycatcher declined rapidly (Unitt 1987). As of 2007, there were 1,299 known territories occurring within 288 breeding sites throughout the southwestern willow flycatcher's range. Of the 1,299 territories, 930 were surveyed in 2007 and the remaining 369 had been surveyed in 2006 or earlier (Durst et al. 2008a). Short-term studies on southwestern willow flycatcher have shown either a decline in population or no trend (Finch and Stoleson 2000). Within the Plan Area, significant declines have occurred along the Lower Colorado River, and occupied sites have declined in the Mojave River (Durst et al. 2008a). Overall, this subspecies is considered to be in decline (NatureServe 2011).

The majority of known territories and breeding sites occur in Arizona, New Mexico, and California. As of 2007, 96 breeding sites supporting approximately 172 territories have been documented in California, accounting for about 33% of all documented breeding sites in the subspecies' range and 13% of all documented nesting territories for that year (Durst et al. 2008a). Arizona and New Mexico currently account for the majority of the documented breeding sites (57%) and documented territories (75%) (Durst et al. 2008a). In California, the largest populations are along the South Fork Kern River, the Owens River, San Luis Rey River, and Santa Margarita River (USFWS 2002); a portion of the Owens River occurs within the Plan Area (but few, if any, actual territories now occur within the Plan Area).

The other two California subspecies of willow flycatcher, *E. t. adastus* and *E. t. brewsteri*, have also suffered severe declines and consequently are also listed as endangered by the State of California. Intense agricultural and flood control activities in the Central Valley virtually eliminated the riparian habitat used by *E. t. brewsteri* (Serena 1982), and both *E. t. adastus* and *E. t. brewsteri* meadow habitats in the Sierra Nevada have been impacted by grazing (Stefani et al. 2001).

Reasons for Decline

The primary threat to the southwestern willow flycatcher is loss, modification, and fragmentation of suitable riparian habitat (Sogge et al. 2010). In general, increased human populations and development have resulted in a decline of riparian habitat, a habitat type that is naturally rare, patchy, and dynamic in the Southwest due to the varying hydrologic conditions of the region. The specific primary causes for loss and modification of riparian habitats have been dams and reservoirs, water diversion and groundwater pumping, channelization, flood control, agriculture, recreation, and urbanization (Sogge et al. 2010).

Impacts on suitable riparian habitat and conversion of adjacent native upland habitat have also resulted in indirect effects that are detrimental to this subspecies. Brown-headed cowbirds are typically associated with anthropogenic influences, such as agriculture (cattle

grazing), recreation (camp grounds and golf courses), and urbanization (lawns) (USFWS 2002). Although cowbird parasitism is not considered to be a primary threat to southwestern willow flycatcher, combined with other threats and stressors such as habitat loss and degradation, cowbird parasitism could be a significant contributor to population decline (USFWS 2002).

In California, the invasion of tamarisk and giant reed (*Arundo donax*) in riparian habitats has also been facilitated by anthropogenic disturbances (USFWS 2002). Although southwestern willow flycatcher is known to nest in monotypic stands of tamarisk, it is highly flammable and has been suggested to pose a threat to southwestern willow flycatcher habitat (USFWS 2002; Finch and Stoleson 2000). However, while some territories have been lost in the last 20 years due to tamarisk fires, tamarisk has also supported many nesting territories, which have produced many hundreds of fledged flycatchers, which maintain and augment the population (Sogge, pers. comm. 2012). Additionally, Paxton et al. (2011b) concluded that using biocontrols such as tamarisk beetle (*Diorhabda* spp.) to eradicate tamarisk may negatively affect birds that have restricted distributions and sensitivity to seasonal defoliation, such as southwestern willow flycatcher, both in the short term and long term. Potential long term adverse and beneficial effects will be related to the rate regeneration and/or restoration of cottonwood and willow riparian habitats relative to the rate of loss of tamarisk. Therefore, for southwestern willow flycatcher, its relationship to tamarisk is more complex than tamarisk simply increasing fire risk (Sogge, pers. comm. 2012). Giant reed forms large monotypic stands that are unsuitable for the subspecies (USFWS 2002) and are also subject to large fires. The risk of fire has also increased along streams where the flow of water has been reduced, due to dams or flood control, allowing for the accumulation of fuel in the understory (USFWS 2002).

Grazing, cowbirds, and water removal (Owens Valley) projects continue to be a threat to Sierra Nevada populations of *E. t. brewsteri* and *E. t. adastus* within their breeding range. Within the Plan Area, the same threats mentioned above for *E. t. extimus* would affect *E. t. brewsteri* and *E. t. adastus* where they impact riparian migration corridors.

5.2.13.2 Habitat Characteristics

In California, the southwestern willow flycatcher is restricted to riparian habitats occurring along streams or in meadows (Craig and Williams 1998; Sogge et al. 2010). As noted above under Distribution and Occurrences, there is a dynamic relationship between suitable habitat and selection of breeding sites, with individuals commonly moving within general breeding areas and among different breeding areas. The structure of suitable habitat typically consists of a dense mid-story and understory and

can also include a dense canopy (60 FR 10695–10715). However, suitable vegetation is not uniformly dense and typically includes interspersed patches of open habitat. Typical plant species associated with their habitat include willow, mulefat, stinging nettle (*Urtica* spp.), cottonwood, tamarisk, and Russian olive (*Elaeagnus angustifolia*). Within the habitat structure parameters discussed above, southwestern willow flycatcher does demonstrate adaptability in that it can occupy riparian habitats composed of native broadleaf species, a mix of native and exotic species, or monotypic stands of exotics (Sogge et al. 2010). This subspecies is known to nest in monotypic stands of Russian olive and tamarisk (60 FR 10695–10715). Furthermore, along the San Luis Rey River in San Diego County, southwestern willow flycatcher has nested in riparian habitat dominated by coast live oak (*Quercus agrifolia*), and in Cliff−Gila Valley in New Mexico they are known to nest in tall box-elder. Plant species composition does not seem as important as a dense twig structure and an abundance of live, green foliage (Sogge et al. 2010). Also, the location of the nest seems to depend more on suitable twig structure and live vegetative cover than height or plant species composition (Sogge et al. 2010).

Riparian habitats within the Plan Area are also important stopovers to *E. t. adastus* and *E. t. brewsteri* as they migrate through (Finch and Kelley 1999). However, during migration willow flycatchers also use non-riparian habitats, including shrublands, grasslands, and agriculture (Finch et al. 2000). Other habitats used during migration typically lack the features associated with breeding sites, such as standing water, moist soils, and patch size and structure (Finch et al. 2000).

Southwestern willow flycatcher nesting sites are generally located near surface water or saturated soils. Due to the variability of hydrologic conditions in Southern California, water availability at a site may range from inundated to dry from year to year or within the breeding season. Nonetheless, moisture levels must remain high enough to support appropriate riparian vegetation (Sogge et al. 2010). Dense willow thickets are the most important habitat component for breeding *E. t. adastus* and *E. t. brewsteri* in California (Stefani et al. 2001).

5.2.13.3 Occurrence within Plan Area

Within the Plan Area, breeding southwestern willow flycatchers have been found at five general locations: Owens River Valley, Mojave River, San Felipe Creek (a tributary of the Salton Sea), the Lower Colorado River between Hoover and Parker, and the Lower Colorado River between Parker and the international boundary, which are discussed in detail below (Durst et al. 2008a). Willow flycatcher populations at these locations still exist, although numbers of territories have greatly declined at some locations, especially along the

Colorado River (Durst et al. 2008a). There are no known general locations in the Plan Area that previously supported, but no longer support, southwestern willow flycatchers.

Owens River Valley: Most recently (as of 2007), Durst et al. (2008a) identified 28 territories at five sites in the Owens River Valley. However, almost all these territories occur north of the Plan Area. Within the Plan Area, two territories were located along the Owens River near Lone Pine in 1999, but the current breeding status at this location is unknown. Rourke et al. (2004) surveyed Hogback Creek near Lone Pine in 2001, but found no southwestern willow flycatchers. It is possible that none of the extant southwestern willow flycatcher territories found in the Owens River Valley occur within the Plan Area.

Mojave River: Durst et al. (2008a) stated that as of 2007, four nesting territories occur along the Mojave River near Victorville, but that territories are now gone from at least three other sites (Oro Grande, Upper Narrows, and Victorville I-15). Nearby Holcomb Creek also once supported nest territories.

San Felipe Creek: San Felipe Creek is a tributary of the Salton Sea and as of 2007 supported four southwestern willow flycatcher nesting territories (Durst et al. 2008a).

Lower Colorado River – Hoover to Parker: As of 2007, Durst et al. (2008a) identified 14 territories remaining at six sites along this stretch of the Colorado River. However, most of these territories occur at Topock Marsh on the Arizona side of the border. A California territory at Trampas Wash is considered extirpated (Durst et al. 2008a).

Lower Colorado River – Parker to South International Border: At one time, breeding southwestern willow flycatchers were located at 16 sites along this stretch of the Lower Colorado River, mostly on the Cibola and Imperial NWRs. By 2007, the number of territories was reduced to one. McLeod and Koronkiewicz (2009) resurveyed this stretch in 2008 and "rediscovered" some territories (e.g., at Big Hole Slough), but territory numbers remain very low.

There are four historical (i.e., pre-1990) occurrences for southwestern willow flycatcher recorded in the Plan Area (CDFW 2013; Dudek 2013). The southwestern willow flycatcher occurrences are located north of Independence in Inyo County and in the vicinity of the cities of Mojave and California City(Figure SP-B13). There are 101 recent (i.e., since 1990) occurrence records for willow flycatcher;the vast majority are only identified as willow flycatcher (CDFW 2013; Dudek 2013). There are five recent records for southwestern willow flycatcher along the Lower Colorado River in the stretch between the Cibola and Imperial NWRs, just south of where I-10 crosses the river, and in

the Havasu NWR area. There are also recent occurrences for southwestern willow flycatcher north of Niland east of the Salton Sea, in the Mojave River Narrows Regional Park, and in a tributary to the Owens River just above Tinemaha Reservior. The remaining 100 recent willow flycatcher occurrences are located in several regions of the Plan Area, including the Ridgecrest and China Lake Naval Air Weapons Station, the Fremont Valley in the western Mojave, Amargosa Canyon, the southern Sierra Foothills west of Red Rock Canyon State Park, the cities of Mojave and California City, Galileo Park north of 20 Mule Team Parkway, the southwestern portion of Edwards Air Force Base, the western portion of Mojave National Preserve, the Kingston Range, the Morongo Valley, Lake Tamarisk Golf Course in the Chuckwalla Valley, and north of Niland east of the Salton Sea (see Figure SP-B13 in Appendix B).

The model generated 329,611 acres of modeled suitable habitat for southwestern willow flycatcher in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.2.14 Yuma Clapper Rail

5.2.14.1 Status and Distribution

Regulatory Status

The Yuma clapper rail (*Rallus longirostris yumanensis*) is a state-listed threatened and a fully protected species in California. It is also a federally listed endangered species. A federal recovery plan for the Yuma clapper rail was completed in 1983 by the USFWS (1983b) and a Draft Revised Recovery Plan was published in February 2010 (USFWS 2010c).

Natural History

The principal prey of the Yuma clapper rail are two introduced species of crayfish (*Procambarus clarkii* and *Orconectes virilis* (Inman et al. 1998). Ohmart and Tomlinson (1977) found that about 95% of the stomach contents of two Yuma clapper rail specimens were crayfish, leading them to suggest that the range shift of the Yuma clapper rail may have been facilitated by the introduction and spread of the crayfish. Other prey items taken by Yuma clapper rail include small fish, insects, amphibian larvae, clams, and other aquatic invertebrates (Todd 1986; USFWS 2010c).

The Yuma clapper rail begins breeding activities in the early spring, usually in March or early April (Eddleman 1989), although mating calls may be heard as early as February (USFWS 2010c). Breeding begins with the establishment of breeding territories. Birds occupying more peripheral territories may mate a month or so later (Arizona Game and

Fish Department [AGFD] 2007). Both males and females vigorously defend territories. Nesting occurs from March through May, but can vary with location and annual seasonal rainfall patterns (USFWS 2010c).

Observed clutch sizes for 15 Yuma clapper rails nests in the lower Colorado River and Salton Sea ranged from 5 to 8 eggs (Eddleman and Conway 2012). Incubation was observed to last 23 to 28 days at nests in Arizona (Eddleman and Conway 2012). Both males and females incubate the eggs, with males incubating during the night shift and females incubating during the day (Eddleman 1989). Hatching success is high but juvenile mortality is also high (Bennett and Ohmart 1978; Eddleman 1989).

Young are precocial and within about 2 days of hatching they accompany adults on foraging trips, learning quickly to capture their own prey (Hunter et al. 1991). Family groups stay together for about 1 month, after which time the chicks separate from the parents. First flight occurs about 60 days after hatching (AGFD 2007).

An important nesting consideration is the ability of the Yuma clapper rail to move nests in response to shifts in high water level (Bennett and Ohmart 1978; Eddleman 1989; Jackson 1983). Although nests may be from 6 centimeters (approximately 2.5 inches) to over 1 meter (approximately 3.3 feet) above the water level (average = 19.8 centimeters [approximately 7.8 inches]) (Eddleman 1989), as water levels rise, the birds may raise the level of existing nests or move eggs to a different nest. Consequently, the Yuma clapper rail may have several nests available for use (Conway and Eddleman 2000, cited in USFWS 2010c).

The Yuma clapper rail shows seasonal variability in its use of habitat and in its home range size (USFWS 2010c). It was first assumed that the Yuma clapper rail migrated south during the winter (Smith 1974; Todd 1986), but Eddleman (1989) observed that up to 70% of the populations he studied remained at their site year-round. The exact nature and extent of migratory activity by the Yuma clapper rail remains unclear and is an important topic for future research (USFWS 2006b, 2010). For a more detailed discussion on the movement patterns of Yuma clapper rail, refer to the species profile in Appendix B.

Home ranges are variable over different seasons, ranging on average from 7 to 8 hectares (17 to 20 acres) in the early and late breeding periods, to 15 hectares (37 acres) in the post-breeding period, and 24 hectares (59 acres) in the late winter period (Conway et al. 1993). Females have larger ranges than males in the post-breeding period at 21 hectares (51 acres), compared to 9 hectares (22 acres), but the two sexes have similar home range sizes the rest of the year (Eddleman 1989).

The Yuma clapper rail is prey for several species, including coyote, common raccoon, great horned owl, Harris' hawk (*Parabuteo unicinctus*), and northern harrier (USFWS 2010c). Because these predators are generalists, however, the rail probably is not a critical element of their diets and likely is taken opportunistically.

General Distribution and Populations Trends

The Yuma clapper rail breeds along the lower Colorado River (including La Ciénega de Santa Clara in Mexico), the Gila River drainage in Arizona, Lake Mead (and the Overton Arm) and its local tributaries, the Virgin River in Nevada and Utah, and the Salton Sea/Imperial Valley areas of California. Figure 1 shows the general breeding range of the species, while Figure SM-B16 indicates known occurrence in the Plan Area. In the Plan Area, the main habitat areas for this subspecies are located along the Colorado River and around the Salton Sea (including Dos Palmas Springs).

There are at least three "outlier" observations for Yuma clapper rail. In 1977, an individual was identified by vocalization on several days at Harper Lake northwest of Barstow (Figure SP-B16) but was not observed subsequently and was considered to be an unpaired individual (CDFW 2013). In 1978, the Yuma clapper rail was identified at Cronese Lake in the central Mojave (Garrett and Dunn 1981). In 1989, a single Yuma clapper rail was observed at the Ash Meadows National Wildlife Area located about 90 miles northwest of Las Vegas.

The Yuma clapper rail in the United States has shown recent range extensions northward from the Colorado River Delta and the southern end of the Colorado River into Lake Mead and the Virgin River, indicating that the species is reproducing enough to support such expansion (USFWS 2006b, 2010). The species' first recovery plan (USFWS 1983b) indicated that the breeding population had been stable for 10 years at the desired level of 700 to 1,000 individuals. As a result, a down-listing package was prepared for the Federal Register in 1983. However, subsequent flooding of important habitat on the Lower Colorado River resulted in the proposal not being published (USFWS 2006b). For a more detailed discussion on the assessment of long-term population trends for the Yuma clapper rail, refer to the species profile in Appendix B.

Reasons for Decline

Habitat destruction and modification is a primary threat to the Yuma clapper rail (USFWS 2010c). The natural hydrologic regime along the Lower Colorado River has been altered by damming, channelization, and bank stabilization, the last of which has separated the main river channel from backwater and floodplain areas where marsh habitats would naturally

form (USFWS 2010c). While damming has likely created additional marsh habitat for rail in some areas, the dams have resulted in altered flood regimes from historical seasonal winter and spring flooding events that are necessary to maintain healthy marsh systems. These natural flooding events would have removed much of the thick matting of dead vegetation and build-up of sediments that allow for efficient foraging and escape from predation. Without active management, the value of these marsh habitats for Yuma clapper rail is reduced, and the habitat may disappear altogether (USFWS 2010c). On the other hand, dams have also resulted in sedimentation of ancillary streams and creeks upstream, thereby increasing the extent of backwaters and marshes available for the Yuma clapper rail. This creation of new habitat has been cited as one reason for the expansion of the species' range upstream.

5.2.14.2 Habitat Characteristics

Among the subspecies of clapper rail, only *yumanensis* is known to breed in freshwater marshes. By far, the preferred habitat consists of cattails and bulrush (Anderson and Ohmart 1985; Todd 1986; Eddleman 1989).

Optimum habitat for the Yuma clapper rail results from a complex interplay of water levels, appropriate vegetation and vegetation characteristics (e.g., matting, dry areas, senescence), the timing of seasonal flooding, and possibly the timing of crayfish reproduction (Bennett and Ohmart 1978; Todd 1986). In a draft Recovery Plan for the Yuma clapper rail, the USFWS (2010) characterized optimum habitat as consisting of:

> "…a mosaic of emergent vegetation averaging greater than 2 meters (6 feet) high (Anderson and Ohmart 1985; Eddleman 1989), shallow (less than 30 centimeters [12 inches]) open water areas either as channels or pools with minimal daily water fluctuation (Tomlinson and Todd 1973; Gould 1975), open dry ground (slightly higher than the water level) between water, vegetation, or marsh edge for foraging and movement (Gould 1975; Anderson and Ohmart 1985; Eddleman 1989; Conway et al. 1993), and a band of riparian vegetation on the higher ground along the fringes of the marsh that provides cover and buffer areas that may be used seasonally (Eddleman 1989)."

An overriding consideration for nesting by the Yuma clapper rail is that the nest substrate be stable (Eddleman 1989; USFWS 2006b, 2010). Sparsely vegetated areas are more likely to be occupied if crayfish are abundant (Anderson and Ohmart 1985). The Yuma clapper rail depends on a continuous source of water, most likely because crayfish are similarly dependent. However, the species also seems tolerant of seasonal fluctuations in water level

that characterize the Colorado River (Eddleman 1989), as long as the change in level is not too abrupt (Conway and Eddleman 2000, cited in USFWS 2010c). Similarly, Gould (1975) suggested that short-term changes in water level should be avoided. Rails may have several nests and can move eggs to nests that are less threatened if need be, but if the habitat dries out, rails will abandon the area (Bennett and Ohmart 1978; Johnson and Dinsmore 1985). For a more detailed discussion on the habitat requirements of Yuma clapper rail, refer to the species profile in Appendix B.

5.2.14.3 Occurrence within Plan Area

The historical distribution of the Yuma clapper rail is unclear. Todd (1986), in an extensive investigation of the Yuma clapper rail literature, reported that rails were first observed by J.G. Cooper near Fort Mojave in 1884. This is likely the earliest record. However, Joseph Grinnell performed an extensive survey of the Colorado River between Needles and Yuma in 1914 and did not record any observations of this species. However, he later documented the Yuma clapper rail from the Lower Colorado River (Grinnell and Miller 1944, cited in Todd 1986). The Plan Area includes eight historical (i.e., pre-1990) CNDDB records for Yuma clapper rail, as well as others located just outside the Plan Area (CDFW 2013). Several of the historical occurrences are along the Lower Colorado River south of Parker to about 22 miles north of Yuma, Arizona. Historical occurrences are also located at the Salton Sea, along the All American Canal, the New River, and the Holtville main drain in the Imperial Valley, as well as a single record each atat Harper Lake in 1977 and Cronese Lake in 1978 (see Figure SP-B16 in Appendix B).

The Yuma clapper rail appears to respond positively to human activities that create habitat. Construction of dams both on the Colorado River and along adjacent tributaries has possibly contributed to the shift in the Yuma clapper rail's distribution (Ohmart and Smith 1973; Anderson and Ohmart 1985). These dams have the effect of creating sedimentation and backwater areas, thus providing additional shallow-water emergent habitat required by the Yuma clapper rail (CVAG 2007). In 1905, severe flooding of the region by the Colorado River broke through levees and allowed the Salton Sea to once again hold water, creating habitat that now supports Yuma clapper rails.

The recent (i.e., since 1990) documented distribution of the Yuma clapper rail in the Plan Area is similar to the historical distribution, but with some apparent expansion along the Colorado River. The distribution now ranges from about Lake Havasu to near Yuma, Arizona. The recent distribution in the Salton Sea/Imperial Valley area is similar to the historical distribution. The Coachella Valley Habitat Conservation Plan (CVCC 2007) reports the Yuma Clapper Rail is found on Salt Creek and the Dos Palmas oasis in the southern Coachella Valley. The CNDDB contains 37 records for the period between 1990

and 2010 (CDFW 2013) and the USFWS database includes 20 records from 2004 to 2010 (USFWS 2011b) (see Figure SP-B16 in Appendix B). (It appears that there is some overlap between the USFWS and CNDDB databases for the period from 2004 to 2010, but the USFWS database contains the most recent data from USFWS protocol surveys.)

The model generated 54,978 acres of modeled suitable habitat for Yuma clapper rail in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.3 Fish

5.3.1 Desert Pupfish

5.3.1.1 Status and Distribution

Regulatory Status

The desert pupfish (*Cyprinodon macularius*) is both state-listed and federally listed as endangered. Critical habitat for desert pupfish was designated in 1986 (51 FR 10842–10851) and a desert pupfish recovery plan was completed in 1993 (USFWS 1993).

Natural History

Pupfish are opportunistic omnivores, thriving on a diet of algae, aquatic plants, detritus, and small invertebrates (Crear and Haydock 1971 and Naiman 1979, as cited in Sutton 1999). Adult foods include ostracods, copepods, and other crustaceans and insects; pile worms; mollusks; and bits of aquatic macrophytes torn from available tissues (USFWS 1993). Legner et al. (1975) found that desert pupfish were more effective than mosquitofish at controlling mosquito populations. Pupfish have also been known to eat their own eggs and young on occasion. Detritus or algae are often predominant in their diets (USFWS 1993). Pit digging, the active excavation of soft bottoms in search of food, is a pupfish behavior described by Minckley and Arnold (1969); these pits are defended when occupied. Foraging is typically a daytime activity, and fish may move in response to daily warming from shallower water during morning to feed in deeper places later in the day (USFWS 1993).

Desert pupfish may become sexually mature as early as 6 weeks of age at 1.5 centimeters in length under conditions of abundant food and suitable temperature. Desert pupfish typically live for a year, but may live as long as 2 to 3 years. Although they may breed during their first summer, most do not breed until their second summer, when their length may have reached a maximum of 7.5 centimeters (Moyle 2002). In favorable conditions a pair of pupfish can

produce 800 eggs in a season (ICF 2009). Eggs appear to be randomly deposited within the male territory. Although males actively patrol and defend individual territories, there is no directed parental care (USFWS 1993).

McMahon and Tash (1988) found that when desert pupfish occupied open pools, 84% of the total number produced emigrated. They found that when pupfish were prevented from emigrating, pupfish exhibited symptoms of overpopulation. Characteristics of overpopulation were not apparent in pupfish occupying open pools. Seasonal temperatures influenced the timing and magnitude of emigration. In summary, pupfish may regulate their populations via emigration. Many of the locations where they are currently found are isolated from other populations. However, complete isolation mainly has been an issue in artificial populations, although even in these populations "complete isolation" no longer occurs given CDFW's recent inoculation of refuges with wild fish. Most natural populations have some connection to other populations occasionally (e.g., via flash flood), although these opportunities for mixing are brief and infrequent. This may become more of an issue given the uncertainty of the Salton Sea. Desert pupfish congregate in the summer where adult females swim in loose schools and leave the school when attracted by a territorial male to spawn. Pupfish movement between the Salton Sea and nearby drains has been observed (Sutton 1999). Sutton (2002) describes desert pupfish summer movement between a drain (although not connected directly to the Salton Sea) and a shoreline pool, as well as movement of approximately 0.5 kilometer (0.3 mile) from Salt Creek to a downstream shoreline pool (although not connected to the Salton Sea). Sutton (2002) hypothesizes that movements from Salt Creek to the shoreline pool were due to water level drops. The technique used by Sutton (2002) for tracking desert pupfish holds promise for further desert pupfish movement studies.

Currently, the major threat to the species is the presence of exotic aquatic species, particularly tilapia (*Tilapia* spp.), sailfin molly (Poecilia latipinna), , western mosquitofish (*Gambusia affinis*), several snail species, and crayfish (*Procambarus clarkii*). These and other introduced fish species primarily affect pupfish populations through predation, competition, and behavioral interference (CVAG 2007). Off-road vehicle use can be problematic in some areas, and currently is more of an issue than is grazing.

The desert pupfish appears to go through cycles of expansion and contraction in response to natural weather patterns (51 FR 10842–10851; USFWS 1993; Weedman and Young 1997, cited in USFWS 2010d). In very wet years, populations can rapidly expand into new habitats (Hendrickson and Varela-Romero 1989, cited in USFWS 2010d). In historical times, this scenario would have led to panmixia among populations over a very large geographic area (USFWS 1993).

General Distribution and Populations Trends

The desert pupfish occurs in desert springs, marshes, and tributary streams of the lower Gila and Colorado River drainages in Arizona, California, and Mexico. Natural populations of desert pupfish also occur in the Salton Sea and associated irrigation drains and shoreline pools. It also formerly occurred in the slow-moving reaches of some large rivers, including the Colorado, Gila, San Pedro, and Santa Cruz.

In its 5-year review, USFWS (2010d) concluded that threats to the species and their overall level of intensity remain similar to when the species was originally given a recovery priority number of 2C. Priority number 2C is indicative of a high degree of threat, a high potential for recovery, and taxonomic classification as a species.

Reasons for Decline

USFWS (2010d) summarizes the threats to desert pupfish survival. These include threats relating to destruction or curtailment of habitat or range (USFWS Factor A), including loss and degradation of suitable habitat through groundwater pumping or water diversion; contamination from agricultural return flows, as well as other contaminants; and physical changes to water properties involving suitable water quality. There is no new information to suggest that overutilization for commercial, recreational, scientific, or educational purposes (USFWS Factor B) are threats. The effect of disease or predation (USFWS Factor C) is a potential threat to desert pupfish. For a more detailed discussion of threats to the desert pupfish, refer to the species profile in Appendix B.

5.3.1.2 Habitat Characteristics

Found in water of desert springs, small streams, and marshes below 1,515 meters (5,000 feet) elevation (USFWS 1993), this species tolerates high salinities, high water temperatures, and low dissolved-oxygen concentrations. In the mid-2000s CDFW found desert pupfish in the Salton Sea at depths of 7 to 8 feet while conducting fish monitoring surveys. Pupfish typically prefer clear water, with either rooted or unattached aquatic plants, restricted surface flow, and sand–silt substrates (Black 1980; USFWS 1993). Pupfish use shallow water habitats extensively, often occupying such habitat at temperatures that are above the thermal optimum for invasive fishes. Pupfish do well if these habitats have little vegetation apart from mats of benthic algae over a fine-grained mineral or detrital substrate; they also utilize areas with aquatic or emergent vascular vegetation (ICF 2009). Desert pupfish in general are noted for their tolerance of environmental stress; they can tolerate dissolved-oxygen concentrations as low as 0.13 parts per million (Helfman et al. 1997). Their temperature tolerance ranges from a low of

4.4°C (Schoenherr 1990) to a high of 42.4°C (Carveth et al. 2006). Their salinity tolerance ranges from 0 to 70 parts per thousand for eggs and adults (Barlow 1958; Schoenherr 1988) and up to 90 parts per thousand for larvae (Schoenherr 1988). Martin and Saiki (2005) found that desert pupfish abundance was higher when vegetative cover, pH, and salinity were high and when sediment factor and dissolved oxygen were low. They hypothesize that water quality extremes (especially high pH and salinity, and low dissolved oxygen) limit the occurrence of nonnative fishes.

5.3.1.3 Occurrence within Plan Area

Historically, desert pupfish occurred in the Lower Colorado River in Arizona and California, from about Needles downstream to the Gulf of Mexico and onto its delta in Sonora and Baja (CVAG 2007). In California, pupfish inhabited springs, seeps, and slow-moving streams in the Salton Sink basin, and backwaters and sloughs along the Colorado River. Desert pupfish also occurred in the Gila River Basin in Arizona and Sonora, including the Gila, Santa Cruz, San Pedro, and Salt Rivers; the Rio Sonoyta of Arizona and Sonora; Puerto Penasco, Sonora; and the Laguna Salada Basin of Baja California. The Coachella Valley MSHCP (CVAG 2007) describes a refugium population in the larger pools around the Thousand Palms oasis area that has been extirpated by invasive exotics, particularly crayfish. A removal is underway, but pupfish have yet to be re-introduced. Overall, there are approximately four historical (i.e., pre-1990) desert pupfish occurrence records in the Plan Area (CDFW 2013; Dudek 2013). These occurrences are located within the southern portion of the Plan Area (Figure SP-F01), with the majority of occurrences detected in Imperial County.

Because *C. eremus* occurs only in southern Arizona and Mexico (USFWS 2010d) and *C. arcuatus* is now extinct, their distribution information is not discussed further; *C. macularius* is described within the Plan Area (see Figure SP-F01 in Appendix B). USFWS (2010d) describes that currently five natural populations persist in California, restricted to two streams tributary to, and many shoreline pools and irrigation drains of, the Salton Sea: San Felipe Creek/San Sebastian Marsh, Salt Creek (within the Dos Palmas Conservation Area of the Coachella Valley Multiple Species Habitat Conservation Plan [MSHCP; CVAG 2007]), Salton Sea, irrigation drains of the Salton Sea, and a wash near Hot Mineral Spa (a natural population added since the 1993 recovery plan). The desert pupfish population in Salt Creek is stable to increasing, and currently has few nonnative species (Keeney 2010a, cited in USFWS 2010d). San Felipe Creek also has a stable to increasing population. California Department of Fish and Wildlife (CDFW) surveys have found a persistent population of western mosquitofish (*Gambusia affinis*) in San Felipe Creek in recent years. In addition, there are a number of refuge or captive populations of desert pupfish in California at a variety of sites (USFWS 2010d): Anza-Borrego Desert State Park; Oasis Springs Ecological Reserve; Salton Sea State Recreation Area (RA); Dos Palmas Reserve;

Living Desert Museum; University of California, Riverside; and Borrego Springs High School. Currently, there are approximately 60 recent (i.e., since 1990) desert pupfish occurrences in the Plan Area in Imperial County, almost entirely around the Salton Sea (CDFW 2013; Dudek 2013; Figure SP-F01).

The model generated 8,155 acres of modeled suitable habitat for desert pupfish in the Imperial Valley portion of the Plan Area. A figure showing the modeled suitable habitat in the Plan Area is included in Appendix C.

5.3.2 Mojave Tui Chub

5.3.2.1 Status and Distribution

Regulatory Status

The Mojave tui chub (*Siphateles bicolor mohavensis*) is state-listed endangered and a fully protected species in California. It is also federally listed endangered as *Gila bicolor mohavensis* (CDFW adopted the genus *Siphateles* which was previously classified under the genus *Gila* based on taxonomic revision of the genus [Simons and Mayden 1998]). A recovery plan for the Mohave tui chub was completed in 1984 (USFWS 1984b).

Natural History

Not much is known about the specific diet of the Mohave tui chub. They forage on a variety of aquatic invertebrates, including plankton and insect larvae, small fish and organic detritus (Archdeacon 2007, cited in USFWS 2009a; NatureServe 2011). Ponds and pools that have aquatic vegetation provide habitat for these food sources (USFWS 2009a).

Mohave tui chubs spawn after 1 year of age (USFWS 1984b). Spawning begins during the spring in March and April when water temperatures are warm enough (64 degrees Fahrenheit [ºF]) (Vickers 1973, cited in USFWS 1984b). Spawning may occur in the fall as well. Egg masses are laid in vegetation where they become attached after fertilization. The eggs are approximately 0.04 inch in diameter and hatch after approximately 6 to 8 days when water temperatures are between 64ºF and 68ºF (USFWS 1984b).

Currently, the populations of Mohave tui chub are restricted to ponds and man-made channels where they do not have any connection to other populations. Past efforts to introduce or transplant additional populations generally have not been successful (USFWS 2009) with the exception of their current locations in Kern and San Bernardino Counties, California. A study conducted at Fort Soda in 1981–1982 found that Mohave tui chub populations increased two to three times during the spring and summer months, and then

decrease during the fall and winter months (Taylor 1982). A study examining the growth and population structure of the Mohave tui chub at a research station northwest of Barstow in the 1980s found that the population was highest in late summer and lowest in late winter (Havelka et al. 1982). Tui chubs gained weight in May, but lost up to 35% of their body weight from June to October before gaining weight again in November. This may be the result of higher metabolic rates during the summer coupled with a possible reduction in planktonic biomass (Havelka et al. 1982).

General Distribution and Populations Trends

Historically, the Mohave tui chub is believed to have occurred throughout the Mojave River drainage (Miller 1946, cited in USFWS 1984b). According to the recovery plan, the Mojave River drainage in the Mojave Desert originally consisted of the Mojave, Little Mojave, and Manix lakes; during the Pleistocene age, these lakes were connected through channels, and Mohave tui chubs were probably found throughout the drainage (USFWS 1984b). As the climate became drier and the lakes receded, the Mohave tui chub was restricted to the Mojave River. During the 1930s, arroyo chub was introduced into the Mojave River and likely hybridized with the Mohave tui chub, thus eliminating the genetically pure Mohave tui chub within the Mojave River (USFWS 1984b). A small population of genetically pure Mohave tui chub persisted in isolated ponds near the terminus of the Mojave River at Soda Springs. Four populations of the Mohave tui chub have also been successfully introduced at the Lark Seep complex at China Lake Naval Weapons Station, Camp Cady Wildlife Area (USFWS 2009a), the Lewis Center in Apple Valley, and Morning Star Mine at Mojave National Preserve. All of these populations are located within the Plan Area.

As concluded in the 2009 5-Year Review for the species, the Mohave tui chub "still meets the definition of endangered in the Act for the following reasons: (1) there are fewer populations of this subspecies now than at the time of listing; (2) the rare nature of this subspecies increases the risk of local extirpations from stochastic events; (3) all populations of the Mohave tui chub are threatened by one or more of the threats described in the Recovery Plan that contributed to its endangered status including habitat loss and alteration, predation from non-native species, with the additional, newly identified threats of parasitism, genetic drift, and extirpation from stochastic events; (4) the lack of consistent and reliable management and monitoring activities for these populations, which makes it difficult to identify and determine the magnitude and imminence of current threats, and therefore, to ensure that the threats will be identified in time and ameliorated; and (5) the failure to meet any of the downlisting or delisting criteria in the Recovery Plan" (USFWS 2009a).

Reasons for Decline

The American Fisheries Society publication of its endangered, threatened, or of special concern fishes of North America identified two main threats to Mohave tui chub: 1) the present threatened destruction, modification, or curtailment of its habitat or range; and 2) other natural or man-made factors affecting its continued existence (hybridization, introduction of non-native or transplanted species, predation, or competition) (Williams et al. 1989, cited in USFWS 2009a).

The Mohave tui chub is already extirpated from its historical distribution in the Mojave River. As one of the criteria for delisting the Mohave tui chub, the Recovery Plan includes the return of the Mohave tui chub into its historical range in the Mojave River. Over the years, the aquifer of the Mojave River has been overdrafted, resulting in the loss of aquatic habitat. Many of the areas within the river are now shallow and lack the lacustrine conditions once characteristic of portions of the Mojave River drainage, thus reducing the suitable habitat available for Mohave tui chub reintroduction.

A parasitic Asian tapeworm was found in Lake Tuendae (Soda Springs), and it initially had a deleterious effect on the population there. It was found to contribute to a reduced growth rate of Mohave tui chub in captivity, but not the survival rate (Archdeacon 2007). Research on Asian tapeworm parasitism has shown no longterm, debilitating impacts on Mohave tui chub populations (Archdeacon 2007, cited in USFWS 2009a).

Non-native species, such as bullfrogs and sport fish (e.g., bass and catfish), were introduced into the river. Predation on Mohave tui chub from these species contributed to its extirpation within the Mojave River (Williams et al. 1989, cited in USFWS 2009a). Mosquitofish were found in Lake Tuendae (Soda Springs) in 2001 and were found to reduce the survival rate of the chubs when no cover is provided in the environment (Archdeacon 2007). They also compete for food and other resources, which may pose a threat to the Mohave tui chub.

Other threats to the Mohave tui chub include regulatory mechanisms. For example, USFWS (2009b) states that the military installations do not obtain incidental take permits under the California ESA; however, China Lake Naval Air Weapons Station implements Section 7(a)(1) of the federal ESA, which requires Federal agencies to utilize their authorities in the furtherance of the purposes of the ESA by carrying out programs for the conservation of federally endangered and threatened species.. It should be noted that at the time of the 5-Year Review, the only proposed activities that would result in the take of Mohave tui chub were for research permits which is purposeful take (USFWS 2009a).

5.3.2.2 Habitat Characteristics

Historically, within the Mojave River, the Mohave tui chub was associated with deep pools and sloughs of the river and was not found very far into small tributaries (USFWS 1984b). Although the Mohave tui chub does not currently occupy the Mojave River, a few perennial stretches of the river remain that could support a fishery. The habitat requirements for this species include configuration, ecology, and water quality (Archbold 1996, cited in USFWS 2009a). The configuration of a lacustrine pond or pool should include a minimum water depth of 4 feet with some freshwater flow for a mineralized and alkaline environment (USFWS 2009a; NatureServe 2011). The pools or ponds should include some aquatic plants (e.g., *Ruppia maritima*, *Typha* spp., and *Juncus* spp.), which provide habitat for aquatic invertebrates consumed by Mohave tui chub and a substrate for egg attachment (USFWS 2009a). Aquatic ditchgrass (*Ruppia maritima*) appears to be the preferred vegetation for egg attachment and thermal refuge in summer months (USFWS 1984b). In addition, the Mohave tui chub is sensitive to predation from other fish species, and pools should be relatively free of arroyo chubs and other non-native aquatic wildlife species (USFWS 2009a). Finally, to be suitable for Mohave tui chub, the water should have water quality parameters within the tolerable range for this species and be free of toxic substances or the threat of toxic substance spills (USFWS 2009a). Water quality parameters include a temperature range from 37ºF to 97ºF, dissolved oxygen at greater than 2 parts per million, a salinity of 40 to 323 milliosmols per liter, and a pH of up to 9 with 10 being tolerable for a short period of time (Feldmeth et al. 1985, Archbold 1996, and McClanahan et al. 1986, cited in USFWS 2009a).

The current populations are located in primarily man-made or man-supported habitats. The population in Lark Seep is in a perennial body of water that is fed from the wastewater treatment facility in Ridgecrest, California. The population at Camp Cady is located in a man-made, lined pond that receives water from a pump. The populations at Soda Springs occur in two bodies of water, one is a man-made pond that receives water from a pump, and the other is an isolated spring on the edge of Soda Lake (USFWS 2009a). The population at the Lewis Center is in two small man-made ponds withwater supplied from a pump, and at Morning Star Mine, the population is in a man-made pond created by a perched aquifer.

5.3.2.3 Occurrence within Plan Area

A Mohave tui chub historically occurred in the Mojave River basin as the only native fish within the system. By 1970, the genetically pure Mohave tui chub had been eliminated from the Mojave River due to several factors including hybridization with arroyo chub, introduction of other non-native, competitive, and predatory aquatic species to its

historical habitat (e.g., bass (*Micropterus* spp.), catfish (*Ictalurus* spp.), trout (*Oncorhynchus* spp.), bullfrog, and crayfish (*Procambarus clarki*) (Miller 1969); habitat alteration; water diversions; and pollution (USFWS 2009a). At the time of listing in 1970, four populations were known to exist; three were located in San Bernardino County: Piute Creek, Two Hole Spring, and Soda Springs; and one in Paradise Spa, Nevada (USFWS 2009a). There are nine historical (i.e., pre-1990) records in the Plan Area contained in the CNDDB, occurring in the eastern end of Mojave National Preserve and along the northern flank of the San Bernardino Mountains (CDFW 2013; Dudek 2013) (see Figure SP-F02 in Appendix B).

A population was established in 1978 at the Desert Research Station near Hinkley, California; however, in 1992 the pond dried up and the population was extirpated. As of 2011, there were five populations of genetically pure Mohave tui chubs: Soda Springs and Morning Star Mine at Mojave National Preserve; Lark Seep at China Lake Naval Weapons Station; Camp Cady Wildlife Area, and the Lewis Center in Apple Valley (see Figure SP-F02 in Appendix B). All of these locations are within the Plan Area. The Camp Cady Wildlife Area is managed by CDFW; Soda Springs Mojave National Preserve and Morning Star Mine are managed by the National Park Service (NPS); and the Lark Seep complex is located on a naval base managed by the Department of Defense (DOD).

The model generated 360 acres of modeled suitable habitat for Mohave tui chub in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.3.3 Owens Pupfish

5.3.3.1 Status and Distribution

Regulatory Status

The Owens pupfish (*Cyprinodon radiosus*) is state-listed endangered and a fully protected species in California. This species is also federally listed endangered. This species is included in the USFWS *Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California* (USFWS 1998b).

Natural History

Owens pupfish are opportunistic omnivores and consume a variety of plant and animal foods. Their diet changes seasonally and generally includes whatever invertebrates and plants are most abundant at that time (USFWS 1998b). However, they primarily feed on aquatic insects and are an effective biological control agent for mosquitos (USFWS 2009b; USFWS 1998b). They do not prey on other fishes (USFWS 1998b).

Owens pupfish breed from April through October (BLM 2011a). Females spawn over soft substrates in spring and summer when water temperatures are near 14°Celsius (C) (57° F) (USFWS 1998b). They may spawn up to 200 times per day, laying one or two eggs at a time (USFWS 2009b). Males are very aggressive during the breeding season as they protect their breeding territory (BLM 2011a). Incubation lasts for approximately 6 days before hatching in water that ranges in temperature from 75°F to 81°F. On average, 95% of spawned eggs are fertilized. Juvenile pupfish reach sexual maturity in 3 to 4 months and are generally able to spawn before their first winter (USFWS 2009b).

In a study examining Owen's pupfish mating systems and sexual selection, it was found that the size of the mother did not strongly influence egg size or fry size. In addition, individual egg size was not correlated with fry size (Mire and Millett 1994).

Little information is known regarding this species' spatial activity. However, CDFW (2013) refers to migration between areas. Males are territorial and females occupy areas at the margins of territories.

Generally, the lifespan of Owens pupfish is rarely over 1 year. However, they live up to 3 years in refuge habitats (USFWS 2009b).

Owens pupfish congregate in small schools (USFWS 2009b). Owens pupfish demography has been studied only in intensively managed refuge habitats with little environmental variation. Demographic studies of other pupfishes in the Death Valley system, however, suggest large seasonal variation in population size. Although studies of Owens pupfish in managed refuge habitats indicate little seasonal variation in population size, unmanaged populations may experience more temporal variation in habitats that are more representative of areas historically occupied (USFWS 2009b).

General Distribution and Populations Trends

The Owens pupfish is restricted to the Owens Valley portion of the Owens River in Mono and Inyo counties, California. Based on historical observations, Owens pupfish is believed to have occupied all of the Owens River and possibly the Owens River Delta at Owens Lake. Currently, it occurs at Fish Slough, Mule Springs, Well 368, and Warm Springs (USFWS 2009b). Eight of the 17 CNDDB occurrences are within the Plan Area, while the remaining occurrences are farther north and east of the Plan Area (CDFW 2013).

By the 1930s Owens pupfish was scarce throughout most of its historical range. It was believed to be extinct from 1942; until in 1964 when a single population of approximately 200 fish was rediscovered in Fish Slough (USFWS 1998b). This was the only known existing population when Owens pupfish was listed as federally endangered in 1967. This

population still persists today (USFWS 2009b). Since its listing, three additional populations have been established at Warm Springs, Well 368, and Mule Springs, (USFWS 2009b). These additional existing populations were established from progeny of the remnant population at Fish Slough (USFWS 1998b). All existing populations are small, ranging from 100 to 10,000 individuals. The Owens pupfish still faces a high degree of threat, but it also has a high recovery potential (USFWS 2009b).

Reasons for Decline

The 1998 Recovery Plan states that Owens pupfish is affected by non-native species and habitat modification for water diversions that altered Owens River flows (USFWS 1998b, 2009b). Currently, all populations of Owens pupfish are threatened by loss of habitat resulting from cattail encroachment. Emergent vegetation and accumulated detritus covers and reduces the substrate used by the pupfish for breeding. Emergent vegetation also reduces water depth, elevates water temperature, and potentially produces severe anoxic conditions (USFWS 2009b).

Owens pupfish is also seriously threatened by non-native predators. Because populations are highly localized and relatively small, they can be threatened by a single individual predator. At the time of listing in 1967, several non-native fish predators affecting Owens pupfish were identified: largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), brown trout (*Salmo trutta*), and bluegill (*Lepomis macrochirus*). Since its listing, mosquitofish (*Gambusia affinis*), crayfish (*Pastifasticus leniusculus*), and bullfrogs have been introduced into the pupfish's habitat and also threaten Owens pupfish. Besides eating young and adult Owens pupfish, non-native predators compete with Owens pupfish for food and habitat (USFWS 2009b).

Additionally, the Owens pupfish is highly vulnerable to extinction from stochastic (random) demographic, genetic, and catastrophic environmental events because the existing populations are small and isolated. Demographic stochasticity refers to random variability in survival and/or reproduction among individuals that can have a significant impact on population viability when populations are small and short-lived with low fecundity (reproductive output). Genetic stochasticity results from the changes in gene frequencies caused by the loss of genetic variation when a new population is established by a very small number of individuals (i.e., the founder effect). This can result in random gene fixation in which some portion of gene loci are fixed at a selectively unfavorable allele (a different form of a gene) because natural selection is not intense enough to overcome random genetic drift. Inbreeding bottlenecks in which a significant percentage of a population is killed or prevented from breeding may also occur in small, isolated populations. Environmental stochasticity is the variation in birth and death rates from one

season to the next in response to weather, disease, competition, predation, or other external factors. These three factors may act alone or in combination to reduce the long-term viability of small populations (USFWS 2009b).

5.3.3.2 Habitat Characteristics

Owens pupfish occurs in shallow water habitats in the Owens Valley (CDFW 2013). It will occupy most aquatic habitat where water is relatively warm and food is plentiful (USFWS 2009b). However, it prefers warm, clear, shallow water, free of exotic fishes, and requires areas of soft substrate for spawning (CDFW 2013; USFWS 2009b). In addition, Owens pupfish habitat differs from the habitat of other pupfish. Specifically, aquatic habitats associated with the Owens River are typically colder, frequently covered by ice during winter, and lower in conductivity and salinity than habitats occupied by other pupfish species (USFWS 2009b).

All life stages may be found in the various microhabitats available with little apparent documented preference. However, adults frequently occupy deeper water than juveniles. Male pupfish are territorial and defend areas of substrate from competing males. Females occupy habitats along the margins of these territories (USFWS 2009b).

5.3.3.3 Occurrence within Plan Area

Five of the eight occurrences in the Plan Area were last documented prior to 1990 (Figure SP-F03). All of these are found within Owens Valley of Inyo County and have possibly been extirpated (CDFW 2013; Dudek 2013).

Three recent occurrences (i.e., since 1990) of Owens pupfish occur in the Plan Area. One occurrence is at Well 368, located 0.2 mile west of the Owens River and 2.5 miles south of Mazourka Canyon Road (see Figure SP-F03 in Appendix B). Last observed in 1999, this occurrence is presumed extant. In 1988, pupfish from Warm Springs were introduced into the ponds at this location, and both adults and juveniles were abundant throughout the North Fork Area in 1999. It is owned by the Los Angeles Department of Water and Power (LADWP) (CDFG 2012b).

The model generated 17,547 acres of modeled suitable habitat for Owens pupfish within the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.3.4 Owens Tui Chub

5.3.4.1 Status and Distribution

Regulatory Status

The Owens tui chub (*Siphateles bicolor snyderi*) is state-listed endangered and a fully protected species in California. This species is also federally listed as endangered. Critical habitat for this species was designated on August 5, 1985 (50 FR 31592–31597). This species is included in the USFWS *Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California* (USFWS 1998b). The 5-year review for this species (USFWS 2009b) found that threats that were present when the Owens tui chub was listed are still present with new threats identified. The recovery priority number assigned was 3, which indicates the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery (USFWS 2009b).

Natural History

The results of a gut content analysis indicate that Owens tui chub is an opportunistic omnivore that utilizes a wide variety of food items (McEwan 1991). Aquatic vegetation is especially important as it provides forage and habitat for aquatic invertebrates, the main food item of the Owens tui chub (McEwan 1989, as cited in Geologica 2003; McEwan 1991). Specific food items that appear to be of importance include chironomids, larvae of two species of hydroptillid caddisfly, other aquatic invertebrates, plant material, and detritus (McEwan 1991).

Sexual maturity in Owens tui chub appears dependent on the microhabitat. For example, sexual maturity in springs with constant water temperature has been recorded at 2 years for females and 1 year for males, in comparison to more varied temperatures where males and females reach sexual maturity at 2 years (McEwan 1990, as cited in USFWS 2009b). In general, tui chubs congregate from later winter to early summer to spawn over aquatic vegetation or gravel substrates (Kimsey 1954, as cited in Geologica 2003). More specifically, McEwan (1990, as cited in USFWS 2009b), recorded spawning from late winter to early summer at spring habitats, and from spring to early summer in riverine and lacustrine or lake-like habitats. Spawning appears to be triggered by day length and warming water temperatures (McEwan 1989, 1990, as cited in USFWS 2009b). With the adhesive quality of the eggs, spawning usually occurs over gravel substrate or aquatic vegetation (USFWS 2009b). Multiple spawning bouts during the breeding season are likely (Moyle 2002), and females may produce large numbers of eggs at each bout (Geologica 2003). Embryos hatch in 3 to 6 days (Moyle 2002), and may be influenced by water temperature, with eggs hatching

earlier in warmer water (Cooper 1978, as cited in USFWS 2009b). Larvae remain near aquatic plants after hatching (Moyle 2002). Growth during the first summer is rapid and slows at maturity, usually in the second to fourth year (Moyle 2002).

The dispersal, home range, and migratory patterns of Owens tui chub are not well understood. Many of the locations where they are currently found are completely isolated from other populations. Tui chubs congregate from late winter to early summer to spawn over aquatic vegetation or gravel substrates (USFWS 2009b). For a more detailed discussion of the dispersal, home range and migratory patterns of Owens tui chub, refer to the full species profile in Appendix B.

General Distribution and Populations Trends

The Owens tui chub is endemic to the Owens Basin (Owens Valley, Round Valley, and Long Valley) of Inyo and Mono Counties, California (CDFW 2013; USFWS 1998b).

Since its listing in 1985, three new populations of Owens tui chub have been established, bringing the current number to six. Four of these populations are in small, manmade or man-altered waters, and one is outside the historical range of the species at an artificial lake (Sotcher Lake). USFWS (2009b) recommends that a Recovery Priority Number of 3 be assigned to Owens tui chub, which indicates that the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery. The threats that were present when the Owens tui chub was listed are still present with new threats identified (USFWS 2009b).

Reasons for Decline

USWFS (2009) provides a detailed explanation of the threats to Owens tui chub, which are summarized here. Currently, the major threat to the species is introgression (i.e., hybridization) with Lahontan tui chub (Chen et al. 2007), which has resulted in extirpation throughout most of its range (USFWS 2009b). In 1973, the Lahontan tui chub was introduced as baitfish into many of the streams in the Owens Basin. For a more detailed discussion of the threat of Lahontan tui chub, refer to the full species profile in Appendix B.

USFWS (50 FR 31592–31597) identified extensive habitat destruction and modification as threats to the Owens tui chub, and this is current as of today. Currently, Owens Basin water is in high demand that is expected to increase, which would reduce the overall availability of surface waters. The survival of two populations (White Mountain Research Station and Mule Spring) is dependent upon the continual maintenance of the artificial water supply and assurance of adequate water quality. The Upper Owens Gorge population is a pool created by a beaver dam that is eroding, which is slowly reducing the lacustrine habitat for Owens tui chubs.

Submerged aquatic vegetation is a key habitat requirement for the Owens tui chub, but not with large amounts of emergent vegetation because it may provide cover for nonnative predators of Owens tui chubs, such as bullfrogs and crayfish (*Procambarus* sp.). For a more detailed discussion of the impact of emergent vegetation, refer to the full species profile in Appendix B.

Since listing, evidence of disease has been observed in some populations of the Owens tui chub (USFWS 2009b). In AB Spring at Hot Creek Headwaters, Bogan et al. (2002, as cited in USFWS 2009b) found evidence of infection in six of the seven Owens tui chubs that were collected for genetic analysis. Since disease has been identified in Owens tui chubs, it is considered a threat. However, the magnitude of this threat is unknown (USFWS 2009b).

The final listing rule (50 FR 31592–31597) identified predation by introduced non-native fish as a major threat to the Owens tui chub. For a more detailed discussion of the impact of non-native fish, refer to the full species profile in Appendix B.

The inadequacy of existing regulatory mechanisms is considered a threat at this time by USFWS (2009b), largely due to unregulated actions that could overdraft the aquifer in the Owens Valley Groundwater Basin area, which may result in reduced or no water flow to existing isolated springs and headwater springs of streams in the Owens Basin. The issue stems from the fact that the aquifer in the Owens Basin has not been adjudicated and its use is not regulated. Any reduction in flow from springs in the Owens Basin would result in further reductions of habitat quality and quantity for the Owens tui chub at springs and tributaries of the Owens River.

Currently, Owens tui chub populations are small, between 100 and 10,000 individuals; therefore, random events that may cause high mortality or decreased reproduction could readily eliminate an entire population, which would have a significant effect on the viability of Owens tui chub populations. Furthermore, because the number of populations is small (six) and each is vulnerable to this threat, the risk of extinction is exacerbated (USFWS 2009b). The Owens tui chub has experienced population loss from environmental stochastic events and will likely do so in the future. For example, the Cabin Bar Ranch population was lost because of an apparent failure to maintain adequate water quality and quantity and the introduction of non-native predators. Another example is the disappearance of Owens tui chub from the Owens Valley Native Fishes Sanctuary (Fish Slough). Reasons for the loss of this population are not known, but the small, isolated nature of this population likely contributed to their extirpation (USFWS 2009b).

In small populations, such as the Owens tui chub, there are a number of factors that may reduce the amount of genetic diversity retained within populations and may increase the

chance that deleterious recessive genes are expressed. Loss of diversity could limit the species' ability to adapt to future environmental changes and contributes to inbreeding depression (i.e., loss of reproductive fitness and vigor) (USFWS 2009b). Deleterious recessive genes could reduce the viability and reproductive success of individuals. Isolation of the six remaining populations, preventing any natural genetic exchange, will lead to a decrease in genetic diversity.

5.3.4.2 Habitat Characteristics

The Owens tui chub occurs in low-velocity waters with well-developed beds of aquatic plants, rocks, and undercut banks with bottoms of gravel (Leunda et al. 2005; Moyle 2002). Dense aquatic vegetative cover is likely important to Owens tui chubs for predator avoidance, reproduction, water velocity displacement, and feeding (McEwan 1989, as cited in Geologica 2003; McEwan 1991). Plant species observed in occupied habitat at the Hot Creek Headwaters population include watercress (*Nasturtium officinale*), water fern (*Azolla filiculoides*), duckweed (*Lemna* sp.), pondweed (*Potamogeton* sp.), aquatic buttercup (*Ranunculus aquatilis*), and elodea (*Elodea canadensis*) (McEwan 1991). For a more detailed discussion of the preferred habitat structure of Owens tui chub, refer to the full species profile in Appendix B.

Water temperature within occupied habitat varies to a great degree (as summarized in Geologica [2003]). It can be fairly constant at spring sites (14–18°C [57–64°F]), hotter at hot springs (21–25 °C [70–77°F]), and cooler in a river (36–78°F [2–25°C]) (Geologica 2003). Within occupied habitat where measurements exist, pH ranges from 6.6 to 8.9 (McEwan 1989; Geologica 2003), dissolved oxygen varies from 5 to 9.3 milligrams/liter (Malengo 1999; Geologica 2003), and alkalinity varies from 68.0 to 88.4 parts per million (McEwan 1989).

The Owens tui chub is restricted to six total populations, five of which are within the historical range of the species. Of these five populations, three (Hot Creek Headwaters, Little Hot Creek Pond, and Upper Owens Gorge) are located in small, isolated, man-altered portions of these waterways. The other two populations (Mule Spring and White Mountain Research Station) exist in manmade ponds at upland sites with water supplied by artificial methods. A detailed account of the habitat at each of the extant populations can be found in the 5-year review (USFWS 2009b).

5.3.4.3 Occurrence within Plan Area

Early fish collections in the Owens Basin documented Owens tui chub in Owens Lake, several sites along the Owens River from Long Valley to Lone Pine, tributary streams near

the Owens River in Long Valley and Owens Valley, Fish Slough, and irrigation ditches and ponds near Bishop, Big Pine, and Lone Pine (Miller 1973; USFWS 2009b). Although there are two historical (i.e., pre-1990) records for Owens tui chub in the Plan Area in the CNDDB (Figure SP-F04;CDFW 2013; Dudek 2013), the scattered distribution of these localities and the ease with which researchers captured fish suggest that Owens tui chub were common and occupied all valley floor wetlands near the Owens River in Inyo and Mono counties (USFWS 2004).

Currently, genetically pure Owens tui chub is limited to six isolated sites in the Owens Basin: Hot Creek Headwaters (AB Spring and CD Spring), Little Hot Creek Pond, Upper Owens Gorge, Mule Spring, White Mountain Research Station (operated by the University of California), and Sotcher Lake, the last of which is outside the historical range of the species in Madera County (USFWS 2009). However, there are only three recent occurrence records documented in the CNDDB database (Figure SP-F04; CDFG 2013; Dudek 2013). In 1987, Owens tui chub were found occupying irrigation ditches and a spring at Cabin Bar Ranch on the southwest shore of Owens Dry Lake, and became known as the Cabin Bar Ranch population (USFWS 2009b). Predation from introduced largemouth bass (*Micropterus salmoides*) and bluegill sunfish (*Lepomis macrochirus*), and failure to maintain adequate water quality and quantity, extirpated the Cabin Bar Ranch population of Owens tui chub in 2003 (USFWS 2009b). However, prior to extirpation, 24 individuals were placed in an artificial pond and moved to Mule Spring in 1990; all extant fish of this group descend from this transplant (Chen et al. 2007). The Plan Area only includes the former Cabin Bar Ranch population, withthe Mule Spring population (see Figure SP-F04 in Appendix B) adjacent and outside of the Plan Area boundary. USFWS (1998b) has proposed two conservation areas within the Plan Area: Black Rock, and Southern Owens Dry Lake (the Cabin Bar Ranch population was found on the southwest shore of Owens Dry Lake).

The model generated 17,384 acres of modeled suitable habitat for Owens tui chub in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.4 Mammals

5.4.1 Burro Deer (Planning Species)

5.4.1.1 Status and Distribution

Regulatory Status

The burro deer (*Odocoileus hemionus eremicus*) is not federally or state listed and has no other special status species designations. This species is considered a DRECP "Planning Species."

Natural History

Burro deer foraging patterns vary seasonally and are dictated by water availability and quality of forage plants (Marshal et al. 2006a). Their forage is dominated by browse and forbs, with only 10% of their diet consisting of grasses and succulents (Krausman et al. 1997; Marshal et al. 2006b, 2012). During the driest season, in spring and pre-monsoonal summer, burro deer are closely associated with water sources and, consequently, rely on riparian, xeroriparian, and desert wash communities that produce most of the high-quality forage. Forage plants include catclaw (*Acacia greggii*), desert ironwood (*Olneya tesota*), palo verde (*Parkinsonia florida*), honey mesquite (*Prosopis glandulosa*), and cheese bush (*Hymenoclea salsola*). Deer foraging adjacent to the Colorado River include salt cedar (*Tamarix* spp.), cattails (*Typha domingensis*), and arrowweed (*Pluchea sericea*) in their diet (Marshal et al. 2004, 2006b, 2012).

Following the onset of the monsoon between late July and early August, burro deer are less constrained by water sources and are found on steeper ground at high elevations (Marshal et al. 2006a). Common forage plants for burro deer in piedmont and mountainous areas are creosote bush (*Larrea tridentata*), burro-weed (*Ambrosia dumosa*), brittle-bush (*Encelia farinosa*), and ocotillo (*Fouquieria splendens*) (Marshal et al. 2006b).

As noted above, burro deer forage is dominated by browse vegetation. Microhistological examination of deer pellets found that diets of burro deer had high proportions of browse (76%–85%) in all seasons and low proportions of grasses (1%–2%) and forbs (4%–8%). Browse plants were dominated by saltbush (*Atriplex* spp.), Mexican tea (*Ephedra californica*), desert ironwood, palo verde, and honey mesquite (Marshal et al. 2004, 2012).

Burro deer tend to rut and mate later than most mule deer (Heffelfinger 2006). Rutting and mating may occur as early as late December and as late as March (Celentano and Garcia 1984; Marshal et al. 2006a).

Fawning occurs between July and mid-October, timed to take advantage of summer monsoon rains. Fawning occurs in both riparian and mountainous desert habitats, although observations made during fawning indicate that occurs in areas characterized by low hills with a network of interconnecting washes (Celentano and Garcia 1984). Does with fawns then move into more mountainous terrain where they have a tendency to avoid valley floors and ridges, which are associated with higher predator densities (Marshal et al. 2006a). Fawns are believed to be susceptible to coyote (*Canis latrans*) and golden eagle (*Aquila chrysaetos*) predation until they are at least 6 months old (Marshal et al. 2006a).

Burro deer generally follow a seasonal migratory pattern in the Plan Area. During the drier spring and summer periods, burro deer occur in riparian woodlands and washes bordering major water sources such as the Colorado River, Coachella Canal, or Great American Canal. As the summer monsoonal rains arrive, between late July and August, burro deer migrate to the desert mountains, coinciding with the flush of new growth for desert forage plants and raising fawns (Celentano and Garcia 1984). Burro deer only shift back to the lowlands in spring as temporary waters sources dry out. Migration is not universal, however, and some burro deer remain around permanent water sources in the Chocolate Mountains (Celentano and Garcia 1984).

Home range patterns vary considerably between seasons. During the hot spring and summer months, deer are restricted to permanent water sources and do not range far. Burro deer occupying Colorado River riparian woodlands may have home range as small as 1 square mile, while deer in dry wash woodland may have home ranges of 2–8 square miles (Celentano and Garcia 1984). During the cooler winter months, when movement is not restricted by water or high temperatures, individual ranges in the mountains may cover 30–50 square miles.

Rainfall has an important influence on mule deer populations in the deserts of Southern California, with both abundance and population dynamics related to the amount of rainfall. Forage resources in deserts are affected primarily by rainfall, which is highly variable seasonally between years and across the range. As a result, resource availability and its influence on deer populations is highly variable from year to year (Marshal et al. 2002, 2005). Despite these general relationships, however, there is currently no direct evidence linking burro deer population dynamics to the large-scale climatic variation caused by El Niño southern oscillation events (Marshal and Bleich 2011).

During the summer monsoonal season, rainfall events tend to produce strip rains, where a large amount of rain falls on an area about 1 kilometer wide and several kilometers long, with little rain falling on adjacent areas. Strip rains produce a highly heterogeneous response in plant growth (Marshal et al. 2005) and a patchy distribution of forage biomass and quality. Burro deer respond to this heterogeneity by selecting areas with rapidly growing plants, such as those in areas that recently received rainfall, because forage from those plants are high in water, protein, and digestibility. When rapidly growing forage is not available, deer may select areas of high forage biomass, where they can take advantage of forage of higher digestibility before plant biomass and digestibility decrease. When forage water decreases beyond a critical threshold, however, locations of permanent water, including catchments, may become most important in determining deer distribution, and forage growth and biomass become secondary to water availability (Marshal et al. 2005).

It is unclear to what degree mule deer compete or interact with other large- and medium-sized herbivores in the area, such as bighorn sheep (*Ovis canadensis*), feral ass (*Equus asinus*), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), and desert tortoise (*Gopherus agassizii*). Studies assessing the overlap between deer and the feral ass indicate biologically significant overlap, but with the burro deer diet containing more browse and forbs and significantly less grass than the ass (Marshal et al. 2012). Burro deer and bighorn sheep may share diets where their habitats overlap, but they exhibit seasonal separation. In the driest periods of spring and summer, when bighorn sheep may use desert washes, burro deer tend concentrate in riparian habitats.

Potential predators of burro deer include mountain lion (*Puma concolor*), coyote, bobcat (*Lynx rufus*), and golden eagle. However, the extent to which predators affect burro deer populations is currently unknown. Marshal et al. (2006a) suggest that predators, particularly coyote, may be responsible for females with fawns avoiding valley floors and ridges until the fawns are at least 6 months old. Predator exclusion experiments in Arizona have shown that predation is a significant factor in fawn mortality (Heffelfinger 2006).

General Distribution and Populations Trends

Mule deer are widespread across most of the western United States, western Canada, and south into northern Mexico. The burro deer subspecies is native to the Mojave and Sonoran deserts of the southwestern United States and northern Mexico. Within California, the burro deer is found in southeastern Imperial County, eastern Riverside, and as far north as the southeastern corner of San Bernardino County. From the Colorado River they range west into California along vegetated washes to the Coxcomb Mountains, Palen Mountains, Chuckwalla Mountains, Chocolate Mountains, and formerly through the Imperial Valley to Indio. Burro deer are predominately associated with major river corridors and dry desert washes leading down to the Colorado River and other major rivers. In the hottest months deer are found close to permanent water and forage sources such as the Colorado River. However, with the onset of the summer monsoons in early August and September, burro deer may disperse to the desert mountains (Celentano and Garcia 1984).

Burro deer are not currently listed as threatened or special status, but are managed in California for their recreational, educational, and hunting value. Available evidence suggests the population is stable. Past surveys estimated a population of about 2,000 individuals (Celentano and Garcia 1984), with estimates in the 1980s and 1990s varying between 2,000 and 5,000 individuals (CDFG 1997). More recent estimates in the early 2000s from telemetric and remote photographic studies estimate herd densities of 0.05–0.13 deer per square kilometer (Marshal et al. 2006c), indicating a population in the in the range of 970 and 2,500 individuals.

For hunting purposes, population trends and herd health have generally been inferred from harvest data, climatic conditions, and plant productivity (Celentano and Garcia 1984). However, deer harvests observed a fourfold increase between 1948 and 1998 (Marshal et al. 2002). Such an increase is a reflection of increased hunting intensity and changes in reporting methods for harvested deer (Celentano and Garcia 1984; CDFG 1997). The increased hunting intensity has, thus far, had no detectable effect upon the population. Current population size and composition are estimated from harvest models, developed in the mid-2000s. The most recent available estimate for 2007 puts the population close to historical levels: 1,940 individuals in 2007 compared to 2,000 individuals in 1940 (CDFG 2007).

Estimates of herd composition are highly variable. Celentano and Garcia (1984) estimated sex and age ratio using aerial and ground telemetry, and Thompson and Bleich (1993) tested the efficacy of ground, aerial, and hunter surveys in estimating herd composition but did not estimate abundance. The most recent population estimates for the East Chocolate–Cargo Muchacho area concluded that burro deer occur at densities between 0.05-0.13 deer per square kilometer. This estimate is comparable to the historical estimates of deer densities of 0.08 deer per square kilometer in 1940 and 0.11 deer per square kilometer in 1952 (Marshal et al. 2006c).

Reasons for Decline

Historically burro deer have faced a range of threats from activities associated with an increasing human population in southeastern California. Development and agriculture along the Colorado River has reduced access to the summer riparian habitats, introduced invasive species such as salt cedar, and reduced the availability of native habitats. In addition, increased recreation development and flood control measures have contributed to reduced available summer habitat.

In areas away from the riparian lowlands, increased recreational use of desert washes by off-highway vehicles (OHVs) has resulted in localized disturbances of burro deer, and effectively has reduced connectivity between riparian and mountain habitats. Other localized impacts include mining operations and energy development (Celentano and Garcia 1984).

Historically poaching, road kill, and drowning in canals have all been identified as significant sources of mortality, although measure taken to reduce road kill and drowning have had some success in reducing these mortality factors (CDFG 1995).

Competition from non-native grazing animals such as feral ass may represent a long-term pressure in shared habitat (Celentano and Garcia 1984; CDFG 1997). The most recent research confirms significant biological overlap in the diet of both species (Marshal et al. 2012).

Other threats found throughout the southwestern desert region include introduction of non-native pasture plants; overstocking and competition from cattle, domestic sheep, and goats; and extensive oil and gas development. However, as yet, these threats appear to be absent from the Southern California range of burro deer (Heffelfinger et al. 2006; Heffelfinger 2006).

5.4.1.2 Habitat Characteristics

The burro deer is a large ungulate that shifts seasonally between desert riparian washes and more open, mountainous terrain. It depends on the availability of water and tracks the best available forage throughout the year. Burro deer need to drink at least every 3–4 days, but tend to drink each night, and therefore require predictable water sources. Consequently, their seasonal distribution is closely associated with water availability (Celentano and Garcia 1984).

During the driest season, between January and March, deer concentrate in lowland riparian habitats, including riparian forest, alluvial and riparian scrub, and alluvial woodland, where water is predictable and forage vegetation quality is relatively high. With the onset of the summer monsoonal rains in July and August, burro deer are less constrained by water sources and use the network of alluvial and wash communities to migrate between lowland riparian communities and the mountainous desert communities that include Sonoran Desert scrub, alluvial woodland, and Joshua tree woodland (Celentano and Garcia 1984; Marshal et al. 2006a). Burro deer remain at high elevations throughout the autumn and winter (Marshal et al. 2006a), only returning to more predictable forage and water sources at lower elevations in spring (Table1).

Burro deer track the highest quality forage, which depends on monsoonal and winter rainfall. Monsoonal rainfall in particular can be highly localized, and consequently forage quality is very heterogeneous (Marshal et al. 2006a, 2006b). As a result, burro deer abundance and distribution can be highly variable from year to year (Marshal et al. 2006c).

5.4.1.3 Occurrence within Plan Area

The distribution of burro deer within California was described as far back as 1936 and appears to reflect their current distribution, though it is thought that their former range extended northwest through the Imperial Valley to Indio, and may once have extended around the west side of the Salton Sea (Celentano and Garcia 1984). Much of the area west

of Salton Sea and north to Indio was converted to agriculture several decades ago. No pre-1990 occurrences are recorded within the CNDDB; however, annual harvest population estimates indicate that burro deer population fluctuated between 2,000 and 5,000 individuals between 1940 and 1990 (Celentano and Garcia 1984; CDFG 1997, 2007).

There is no evidence to suggest that burro deer distribution differs from historical (pre-1990) distribution described above. Because burro deer is not a state special-status species, it is not tracked in the CNDDB. However, data compiled by the Conservation Biology Institute (CBI) includes at least six mapped occurrence locations within the Desert Renewable Energy Conservation Plan (DRECP) Area (Figure SP-M02) (Data Basin 2013). Three of the occurrences were along or near the Colorado River, including one near Blythe and the other two in the Palo Verde Area. Two adjacent occurrences are located in the Smoketree Valley area and the other occurrence is near Clemens Well in the valley between the Orocopia and Chocolate mountains. The most recent available estimates made to assist with hunting and herd management put the current burro deer population at about 2,000 individuals (CDFG 2007).

The model generated 1,150,569 acres of modeled suitable habitat for burro deer within the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.4.2 California Leaf-Nosed Bat

5.4.2.1 Status and Distribution

Regulatory Status

The California leaf-nosed bat (*Macrotus californicus*) is a California Species of Special Concern and a BLM sensitive species.

Natural History

California leaf-nosed bat appears to be entirely insectivorous (Anderson 1969). Prey for California leaf-nosed bat include Orthoptera (crickets and grasshoppers), Lepidoptera (moths), Coleoptera (beetles), Homoptera (cicadas), and Hymenoptera (ants) (Anderson 1969; Huey 1925; Ross 1961). They are vegetation gleaners and likely take prey directly from the ground because some of their prey are flightless (Anderson 1969; Bell and Fenton 1986). They usually emerge from day roosts 90 minutes to 2 hours after sunset during the summer and forage in two main bouts during the night (Anderson 1969). During the winter, they may emerge around sunset or shortly after (e.g., within 30 minutes) and forage for about 2 hours (Brown 2005). They may use night roosts that are different from their day roosts (Anderson 1969; also see Hatfield 1937 for use of buildings as night roosts).

Breeding occurs in the fall when males and females come together after young of the year are weaned (Anderson 1969). Ovulation occurs in September and October (Bleier 1971), and unlike many other bat species that store sperm over the winter and delay fertilization, fertilization occurs immediately after mating, and implantation occurs in later October and November to January (Bleier 1971; Carter and Bleier 1988). Gestation is 8 to 9 months and includes about a 4.5-month diapause period when growth and development is slowed (Bleier 1971; Bleier and Ehteshami 1981; Bradshaw 1962; Crichton and Krutzsch 1985; Crichton et al. 1990). Growth rate and diapause is under control of the hormone progesterone (Crichton and Krutzsch 1985; Crichton et al. 1990). Females form maternity colonies in the spring (Anderson 1969). Birth to one pup (or rarely twins) occurs in May, June, or early July, and young are weaned by August (Anderson 1969; Bleier 1975; Bradshaw 1962; Carter and Bleier 1988). Females are reproductively active in their natal year, but males become sexually mature in their second year (Carter and Bleier 1988). Longevity is at least 14 years, based on banding studies (Brown 2005).

California leaf-nosed bats are year-long residents in California, and there are no data regarding seasonal movement or migration (Anderson 1969), although some individuals may migrate to Mexico in the winter (Zeiner et al. 1990). In California, they occur in geothermically heated winter roosts (Bell et al. 1986), so they may not need to move far between summer and winter areas to find suitable roosting sites. Roost site use does vary seasonally, however, with mixed male/female roosts in the winter and mostly segregated, large, female maternity roosts and smaller, dispersed male roosts during the spring through summer reproductive season (Anderson 1969; Brown 2005), indicating at least local seasonal movements and roost use related to reproduction.

There is some information about spatial activity related to foraging. Vaughan (1959, as cited in Zeiner et al. 1990) reported that California leaf-nosed bats forage up to 1.3 kilometers (1 mile) from the roost, but that most activity occurs near the roost. Using radiotelemetry, Brown et al. (1993, as cited in Brown 2005) observed foraging in desert wash within 10 kilometers (6.2 miles) of roost sites. As observed by Williams et al. (2006), they generally forage in riparian habitats without any apparent differential selection of riparian type. They also forage at open water sites near potentially suitable roosting habitat (Rabe and Rosenstock 2005). Their ability to fly fast suggests that they could forage fairly far from roost sites. In addition, their selection of limited roosting areas (i.e., primarily temperate caves and mines) suggests that they may be capable of flying quite far to suitable foraging areas that support abundant insect prey, even if most activity is near roost sites (e.g., Williams et al. 2006).

Desert riparian communities are very spatially limited resources used by a large number of bat species. A likely important factor in bat community diversity and ecological

relationships in desert riparian areas is resource partitioning. Black (1974) suggested that bats may employ several types of foraging and food partitioning mechanisms that could reduce interspecific competition, including size and type of prey; periods of activity (most bat prey are active within a few hours of sunset, but different prey have different peak activity periods); spatial partitioning, such as between-, within-, and below-canopy foragers; and flight patterns, such as slow vs. fast flying, maneuverability, and hovering. For a more detailed discussion on the habitat preferences of the California leaf-nosed bat, refer to the species profile in Appendix B.

General Distribution and Populations Trends

The California leaf-nosed bat occurs from southern Nevada and Southern California south to northern Sinaloa, southwestern Chihuahua, Baja California, and Tamaulipas, Mexico (Wilson and Reeder 2005). In California, the California leaf-nosed bat occurs in the desert regions of eastern San Bernardino (i.e., excluding the western Mojave region), Riverside, and San Diego counties and all of Imperial County.

There are no recent quantitative population trend data for the species, but it is described to have declined in desert regions, although it is still common in some areas of the Colorado River (Zeiner et al. 1990). Further, information collected by Ellison et al. (2003) for California leaf-nosed bat indicates that assessing population trends for this species will be a challenge. Ellison et al. (2003) reviewed information for 143 locations in Arizona, Nevada, and California. Counts at occupied sites ranged from 1 to 2,000 individuals. Trends were analyzed for five colonies, including three winter colonies and two summer colonies, and no positive or negative population trend was apparent. They also noted that the number of individuals at roost sites can fluctuate dramatically both between and within seasons, so population sampling would need to account for this apparent natural temporal variation. Non-systematic or anecdotal reports of the numbers of individuals at sites will not be adequate to assess population trends for this species.

Reasons for Decline

The two main threats to this species likely are (1) disturbances of roost sites due to human entrance, mine closures, and mine reactivation (Brown 2005; Zeiner et al. 1990) and (2) loss and degradation of desert riparian habitats (Brown 2005). Brown (2005) cites the loss of desert riparian habitat to development of golf courses and residential housing in the Coachella Valley as a threat to the species. Another potential threat is direct or secondary poisoning and loss of prey related to pesticide use for agriculture and golf course operations, although no information is available to indicate this impact.

Several recent studies have documented substantial mortality of bats at wind facilities (e.g., Baerwald and Barclay 2009; Cryan 2011; Cryan and Barclay 2009). A general review of the wind facility–related literature failed to reveal evidence for, or discussions of, California leaf-nosed bat fatalities or assessed risks at wind facilities (e.g., Baerwald and Barclay 2009; Cryan 2011; Cryan and Barclay 2009; Cryan and Brown 2007; Kuvlesky et al. 2007). This is likely because of the species' limited range in the southwestern United States and, further, because relatively little systematic post-project bat fatality monitoring data have been collected for large wind energy projects in the southwest (Solick and Erickson 2009). However, California leaf-nosed bats in the Plan Area could be at elevated risk of turbine strikes or from other associated causes (e.g., barotrauma) if a wind facility was located within a few miles of a day roost site (where most foraging activity occurs) and strikes would most likely occur during emergence and return to the day roost. Risk of strikes may also be higher when bats are moving between maternity roosts and winter sites in the fall and spring.

5.4.2.2 Habitat Characteristics

The California leaf-nosed bat is primarily a cave and mine dwelling species (Anderson 1969; Arita 1993; Arnold 1943; Howell 1920), but also occupies buildings (Anderson 1969). In Arizona, they have also been found in "open" bridge structures that have cave-like chambers at either end (Davis and Cockrum 1963), but most bridge structures are unlikely to be suitable as day roosts. California leaf-nosed bats have been observed using buildings as night roots east of Searchlight, Nevada (Hatfield 1937). Most winter roost sites in California are mine tunnels at least 100 meters (328 feet) long (Brown 2005). Roost chambers have large ceilings and considerable fly space (Anderson 1969). Roost sites are not always completely dark, and individuals may roost within 10 to 30 meters (33 to 98 feet) of the roost opening. This species does not hibernate and is unable to use torpor to reduce energy expenditures (Anderson 1969; Bell et al. 1986) so roosts that are used year-round in the desert must maintain temperate microclimates. California leaf-nosed bats have a thermoneutral zone of 33°C to 40°C (91°F to 104°F) and appear to adapt behaviorally rather than physiologically by roosting in geothermically heated winter roosts that have a stable year-round temperature of about 29°C (89°F) (Bell et al. 1986). A characteristic of winter roost sites is that they are warm and humid, with little air circulation (Brown 2005). Summer roosts may be in more shallow natural rock caves (Brown 2005). California leaf-nosed bats are tolerant of the highly ammoniated atmosphere of many caves and mines and can tolerate higher concentrations than humans (Mitchell 1963).

California leaf-nosed bats forage in riparian and desert wash areas in California and Nevada (Brown 2005; Huey 1925; Williams et al. 2006) and at tinajas (water-carved natural rock pools) in southwestern Arizona (Rabe and Rosenstock 2005). Williams et al. (2006) observed California leaf-nosed bats generally using riparian marsh, mesquite bosque, riparian woodland, and riparian shrubland without any apparent differential selection. The tinajas in the Rabe and Rosenstock (2005) study provided open flight approaches and were located near suitable roosting sites (cliffs and rocky canyons). Zeiner et al. (1990) lists suitable habitats as desert riparian, desert wash, desert scrub, desert succulent scrub, alkali desert scrub, and palm oases.

5.4.2.3 Occurrence within Plan Area

There are two historical (i.e., pre-1990) CNDDB records for the Plan Area located west of Yuma, Arizona, and north of I-8 (CDFW 2013; Dudek 2013). There are also several historical anecdotal reports for California leaf-nosed bat in the California desert. Howell (1920) noted that it was common in caves and mines and that the Salton Sea area supported many caves created by wave action of the sea along its historical coastline. Howell (1920) observed up to 200 individuals in a single colony. Arnold (1943) observed the species in the winter in mines and powder magazines near the Laguna and Imperial dams in Imperial County, and Huey (1925) observed a colony of about 500 individuals in a mine shaft north of Potholes in Imperial County.

There are 43 recent (i.e., since 1990) records for the Plan Area, including 39 CNDDB records (CDFW 2013) and four roost sites. The recent records are generally concentrated in southern portions of the Plan Area, including several records for Joshua Tree National Park, with four roost sites observed by Brown; several records along the Lower Colorado River between Lake Havasu City and Yuma, Arizona; a small cluster west of the Blythe; a small cluster in the Cargo Muchacho Mountains northwest of Yuma; and scattered records for the Chocolate Mountains east of the Salton Sea, east San Diego County, and the Clipper Mountains just south of I-40 (see Figure SP-M03 in Appendix B).

The model generated 8,046,536 acres of modeled suitable habitat for California leaf-nosed bat in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.4.3 Desert Bighorn Sheep

5.4.3.1 Status and Distribution

Regulatory Status

Most of the Plan Area supports desert bighorn sheep (*Ovis canadensis nelsoni*), which is fully protected[2] under Fish and Game Code Section 4700 and does not have any state sensitive species designations. Desert bighorn sheep is a BLM sensitive species.

Natural History

Desert bighorn sheep are generalist foragers and feed on a wide variety of plant species (Miller and Gaud 1989; Shackleton 1985). For example, Miller and Gaud (1989) documented 121 plant taxa in fecal samples and through direct observations of desert bighorn sheep in a Sonoran Desert habitat in Western Arizona over an 11-year period. However, the composition of their diet varies with season and location (Bleich et al. 1997; Miller and Gaud 1989; Shackleton 1985; Wehausen 2006). They must be able to access the seasonal abundance of plants at various elevations in various habitat types to maximize resources. Desert bighorn sheep adjust their feeding ranges to exploit areas with more nutritive resources, such as within bajadas, early in the season as high-protein grasses emerge. The relationship between nutritive resources, reproductive success, and optimal timing of birth is complex. Lamb survival is strongly related to spring body growth, so the earlier they are born the more they can grow before forage quality quickly declines in late spring (Wehausen 2005). However, the earlier the birth, the more likely that ewes will have inadequate food quality during late gestation and early lactation (Wehausen 2005.) The factor that controls this relationship is the body condition of the ewes coming into the reproductive season, with ewes in better condition ovulating earlier in the season because they have the condition to withstand the period with lower nutrient resources (Wehausen 2005). For a full discussion of desert bighorn sheep foraging activities, refer to the full species profile in Appendix B. Desert bighorn sheep typically stay close (i.e., within 2 to 3 miles) to reliable sources of water during hot summer months and drink large quantities at each visit (USFWS 2000).

The primary desert bighorn breeding season, or rut period, is between August and November in west Mojave Desert (Wehausen 2006). The gestation period is about 6 months (range of 171 to 178 days (Shackleton et al. 1984). Desert bighorn sheep tend to have relatively high conception rates, with a reported rate of 77% to 85% (USFWS 2000).

[2] Limited hunting allowed.

The lambing period depends on location and resources available, but generally desert bighorn sheep have a long lambing season. In the Mojave Desert, lambing occurs somewhat later than more southerly areas and may begin in December and end in June, with a small percentage of births commonly occurring in summer as well (Wehausen 2006). Lambs usually are weaned by 6 months of age.

Mortality rates are highest in the first year of life and lamb survival (to 6 months of age) varies by group and year (Shackleton 1985; USFWS 2000) and is related to several factors. Reproductive success in ruminants such as desert bighorn sheep is associated with the mother's body weight, access to resources, quality of home range, and age. As discussed above, lamb survival to summer is strongly related to body growth during the spring (Wehausen 2005). For a full discussion on desert bighorn lamb survival rates, refer to the full species profile in Appendix B.

Desert bighorn sheep exhibit seasonal differences in habitat use patterns (USFWS 2000), and some populations of females may migrate seasonally between mountain ranges (Jaeger 1994). Seasonal migration by desert bighorn sheep may be more common than previously thought (Wehausen, pers. comm. 2012). They tend to concentrate in areas with water during the hot summer months and expand their ranges away from water sources in the cooler, wetter season (USFWS 2000). They also alter their ranges during rutting and lambing seasons (USFWS 2000). Home range size depends on the availability of required resources, such as water, forage, and lambing habitat, and, thus, varies geographically (USFWS 2000). Forage quantity and quality, season, sex, and age also influence home range sizes. Generally, ram home ranges are larger than those of ewes. In the San Jacinto Mountains, based on a fixed kernel method for estimating home range (95% utilization distribution), the average estimated home range size was approximately 9.8 square miles for rams and 7.8 square miles for ewes (USFWS 2000).

The social structure of desert bighorn sheep is matrilineal (based on female associations). They exhibit gregarious and philopatric (remaining in natal area) behaviors (USFWS 2000). However, rams do not show the same level of philopatry as females and tend to range more widely, often moving among groups of ewes (USFWS 2000). At 2 to 4 years of age, young rams follow older rams away from their natal group during the fall breeding period, often returning after this period. Rams may use the same travel routes year after year (USFWS 2000).

Long-distance inter-mountain range dispersal movements are important for desert bighorn sheep, primarily by rams, but also by ewes (Wehausen 2006). Bleich et al. (1990) documented substantial intermountain movement between mountains in southeastern California. Recent information indicates that intermountain movements and natural recolonizations are not rare occurrences (Bleich et al. 1996; Epps et al. 2010). Epps et al.

(2010) analyzed DNA information and found that both native and translocated desert bighorn sheep have colonized "empty habitats." Wehausen (pers. comm. 2102) reports that additional natural colonizations have occurred in several ranges, including Deep Springs, Coso, South Soda, South Bristol, Iron, Little Maria, and Cushenbury (San Bernardino Mountains). Further, ewe movements to new groups once thought be rare (e.g., USFWS 2000) are now known to be much more common (Wehausen, pers. comm. 2012). For example, 3 of 10 radio-collared females moved from the Marble Mountains to the South Bristol Mountains in 1992 when that vacant range was colonized (Wehausen, pers. comm. 2012). The available information now indicates that over the past 25 years recolonizations have exceeded the extinctions that occurred in the mid-20th century during a 30-year drought period and during a period when desert bighorn sheep were being adversely affected by human activities (Wehausen, pers. comm. 2012).

In addition to being sensitive to natural predators, desert bighorn sheep may be in competition with both native and non-native animals such as mule deer, livestock, and feral burros for water and food sources (USFWS 2000). Cattle, sheep, and goats may be serious direct and indirect competitors for food and water sources, and may also be sources of disease (USFWS 2000). For a full discussion on competition for resources between desert bighorn sheep and other animals, refer to the full species profile in Appendix B.

Domestic sheep are the major disease source for the northern bighorn populations, and sheep contact has been associated with major bighorn die-offs (Wehausen 2006). Goats also may be a disease source for desert bighorn sheep (USFWS 2000). Diseases contracted from domestic sheep and goats are described subsequently under Reasons for Decline.

General Distribution and Populations Trends

Desert bighorn sheep occur in the desert mountain ranges from the White Mountains in Mono and Inyo counties, south to the San Bernardino Mountains, then southeast to Mexico (Wehausen 2006; Shackleton 1985). An isolated population occurs in the San Gabriel Mountains (Zeiner et al. 1990). Beyond California, its range extends into southern Nevada, southern Utah, southwestern Arizona, and northwestern Mexico and Baja California, Mexico (Shackleton 1985). Although desert bighorn sheep has a broad overall geographic range, actual populations within the range are scattered and discrete (Shackleton 1985).

The 2009 estimate for the northern populations of desert bighorn sheep is a population of approximately 4,800 individuals (CDFG 2010a). This compares with an estimated population of 3,737 individuals in 1972 and 4,500 individuals in 2003 (CDFG 2010a). Although the broad estimate indicates an increasing or at least stable population, local populations have shown more variability, with some local population declines (CDFG 2010a).

Reasons for Decline

The potential impacts of threats and stressors are closely related to the metapopulation population structure of desert bighorn sheep in the Plan Area. Metapopulations are characterized by groups of partially isolated populations (or subpopulations) that are typically connected by emigration and immigration pathways that allow for exchange of individuals (and genetic material) and for colonizations after local extinctions. Desert bighorn sheep exhibit such a metapopulation structure in the Plan Area in that small local populations are largely restricted to steep, isolated rocky mountain ranges that are scattered across the desert landscape and which are separated by substantial expanses of unsuitable habitat (Bleich et al. 1990; Epps et al. 2010). Based on Epps et al. (2003), there are 13 metapopulations in California, of which approximately 8 occur in the Plan Area. Within each metapopulation in the Plan Area, there are separate population groups ranging from 1 population in the San Gabriel metapopulation to 18 populations in the South Mojave metapopulation (see Table 1 in Epps et al. 2003). In the 2004 population inventory, of the most frequent population size classes in the Plan Area were either 0 or 25-100 (see Table 2 in Epps et al. 2003). As discussed in Spatial Behavior, inter-mountain movements are not rare, but conservation of the species in the Plan Area depends on maintaining intermountain habitat connectivity that allows for dispersal and migrations between populations, and recolonizations of empty habitats (Bleich et al. 1990). This intermountain habitat includes "stepping stones" within movement corridors that are not permanent habitat, but which facilitate movement (Bleich et al. 1990).

Desert bighorn sheep are threatened by loss and fragmentation of important habitats (e.g., lambing and feeding areas, escape terrain, water, travel, and dispersal routes), disease (mostly livestock derived), predation, drought, potential resource competition, and negative interactions with humans (USFWS 2000; Wehausen 2006). In addition, some of these threats are interrelated and interactive. For example, habitat fragmentation has resulted in loss of genetic diversity (Epps et al. 2005), which can result in reduced fitness and vigor and make desert bighorn sheep more vulnerable to other threat factors or stressors such as disease, drought, and predation.

For a full discussion on the threats and stressors to desert bighorn sheep populations, refer to the full species profile in Appendix B.

5.4.3.2 Habitat Characteristics

Desert bighorn sheep are mobile and wide-ranging and require a variety of habitat characteristics related to topography, visibility, forage quality and quantity, and water availability (USFWS 2000). Desert bighorn sheep prefer areas on or near mountainous

terrain that are visually open, as well as steep and rocky (Wehausen 2006). Steep, rugged terrain is used for escape and lambing. Alluvial fans and washes in flatter terrain are also used for forage and water and as connectivity habitat between more rugged areas. However, based on an assessment of radiotelemetry data, Epps et al. (2007) conducted a least cost path analysis for bighorn sheep in the Mojave Desert of California. That analysis used a large genetic data set from 26 different populations and resulting estimated gene flows between populations lacking anthropogenic barriers to determine which of three slope cutoffs (5%, 10%, and 15%) best defined preferred habitat. The three slope cutoff values considered were based on a review of extensive data on telemetered bighorn sheep that showed that a 10% slope cutoff contained most of those points; thus, the other two values chosen were each a 5% difference from 10%. For their least cost pathway analysis, they found that 10% and 15% slope cutoff were fairly equivalent in defining preferred habitat. For a 20% slope cutoff, many telemetry points would fall outside the polygons. Epps et al. (2007) found that desert bighorn sheep mainly used slopes greater than 10% in intermountain habitats. They used 15% slope as a cutoff value in a model for 'effective geographical distance', or EGD, where cells with slopes less than 15% were considered 10 times more costly to cross than cells with slopes greater than 15%. Because desert bighorn sheep predator avoidance is based on vigilance and visual contact, they tend to avoid dense vegetation (USFWS 2000).

Desert bighorn sheep occur in the following habitats: alpine dwarf-shrub, low sage, sagebrush, bitterbrush, pinyon-juniper, palm oasis, desert riparian, desert succulent shrub, desert scrub, subalpine conifer, perennial grassland, montane chaparral, and montane riparian (Zeiner et al. 1990). A wide range of forage resources and vegetation associations is needed to meet annual and drought-related variations in forage quality and availability (USFWS 2000). Seasonal forage available in alluvial fans and in washes provides a diversity of browse during warmer periods that support lactation and thus is important for reproduction and recruitment of lambs. Foraging behavior is described in more detail herein.

Surface water is an important habitat element for desert bighorn sheep, although individuals can survive without drinking surface water (Wehausen 2006). While desert bighorn sheep may drink water in the cool season, in years of poor forage growth, surface water is most important during the May through October hot season, when most females and associated lambs and yearlings live largely within 2 to 3 miles of water. Males join them at these water sources as the hot season progresses with the onset of the breeding season (Wehausen, pers. comm. 2012). In populations in the eastern Mojave Desert (Old Dad Peak, Kelso Mountains, and Marl Mountains), females occur in areas closer to water and more rugged terrain than males (Bleich et al. 1997). Water sources adjacent to escape terrain are preferred and a lack of water may be a limiting factor in the distribution of

desert bighorn sheep populations; there are no known large populations in regions lacking water (Wehausen 2006).

Outside the breeding season, males and females commonly occupy different habitats and usually only come together during the rut period (USFWS 2000). Females prefer particularly steep, safe areas for bearing and initial rearing of lambs (Bleich et al. 1997), especially areas of steep limestone if available (Wehausen 2006). Steep topography is not only important for lambing and rearing, but also helps desert bighorn sheep escape from predators (USFWS 2000). Because desert bighorn sheep primarily rely on their sense of sight to detect predators, open terrain with good visibility is critical for protection from predation (USFWS 2000). Males tend to occupy much less rugged habitat during the lambing season (Wehausen 2006).

5.4.3.3 Occurrence within Plan Area

All of the CNDDB occurrences of desert bighorn sheep within 5 miles of the Plan Area are historical (i.e., before 1990). These occurrences range from the Last Chance Range near the northeastern portion of the Plan Area south to the Chocolate Mountains in the southeastern portion of the Plan Area. Records marking the eastern boundary of the CNDDB records are from near Straw Peak, the Newberry Mountains, and the San Bernardino Mountains east of Joshua Tree National Monument (CDFW 2013).

The CDFG (2010c) prepared the *Biennial Report to the Legislature Regarding Bighorn Sheep Management* pursuant to Section 4094 of the California Fish and Game Code. This report summarizes census information related to long-term management of desert bighorn sheep (including the authorization of hunting tags) and includes sheep counts in specific management units in 2009 and 2010. The distribution of desert bighorn sheep is grouped by a regional system of subpopulations (or metapopulations) based on natural physical features such as geography and vegetation that affect species occurrence, as well as manmade obstacles that affect distribution, such as freeways (CDFG 2010c). Aerial surveys in 2009 and 2010 documented 1,022 desert bighorn sheep, including ewes, lambs, and rams, in the following mountain ranges: Marble Mountains; Clipper Mountains; Kelso Peak and Old Dad Peak; Clark, Kingston, and Mesquite Mountains; Orocopia Mountains; Sheephole Mountains; South Bristol Mountains; Cady Mountains; White Mountains; and San Gorgonio Mountains. The 1,022 individuals represent minimum populations in these areas because they were the only animals actually observed; population size is assumed to be larger (CDFG 2010c).

The model generated 4,893,423 acres of inter-mountain habitat and 7,976,800 acres of mountain habitat for bighorn sheep in the Plan Area. Appendix C includes a figure showing the modeled inter-mountain and mountain suitable habitat in the Plan Area.

5.4.4 Desert Kit Fox (Planning Species)

5.4.4.1 Status and Distribution

Regulatory Status

The desert kit fox (*Vulpes macrotis arsipus*) is not federally or state listed and has no other special status species designations. This species is considered a DRECP "Planning Species."

There is disagreement about the taxonomic relationship of kit fox (*Vulpes macrotis*) and swift fox (*V. velox*) and subspecific designations for kit fox (e.g., Dragoo et al. 1990; Mercure et al. 1993; 57 FR 28167–28169).

Natural History

Several studies in California, Arizona, and Utah, as summarized by Tannerfeldt et al. (2003), show that the primary food sources for kit foxes are rodents and lagomorphs, including jackrabbit (*Lepus* spp.) and cottontails (*Sylvilagus* spp.). On the Carrizo Plain in California, San Joaquin kit fox prey included kangaroo rats, pocket mice (*Chaetodipus* spp. and *Perognathus* spp.), deer mouse., black-tailed jackrabbit, desert cottontail (*Sylvilagus audubonii*), and California ground squirrel (*Spermophilus beecheyi*) (White and Ralls 1993). In the Plan Area, it is expected that primary prey for desert kit fox include black-tailed jackrabbit, desert cottontail, Merriam's kangaroo rat (*D. merriami*) (the most common and widespread kangaroo rat in the Plan Area), various pocket mice species, other rodents such as woodrats (*Neotoma* spp.) and California ground squirrel, and various small reptiles.

Hunting is almost strictly nocturnal, with kit foxes resting in their dens during the day (Egoscue 1956; White et al. 1995). As noted under spatial activity, individuals may move several miles daily, but it is likely that foraging distances are closely related to prey availability, which is likely variable spatially and temporally (Egoscue 1956).

The desert kit fox reproductive period in the Plan Area is generally December to late May (O'Farrell and Gilbertson 1986), which is consistent with other parts of the kit fox's range (e.g., Egoscue 1956; McGrew 1979). In the O'Farrell and Gilbertson (1986) study in the western Mojave, males maintained scrotal development throughout the year, but females were reproductive in December and January. Gestation is approximately 49–56 days (McGrew 1979), and females in the O'Farrell and Gilbertson (1986) study were lactating

in March and April, indicating birth in February and March. Kit fox litters are 2–6 pups (Egoscue 1956; McGrew 1979; Tannerfeldt et al. 2003; USFWS 2010), and pups emerge from the natal den at about 4 weeks of age (USFWS 2010). Both adults provide care to pups. Initially males do most of the hunting while lactating females remain in the den (Egoscue 1956). In the O'Farrell and Gilbertson (1986) study, pups were absent from natal dens by the end of May. However, for San Joaquin kit fox, pups remain under the care of adults for 4 to 5 months, before beginning to disperse from their natal area as early as July and continuing through August and September (Moonjian 2007; USFWS 2010). Some offspring remain with their parents and help raise the next litter during the following year (USFWS 2010).

Desert kit foxes are quite mobile and have relatively large home ranges. In the western Mojave, O'Farrell and Gilbertson (1986) estimated ranges of the approximately 494 acres based on radiotelemetry data. Data for other subspecies indicate at least as large to much larger home ranges, with home-range size likely related to resource availability. For San Joaquin kit fox, Koopman et al. (2001) determined a mean adult home-range size of approximately 1,072 acres and a mean pup home-range size of 325 acres on the Naval Petroleum Reserves in western Kern County (USFWS 2010). Briden et al. (1992, as cited in USFWS 2010) found that denning ranges (the area encompassing all known dens for an individual) for San Joaquin kit fox averaged approximately 1,169 acres in western Merced County.

Daily movements of desert kit foxes in western Arizona during the period of December through March averaged 8.9 miles (14.3 ±0.71 kilometers/night) for males and 7.4 miles (11.8 ±1.08 kilometers/night) for females (Zoellick et al. 1989). Males tended to move greater distances during the breeding season compared to pup rearing and pair formation periods (Zoellick et al. 1989). O'Farrell and Gilbertson (1986) did not observe young remaining in their natal territory and recorded a maximum dispersal of approximately 20 miles (32 kilometers) by a female. Egoscue (1956) reported movements up to 20 miles by juvenile kit foxes in western Utah. However, in the San Joaquin kit fox, which has been much more extensively studied than desert kit fox in the Plan Area, some offspring remain with their parents (Ralls et al 2001).

Fairly extensive research has been conducted on the ecological relationships of kit foxes to other species, and in particular to coyotes, which is a common predator of kit foxes (e.g., Rall and White 1995; White et al. 1995; White and Garrott 1997; Kozlowski et al. 2008) and direct competitor for prey (e.g., White et al. 1994, 1995; Arjo et al. 2007; Kozlowski et al. 2008). A brief summary of some of these studies, as they may relate to conservation of the desert kit fox in the Plan Area, is provided here.

Several studies have noted dramatic kit fox population fluctuations in relation to prey availability. For example, in San Joaquin kit fox, Cypher et al. (2000) found that high kangaroo rat densities positively influenced the growth of a kit fox population, while Moonjian (2007) found that low densities of kit foxes in the Palo Prieto area of western Kern County were associated with low densities of kangaroo rats. Local extirpations have also been linked to the previous loss of kangaroo rat populations (Cypher et al. 2000). White and Ralls (1993) found that prey scarcity related to drought reduced reproductive success in San Joaquin kit fox on the Carrizo Plain, with no reproduction by nine tracked females in 1990.

Prey selection by San Joaquin kit fox may also track availability. A 15-year study at the Naval Petroleum Reserves in western Kern County found that the dominant prey item alternated over time between kangaroo rats and leporids (Cypher et al. 2000). Similar prey studies have not been conducted for desert kit fox, but it is expected that patterns would be similar because desert rodent and lagomorph populations also vary substantially in relation to environmental conditions and possibly demographic factors. For example, Beatley (1969) found that desert rodent reproduction and population densities in southern Nevada were strongly associated with fall rain and production of winter annuals plants. Black-tailed jackrabbit densities and distribution appear to have a more complex relationship with environmental conditions because their diet shifts between seasons, locations, years, and vegetation types (Hayden 1966; Johnson and Anderson 1984; Wansi et al. 1992). The length of the jackrabbit breeding season appears to be related to the production of herbaceous vegetation (Lechleitner 1959), and reproductive activity appears to be density-dependent, which can result in wide population fluctuations on 7–10-year cycles (French et al. 1965; Wagner and Stoddart 1972; Smith 1990).

Coyote are both predators of kit foxes and direct competitors for food, with substantial spatial, temporal, and dietary overlap (White et al. 1994, 1995; Kozlowski et al. 2008). Habitat and land use changes that attract coyotes therefore would likely have an adverse effect on desert kit foxes. Arjo et al. (2007), for example, suggest that invasion of a site in western Utah (the same site studied by Egoscue in the 1950s) by cheatgrass (*Bromus tectorum*), replacing native Great Basin shrub communities, and the addition of artificial water sources have altered prey abundance and attracted coyotes, to the detriment of kit foxes. Kit foxes do not require free water and are less water-limited than coyotes. The increased abundance of coyotes may have increased direct competition for food resources, with kit foxes having to focus on small rodents due to increased predation of lagomorphs by coyotes (Arjo et al. 2007). On the same Utah site, Kozlowski et al. (2008) found that kit foxes and coyotes used space within their home ranges differently, with kit foxes using areas of vegetation and ruggedness not favored by coyotes, but interactions were still common and 56% of kit fox mortalities were attributed to coyotes.

General Distribution and Populations Trends

For the purpose of this profile, the range of the desert kit fox (*V. m. arsipus*) as described by Hall (1981) for *V. velox arsipus* is used. The desert kit fox is a year-round resident of the southwestern deserts of California, southern Nevada, the lower elevations of western and southern Arizona, and northern Mexico. Its western boundary that separates it from the federally listed and isolated San Joaquin kit fox subspecies is the Antelope valley in the west Mojave. The Tehachapi and Southern Sierra Mountain ranges form a physical barrier between desert kit fox and San Joaquin kit fox, although Mercure et al. (1993) suggest that the lower elevation Tehachapi range may be more permeable to movement than the Southern Sierra range.

Population status and trends in the Plan Area are unknown, but it has been characterized as uncommon to rare in arid regions in California (Zeiner et al. 1990). Meany et al. (2006) state that kit fox populations "plummeted" in the last half of the 19th and early 20th century due to predator and rodent controls. They report that the kit fox population in Colorado may be close to extirpation, populations in Oregon and Idaho are extremely low, and populations in the Great Basin Desert in Nevada and Utah may be in decline. The only states Meaney et al. (2006) indicate may still have stable populations are Arizona, New Mexico, and Texas.

In March 2013, the Center for Biological Diversity (CBD) submitted a petition to the California Department of Fish and Wildlife (CDFW) to list the desert kit fox as threatened under the California Endangered Species Act (Kadaba et al. 2013). The CBD cited large-scale energy development as a primary threat, in concert with OHV use, grazing, agriculture, military activities, urbanization, climate change, and increased anthropogenic disease risks (Kadaba et al. 2013). Although the species' status and trends in the Plan Area are unknown, it is reasonable to assume that the threats and stressors cited in the CBD petition have resulted in loss, fragmentation, and degradation of habitat for kit fox in the Plan Area and at least local impacts on local populations subject to these threats and stressors (see Threats and Environmental Stressors). Whether these effects, as outlined in the petition, have risen to the level of warranting a listing as threatened is yet unknown and await analysis and determination by CDFW.

Reasons for Decline

An initial cause of population declines in kit fox was predator and rodent controls in the 19th and 20th centuries (Meaney et al. 2006). Several threat factors cited by Meaney et al. (2006) for Colorado that may apply to the desert kit fox in the Plan Area are habitat degradation, loss and fragmentation from development, roads, recreation, and grazing.

The expansion and increased abundance of coyotes, which is the main predator of kit foxes, is also a threat.

A potentially devastating current threat to desert kit fox is canine distemper, which was determined to be the cause of death of several kit foxes at and near a solar energy project located west of Blythe in fall 2011 (Clifford et al. 2013). The source of the distemper outbreak is not known and may have been a domestic dog or native wildlife such as badger. This distemper outbreak is the first documented incident in wild kit foxes (Clifford et al. 2013). Subsequent trapping of 39 individuals in January 2012 at the outbreak site found that all appeared healthy, but the capture rate at the affected site was low, indicating a reduction in the local population (Clifford et al. 2013). Although the recent outbreak of canine distemper is the first documented incident in wild kit foxes, O'Farrell and Gilbertson (1986) suggested that canine distemper or some other viral or bacterial disease may have been a causal factor in the apparent starvation deaths of several desert kit fox individuals during a study conducted from 1977 to 1979 in the western Mojave, because one clinical symptom of distemper is anorexia and gradual loss of activities, which can result in starvation.

In addition to habitat impacts and disease, it is expected that desert kit fox is also vulnerable to various human activities, including recreation such as OHVs. However, O'Farrell and Gilbertson (1986) found that most dens were within 490–656 feet (150–200 meters) of roads or jeep trails in the Rand Open Area in the western Mojave that was subject to unlimited OHV activity during the study from 1977 to 1979 (i.e., there was no apparent tendency to locate dens away from roads or trails). However, mortalities related to shooting, vehicle collisions, den collapse (which could result from OHV activity), and potentially canine distemper (which could be transmitted by dogs) were observed.

In more urbanized areas, vehicle collisions are a frequent source of mortality of kit foxes. Bjurlin et al. (2005) found that vehicle collisions were the primary cause of mortality of San Joaquin kit foxes in the Bakersfield area, whereas predation is the more common cause of mortality of the subspecies in natural areas (e.g., Ralls and White 1995). Bjurlin et al. (2005) found that while kit foxes frequently crossed local roads, collisions were statistically more likely to occur on arterials with higher traffic densities and speeds; about 69% of all documented strikes were on four- and six-lane arterials and about 88% of all strikes were on roads with posted speed limits of 45, 50, or 55 miles per hour (56% of strikes were on roads with a 55-mile-per-hour speed limit). Bjurlin et al. (2005) also found that collisions on roads were disproportionate to males during the winter in association with territorial defense, mating, and exploratory movements. Further, even though den selection was not related to road proximity, close proximity of dens to roads increased collision risk.

Desert kit fox is also vulnerable to rodenticide poisoning (Shitoskey 1975; Meaney et al. 2006). Shitoskey (1975) demonstrated that three rodenticides—sodium monofluoroacetate (compound 1080), strychnine alkaloid, and zinc phosphate—were lethal to kit fox when administered directly. Sodium monofluoroacetate and strychnine alkaloid were also lethal when kit fox ingested kangaroo rats killed by the two rodenticides, but kit fox was able to tolerate kangaroo rats contaminated with zinc phosphate. For a more detailed discussion on threats to this species, refer to the species profile in Appendix B.

5.4.4.2 Habitat Characteristics

Kit foxes generally inhabit arid regions that receive less than about 16 inches (400 millimeters) of rain annually (Tannerfeldt et al. 2003). In the Plan Area, desert kit fox primarily occurs in open desert scrub habitats on gentle slopes. Creosote bush scrub in California is the most common habitat association for desert kit fox in California (McGrew 1979). A similar association with creosote brush scrub for den sites has been documented in Arizona (Zoellick 1985; Zoellick et al. 1989). In the Great Basin Desert portion of the Plan Area, suitable habitat includes saltbush (*Atriplex* spp.) scrubs. Penrod et al. (2012) created a suitable habitat model for desert kit fox that covers the Plan Area and that incorporates vegetation, topography, and road density and classifies habitat as good, fair, marginal, and unsuitable. "Good" habitat includes creosote bush–white bursage desert scrub or mixed salt desert scrub on slopes less than 5% and with low road density. "Fair" habitat includes areas with slopes less than 5% and other vegetation types suitable for kit fox such as playas and washes or medium road densities. "Marginal" habitat includes areas with slopes of 5%–15% or vegetation/cover types marginal for kit fox such as dune fields. "Unsuitable" areas includes slopes greater than 15%, unsuitable vegetation/cover types such as unvegetated lands, rocklands, bedrock, cliff and outcrop, and developed and cultivated lands.

Dens are an important resource for kit fox because they provide microclimate moderation and protection from predators, and may be a limiting resource for kit fox distribution (Arjo et al. 2003). Kit foxes form monogamous pairs (at least through a breeding season) and often small family groups that occupy den complexes (Ralls and White 2003; Ralls et al. 2007). Kit foxes may dig their own dens, use dens created by other species such as badger (*Taxidea taxus*), or expand on burrows created by smaller species such kangaroo rats (*Dipodomys* spp.) and prairie dogs (*Cynomys* spp.) (Arjo et al. 2003; Tannerfeldt et al. 2003).

Kit fox dens typically have multiple entrances (Egoscue 1956; O'Farrell and Gilbertson 1986; Tannerfeldt et al. 2003). In the O'Farrell and Gilbertson (1986) study, dens averaged 3–5 entrances, with up to 10 entrances. Natal (pupping) dens used by desert kit foxes from January to the end of May were larger and had more entrances (5–8) than non-natal dens

(3–4) used from June through December (O'Farrell and Gilbertson 1986), which also appears generally common in kit foxes (e.g., Arjo et al. 2003; Tannerfeldt et al. 2003).

Kit foxes use numerous dens, switching dens frequently, and dens tend to be clustered (Tannerfeldt et al. 2003). Clusters include several dens (in one study, up to 17) that may be more than 328 feet (100 meters) apart (Tannerfeldt et al. 2003). In San Joaquin kit fox, den switching may occur several times monthly and most often during the dispersal season, but switching is also related to age class with adults tending to use more dens than juveniles (Tannerfeldt et al. 2003).

Natal dens in the western Mojave appeared to be spaced, with possible territorial exclusivity, with a minimum inter-den distance of approximately 1.25 miles (2 kilometers) (O'Farrell and Gilbertson 1986). This spacing may reflect territorial requirements and carrying capacity (O'Farrell and Gilbertson 1986). Similarly, in western Utah natal dens were at least 2 miles (3.2 kilometers) apart (Egoscue 1975). In San Joaquin kit fox, territories of adjacent social groups had only slight overlap (White and Ralls 1993).

Selection of den sites does not appear to be strongly related to nearby human activities, nor do kit foxes appear to actively avoid man-made features such as roads and structures. O'Farrell and Gilbertson (1986) found that most desert kit fox dens were within 492–656 feet (150–200 meters) of roads or trails in the western Mojave. Bjurlin et al. (2005) found that almost 10% of San Joaquin kit dens in the Bakersfield area were within 100 feet of road centerlines and that some dens used features of major roads, including culverts, embankments and underpasses, and drainage basins or canals immediately adjacent to roads.

5.4.4.3 Occurrence within Plan Area

The desert kit fox's range historically included the entire Plan Area. There is a general lack of recent distribution information for this species; however, the desert kit fox's current distribution is considered to include the entire Plan Area (Figure SP-M04).

The model generated 15,686,640 acres of modeled suitable habitat for desert kit fox in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.4.5 Mohave Ground Squirrel

5.4.5.1 Status and Distribution

Regulatory Status

The Mohave ground squirrel (*Xerospermophilus mohavensis*) is state listed as threatened in California. It has no current federal designation and the USFWS published a 12-month finding in October 2011 that listing of the Mohave ground squirrel as threatened or endangered is not warranted at this time (76 FR 62214–62258).

Natural History

The Mohave ground squirrel feeds primarily on plant material. In the short term, they specialize in foraging on certain plant species, but as these sources become less available throughout the active season, the Mohave ground squirrel adapts its foraging strategy to maximize energy intake, exploiting food sources that are intermittently available (75 FR 22063–22070). High water content may be a component of their food selection as plants are eaten at different times depending on their water content (Best 1995; 75 FR 22063–22070). For a more detailed discussion on the dietary preferences of the Mohave ground squirrel, refer to the full species profile in Appendix B.

The Mohave ground squirrel breeding season is from mid-February to mid-March (Best 1995; Laabs 2006). Males emerge from hibernation in February, up to two weeks before females, and during this time they may be territorial (Best 1995). Females generally only occupy male territories for one or two days then establish their own home ranges after copulation. Recent radiotelemetry data indicate that males expand their activity areas the breeding to overlap several established female ranges, (upublished data, Leitner, pers. comm. 2012). Males stake out the overwintering sites of females to mate with them when they emerge (MGSWG 2011).

Pregnant females are present from March through April (Leitner, pers. comm. 2012) and gestation lasts from 29 to 30 days (Best 1995). Litter sizes range from four to nine (Best 1995), though mortality of juveniles is high during the first year, especially for juvenile males (MGSWG 2011). Parental care and lactation continues through mid-May. Litters generally appear above ground in early May (Harris and Leitner 2004). Females will breed at 1 year of age if environmental conditions are suitable, but males do not mate until 2 years of age (MGSWG 2011).

The amount of fall and winter precipitation generally determines Mohave ground squirrel reproductive success. In low rainfall years (e.g., less than 6.5 cm (2.6 in.)), they may forego

breeding (MGSWG 2011), and breeding may not occur for several years during prolonged drought (Best 1995). Because of the small geographic range of the species, low rainfall can lead to reproductive failure throughout the range (MGSWG 2011). During these periods, all available forage may be converted to body fat and squirrels can enter dormancy as early as April (Leitner 1999).

The Mohave ground squirrel is generally only active above ground between February and July (MGSWG 2011), but the active period may begin as early as mid-January (Harris and Leitner 2004). Adults generally enter aestivation earlier than juveniles (MGSWG 2011). Timing of emergence varies geographically as it appears to depend on temperature and elevation (Gustafson 1993; Laabs 2006). Furthermore, the timing of emergence and length of the active season varies by sex, age, and availability of food resources (MGSWG 2011). For a more detailed discussion on the activity periods of the Mohave ground squirrel, refer to the full species profile in Appendix B.

Harris and Leitner (2004) conducted a 5-year radiotelemetry study of home range use by Mohave ground squirrels in the Coso Range in Inyo County. At this study site, individual Mohave ground squirrel home ranges (calculated using both minimum convex polygon and adaptive kernel methods) varied substantially by year, individual, sex, and season (i.e., mating season vs. post-mating season). Generally, males have larger home ranges than females, with the most pronounced differences during the mating season. For a more detailed discussion on the home range size of the Mohave ground squirrel, refer to the full species profile in Appendix B.

Mohave ground squirrels maintain three types of burrows within their home ranges: (1) home burrows that are used overnight during the active season and usually located at the edge of a home range; (2) aestivation burrows; and (3) accessory burrows that are used during social interactions or for escape and thermoregulation during the midday (Best 1995). Burrows are typically constructed under large shrubs (MGSWG 2011).

Harris and Leitner (2005) used radiotelemetry to track dispersal movements by juvenile Mohave ground squirrels in their first year to hibernation sites. Most juveniles dispersed relatively long distances from their natal burrow area, and exhibited dispersal that is farther than other squirrels and other mammals in proportion to home range sizes (Harris and Leitner 2005). For a more detailed discussion on dispersal of the Mohave ground squirrel, refer to the full species profile in Appendix B.

There is little direct information on the potential role of Mohave ground squirrels in maintaining ecological relationships and processes. Their burrow systems likely provide refuge for other species that do not dig their own burrows such as snakes and lizards and

potentially other small rodents. The range of the Mohave ground squirrel is entirely overlapped by the diurnal white-tailed antelope squirrel, but there appears to be little direct competition between the two species (MGSWG 2011). For a more detailed discussion on the interaction between the antelope squirrel and Mohave ground squirrel, refer to the full species profile in Appendix B. They are probably prey for several natural predators, such as coyote, American badger, bobcat, red-tailed hawk, golden eagle, prairie falcon, common raven, and Mojave rattlesnake (Best 1995).

General Distribution and Populations Trends

Endemic to California, the Mohave ground squirrel is exclusively found in the northwestern Mojave Desert in San Bernardino, Los Angeles, Kern, and Inyo counties (Best 1995).

Data are lacking to assess population abundance and trends for the Mohave ground squirrel (76 FR 62219). Systematic or sample-based surveys in the species' range have not been conducted at a level that allow for population estimates and comparisons over time.

Reasons for Decline

The primary threat to the Mohave ground squirrel has been habitat loss and fragmentation (Leitner 2008; MGSWG 2011). The Mohave ground squirrel's range has been reduced or its habitat destroyed and degraded by urban and rural development on private and public lands, agricultural development, military activities, energy projects, and transportation (Leitner 2008; MGSWG 2011).

Livestock grazing and OHVs may also cause habitat degradation and have direct impacts on Mohave ground squirrel (Leitner 2008; MGSWG 2011).

Grazing by cattle and sheep can affect vegetative structure, disturb soils, accelerate erosion, and collapse burrows (MGSWG 2011). Cattle and sheep forage on winter fat foliage, which is also important to Mohave ground squirrel, especially in years with low precipitation and annual forb production (MGSWG 2011). Although livestock grazing is listed as a potential threat to Mohave ground squirrel, the BLM has been eliminating or reducing grazing in some areas of the species range (76 FR 62237) and grazing does not occur on military lands, state parks or CDFW ecological reserves (Leitner, pers. comm. 2012). The USFWS 12-month finding on October 6, 2011 conclude that livestock grazing is not currently a threat to the Mohave ground squirrel (76 FR 62214–62258).

OHV use is a threat to Mohave ground squirrel through direct collisions, disturbance of soil, destruction of shrubs, and facilitation of invasive species that displace native species along dirt roads and trails (MGSWG 2011). The West Mojave Plan Route Designation report

indicates that 47% of 310 vegetation transects are bisected by some type of off-road vehicle track (MGSWG 2011). The four BLM-operated OHV areas (Jawbone Canyon, Dove Springs, El Mirage, and Spangler Hills) cover over 417 km^2 (161 mi^2) within the Mohave ground squirrel's range (MGSWG 2011).

Prolonged drought is another threat to the Mohave ground squirrel. Low rainfall causes reduced productivity of annual plants, which can cause Mohave ground squirrels to forego breeding during drought periods because insufficient energy is available to support gestation and lactation (Best 1995; Harris and Leitner 2004). Local population extinction can result with prolonged drought events that suppress reproduction for several years (Best 1995). Prolonged drought events alone would not pose a serious threat to the species, considering its likely adaptations for these conditions, such as prolonged aestivation and long dispersal movements that allow for recolonization (Best 1995; Harris and Leitner 2005). However, habitat loss, fragmentation, and degradation can preclude recolonization of habitat from which local populations have been extirpated as a result of drought because the sites become functionally isolated from occupied areas (Laabs 2006).

Urban and rural uses have introduced potential impacts to Mohave ground squirrel that may occur where habitat is near development. Domestic cats (*Felis catus*) and dogs (*Canis familiaris*) may be predators and the use of rodenticides and pesticides around agricultural fields, golf courses, earthen dams, and canal levees may directly affect the species (MGSWG 2011).

Although common raven is a natural predator, their populations have increased substantially within the Mohave ground squirrel's range and they are a known predator for small mammals (MGSWG 2011). Therefore, ravens may be exerting higher predation pressure on the species than occurred historically.

5.4.5.2 Habitat Characteristics

The Mohave ground squirrel occurs in a variety of desert shrubland habitats. Although most often found in creosote bush scrub, it has also been recorded in desert saltbush scrub, desert sink scrub, desert greasewood scrub, shadscale scrub, Joshua tree woodland, and Mojave mixed woody scrub (Best 1995; 75 FR 22063–22070; MGSWG 2011). Mohave ground squirrel typically occupies areas with open vegetative cover and small bushes (< 0.6 meter (2 feet) in height) spaced approximately 6 to 9 meters (20 to 30 feet) apart (Best 1995).

Mohave ground squirrel prefers deep, sandy to gravelly soils on flat to moderately sloping terrain and will avoid rocky areas for the most part (Best 1995; MGSWG 2011). The species is not known to occupy areas of desert pavement (MGSWG 2011). Soil characteristics are particularly important because Mohave ground squirrels construct

burrows to provide temperature regulation, avoid predators, and use during the inactive season (75 FR 22063–22070).

5.4.5.3 Occurrence within Plan Area

The presumed historical range of the Mohave ground squirrel within the northwestern Mojave Desert was bounded on the south and west by the San Gabriel, Tehachapi, and Sierra Nevada mountain ranges; on the northwest by Owens Lake, and on the northeast by Granite and Avawatz mountains; and on the east and southeast by the Mojave River (Leitner 2008; MGSWG 2011). In addition, the species was historically found in one locality east of the Mojave River in the Lucerne Valley. Its historical range covered about 20,000 square kilometers (km^2) (7,722 square miles (mi^2)) (Gustafson 1993), which is the smallest geographic range of any ground squirrel species in the United States. However, for the 12-month finding for the species published in October 2011, the USFWS used a somewhat larger historical range of approximately 21,525 km^2 (8,311 mi^2) (76 FR 62214–62258). The USFWS also stated in its 12-month finding that the range of the Mohave ground squirrel may be larger that defined in the finding or previously published based on recent sightings, such as in an interior valley of the Tehachapi Mountains and in the Panamint Valley about 8 kilometers (5 miles) north of the defined range (76 FR 62214–62258).

Based on the range used by Leitner (2008), about 88% of the historical range of the species is within the Plan Area (only the Coso Range in the northern extent of its historical range is excluded).

Approximately 28% of the CNDDB records for the Mohave ground squirrel are historical or have no date. These records are located throughout the species' range (CDFW 2013) (see Figure SP-M05 in Appendix B).

The current range is reduced from the historical range as a result of the likely extirpation of the Mohave ground squirrel in the western portion of the Antelope Valley and potentially south of Victorville and southeast to Lucerne Valley (MGSWG 2011). The current range is estimated to be about 19,000 km^2 (6,640 mi^2) (MGSWG 2011).

The occurrence of Mohave ground squirrel is likely to be patchy within its range, even within apparently suitable habitat (MGSWG 2011). However, as noted by Leitner (2008), occurrence records tend to be concentrated in certain areas where trapping studies have been focused; these studies are discussed in more detail below. There has not been a systematic, range-wide census or statistically based random sampling study to determine occupation throughout the species' range (Leitner 2008). About 88% of the geographic

area of known existing populations of the species, based on Leitner (2008), occur in the Plan Area (only a portion of the Coso Range-Olancha Core population is outside this area).

Within the Plan Area, the published Mohave ground squirrel range extends from Inyo County east of Owens Lake in the north to a few miles east of Rabbit Springs in Lucerne Valley in the south, and from the Granite Mountains in Fort Irwin in the east to the cities of Mojave, Lancaster, and Palmdale in the west (Leitner 2008). Leitner (2008) provides the most current status of the Mohave ground squirrel based on compilation of a database, including unpublished field studies, surveys, and incidental observations for the 10-year period from 1998 through 2007. This database includes 1,140 trapping sessions, of which 102 resulted in observation of the species, and 96 additional incidental observations. Most of these studies and observations have been conducted in the southern part of the species' range south of SR 58 and no range-wide systematic or statistically based random sampling has been conducted to characterize the species' status throughout its range. Leitner (2008) emphasizes that there are large areas of potential habitat where the species' status is unknown, especially on the China Lake Naval Air Weapons Station and Fort Irwin.

Approximately 52% of the CNDDB records are located on public lands managed by the BLM, DOD, California Department of Transportation, Department of Parks and Recreation (DPR), Kern and San Bernardino counties, and the LADWP. Approximately 21% are located on privately owned lands. The ownership of the remaining 27% of the CNDDB records is unknown (CDFG 2012b).

Important areas for the conservation of the Mohave ground squirrel were established to inform planning efforts for conservation of this species' habitat for the DRECP. The original data included only a limited number of population centers and linkages defined by Phil Leitner, PhD, of California State University of Stanislaus in 2008. The data were revised in 2012 based on input from Leitner and other Mohave ground squirrel experts. The habitats were defined using field observations, historical and current species occurrence records, habitat suitability, including disturbance analysis, the USGS 2013 Habitat Suitability Model, expert input, and topography. The following habitat types were described and their acreages within the Plan Area are included in Table 5-2.

- Key Population Centers – These include habitat with high detection rates, evidence of breeding, and/or temporally persistent occurrence. They were digitized based on expert input acquired during recent surveys and field observations.
- Habitat Linkages – These are hypothesized linkages based on the best available science. Linkages were based on detections, habitat suitability (from USGS model), potential corridors as defined by topography, and expert input.

- Habitat Expansion Areas – From the Mohave ground squirrel TAG Conservation Priorities document 2010. Expansion habitat allows for juvenile dispersal (up to 5 miles) and additional connectivity through contiguous blocks of habitat, lessening the dependence on hypothesized linkages. These areas were defined by buffering population centers and linkages to 5 miles and then removing unviable areas.
- Climate Change Extensions – Mohave ground squirrel are predicted to move north and west into suitable habitat providing refugia from drought. The boundaries of these areas are determined based on personal communications with Phil Leitner and observations based on climate change models in addition to the general features used in the definition of all habitat types and the USGS model.

Table 5-2
Mohave Ground Squirrel Important Areas in the Plan Area

Mohave Ground Squirrel Important Area Type	Acreage
Key Population Center	674,755
Linkage	413,009
Expansion Area	562,834
Climate Change Extension	224,249
Total	**1,874,847**

The model predicts 3,501,554 acres of Mohave ground squirrel habitat in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.4.6 Pallid Bat

5.4.6.1 Status and Distribution

Regulatory Status

The pallid bat (*Antrozous pallidus*) is a California Species of Special Concern and a BLM sensitive species.

Natural History

Pallid bats forage about 0.5 to 2.5 meters [1.6 to 8.2 feet] above the ground surface, and their foraging behavior is directed toward prey that are close to the ground, on the ground, or perched on exposed vegetation (O'Shea and Vaughan 1977). They may forage both aerially and by gleaning from plants, and they have also been observed to take prey by crawling along the ground. Their diet generally has been described to include scorpions,

ground crickets, solpugids, darkling ground beetles, carrion beetles, short-horned grasshoppers, cicadas, praying mantids, long-horned beetles, and sphingid moths (Hermanson and O'Shea 1983).

Pallid bats breed in October through December, and possibly through February (Hermanson and O'Shea 1983). Females store sperm and ovulation occurs during the following spring. Gestation is approximately 9 weeks, and birth in the southwestern United States typically occurs from May through June (Hermanson and O'Shea 1983). Litter size is typically 2 young (approximately 80% of litters (Bassett 1984)), and occasionally 3; yearling females may breed but litter size is 1 (Davis 1969; Hermanson and O'Shea 1983). The young are born relatively undeveloped, but they mature rapidly and engage in their first flight at 33 to 36 days (Davis 1969). They achieve full adult flight capability by about 49 days of age and full adult weight by 56 days of age (Hermanson and O'Shea 1983).

Pallid bats in central Arizona exhibited a bimodal foraging activity pattern, with two foraging bouts separated by a period of night roosting, with the timing and duration of these activities seasonally variable (O'Shea and Vaughan 1977). During the summer months, time away from the roost varies between approximately 45% to 58% of the night.In September and October, time away from the roost varies between 25% to 27% of the night (O'Shea and Vaughan 1977). Pallid bats may be active outside the roost any time of year, but their activity during the winter may be erratic, which probably is associated with cold periods when they are in torpor.

During July through August, pallid bats in central Arizona showed little fidelity to specific roosting sites, but during the cooler months they showed greater fidelity to certain roosting sites (O'Shea and Vaughan 1977), which may reflect more specific roost requirements during the colder months to maintain thermoregulation.

The distances that pallid bats travel during foraging bouts may be limited by the availability of night roosts because they frequently bring large prey to these sites where it is then eaten (O'Shea and Vaughan 1977). Bell (1982), for example, observed pallid bats foraging within 3 kilometers (1.9 miles) of roost sites in desert grasslands in New Mexico. A radio-tracking study in British Columbia found that foraging occurred within 1.5 kilometers (0.9 mile) of day roost sites (Rambaldini 2006). For a more detailed discussion on foraging habits of pallid bat, refer to the species profile in Appendix B.

Pallid bats may share both day and night roosts with other bat species such as Brazilian free-tailed bat and Yuma myotis (Hermanson and O'Shea 1983; Licht and Leitner 1967), but there is no evidence in the literature of competitive or symbiotic relationships with

other bats. Congregations with other bat species at both day and night roosts may simply reflect use of limited resources.

Black (1974) suggested that bats may employ several types of foraging and food partitioning mechanisms that could reduce inter-specific competition, including size and type of prey; periods of activity (most bat prey are active within a few hours of sunset, but different prey have different peak activity periods); spatial partitioning, such as between-, within-, and below-canopy foragers; and flight patterns, such as slow vs. fast flying, maneuverability, and hovering.

Compared to other bat species, pallid bats emerge from day roosts relatively late in the evening (Hermanson and O'Shea 1983), but there is no information to suggest that this reflects competition for prey with other species. Artificial lighting may affect competitive predator-prey relationships among bats.

General Distribution and Populations Trends

The pallid bat is widespread throughout the western United States; southern British Columbia, Canada; and mainland and Baja California, Mexico (Hermanson and O'Shea 1983; Hall 1981). Within the United States, it ranges east into southern Nebraska, western Oklahoma, and western Texas. The pallid bat is locally common in the Great Basin, Mojave, and Sonoran deserts (especially the Sonoran life zone) and grasslands throughout the western United States, and it also occurs in shrublands, woodlands, and forests at elevations up to 2,440 meters (8,000 feet) (Hermanson and O'Shea 1983; Hall 1981). The pallid bat occurs throughout California, except at the highest elevations of the Sierra Nevada range.

Pallid bat is a California Species of Special Concern, but there is little data available to assess population status and trends. In California, Miner and Stokes (2005) noted a serious decline of pallid bats in the South Coast Ecoregion, especially in low-lying areas. They report that even as late as 1948 the species was considered to be abundant in buildings, but that by the 1970s only 1 of 12 known roost sites was still extant. Recent survey information for San Diego County indicates that few roosts that support bat species typically found in association with the pallid bat also include the species (Miner and Stokes 2005). Based on this apparent population decline, Miner and Stokes (2005) concluded that pallid bats are highly intolerant of urban development.

Reasons for Decline

As a colonial roosting species, pallid bats are particularly vulnerable to disturbances of roost sites through vandalism, extermination, and destruction of buildings used as roost

sites (Hermanson and O'Shea 1983), as well as to recreational activities such as rock climbing. Miner and Stokes (2005) found that pallid bats have abandoned almost all previously occupied sites in the urbanized areas of the South Coast Region since the late 1940s. Beck and Rudd (1960) observed that female pallid bats are particularly sensitive to disturbance during the period prior to giving birth through weaning. A single disturbance may cause them to abandon the maternity roost prior to giving birth or to move to a more secluded part of the roost after giving birth (Beck and Rudd 1960).

Food availability may be reduced by pesticides or habitat modification or degradation such as conversion to agriculture, prescribed fires, and wildfires. Pesticides and heavy metals also may contaminate prey, causing secondary poisoning. Because this species often forages on the ground, it is susceptible to predation by urban-related predators (e.g., cats and possibly dogs) and potentially collection or harassment by humans.

Several recent studies have documented substantial mortality of bats at wind energy facilities (e.g., Baerwald and Barclay 2009; Cryan 2011; Cryan and Barclay 2009). While, as of 2010, there have been no reported fatalities of pallid bats at wind energy facilities (e.g., Tetra Tech EC Inc. 2010), Solick and Erickson (2009) indicate that there have been relatively few systematic, post-project, bat-fatality monitoring data collected for large, wind-energy projects in the arid southwestern United States. Although fatalities of this species at wind energy facilities have not been documented, it is expected that the species could be at risk from turbine strikes, or other factors associated with turbine operation, such as barotrauma, hypothesized to cause bat fatalities at wind facilities (Cryan and Barclay 2009). Pallid bats would be at greatest risk of turbine strikes or from other associated causes if a facility was located within a few miles of a day roost site (where most foraging activity occurs), and strikes would most likely occur during emergence and return to the day roost. Risk of strikes may also be higher during dispersal when young are leaving the natal roost site and fly in straight lines from the roost at altitudes of 80 feet or more (O'Shea and Vaughan 1977). Risk of strikes may be relatively low during foraging activities because pallid bats tend to forage on or close to the ground.

5.4.6.2 Habitat Characteristics

Pallid bat day roosting habitat typically includes rocky outcrops, cliffs, and spacious crevices with access to open habitats for foraging (Hermanson and O'Shea 1983; Vaughan and O'Shea 1976). Pallid bats may also roost in caves, mines, bridges, barns, porches, and bat boxes, and even on the ground under burlap sacks, stone piles, rags, baseboards, and rocks (Beck and Rudd 1960; Rambaldini 2006). Radiotelemetry data has also shown that in the desert pallid bats will roost in holes on the ground and in rock crevices on creosote bush flats, not just in mountain ranges (Brown, pers. comm. 2012). Up to the late 1940s, they were common in

buildings at low elevations of the South Coast Ecoregion (Miner and Stokes 2005). For example, in the Newhall area of Southern California, they recently were observed using buildings for both day and night roosts (Johnson 2006). In Northern California, they were observed using buildings and large-diameter, tall, live trees and snags in mature forest stands for both day and night roosting (Baker et al. 2008). In Baker et al. (2008), live trees and snags used for roosting were consistently tall in height, large in diameter, and located in mature stands in micro-sites with low percentages of overstory and mid-story cover. Day roosts generally are warm, have obstructed entrances and exits, and are high enough to avoid terrestrial predators (Rambaldini 2006). A study of night roosts, including rock overhangs, bridges, and buildings, in Oregon found that they were protected from rain and allowed free flight space for bats in and out of the roost (Lewis 1994).

Although pallid bats may use a variety of roosting habitats, they are also selective of roost sites with microenvironments that minimize energy expenditure through adaptive hypothermia and maintain low metabolic rates (Vaughan and O'Shea 1976). In spring and fall at roost sites in Central Arizona, they used vertical crevices that passively warmed during the afternoon prior to emergence, and in the summer, they used deep horizontal crevices that acted as heat sinks and kept ambient temperatures low (Vaughan and O'Shea 1976). A roost temperature of about 30°C (86°F) is considered about optimal for maintaining low metabolic rates (Trune and Slobodchikof 1976; Vaughan and O'Shea 1976). In desert regions, roost sites are often near water, although they have been observed in areas without apparent water sources (Hermanson and O'Shea 1983).

Foraging habitats for pallid bats are varied and include grasslands, oak savannah woodlands, open pine forests, talus slopes, and agricultural areas (Rambaldini 2006). In a study of bat use of riparian habitats in southern Nevada, including riparian marsh, mesquite bosque, riparian woodland, and riparian shrubland, Williams et al. (2006) recorded about 88% of pallid bat occurrences in riparian woodland.

5.4.6.3 Occurrence within Plan Area

The DRECP species occurrence database for pallid bat, composed of BLM and CNDDB, records, and observations by Brown, includes 20 historical records (i.e., pre-1990) for the Plan Area, dating from 1911 to 1981 (CDFW 2013; Dudek 2013), and two with an unknown observation date. An additional 11 records are from areas within 5 miles of the Plan Area boundary. The historical occurrences in the Plan Area include the southern Owens Valley–eastern Sierra Nevada–Inyo Mountains area, the Mesquite Mountains in eastern San Bernardino County, the Twentynine Palms area, the Lower Colorado River, and the Salton Sea area.

There are 40 recent (i.e., since 1990) records in the Plan Area and 10 additional records within the 5-mile buffer area around the Plan Area (CDFW 2013; Dudek 2013). The geographic areas of recent occurrences are similar to the historical occurrences, with small clusters of observation in the Owens Valley–eastern Sierra Nevada area, Providence Mountains, Kingston Range, Avawatz Mountains, Cady Mountains, Twentynine Palms area, Little San Bernardino Mountains, Hexie Mountains, the Lower Colorado River, Chocolate Mountains, and the Peninsular Range in east San Diego County (see Figure SP-M07 in Appendix B).

As with the historical data, the specificity of these recent occurrence data are variable, with some records identifying roosts and others only including general location information for observations. This dataset, therefore, should be viewed as reflecting the recent documented distribution of the species in the Plan Area and should not be used as detailed data for specific roost sites.

The model generated 19,196,457 acres of modeled suitable habitat for pallid bat in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.4.7 Townsend's Big-Eared Bat

5.4.7.1 Status and Distribution

Regulatory Status

The Townsend's big-eared bat (*Corynorhinus townsendii*) is a California Species of Special Concern and has recently been proposed for listing as a Threatened species under the California Endangered Species Act and a BLM sensitive species.

Natural History

Several studies in various parts of the Townsend's big-eared bat's range found that Lepidoptera (moths) are its primary prey, including in the southwest (Ross 1967), eastern and western Oregon (Whitaker et al., 1977, 1981), and Virginia (Sample and Whitmore 1993).

Reproduction by Townsend's big-eared bats in California is fairly well known, based on a study by Pearson et al. (1952). Breeding begins in autumn, with peak breeding in November through February. Females store the sperm until ovulation in the spring, which may occur during and after females leave hibernation. Upon leaving hibernation, females form maternity colonies in the late spring and early summer; males during this period appear to roost singly (CDFG 1998). Gestation varies from 8 to 14 weeks, depending on degree of torpor and spring temperatures. Females have one pup. In California, birth occurs in the late

spring to early summer over a 3- to 5-week period beginning in late May. Although young are born fairly undeveloped, they grow rapidly and reach adult body proportions (i.e., forearm length) in 1 month. They are capable of flying in 2.5 to 3 weeks and are weaned by 6 weeks. Both males and females are reproductive in their first autumn. Immediate postnatal mortality is about 4% to 5%, and 3-year survival is 70% to 80% for adults and 38% to 40% for yearling (i.e., survival increases with age) (Kunz and Martin 1982).

Female maternity groups are stable and faithful to roost sites that may be used by several generations (CDFG 1998). Females remain in the natal group while males disperse after their first summer (CDFG 1998). Maternity roosts begin to break up in August.

Pierson and Rainey (CDFG 1998) characterize Townsend's big-eared bat as "quite sedentary" because marked animals (all females) moved no more than a few kilometers from their natal roost. Also, most activity outside of day roosts (e.g., foraging, night roosting) occurring relatively close to the roost (CDFG 1998). Recorded maximum distance from the day roost in California is 32.2 kilometers (20.0 miles) and 64.4 kilometers (39.9 miles) in Kentucky (Kunz and Martin 1982). Average distance from maternity roosts to winter hibernacula is 11.6 kilometers (7.2 miles) (range: 3.1 to 39.7 kilometers [1.9 to 24.6 miles]) (Kunz and Martin 1982). Based on a personal communication from Pearson, Pierson and Rainey (CDFG 1998) noted that when maternity colonies disband in the fall, a banded individual had never been recorded at hibernacula more than 43 kilometers (27 miles) from the banding site. However, there is also indirect evidence that Townsend's big-eared bats can travel much longer distances than indicated by direct observations of foraging activity and movement between maternity roosts and hibernacula, based on telemetry and banding studies. The genetic work by Piaggio et al. (2009) indicated gene flow by dispersing males in Colorado has occurred between roost sites 310 kilometers (192 miles) apart.

Townsend's big-eared bats may share hibernacula with other bat species; in the eastern United States, it has been found in association with Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) and in the western United States with big brown bat, cave myotis (*Myotis velifer*), wester small-footed myotis (*M. ciliolabrum*), dark nosed small-footed myotis (*M. melanorhinus*),[3] and Californian myotis (Kunz and Martin 1982), but there is no evidence in the literature of direct competitive or symbiotic relationships with other bats. Congregations with other bat species at both day and night roosts may simply reflect use of limited resources.

[3] Both *M. coliolabrum* and *M. melanorhinus* were once considered subspecies of *M. leibii*, which is the species listed in Kunz and Martin (1982), but Wilson and Reeder (2005) list both as distinct species.

General Distribution and Populations Trends

The Townsend's big-eared bat ranges throughout the western United States; British Columbia, Canada; and Mexico (Kunz and Martin 1982). In the United States, it occurs in a continuous distribution in all of the western states and east into western South Dakota, northwestern Nebraska, southwestern Kansas, western Oklahoma, and western Texas (Piaggio et al. 2009). Within California, Townsend's big-eared bat occurs throughout the state, with the exception of alpine and subalpine areas of the Sierra Nevada, although they have been found in the subalpine zone in the White Mountains to the east of the Sierra (Szewczak et al. 1998).

Townsend's big-eared bat is a California Species of Special Concern and BLM sensitive species, but there are little systematic data to quantitatively assess population status and trends (e.g., numbers of individuals). However, past studies have shown a broad-ranging decline in the species through large parts of its range in the western United States (i.e., mainly the *C .t. townsendii* and *C. t. pallescens* subspecies). Human disturbance has eliminated most historical roosting sites in California and all known previously occupied limestone caves in the state have been abandoned (see discussion in Reasons for Decline). The census by Pierson and Rainey (CDFG 1998) in California, conducted from 1987 to 1991, found substantial population declines over the previous 40 years, with a 52% loss in the number of maternity colonies, a 44% decline in the number of available roosts, a 55% decline in the total number of animals (primarily adult females), and a 32% decrease in the average size of remaining colonies. Fate of roosts sites was related to the type of roost, with 88% of roosts in buildings no longer available, and 50% of roosts in caves and 57% in mines no longer used. For a more detailed discussion of population trends of Townsend's big-eared bat, refer to the full species profile in Appendix B.

Reasons for Decline

Townsend's big-eared bats are very sensitive to human disturbances, and a single disturbance of a maternity roost or hibernation site may cause abandonment (Zeiner et al. 1990; Kunz and Martin 1982). All known limestone cave sites in California, for example, have been abandoned (Zeiner et al. 1990). Sherwin et al. (2000) found that occupied day roosts were typically subject to little human disturbance. There has been a significant decline in occupied Townsend big-eared bat roosts in California. The primary cause for the observed declines was determined to be human disturbance of roosting sites (CDFG 1998). The selection of relatively cold parts of caves near entrances and where there is good ventilation during hibernation makes Townsend's big-eared bats sensitive to human disturbance (including deliberate vandalism and extermination) during a period when they would be least likely to respond quickly. Also, they tend to hang from ceilings and walls in

exposed parts of roosts, making them more susceptible to disturbance (CDFG 1998). It is important that hibernacula be protected from human disturbance because animals can be aroused from hibernation and forced to use fat stores necessary for hibernation.

Pierson and Rainey (CDFG 1998) provided specific information for threats to roosts in the Plan Area which included include threats from recreational activities, mine closure for hazards and reactivation of old mining claims. For a full discussion of threats to Townsend's big-eared bat populations in the Plan Area, refer to the full species profile in Appendix B.

Several recent studies have documented substantial mortality of bats at wind facilities (e.g., Baerwald and Barclay 2009; Cryan 2011; Cryan and Barclay 2009). Despite fairly extensive monitoring, with many documented fatalities of other bat species (primarily migrant species), as of 2004, no Ozark or Virginia big-eared bats had been known to be killed at wind facilities (or at communications towers) (Johnson and Strickland 2004). In 2010, TetraTech also reported no documented fatalities of Townsend's big-eared bats at wind facilities (TetraTech EC Inc. 2010). A general review of the wind facility–related literature also failed to reveal evidence for, or discussions of, Townsend's big-eared bat fatalities or assessed risks at wind facilities (e.g., Baerwald and Barclay 2009; Cryan 2011; Cryan and Barclay 2009; Cryan and Brown 2007; Johnson and Strickland 2004; Johnson and Erickson 2008; Kuvlesky et al. 2007; Piorkowski and O'Connell 2010). Nonetheless, the USFWS has expressed concern about the potential for fatalities of the endangered Virginia big-eared bats from wind facilities in the eastern United States as they move between caves (e.g., see Johnson and Strickland 2004). Big-eared bats in the Plan Area similarly could be at elevated risk of turbine strikes or other associated causes (e.g., barotrauma) if a wind facility were located within a few miles of a day roost site (where most foraging activity occurs), and strikes would most likely occur during emergence, return to the day roost, or when seeking a night roost between bouts of foraging. Risk of strikes may also be higher when bats are moving between maternity roosts and hibernacula in the fall and spring and when young are dispersing from the maternity roost in late summer.

5.4.7.2 Habitat Characteristics

Townsend's big-eared bat is primarily associated with mesic habitats characterized by coniferous and deciduous forests and riparian habitat, although it also occurs in xeric areas (Kunz and Martin 1982). In California, this species was historically associated with limestone caves and lava tubes located in coastal lowlands, agricultural valleys, and hillsides with mixed vegetation. Within the Plan Area, Townsend's big-eared bat is primarily associated with mines in the California desert, and also largely associated with man-made structures, tunnels, caves, and the basal hollows of old-growth redwood trees. The species also occurs in

man-made structures and tunnels (Kunz and Martin 1982), mines (López-González and Torres-Morales 2004), and the basal hollows of old-growth redwood trees (*Sequoia sempervirens*) on the north coast of California (Gellman and Zielinski 1996; Zielinski and Gellman 1999). It has been suggested that the Townsend's big-eared bat has become more common in the western United States due to the availability of man-made structures (Kunz and Martin 1982). Many roosting sites in the California coastal area are in buildings, but in the Plan Area most roosting sites appear to be in abandoned mines (CDFG 1998).

Unlike many cave-roosting bat species, Townsend's big-eared bat only roosts in the open, often hanging from walls and ceilings (CDFG 1998). In the summer maternity roosts, females roost in the warm parts of caves and buildings in clusters (Kunz and Martin 1982). The census of maternity roosts in California found an overall mean colony size of about 112 individuals (CDFG 1998), which is larger than generally reported in the literature (e.g., Kunz and Martin 1982). Males appear to roost solitarily near the maternity roosts. In winter, roosting occurs solitarily or in small clusters, and Townsend's big-eared bat may share hibernacula with other bat species (Kunz and Martin 1982) (see Ecological Relationships). This species may require relatively cold temperatures to hibernate (Humphrey and Kunz 1976). Townsend's big-eared bats roost in relatively cold parts of caves in well-ventilated areas near entrances, but may move to more temperate parts of the cave if temperatures become too cold (e.g., subfreezing) (Clark et al. 2002; Humphrey and Kunz 1976; Kunz and Martin 1982).

Pierson and Rainey (CDFG 1998) examined potentially suitable and accessible caves, tunnels (e.g., old mine workings, water diversion tunnels, and abandoned railroad tunnels), abandoned and little-used buildings, and older (pre-1960) bridges throughout California. Censuses of bats at occupied roosts were based on direct counts or estimates for an area covered by a cluster of bats. For a detailed discussion of the physical characteristics of roosts described in Pierson and Rainey (CDFG 1998), refer to the full species profile in Appendix B. Assessing and characterizing hibernacula was more difficult than maternity sites because individuals tend to move among different sites during a hibernation season (CDFG 1998). Similar to maternity roosts, hibernacula are typically caves, or cave analogues, but differ in often being L-shaped, with vertical and horizontal entrances that generate a "cold sink" with significant air flow. Consistent with the literature for the species, hibernacula used in California often represent the coldest non-freezing temperature available. For a full discussion of hibernacula of Townsend's big-eared bats, refer to the full species profile in Appendix B.

Townsend's big-eared bats forage for insects in a variety of habitats, primarily between the canopy and mid-canopy of forests, woodlands, and riparian zones, but also in sagebrush

shrubsteppe (Fellers and Pierson 2002). Fellers and Pierson (2002) noted that Townsend's big-eared bats avoided foraging in grasslands.

5.4.7.3 Occurrence within Plan Area

Townsend's big-eared bat may occur throughout the Plan Area, but there are relatively few documented large maternity and/or hibernation roosts. A comprehensive review of the species' distribution was conducted by Pierson and Rainey (CDFG 1998) based on a review of historical records and field surveys conducted from June 1987 to January 1991. Their review included portions of the Plan Area known to support substantial populations, including the Owens Valley and areas east of the Sierra Nevada Range in Inyo County, the Providence Mountains in San Bernardino County, and the Lower Colorado River area in San Bernardino, Riverside, and Imperial counties (see Figure 1 in CDFG 1998). They surveyed all known maternity colonies with at least 30 individuals. Most of the active large maternity roosts within or near the Plan Area were in abandoned mines east of the Sierra Nevada range and the western slopes of the White Mountains bordering the Owens Valley. Active maternity roots were also found in the Kingston Range area of eastern Inyo County, the Providence Mountains in northeastern San Bernardino County, and along the Lower Colorado River in eastern Riverside County. An active maternity roost and a hibernation roost were also found in east San Diego County. For a full discussion of roost locations in the Plan Area, refer to the full species profile in Appendix B.

The DRECP species occurrence database for Townsend's big-eared bat, comprising BLM and CNDDB records, includes 13 historical records (pre-1990) for the Plan Area, dating from 1914 to 1983 (CDFW 2013; Dudek 2013), as well as one record with an unknown observation date. An additional 8 records are from areas within 5 miles of the Plan Area boundary. These data generally accord with the information provided in Pierson and Rainey (CDFG 1998), with clusters of occurrences in the southern Owens Valley–eastern Sierra Nevada area, especially the mountain ranges north of Ridgecrest. Historical records are also known from the Providence Mountains, the Kingston Range, the Lower Colorado River, and Hesperia north of the San Bernardino Mountains.

There are 39 recent (i.e., since 1990) records in the Plan Area and 42 additional records within the 5-mile buffer area around the Plan Area (CDFW 2013; Dudek 2013). The geographic areas of the recent occurrences are similar to the historical occurrences, with clusters of observations in the Owens Valley–eastern Sierra Nevada area, Providence Mountains, and the Kingston Range. There is also a cluster of recent occurrences north of Barstow and along the northern slopes of the San Bernardino Mountains (see Figure SP-M08 in Appendix B). There are relatively few recent occurrences from the Lower Colorado River, consistent with the information reported by Pierson and Rainey (CDFG 1998).

As with the historical data, the specificity of these recent occurrence data are variable, with some records identifying roosts and others only including general location information for observations. This dataset, therefore, should be viewed as reflecting the recent documented distribution of the species in the Plan Area and should not be used as detailed data for specific roosts sites.

The model generated 16,824,190 acres of modeled suitable habitat for Townsend's big-eared bat in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5 Plants

5.5.1 Alkali Mariposa-Lily

5.5.1.1 Status and Distribution

Regulatory Status

Alkali mariposa-lily (*Calochortus striatus*) is not federally or state listed but is a BLM sensitive species. The alkali mariposa-lily has a CRPR of 1B.2. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CDFG 2012b). CRPR species with a threat rank of .2 are "fairly endangered in California, with 20%–80% of occurrences threatened/moderate degree and immediacy of threat" (CNPS 2011). The alkali mariposa-lily has a California Heritage Element Ranking of S2, indicating that it is "imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province" (CDFG 2012b).

Natural History

Alkali mariposa-lily is a perennial bulbiferous herb in the lily family (Liliaceae) (Jepson Flora Project 2011; CNPS 2011). Alkali mariposa-lily stands approximately 1 to 4.5 decimeters (3.9 to 17.7 inches) in height (Munz and Keck 1968). Alkali mariposa-lily blooms from April to June (CNPS 2011). Alkali mariposa-lilies have perfect flowers (i.e., which contain both the male and female reproductive parts) (Tollefson 1992, cited in Greene and Sanders 2006). The plants arise from small membranous-coated bulbs. It is unknown whether reproduction is most commonly from seedling establishment or bulb division (Greene and Sanders 2006). Alkali mariposa-lily is pollinated by bees and flies (Tollefson 1992, cited in Greene and Sanders 2006). Although seed dispersal mechanisms for this species are unknown, seeds of some other species of *Calochortus* are gravity-dispersed (Miller et al. 2004).

Abundances of alkali mariposa-lily fluctuate substantially from year to year (NatureServe 2011). The bulb remains dormant and may not sprout in dry years, and the bulb may not compete well since the species is not found in stands of tall grasses (Greene and Sanders 2006). Periodic natural inundation is important to alkali mariposa-lily (Edwards Air Force Base 2002), however, alkali mariposa-lily has been reported as absent from areas with surface salts or areas with permanent standing surface water (Mitchell 1988, cited in Greene and Sanders 2006).

General Distribution and Populations Trends

A majority of the species' known occurrences are within California, with the exception of several occurrences in western Nevada. Occurrences in the Plan Area include Red Rock Canyon, Edwards Air Force Base, the Lancaster area, Box "S" Springs, Cushenbury Springs, Rabbit Springs, Paradise Springs, and Joshua Tree National Park. Abundance figures are complicated by large fluctuations from year to year, making population trends difficult to assess (NatureServe 2011). Despite its relatively wide distribution, the majority of the populations are small with the exception of the metapopulation that ranges from Lancaster to Edwards Air Force Base (CDFG 2012b). For example, at Red Rock Canyon documented populations have ranged from 13 in 1989 to 1,200 in 2003 (CDFG 2012b). On the other hand, there are as many as 165,000 plants in 67 areas documented on Edwards Air Force Base (Greene and Sanders 2006).

Reasons for Decline

Alkali mariposa-lily is threatened by urbanization, grazing, trampling, road construction, hydrological alternations, and water diversions that lower the water table (CNPS 2011). It is also threatened by military operations, dumping, and grading (NatureServe 2011).

The greatest threat to alkali mariposa-lily is the lowering of water tables, which alters the seasonally moist alkaline habitat that this species requires. Urbanization in the Lancaster area is likely the second most severe threat to this species since the largest populations are concentrated near Lancaster (CDFG 2012b; Greene and Sanders 2006). Large populations along Sierra Highway that are primarily on private land and receive minimal protection are in danger of extirpation from expanding urbanization from Lancaster (CDFG 2012b; Greene and Sanders 2006).

Road construction also threatens this species. Historically, extirpations or population declines occurred with construction of SR 18 at Whiskey Springs in the 1920s; with the expansion of Kaiser Cement, now Mitsubishi Cement Corp., in 1988 that included diking the flow of the spring and adding a parking lot at Cushenbury Springs; and with the

development of a site with 300 plants near Radio Tower Meadow in 1989 (Greene and Sanders 2006; Deacon 2007).

Trampling and grazing may also severely reduce alkali mariposa-lily's reproductive capacity. A survey around Lake Isabella found that plants in ungrazed areas were taller, more robust, and more numerous than those in cattle grazed areas. From 1984 to 1991 low-intensity horse grazing was tested at The Nature Conservancy's Kern River Preserve to determine the effect that soil disturbance and reduction of competing grasses and weeds would have on alkali mariposa-lily productivity. The grazed alkali mariposa-lily population did not experience a substantial increase or decrease compared to non-grazed control populations under low-intensity grazing (Tollefson 1992, cited in Greene and Sanders 2006). Pavlik et al. (2011) also documented strong impacts by mammalian herbivores on alkali mariposa-lily growth and reproduction in two consecutive years at Ash Meadows National Wildlife Refuge.

Although it may not be a more widespread problem, ongoing monitoring at The Nature Conservancy's Kern River Preserve suggests that competition from taller grasses, such as beardless wildrye (*Elymus triticoides*) and non-native barley (*Hordeum* spp.), may contribute to population declines (Tollefson 1992, cited in Greene and Sanders 2006).

5.5.1.2 Habitat Characteristics

Alkali mariposa-lily grows in seasonally moist alkaline habitats such as alkaline meadows and seeps, and ephemeral washes, within chaparral, chenopod scrub, and Mojavean desert scrub (CNPS 2011; CDFW 2013; Jepson Flora Project 2011). Alkali mariposa-lily grows in calcareous sandy soil (Fiedler 1985, cited in Greene and Sanders 2006). It prefers claypans and sand dunes, especially along drainages, in halophytic (associated with saline soils) saltbush scrub (Edwards Air Force Base 2002). Periodic natural inundation is important to alkali mariposa-lily (Edwards AFB 2002), however, alkali mariposa-lily has been reported as being absent from areas with surface salts or areas with permanent standing surface water (Mitchell 1988, cited in Greene and Sanders 2006). This species ranges in elevation from 224 to 5,240 feet (BLM 2010a; CDFW 2013).

Some associated species include saltgrass, rushes, sedges (*Carex* spp.), beard grass (*Polypogon* sp.), dock, alkali sacaton (*Sporobolus airoides*), beardless wildrye, dwarf checkerbloom (*Sidalcea malviflora*), rabbitbrush, Baltic rush (*Juncus balticus*), and yellow sweetclover (*Melilotus indicus*) (CDFW 2013).

5.5.1.3 Occurrence within Plan Area

Of the 294 CNDDB occurrences documented in the Plan Area, 16 are considered historical. Occurrences considered historical have not been observed since 1989, or were recorded in

2005, but have been extirpated or possibly extirpated. They range from Kelso Valley southeast to Twentynine Palms with most occurrences at or near Edwards Air Force Base (CDFW 2013; see Figure SP-P01 in Appendix B). The 71 remaining occurrences recorded since 1990 and presumed extant range from Red Rock Canyon State Park southeast to Joshua Tree National Park. The majority of occurrences are located on or in the vicinity of Edwards Air Force Base (CDFW 2013). Alkali mariposa-lily populations are most concentrated in the metapopulation that ranges from Lancaster to Edwards AFB (CDFWa 2013). Thirty-nine occurrences are located on Edwards Air Force Base, and thirty-eight of these are managed by the DOD, while one is privately owned. Other public occurrences include one on lands managed by the DPR at Red Rock Canyon State Park, two on lands managed by Los Angeles County, one on lands managed by the NPS at Joshua Tree National Park, and one on lands managed by Rosamond Community Services. Eighteen are privately owned and ownership is unknown for nine occurrences (CDFW 2013a).

There are 188,549 acres of modeled suitable habitat for alkali mariposa-lily in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.2 Bakersfield Cactus

5.5.2.1 Status and Distribution

Regulatory Status

Bakersfield cactus (*Opuntia basilaris* var. *treleasei*) is both state and federally listed as endangered. It is also a USFS sensitive species. A recovery plan has been prepared for this species: *Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998c). Bakersfield cactus has a CRPR of 1B.1. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CDFG 2012b). CRPR species with a threat rank of .1 are "seriously threatened in California, with over 80% of occurrences threatened/high degree and immediacy of threat" (CNPS 2011). The Ash Bakersfield cactus has a California Heritage Element Ranking of S1, indicating that it is "critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province" (CDFG 2012b).

Natural History

Bakersfield cactus is a perennial stem succulent in the cactus family (Cactaceae) with low-growing stem segments approximately 9 to 20 centimeters (3.5 to 7.9 inches) long (USFWS 2011c; Jepson Flora Project 2011). It blooms from April to May (CNPS 2011). The pollination biology of Bakersfield cactus is only relevant for the portion of the population

that is genetically capable of reproduction by seed. However, that proportion remains unknown (Kentner, pers. comm. 2012). Bakersfield cactus exhibits several features that are characteristic of bee pollination: flowers are large and showy with a watermelon-like odor; it has a long flowering period; and produces large amounts of nutritious pollen from numerous stamens (Jepson Flora Project 2011; Grant and Grant 1979). Flowers of beavertail prickly-pear (*Opuntia basilaris* var. *basilaris*) are commonly visited by beetles and bees, but are pollinated mainly by bees (Grant and Grant 1979).

Chromosome counts indicate that at least some Bakersfield cactus are triploid (2 of the 3 plants that have been examined were triploid ($2n$ = 3X = 33); Pinkava et al. 1977, 1992). Triploid plants are typically at least partially sterile and may have a greatly reduced capacity for sexual reproduction either via pollen or by seed. Triploid populations therefore often rely predominantly on vegetative reproduction—the production of new plants from sources other than seed. Fallen pads can take root. Cactus pads may be dispersed by flood waters. Seed dispersal agents are unknown (USFWS 2011c), but the fruits and vegetative parts of *Opuntia* species in general, such as the spiny pad, are closely linked with seed dispersal and vegetative dissemination by animals (Reyes-Agüero et al. 2006). Bakersfield cactus does not survive prolonged inundation (USFWS 2011c).

Morphological evidence indicates that gene flow (*i.e.,* hybridization) between *O. b. basilaris* and *O. b. treleasei* may be occurring in the populations near Oak Creek. The issue of the ploidy of Bakersfield cactus is highly relevant to the question of hybridization between the varieties. Both the proportion of triploid vs. diploid individuals in Bakersfield cactus populations and the frequency with which triploid individuals produce euploid gametes that would be compatible with the gametes of diploid individuals, including *O. b. basilaris*, is currently unknown (Pinkava et al. 1977, 1992).

Competition with non-native grasses for water is likely the cause of the decline in the number of cactus pads and low rates of reproduction observed in recent population studies at Sand Ridge Preserve (USFWS 2011c). In addition, a decline in pollinators may be partly responsible for the low levels and infrequency of seed set observed (USFWS 2011c). Predation of Bakersfield cactus is unknown though it is not considered to a threat to this species (USFWS 2011c). In Mexico, the seed and fruits of other *Opuntia* species are consumed primarily by rodents, but also by harvester ants, birds, and other mammals (González-Espinosa and Quintana-Ascencio 1986). See Appendix B for additional information regarding Bakersfield cactus' natural history.

General Distribution and Populations Trends

Bakersfield cactus occurs in the Tehachapi Mountain area and the southeastern San Joaquin Valley in Kern County, California (see Figure SP-P02 in Appendix B; Jepson Flora Project 2011). The historical distribution of Bakersfield cactus was likely more or less continuous east of Bakersfield, from Granite Station south to Comanche Point, east to Caliente, and west to Oildale (USFWS 1998c, 2011). However, it is currently restricted to a limited area of central Kern County near Bakersfield in the southern San Joaquin Valley, where the remaining populations occur in 11 general areas (USFWS 2011c), and in the vicinity of Oak Creek and Mojave (Kentner, pers. comm. 2012). Approximately one-third of the historical population has been extirpated (USFWS 1998c). The CNDDB includes 46 occurrences, of which 6 are in the Plan Area (CDFW 2013). However, there are a large number of records from the Plan area that were submitted to CNDDB in 2011, but have not been made publically available yet (Kentner, pers. comm. 2012; CDFW 2013).

Once likely more or less continuous east of Bakersfield, the current range of Bakersfield cactus consists of scattered fragments of these once larger populations (USFWS 2011c).

Though the total population of Bakersfield cactus was not estimated historically, densely spaced clumps of cactus once covered an estimated area of 2 square miles from the Caliente Creek floodplain onto Sand Ridge (USFWS 2011c). When known sites were inventoried in 1989, fewer than 20,000 clumps of Bakersfield cactus were estimated to remain. Only four areas had populations of 1,000 clumps or more: Comanche Point, Kern Bluff, Sand Ridge, and the area north of Wheeler Ridge (USFWS 2011c). A status survey in 2010 and 2011 was conducted to determine the current state of the historical occurrences of Bakersfield cactus throughout its range (USFWS 2011c; Cypher et al. 2011). Based on these surveys which focused on existing CNDDB occurrences, 25 occurrences are confirmed extant, 11 are believed to be extirpated, the status of 3 could not be determined, 2 previously unreported populations were documented, and 6 undocumented translocated populations were identified (CDFG 2012b). Therefore, there is a minimum of 33 extant occurrences (Cypher et al. 2011a).

Reasons for Decline

Agricultural land conversion, oil development, sand mining, urbanization, off-road vehicle use, proposed flood control basins, telecommunication and electrical lines construction, and possibly wildfires were considered threats to Bakersfield cactus habitat at the time of its listing in 1990 (USFWS 2011c). Currently, the loss and modification of habitat from agricultural conversion, wind energy development, and urban, especially residential, development remain the largest threats to Bakersfield cactus (USFWS 2011c; Ketner, pers.

comm. 2012). Threats today also include oil development, off-road vehicle use, sand mining, and competition from non-native grasses. In addition, climate change, air pollution (including elevated nitrogen deposition), loss of pollinators, flooding, and loss of genetic diversity have been identified as potential new threats (USFWS 2011c). However, loss of genetic diversity is not relevant to the unknown proportion of the population that is triploid and undergoing clonal reproduction (Kentner, pers. comm. 2012).

5.5.2.2 Habitat Characteristics

Bakersfield cactus grows primarily in chenopod scrub, but is also found in valley and foothill grassland; and occasionally in cismontane woodland, including blue oak woodland and riparian woodland (CNPS 2011; USFWS 2011c; CDFW 2013; Jepson Flora Project 2011). Some associated species include California filago (*Filago californica*), yellow pincushion (*Chaenactis glabriuscula*), and red brome, as well as other nonnative annual grasses (USFWS 2011c).

Bakersfield cactus occurs on floodplains, ridges, bluffs and low rolling hills, and flats (USFWS 2011c; CDFW 2013). Soils are sandy or gravelly with little silt and clay, are low in organic matter, and may contain cobbles or boulders (CNPS 2011; USFWS 2011c); they are granitic and well-drained (CDFW 2013). Bakersfield cactus ranges from 90 meters (295 feet) (CNPS 2011; CDFW 2013) to 5,000 feet in elevation (Kentner, pers. comm. 2012).

5.5.2.3 Occurrence within Plan Area

Of the nine occurrences documented in the CNDDB within the Plan Area, one is considered historical (i.e., before 1990) with plants that have not been observed since 1934. This occurrence is mapped approximately 1 mile south of Fram (CDFW 2013; see Figure SP-P02 in Appendix B). The historical occurrence in the Plan Area is the east of the recent occurrences described below. Although the historical distribution has not been well documented, it appears that the variety's range has recently expanded to the southeast considering Bakersfield cactus' southern limit as of 1987 was Comanche Point and its eastern limit was Caliente.

The eight recent occurrences of Bakersfield cactus reported in the Plan Area by the CNDDB occur at Oak Creek Pass in the Tehachapi Mountains, and near West Antelope Station and east of Bean Canyon at the foothills of the Tehachapi Mountains (see Figure SP-P02 in Appendix B; CDFW 2013). Three of these occurrences are located on private land; ownership of the others is unknown (CDFW 2013). Most of these occurrences are all newly documented, found in 2009 and 2010, and extend the variety's known range southeast since they occur south of Comanche

Point and east of Caliente, which were considered the range limits in 1987 according to the 5-Year Review (USFWS 2011c).

There are approximately 3,421 acres of modeled suitable habitat for the Bakersfield cactus in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.3 Barstow Woolly Sunflower

5.5.3.1 Status and Distribution

Regulatory Status

Barstow woolly sunflower (*Eriophyllum mohavense*) is not federally or state listed, but is a BLM sensitive species. Barstow woolly sunflower has a CRPR of 1B.2. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CNPS 2013). CRPR species with a threat rank of .2 are "seriously threatened in California, with 20% to 80% of occurrences threatened/moderate degree and immediacy of threat" (CNPS 2011). The Barstow woolly sunflower has a California Heritage Element Ranking of S2, indicating that it is "imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province" (CDFG 2012b).

Natural History

Barstow woolly sunflower is in the sunflower family (Asteraceae) (Jepson Flora Project 2011). It is an annual herb standing approximately 1 to 2.5 centimeters (0.4 to 1 inch) in height that blooms from March to April or May, then goes to fruit in May (CNPS 2011; Jepson Flora Project 2011; NatureServe 2011). Plants tend to be clumped together. As an annual, germination and establishment of this species depends on the amount and timing of winter and spring rains. There is no information available regarding pollinators, seed dispersal, seed germination, or seedling establishment.

General Distribution and Populations Trends

This species is endemic to California's Mojave Desert (Jepson Flora Project 2011). Barstow woolly sunflower is restricted to a range within a 30-mile radius of Kramer Junction in San Bernardino and Kern counties. The eastern-most extant location is Barstow, while the westernmost is the town of Mojave, southernmost is El Mirage, and the northernmost is 25.8 mi northeast of Kramer Junction between Almond Mountain and Black Hills (CDFG 2012a). The species' elevation range extends from 2,000 to 3,600 feet (CDFW 2013). All of

the 63 total CNDDB occurrences are in the Plan Area (CDFW 2013; see Figure SP-P04 in Appendix B). This is an annual plant with populations that fluctuate greatly (by orders of magnitude) from year to year depending on conditions, and also which have a soil seed bank that also likely shows a remarkable amount of fluctuation. Population trends for this species are unknown at this time, but a multi-year, population-level study is underway by BMP Ecosciences and estimated to conclude in 2015.

Reasons for Decline

Threats to Barstow woolly sunflower include military activities, energy and subdivision development, sheep grazing, exotic plant species, off-road vehicle use, highway and road improvements and building, mining, dumping, and pipeline construction (NatureServe 2011; CNPS 2011; MacKay, pers. comm. 2012). Of these threats, those of primary concern include energy development, military activities, sheep grazing, off-road vehicles, and highway improvements (NatureServe 2011; MacKay, pers. comm. 2012). Energy development includes not only construction of solar and wind power production sites, but also utility corridor construction (e.g., roads, transmission lines) (MacKay, pers. comm. 2012). Several Barstow woolly sunflower sites may be extirpated, but their status has not been reported to the CNDDB; however, it is also important to recognize that these plants may be inactive in some years but persist in the seed bank. Currently, only one CNDDB occurrence is recorded as possibly extirpated (CDFW 2013). However, CNDDB Occurrences #9 and #10 occur along Highway 58 and a widening project has occurred along this highway that has likely extirpated these occurrences (CDFW 2013; MacKay, pers. comm. 2012).

5.5.3.2 Habitat Characteristics

Barstow woolly sunflower has been observed in openings within chenopod scrub, Mojavean desert scrub, creosote bush scrub, and also occurs on playas (NatureServe 2011; CNPS 2011; Jepson Flora Project 2011). This species has been observed on bare areas with little soil that frequently contain a shallow subsurface caliche layer (BLM 2005). See Appendix B for additional information regarding Barstow woolly sunflower's habitat characteristics.

5.5.3.3 Occurrence within Plan Area

There are 168 total CNDDB occurrences in the Plan Area, approximately 22% (37) of which have been recorded prior to 1990 or are considered possibly extirpated or are not dated (CDFW 2013). Additional occurrences of Barstow woolly sunflower have been extirpated without having been updated in the CNDDB (MacKay, pers. comm. 2012). The historic occurrences extend from the area around Barstow northwest to the Almond

Mountains foothills, west to the area around Kramer Junction, and south to Stoddard Mountain (CDFW 2013).

The majority of the 129 CNDDB occurrences in the Plan Area recorded since 1990 that are presumed extant are located in the vicinity of Kramer Junction on Edwards Air Force Base. Known extant occurrences now extend farther west, approximately 5.5 miles east of the Mojave Airport, and near Buckhorn Lake about 1 mile north of the Kern–Los Angeles County line. New records farther east are from near Opal and Lane Mountains, as well as Barstow (see Figure SP-P04 in Appendix B). The El Mirage CNDDB occurrence, entered in November 2011, is now the known southernmost occurrence. Of the current occurrences, approximately 53% are on lands owned by the DOD on Edwards Air Force Base, 26% are on BLM land, and 21% are on lands that are privately owned or are likely privately owned (CDFW 2013).

There are approximately 186,866 acres of modeled suitable habitat for Barstow woolly sunflower in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.4 Desert Cymopterus

5.5.4.1 Status and Distribution

Regulatory Status

Desert cymopterus (*Cymopterus deserticola*) is not federally or state listed, but the USFWS was petitioned to list this species in the past. Desert cymopterus is a BLM sensitive species and has a CRPR of 1B.2. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CDFG 2012b). CRPR species with a threat rank of .2 are "fairly threatened in California, with 20% to 80% of occurrences threatened/moderate degree and immediacy of threat" (CNPS 2011). Desert cymopterus has a California Heritage Element Ranking of S2, indicating that it is "imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province" (CDFG 2012b).

Natural History

Desert cymopterus is in the carrot family (Apiaceae) (Jepson Flora Project 2011). Desert cymopterus is a tap-rooted perennial about 15 centimeters (5.9 inches) in height (Jepson Flora Project 2011). As a taprooted perennial, desert cymopterus does not appear to reproduce vegetatively, but rather reproduces via seeds. Seedling establishment has not been reported for this species. Establishment of new individuals in a population may be

infrequent given that many reported desert cymopterus populations are highly dispersed and low density (NatureServe 2011).

Depending on the year, desert cymopterus flowers between early March and mid-May, and may not flower at all in unfavorable years. Poor seed production or seed survival may be a factor in infrequent establishment observed in field studies.

Fruits of desert cymopterus are fairly large and do not seem well adapted for dispersal over long distances. Fruits generally seem to fall relatively close to the parent plant. The fruits have a marginal wing that may facilitate dispersal by wind. However, the wings in *C. deserticola* are reduced and appear to be thickened, which suggests that either wind dispersal is less important in this species or that the winds of the Mojave are sufficient to move seeds with poorly developed wings (Sanders, pers. comm. 2012). In addition, the fruits mature late in the season, typically after the end of the rainy season, so they remain dry and light. Therefore, given that wind is relatively common in the open sandy habitats where this species is found, it could easily push the fruits along the soil surface, although the fruits probably do not become airborne (NatureServe 2011).

Because of the annual variability in rainfall, the underground parts of herbaceous desert perennials, including desert cymopterus, must be able to maintain the populations over time with frequent years of reproductive failure; in addition, they must be able to survive prolonged periods of low soil moisture and entire years without aboveground photosynthetic activity (NatureServe 2011). In dry years, desert cymopterus may not produce flowers or fruit and may even remain dormant underground during the usual growing season. In very wet years, however, they may produce flowers and fruits abundantly.

Population sizes appear to vary greatly from year to year, evidently in response to the amount and timing of winter and spring rainfall, making it difficult to determine population trends (NatureServe 2011).

Refer to Appendix B for additional information regarding the natural history of desert cymopterus.

General Distribution and Populations Trends

The historical distribution of desert cymopterus ranged from Apple Valley in San Bernardino County northward approximately 55 miles to the Cuddeback Lake basin in San Bernardino County, and westward approximately 45 miles to the Rogers and Buckhorn Dry Lake basins on Edwards Air Force Base in Kern and Los Angeles counties. However, the Apple Valley locations have presumably been extirpated resulting in a current distribution that includes the Rogers Dry Lake, Harper Dry Lake, Cuddeback Dry

Lake, and Superior Dry Lake basins (69 FR 64884–64889; see Figure SP-P06 in Appendix B). This species occurs at elevations from 2,000 to 3,000 feet, and possibly up to 5,000 feet (69 FR 64884–64889; CNPS 2011).

Abundance estimates for each population are usually less than 1,000 plants. However, estimating population size is difficult for a number of reasons. First, occurrences and population size fluctuate widely from year to year in response to climatic conditions, especially on the amount of rainfall. Desert cymopterus is dependent upon frequent spring rains. Furthermore, this species may remain dormant underground as a taproot and may not emerge when there is insufficient rainfall, so the number of individuals underground could be greater than the number of individuals aboveground. Also, detectability many be low in years when plants only produce leaves and no inflorescences (NatureServe 2011).

The largest and most robust populations of desert cymopterus occur on Edwards Air Force Base. Seventeen population surveys were performed during a study in 1995, a good year for the species, and population sizes at each location ranged from 1 to 1,929 individuals. In total, 14,093 individuals were counted over an area of 1,465 acres (Tetra Tech 1995, cited in NatureServe 2011).

Reasons for Decline

Desert cymopterus is potentially threatened by habitat alteration and destruction resulting from military activities on Edwards Air Force Base, the expansion of Fort Irwin, oil and gas development, utility construction, renewable energy development, off-road vehicle use, sheep grazing, Land Tenure Adjustment, and urban development (69 FR 64884–64889; CNPS 2011). However, according to the proposed rule (69 FR 64884–64889), the magnitude and relative importance of most of these potential threats were unknown. Grazing by native and non-native herbivores—presumably including mammals, insects, and desert tortoise—is also a threat to this species. This may contribute to the low-density, dispersed nature of the majority of reported desert cymopterus populations by limiting the plants' reproductive potential and reducing their vigor (Bagley 2006).

5.5.4.2 Habitat Characteristics

Desert cymopterus grows in Joshua tree woodland, saltbush scrub, and Mojavean desert scrub communities on loose, sandy soils. The sandy soils required by this species occur on alluvial fans and basins, stabilized sand fields, and occasionally sandy slopes of desert dry lake basins (69 FR 64884–64889).

5.5.4.3 Occurrence within Plan Area

There are a total of 79 occurrences of desert cymopterus in the CNDDB (CDFW2013), all originating from 14 collections, one collection of which was a duplicate (Sanders, pers. comm. 2012). There are three CNDDB occurrences from before 1990. Two of these are located in the vicinity of Leuhman Ridge and Kramer Hills near other occurrences of this species. One of these is possibly extirpated and located over 25 miles southeast of other occurrences east of Victorville (see Figure SP-P06 in Appendix B; CDFW 2013).

There are 230 recent occurrences (status updated since 1990) that range from south of Buckhorn Lake along the Kern–Los Angeles County boundary north to the Black Hills and Fort Irwin (see Figure SP-P06 in Appendix B). Of these, there are 227 recent occurrences (status updated since 1990) that range from south of Buckhorn Lake along the Kern–Los Angeles County boundary north to the Black Hills and Fort Irwin (Figure SP-P06). However, the majority of these occurrences are located on or near Edwards Air Force Base, which may be because Edwards Air Force Base is the only area in the Mojave Desert that has had extensive surveys conducted for desert cymopterus. Those on Edwards Air Force Base and the one occurrence at Fort Irwin are on lands owned by the DOD. Other occurrences on public land include those managed by the BLM in the general vicinity of North Edwards, Harper Lake, and Cuddeback Lake. The remaining nine recent records are either located on private land or the ownership is unknown (CDFW 2013).

There are 344,996 acres of modeled suitable habitat for desert cymopterus in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.5 Little San Bernardino Mountains Linanthus

5.5.5.1 Status and Distribution

Regulatory Status

Little San Bernardino Mountains linanthus (*Linanthus maculatus*) is not federally or state listed, but is BLM sensitive. Little San Bernardino Mountains linanthus has a CRPR of 1B.2. CRPR 1B species are considered “rare, threatened, or endangered in California and elsewhere” (CDFG 2012b). CRPR species with a threat rank of .2 are “fairly threatened in California, with 20% to 80% of occurrences threatened/moderate degree and immediacy of threat” (CNPS 2011). Little San Bernardino Mountains linanthus has a California Heritage Element Ranking of S2, indicating that it is “imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province” (CDFG 2012b).

Natural History

Little San Bernardino Mountains linanthus is an annual herb in the phlox family (Polemoniaceae). It is a diminutive, densely hairy, alternate-leaved annual species approximately 1 to 3 centimeters (0.4 to 1.2 inches) in height (Jepson Flora Project 2011; Patterson 1989). It reproduces via seed, but otherwise its ecology has not been well studied, and little is known about the plant's pollinator relationships, seed viability, or seed germination (Patterson 1989; Sanders 2006; CVAG 2006). The flower is white with a vermilion spot on each spreading lobe on most individuals (Munz 1974), suggesting that the species is almost certainly insect-pollinated (Sanders 2006). The flowering time for this species is March through May (CNPS 2011). A review of the collections shows that approximately one-third of the specimens were collected in March, two-thirds in April, and only a few in February and May (CCH 2011).

General Distribution and Populations Trends

Little San Bernardino Mountains linanthus is endemic to Southern California with occurrences in San Bernardino, Riverside, and Imperial counties (CNPS 2011). This species' range is restricted to the mouth of Dry Morongo Canyon near the City of Desert Hot Springs and the north side of Joshua Tree National Park south of SR 62 in the Little San Bernardino Mountains, and from Whitewater Canyon in the eastern San Bernardino Mountains to Palm Springs. Virtually all of the Palm Springs populations are considered extirpated due to development (Sanders 2006). Additional areas where the species has been recently documented include the mouth of Rattlesnake Canyon and near the Two Hole Spring area on the northern side of the San Bernardino Mountains, and just east of the San Diego County line near Dos Cabezas Spring in Imperial County (see Figure SP-P09 in Appendix B)(CCH 2011; Sanders 2006).

There are four major populations of Little San Bernardino Mountains linanthus (Sanders 2006). All populations are extant except for the Palm Springs populations, which were located in the center of what is now Palm Springs and along I-10 north of the city proper (Sanders 2006). Because of the isolated nature of desert wash systems, the major populations are separated into smaller "population units" associated with individual washes (Sanders 2006). Two new populations have been discovered in the last two decades: a population in the Rattlesnake Canyon and Two Hole Spring areas on the northern side of the San Bernardino Mountains and an Imperial County population located just east of the San Diego County line near Dos Cabezas Spring (CDFW 2013; CCH 2011).

Some estimates have been made of the number of individuals in some occurrences. About 10,000 individuals north of Indian Avenue near the mouth of Big Morongo Canyon

(Riverside County) in 1996 and widespread plants observed in flat areas between Joshua Tree and Indian Cove in 1995 (G. Hemkamp, pers. comm., cited in Sanders 2006). A few hundred individuals were present in the Dry Morongo Canyon (San Bernardino County) area in 1992 and 1995 and six in 1996; and 100 plants in an area south of Joshua Tree near SR 62 in 1986, which were "reduced markedly" in 1987, 150–200 plants in 1988, 25–30 plants in 1990, and 1,000 plants in 1993 (Patterson 1989; CDFW 2013).

There are several gaps in the early records for this species, including a 17-year gap from 1907 to 1924 (Sanders 2006; CDFW 2013; CCH 2011). Only six collections were made between 1924 and 1960 and only two collections were made in the 1970s. Since the end of the 1970s, the number of collections has increased, probably because of the increase in desert botanical work and Patterson's 1989 description of habitat for the species (Sanders 2006).

Population trends are difficult to estimate for the species because population size in a given year appears to depend on environmental conditions and fluctuates greatly from year to year.

Reasons for Decline

Little San Bernardino Mountains linanthus is potentially threatened by habitat disturbance and destruction from urban expansion, OHV use, illegal dumping, and an increase in invasive non-native species (CNPS 2011; CDFW 2013), and flood control activities (CVAG 2006). The largest populations are adjacent to communities, such as Yucca Valley, Joshua Tree, and Desert Hot Springs, that have grown substantially in the last two decades. Additional development pressures associated with the expansion of these communities could impact core populations (Sanders 2006).

Flood control maintenance activities pose a specific threat to the species as these activities change the hydrological regime and sediment-carrying capacity of flows within wash systems. In particular, flood control activities pose a substantial threat to populations of Little San Bernardino Mountains linanthus in the Whitewater Canyon, Mission Creek, and Dry Morongo Canyon Wash areas (CVAG 2006).

OHV use is a particular threat to Little San Bernardino Mountains linanthus because the species grows only in desert washes, which are favored by OHV users because they are so sparsely vegetated (Sanders 2006).

5.5.5.2 Habitat Characteristics

Little San Bernardino Mountains linanthus grows on loose, well-aerated, open sandy benches and flats on the margins of desert washes (Sanders 2006; Jepson Flora Project 2011). It grows at 195 to 2,075 meters (640 to 6,806 feet) elevation (CDFW 2013; CNPS

2011). A review of the elevation data from herbarium collections in the CCH (2011) indicates that the elevation range of the species is from 997 to 4,002 feet (one record indicating a collection from 20 meters elevation appears to be erroneous).

Little San Bernardino Mountains linanthus is always found in open areas that receive no shade from nearby shrubs and is associated with other small annual species, such as sigmoid threadplant (*Nemacladus sigmoideus*), blushing threadplant (*N. rubescens*), evening primrose (*Camissonia pallida*), common loeflingia (*Loeflingia squarrosa*), Arizona nest straw (*Filago arizonica*), and Wallace's woolly sunflower (*Eriophyllum wallacei*) (Sanders 2006).

5.5.5.3 Occurrence within Plan Area

The CNDDB records 27 occurrences for this species (CDFG 2012b). Of the 29 occurrences documented in the CNDDB within the Plan Area, one population east of Yucca Valley and west of Joshua Tree in San Bernardino County, California, is considered historical because the plants were observed once in since 1937 and once in 1940, but these two occurrences are still presumed to be extant (see Figure SP-P09 in Appendix B) (CDFW 2013).

The 27 recent occurrences of Little San Bernardino Mountains linanthus occur along the western boundary of the Plan Area in San Bernardino and Riverside counties (see Figure SP-P09 in Appendix B) (CDFW 2013). Seven of the occurrences are at least partially located in Joshua Tree National Park. Two are located on BLM land just below the mouth of Rattlesnake Canyon in southeastern Lucerne Valley and east of Two Hole Spring at the northeastern base of the San Bernardino Mountains (CDFW 2013). One occurs on private land south of the town of Joshua Tree. The remaining three have unknown ownership and occur on a wash north of Joshua Tree National Park, south of SR 62 east of Joshua Tree, and at Pipes Canyon north of Yucca Valley (CDFW 2013).

There are 343,289 acres of modeled suitable habitat for Little San Bernardino Mountains linanthus in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.6 Mojave Monkeyflower

Until recently, Mojave monkeyflower was included in the figwort family (*Scrophulariaceae*), but it is now placed in the lopseed family (*Phrymaceae*) (Beardsley and Olmstead 2002; Jepson Flora Project 2011). There are also current studies that provide evidence that the genus *Mimulus* should be fragmented into several new genera, so more nomenclatural changes can be expected in the near future for this taxon. Mojave monkeyflower is an annual plant approximately 2 to 10 centimeters (0.8 to 3.9 inches) in size.

5.5.6.1 Status and Distribution

Regulatory Status

Mojave monkeyflower is not federally or state listed, but is a BLM sensitive species. Mojave monkeyflower has a CRPR of 1B.2. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CNPS 2013). CRPR species with a threat rank of .2 are "fairly endangered in California, with 20%–80% of occurrences threatened/ moderate degree and immediacy of threat" (CNPS 2011). Mojave monkeyflower has a California Heritage Element Ranking of S2, indicating that it is considered imperiled in California (CDFG 2012b).

Natural History

Most members of the lopseed family are insect pollinated (Beardsley and Olmstead 2002); and given the showy flowers, Mojave monkeyflower pollinators are probably Hymenoptera (bees, wasps, ants, and sawflies) or Lepidoptera (butterflies and moths). MacKay (2006) hypothesized that the white margin of the corolla reflects ultraviolet light, and the maroon veins extending into this margin act as nectar guides to facilitate pollination.

Small seeds and an annual habit suggest that dispersal of Mojave monkeyflower is mostly abiotic (MacKay 2006; NatureServe 2011). For populations located on rocky slopes above washes, it is probable that gravity carries seeds down into the washes and intermittent water flow may carry seeds further down washes. Although biotic vectors of seed transport are unknown, granivorous ants or rodents may transport seeds over short distances and birds may transport seeds longer distances (MacKay 2006).

Although suitable habitat for this species appears to be fairly abundant, it is quite restricted geographically. Population sizes fluctuate substantially from year to year, probably in response to the amount and timing of precipitation; as an annual, germination and establishment are dependent on the timing and amount of spring rains (MacKay 2006; NatureServe 2011). Unknown unusual germination and establishment requirements may account for the considerable variability in population sizes from year to year (MacKay 2006).

General Distribution and Populations Trends

This species occurs in the Mojave Desert in west-central San Bernardino County (Jepson Flora Project 2011). The populations with the greatest known densities occur south of Daggett and Barstow (MacKay 2006). However, the majority of the historical occurrences in the Barstow area have either been extirpated or impacted (CNPS 2011). The elevation

range of this species extends from 600 to 1,200 meters (1,969 to 3,937 feet) (CNPS 2011) (see Figure SP-P10 in Appendix B).

Population trends for Mojave monkeyflower are unknown at present, but a multi-year population-level study is underway by BMP Ecosciences and expected to be completed by 2015. One CNDDB occurrence has been possibly extirpated, and the status of 9 of the 56 total CNDDB occurrences of Mojave monkeyflower in the Plan Area has not been updated since 1990 (CDFW 2013; MacKay 2006).

Reasons for Decline

Threats to Mojave monkeyflower include development, mining, non-native plants, solar and wind energy projects, grazing, vehicles, and road development (CNPS 2011; NatureServe 2011; MacKay 2006). Additional potential threats include pipeline installation and quarries and test pits adjacent to populations (MacKay 2006). Mojave monkeyflower is also under threat by the potential for the BLM to convert land occupied by this species to private lands, which could then be developed (MacKay 2006; CDFW 2013). The area under consideration for disposal or land exchange is located between Barstow and Victorville (CDFW 2013).

Because population sizes fluctuate considerably annually in response to environmental conditions, Mojave monkeyflower is susceptible to depletion of the seed bank after a series of drought years. In addition, small population sizes increase the risk of inbreeding, which may result in reduced seed set or reduced seed viability (MacKay 2006).

5.5.6.2 Habitat Characteristics

This species occurs in Mojavean desert scrub, specifically creosote bush scrub (MacKay 2006; CNPS 2011). Mojave monkeyflower is associated with the following species or genera, among others: creosote bush, desert senna (*Senna armata*), white burrobrush, ratany (*Krameria erecta* and *K. bicolor*), chollas (*Cylindropuntia* spp.), white bursage, prairie-clovers (*Psorothamnus* spp.), Bigelow's monkeyflower (*Mimulus bigelovii*), desert bells (*Phacelia campanularia*), desert fivespot (*Eremalche rotundifolia*), spiny hopsage (*Grayia spinosa*), and desert trumpet (*Eriogonum inflatum* var. *inflatum*) (MacKay 2006; CDFW 2013).

Mojave monkeyflower commonly occurs in areas that are not subject to regular water flow (MacKay 2006). These areas include the gravelly banks of desert washes with granitic soils and rocky slopes above washes, as well as the sandy openings of creosote bush scrub (MacKay 2006).

5.5.6.3 Occurrence within Plan Area

There are a total of 121 CNDDB occurrences for Mojave monkeyflower in the Plan Area. Of these, 11 occurrences have not been seen since 1990. Of these, one site at Kane Springs (Element occurrence 6) was visited more recently (in 2011) and no plants were found so it is uncertain whether any plants occur here. However, the Kane Springs resurvey in 2011 with negative results does not mean the plants are not in the vicinity (MacKay, pers. comm. 2012). One occurrence along Camp Road is not dated, and no plants were found at this site in 1986 or in 1998. Another one of these is the type locality in Calico and is likely extirpated (CDFW 2013). These records extend from the area around Barstow southeast to the area around the Newberry Mountains, and one occurrence much farther south near Old Woman Springs (see Figure SP-P10 in Appendix B; CDFW 2013).

Of the 121 total CNDDB occurrences in the Plan Area, 110 have been recorded in the CNDDB since 1990 and are presumed extant. One of the major populations of Mojave monkeyflower recorded in the CNDDB since 1990 that is presumed extant is located southeast of Barstow to Ord Mountain. A second concentration of occurrences is located northeast of Adelanto and extends to Helendale. There is an isolated occurrence occur just south of the Black Mountains summit (see Figure SP-P10 in Appendix B). However, if the Stoddard Open Off-Highway Vehicle (OHV) area were surveyed there is a high likelihood that Mojave monkeyflower would be documented, providing a continuum of distribution between the two major areas (MacKay, pers. comm. 2012). The disjunct distributions are the Kane Springs collection east of Rodman (Element occurrence 6) and the Old Woman Springs collection; both areas still need field work (MacKay, pers. comm. 2012).

According to CNDDB records (CDFW 2013), of the 110 recent occurrences, the vast majority are on lands managed by the BLM, and the remaining portion are on lands that are privately owned or whose ownership is unknown (CDFW 2013). However, fourteen of the 19 occurrences turned in by B. West (BLM employee at the time, 1992) included information that the BLM-owned lands were under consideration for disposal, and BLM subsequently disposed of land containing four of those occurrences (CDFW 2013; MacKay, pers. comm. 2012). Also, there is a very high probability that the remaining Brisbane Valley is occupied by Mojave monkeyflower (MacKay, pers. comm. 2012).

There are 176,190 acres of modeled suitable habitat for Mojave monkeyflower in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.7 Mojave Tarplant

5.5.7.1 Status and Distribution

Regulatory Status

Mojave tarplant (*Deinandra mohavensis*) is state listed as endangered but is not federally listed. It is a BLM sensitive species and USFS Region 5 sensitive plant species. Mojave monkeyflower has a CRPR of 1B.3. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CDFG 2012b). CRPR species with a threat rank of .3 are "not very threatened in California, with less than 20% of occurrences threatened/low degree and immediacy of threat or no current threats known" (CNPS 2011). Mojave tarplant has a California Heritage Element Ranking of S2, indicating that it is considered imperiled in California (CDFG 2012b).

Natural History

Mojave tarplant is in the sunflower family (Asteraceae) (Jepson Flora Project 2011). The plant was thought to be extinct at one time but was rediscovered in 1994 by A. Sanders in the San Jacinto Mountains, in Riverside County (Sanders et al. 1997). Mojave tarplant is an annual plant approximately 1 to 10 decimeters (3.9 to 39 inches) in height. Mojave tarplant and the closely related Red Rock tarplant (*Deinandra arida*) are the only two self-compatible species in the genus *Deinandra* (Tanowitz 1982; Baldwin pers. comm. 1997, cited in Sanders 2006b). This may be the result of genetic drift and/or the relative isolation of these two species, which occur on the edge of the desert as local populations (Sanders 2006b). Pollination studies have not been conducted for this Mojave tarplant; however, Faull (1987) has observed small beetles and honey bees visiting Red Rock tarplant flowers.

Mojave tarplant is known to reproduce easily in cultivation (B. Baldwin, pers. comm. 1998, cited in Sanders 2006a) and at a botanical garden has been known to escape into disturbed places (S. Boyd, pers. comm. 1998, cited in Sanders 2006a).

Mojave tarplant blooms from June through January (CNPS 2011). Flowering peaks between August and October. Once flowering has begun, it continues until the plants begin to senesce. Fruit maturity and dispersal are continuous as well. Seed dispersal vectors have not been reported for this species; however, the seeds are relatively heavy and may just fall to the ground around the source plant. The seeds are not armed with any obvious mechanisms, such as hooks or wings, for long-distance dispersal (Sanders 2006a). Baldwin (pers. comm., cited in Sanders 2006b) reports that *Hemizonia* (now *Deinandra*) ray achenes maintain some degree of dormancy while the disk achenes freely germinate.

Mojave tarplant is associated with seasonally saturated clay or silty soils on gentle slopes or low gradient streams, with few shrubs and trees. These saturated areas are typically dry at the surface but provide a substantial water source at depth through summer (Sanders et al. 1997). This species has a discontinuous and possibly relictual distribution (Sanders 2006a), and little is known of its life history and ecological relationships.

General Distribution and Populations Trends

Mojave tarplant is known in Kern, Riverside, and San Diego counties (believed extirpated from San Bernardino County) (CDFGW 2013; see Figure SP-P11 in Appendix B). This species occurs at elevations of 460–1,600 meters (1,509–5,250 feet) (CNPS 2011). The distribution is discontinuous and possibly relictual.

Because this species was only recently rediscovered (in 1994) there is little information available on population trends. Of the eight occurrences in the Plan Area, four are known from BLM land, two are on private land, and ownership is unknown for two of the occurrences. The occurrence on private land near Cutterbank Spring numbered 14 individuals in 2003. Approximately 15,000 plants were observed at the other occurrence on private land located at the south end of Kelso Valley in 2010. Many more plants were observed in 2011 including an additional 1,500 plants in the northeastern portion of the occurrence (CDFW 2013). Of the two occurrences for which ownership is unknown, one numbered in the thousands in 1998 and the other numbered 109 individuals in 2003. Of the four occurrences on BLM land, one numbered 50,000 in 2003 (with 30 rosettes observed very early in the year in 2004), one numbered in the several hundreds in 2008, and one numbered 5,000 in 1998 (and was locally common in 2001 and numbered 3,000 in 2003). Approximately 50,000 plants were observed in 2003 at the last occurrence on BLM land at Cutterbank Spring; 30 plants were observed in 2004 in their rosette form in an early season survey, and plants were "abundant around the springs and in the surrounding drainage channels" in 2010 (CDFW 2013). Overall, there are 69 occurrences in Kern, Riverside, and San Diego counties (CDFW 2013) and most of these appear to have number of individuals estimated once, making it difficult to discern a population trend.

Reasons for Decline

Mojave tarplant is threatened by grazing, recreational activities, development, hydrological alterations, road maintenance, and vehicles (CNPS 2011). The type locality was modified by construction of the Mojave River Forks Dam. Within the Plan Area, cattle grazing occurs at some of the Mojave tarplant occupied areas, and in some areas is locally intense and may pose a threat. However, the sticky plants of the genus *Deinandra* (also called

"tarweeds") may not be palatable to cattle, so grazing may not be a major threat. Trampling by cattle may be a threat around limited watering sources in dry areas (Sanders 2006a).

5.5.7.2 Habitat Characteristics

The Mojave tarplant occurs in open moist sites in arid regions near the margins of the desert, within chaparral, coastal scrub, desert scrub, riparian scrub, and woodland (CNPS 2011; Sanders 2006a; Jepson Flora Project 2011). Plants are typically observed at seeps and along grassy swales and intermittent creeks. The most suitable habitat occurs in mountainous areas within microhabitats of low gradient streams and on gentle slopes with few shrubs and trees. This species is associated with clay or silty soils that are saturated with water early in the year. Mojave tarplant prefers areas that are dry at the surface but which have a substantial water source at depth through summer. Dwarfed plants occasionally are found in drier sites near occupied moist areas (Sanders et al. 1997). This cycle of early saturation with later desiccation may reduce competition from other plant species; dryness during drought years may further reduce competition (Sanders 2006a).

At the type locality, Mojave tarplant was known to occur along a sandy intermittent creek; however, this habitat is now believed to be atypical and not sufficient to maintain a permanent population. Sanders et al. (1997) does note that there are some occurrences of Mojave tarplant associated with sand, where the sand is adjacent to more typical habitat.

5.5.7.3 Occurrence within Plan Area

There are a total of 69 occurrences in the CNDDB, eight of which occur in the Plan Area (CDFW 2013). This species was not known to occur in the Plan Area prior to 1990.

Within the Plan Area, Mojave tarplant is known from the desert slope of the southern Sierra Nevada Mountains in Kern County (Sanders 2006a). There are 13 occurrences in the Plan Area, all within Kern and Inyo counties. The majority of occurrences are located west of SR 14 and east of the Sequoia National Forest, north of I-40: near Cutterbank Spring, in Jawbone Canyon, near Short Canyon, in lower Esperanza Canyon, in lower Water Canyon, and in the vicinity of Cross Mountain (CDFW 2013; see Figure SP-P11 in Appendix B). Mojave tarplant may also occur at Red Rock Canyon in Red Rock Canyon State Park in Kern County (Faull, pers. comm. 1998, cited in Sanders 2006a).

There are 270,463 acres of modeled suitable habitat for Mojave tarplant in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.8 Owens Valley Checkerbloom

5.5.8.1 Status and Distribution

Regulatory Status

Owens Valley checkerbloom (*Sidalcea covillei*) is state listed as endangered but is not federally listed. It is a BLM sensitive species. It was considered for federal listing (proposed as a candidate species) in 1985, but it was removed from the candidate list in 1996 because the USFWS determined that the species was more abundant or widespread than was previously thought, or that it was not vulnerable to any identifiable threat. Owens Valley checkerbloom has a CRPR of 1B.1. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CDFG 2012b). Owens Valley checkerbloom has a California Heritage Element Ranking of S3, indicating that it is "vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation" (CDFG 2012b).

Natural History

Owens Valley checkerbloom is a perennial herb with stems approximately 2 to 6 decimeters (7.9 to 24 inches) in length (Jepson Flora Project (2011). It flowers from April through June (BLM 2011c; CNPS 2011). The pink-lavender flowers are showy and Owens Valley checkerbloom is probably an outcrossing species that is pollinated by insects. Bees are major pollinators in other related *Sidalcea* species (summarized in Leong 2006). The breeding system of Owens Valley checkerbloom is not known, but research on related *Sidalcea* species has found that several species are gynodioecious, meaning that some plants bear hermaphrodite flowers and other plants bear female-only flowers (Leong 2006). Low seed germination rates in Owens Valley checkerbloom have been reported in one study, ranging from 1.6% to 12.5% (Halford 1994). The Halford (1994) study suggested that seed weight may influence germination rates, with heavier seeds producing higher germination rates; plants may produce larger seeds in favorable years. Plant reproduction was reduced by high rates of rabbit and rodent herbivory on study sites (Halford 1994). This study identified that germination rates for Owens Valley checkerbloom may be enhanced through minor treatments such as leaching or cold stratification and mild giberellic acid treatments.

The Owens Valley checkerbloom may be highly sensitive to drought conditions, although DeDecker (1978) suggested that the fleshy roots might help it survive normal drought cycles; individuals observed during the low rainfall years of 1993 and 1994 yielded low weight seeds with low viability (Halford 1994). In addition, local drought conditions may result in more

browsing by rabbits and rodents, which in turn can reduce seed set and reproduction of the species (Halford 1994).

General Distribution and Populations Trends

Owens Valley checkerbloom is endemic to the southern Owens Valley in Inyo County, California (CNPS 2011; BLM 2011b). It grows only in alkali meadow and spring communities scattered along about 125 kilometers (77.7 miles) of the Owens River drainage (Halford 1994). The CNDDB includes 42 occurrences of Owens Valley checkerbloom and 22 of these occurrences are in the Plan Area. Twenty of the 22 occurrences are on lands owned by the LADWP. Due to the lack of long-term surveys, censuses, and/or monitoring studies, population trends of the species are unknown.

Reasons for Decline

The diversion of the Owens River and cattle grazing were the main causes of this species' decline to near extinction (DeDecker 1978). Halford (1994) reported that low annual precipitation, improper timing and intensity of cattle grazing, increased competition from rhizomatous grass species and upland shrubs, and diversions or depletions of naturally occurring water sources are all threats to the species. Lowering of the local water table by pumping and drainage for water diversion, and the resultant invasion of non-native plants, or heavy grazing and associated meadow succession may be a major threat (Hill 1993). Elmore et al. (2006), for example, reported that alkali meadow vegetation in the Owens Valley is groundwater-dependent and plant cover at groundwater-depleted sites is only weakly correlated with precipitation. Grazing, mostly by cattle, is the most frequently mentioned threat in CNDDB records (CDFW 2013). Noxious weeds such as Russian olive (*Elaeagnus angustifolia*) and knapweed (*Centaurea* spp.) occur at a couple of occurrences, and invasion of rubber rabbitbrush (*Ericameria nauseosa*) may result from lowering of the water table.

5.5.8.2 Habitat Characteristics

Owens Valley checkerbloom grows in moist alkaline meadows and seeps at elevations of 3,580 to 4,650 feet (CNPS 2011; CDFW 2013). Almost all occurrences grow in fine, sandy loam with alkaline crusts, but one occurrence is known to grow in stony, calcareous soil (CDFW 2013).

Associated native grasses and herbs include saltgrass, alkali sacaton (*Sporobolus airoides*), basin wildrye (*Elymus cinereus),* Baltic rush, and clustered field sedge (*Carex praegracilis*). Associated shrubs at some sites include rubber rabbitbrush and Great Basin sagebrush. The

endemic Inyo County star-tulip (*Calochortus excavatus*) co-occurs with Owens Valley checkerbloom at some sites (Halford 1994).

5.5.8.3 Occurrence within Plan Area

Owens Valley checkerbloom was first collected in 1891 in an extensive alkali meadow known as Haiwee Meadows, Inyo County, and was not collected again until 1952 when it was found north of Lone Pine in Inyo County. The species was extirpated from its type locality when the Haiwee Reservoir was formed, and by 1978, local botanist Mary DeDecker considered it to be on the brink of extinction (DeDecker 1978). Within the Plan Area, 5 of the 30 known occurrences are considered historical (i.e., pre-1990) and have not been recently observed. These populations are known to be either extirpated, possibly extirpated, or are presumed to be extant (CDFW 2013).

The CNDDB includes 25 recent occurrences (i.e., since 1990) of Owens Valley checkerbloom in the Plan Area. All of these occurrences occur on lands owned by the LADWP (CDFW 2013). All of the occurrences are generally along Highway 395 from the meadow above Tinemaha Creek south to the area 1 mile north of Olancha (see Figure SP-P13 in Appendix B; CDFW 2013).

There are 147,869 acres of modeled suitable habitat for Owens Valley checkerbloom in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.9 Parish's Daisy

5.5.9.1 Status and Distribution

Regulatory Status

Parish's daisy (*Erigeron parishii*) is federally listed as threatened, but is not state listed. Critical habitat was designated on December 12, 2002 (67 FR 78570–78610). A recovery plan addresses this species, *San Bernardino Mountains Carbonate Plants Draft Recovery Plan* (USFWS 1997b). As of 2010, no status changes for Parish's daisy were indicated by USFWS (75 FR 28636–28642). Parish's daisy has a CRPR of 1B.1. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CDFG 2012b). CRPR species with a threat rank of .1 are "seriously threatened in California, with over 80% of occurrences threatened/high degree and immediacy of threat" (CNPS 2011). Parish's daisy has a California Heritage Element Ranking of S2S3, indicating that it is somewhere between "imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable

to extirpation from the nation or state/province" and "vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation" (CDFG 2012b).

Natural History

Parish's daisy is in the sunflower family (Asteraceae) (IPNI 2011). It is an herbaceous, long-lived perennial subshrub approximately 7 to 30 centimeters (3 to 12 inches) in height from its taproot (Mistretta and White 2001; Sanders 2006). It flowers from May through August (CNPS 2011), peaking mid-May to mid-June (Sanders 2006). Based on the conspicuous flowers, pollinators are probably insects and likely include bees, butterflies, and other known pollinators of similar and related species (Sanders 2006). Parish's daisy produces plumed achenes adapted for wind dispersal (Mistretta and White 2001) and does not appear to have a seed dormancy mechanism (Mistretta 1994). Based on observations of seedlings at several sites (Krantz 1979), reproduction is probably primarily by seed rather than vegetatively by rhizomes or stolons. A recent study by Neel and Ellstrand (2001) found no evidence of vegetative reproduction, concluding that the species probably primarily reproduces sexually through outcrossing.

Recent research on allozyme diversity showed that genetic diversity was high (compared to many narrowly endemic plant taxa) and populations were only moderately differentiated, suggesting that gene flow among populations is still high and any recent fragmentation has not yet affected genetic diversity (Neel and Ellstrand 2001). Maintaining the existing large population sizes is an important component in maintaining gene flow among populations (Neel and Ellstrand 2001).

General Distribution and Populations Trends

Parish's daisy is endemic to Southern California, restricted to dry, calcareous (mostly limestone) slopes of the San Bernardino Mountains, with a few collections from granitic areas at the east end of the San Bernardino Mountains and in the Little San Bernardino Mountains (Neel 2000; Sanders 2006). Parish's daisy occurs at elevations between 3,700 and 6,600 feet, most often in washes and canyon bottoms, but sometimes on alluvial benches or steep rocky mountainsides (Mistretta and White 2001). It is estimated that 1,029 acres are occupied Parish's daisy habitat (USFWS 2009d).

The current population status of Parish's daisy is unclear and there is a discrepancy in total reported occurrences of the species. According to the final listing rule in 1994, Parish's daisy was known from fewer than 25 occurrences with a total estimated population size of 16,000 individuals, but at that time, the San Bernardino National Forest

had mapped 87 site-specific occurrences (USFWS 2009d). USFWS (2009d) notes that what constitutes an occurrence has been subjectively defined over various surveys, making it difficult to specify status or change in status of Parish's daisy since it was listed. In addition, there has been an increase in survey efforts for this species since listing that has resulted in an increase in the number of occurrences detected. Sanders (2006) characterizes Parish's daisy as one of the more common carbonate endemics of the San Bernardino Mountains. Nonetheless, there have not been any systematic population studies conducted over time to document population trends.

Reasons for Decline

The main threat to Parish's daisy is limestone mining because this species is mostly restricted to carbonate deposits (USFWS 2009d). Besides direct impacts, dust and artificial lighting can affect the species through dust impacts on soil chemistry and lighting availability for seeds and the impacts of artificial lighting on growing conditions (USFWS 2009d). Sanders (2006) notes that after moistening, the mining dust appears to harden into a cement-like coating. Additional threats listed by USFWS and CNPS include energy development projects, OHVs, fuel-wood collection, fire suppression activities, camping, target shooting, road construction, and residential developments, but these threats are relatively low compared to mining (USFWS 2009d; CNPS 2011).

The specific potential effects of climate change on Parish's daisy are unknown, but if climate change caused a shift to higher elevations due to warmer and drier conditions, as has occurred with other plant species on the Santa Rosa Mountains of Southern California (Kelley and Goulden 2008), this endemic species could be concentrated in a smaller area and more vulnerable to extinction (USFWS 2009d).

5.5.9.2 Habitat Characteristics

Parish's daisy occurs in Mojavean desert scrub and pinyon and juniper woodlands (CNPS 2011) and is largely restricted to loose, carbonate alluvium, although it is occasionally found on other rock types (Sanders 2006). Populations of Parish's daisy are most commonly found along washes on canyon bottoms or on loose alluvial deposits on adjacent benches, but they are also occasionally found on steep rocky slopes (Sanders 2006). Based on this species' occurrence on noncarbonate granitic soils, it is possible that the apparent carbonate preference is due to reduced competition from other plants, although reports of this species on noncarbonate soils are few (Sanders 2006). It has also been observed at sites where soils have been found to be strongly alkaline, implying that the noncarbonate granitic soils may have been influenced in their soil chemistry by adjacent carbonate slopes (Sanders 2006).

Specific plant species associated with Parish's daisy have not been described in the literature, but dominant species within pinyon and juniper woodland where Parish's daisy is typically found include single-leaf pinyon pine (*Pinus monophylla*), Utah juniper (*Juniperus osteosperma*), and more rarely California juniper and western juniper (*Juniperus occidentalis*). Understory species within pinyon and juniper woodland are more variable, but may include mountain-mahogany (*Cercocarpus ledifolius*), Mormon tea (*Ephedra viridis*), Mojave yucca, Joshua tree, and brittlebush.

Parish's daisy co-occurs with another carbonate endemic, Cushenbury oxytheca (*Acanthoscyphus parishii* var. *goodmaniana*). Its presence, however, appears to be negatively related to at least two other carbonate soils species - Cushenbury milk-vetch (*Astragalus albens*) and Cushenbury buckwheat (*Eriogonum ovalifolium* var. *vineum*), which tend to occur on more stable slopes.

5.5.9.3 Occurrence within Plan Area

Parish's daisy was first described by Asa Gray in 1884 from specimens collected by S.B. Parish at Cushenbury Springs in May 1881 (Abrams and Ferris 1960; Krantz 1979). It was reported to be "abundant on stony hillsides at Cushenberry Springs" by Hall (1907), although it is unclear whether Hall was referring to Parish's collections of the species (Sanders 2006). Within the Plan Area, the CNDDB includes two historical occurrences that were documented in 1988 and two historical occurrences for which status is unknown (see Figure SP-P16 in Appendix B). However, each of these occurrences is presumed to be extant.

Within the Plan Area, the CNDDB includes 40 recent occurrences (i.e., post-1990) of Parish's daisy and all are regarded as extant (CDFW 2013; see Figure SP-P16 in Appendix B). The populations occur primarily on USFS and BLM lands, but two of the populations on USFS and BLM lands also extend onto private lands within the Plan Area. Two populations occur within the Joshua Tree National Park and another is located on the University of California Natural Reserve System Burns Pinion Ridge Reserve (CDFW 2013).

In 2009 the USFWS determined that the range and distribution of this species was essentially the same as it was at the time of listing (1994).

There are 187,517 acres of modeled suitable habitat for Parish's daisy in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.5.10 Triple-Ribbed Milk-Vetch

5.5.10.1 Status and Distribution

Regulatory Status

Triple-ribbed milk-vetch (*Astragalus tricarinatus*) is a federally listed endangered species but is not state listed. It is a USFS sensitive species. The federal 5-year review of the species recommended no change needed for the endangered status of the species (USFWS 2009e).Triple-ribbed milk-vetch has a CRPR of 1B.2. CRPR 1B species are considered "rare, threatened, or endangered in California and elsewhere" (CDFG 2012b). CRPR species with a threat rank of .2 are "fairly endangered in California, with 20%–80% of occurrences threatened/moderate degree and immediacy of threat" (CNPS 2011). Triple-ribbed milk-vetch has a California Heritage Element Ranking of S1.2, indicating that it is "critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province" (CDFG 2012b).

Natural History

Triple-ribbed milk-vetch is a short-lived, perennial herb in the pea family (Fabaceae) with stems approximately 5 to 25 centimeters (2 to 10 inches) in length (Hickman 1996). It blooms from February through May (CNPS 2011). Amsberry and Meinke (2007) found that 62% of sample individuals at Wathier Landing were in flower in March 2005, and 38% were beginning to produce fruit. At Catclaw Flat, all sampled plants were in fruit in May 2005. Despite the apparent high productivity of this species, the 5-year review for the species states that "the abundance of this species fluctuates from year to year and may not be present above ground in drought years" (USFWS 2009e, p. 1). Long-term studies of this species have not been conducted to determine its response to wet and dry cycles.

Amsberry and Meinke (2007) noted that all mature reproductive individuals appeared to be perennial and many had obvious woody bases. The longevity of individuals is suspected to be 3 to 5 years, but long-term studies are needed (Amsberry and Meinke 2007).

Pollinators of triple-ribbed milk-vetch are unknown. Amsberry and Meinke (2007) noted that field conditions were too windy to observe pollinators but indicate that the species' showy flowers are typical of legumes pollinated by native bees and honeybees.

Dispersal mechanisms are unknown, but observations of many seedlings around mature reproductive plants suggest that dispersal occurs over short distances within the source populations (Amsberry and Meinke 2007; White 2004). The deme (i.e., groups of isolated

plants) populations and waifs (i.e., isolated plants) probably stem from seeds washed downstream or downslope from the source populations (USFWS 2009e; White 2004).

Little is known about the ecological relationships of triple-ribbed milk-vetch. The 5-year review for the species indicates that the individuals may not appear aboveground during drought years (USFWS 2009e), but Amsberry and Meinke (2007) suggest that reproduction and seedling germination may occur in most years at the source populations. Long-term studies are needed to understand the species' response to wet and dry cycles.

Pollination and dispersal studies have not been conducted, although the species' showy flowers may attract native bees and honeybees, and seedlings are readily observed around source populations (Amsberry and Meinke 2007; White 2004).

Associated plants at the two source populations in the Plan Area—Wathier Landing and Catclaw Flat—are similar, but this similarity is not unexpected because of the close proximity of the two sites. The plant communities at most other occurrences have not been described, but the vegetation community at the East Deception Creek site, which is a deme population of about 50 individuals on a scree slope, includes creosote bush, Schott's indigo bush, rush milkweed (*Asclepias subulata*), five-scaled white burrobrush, and deerweed (*Acmispon glaber*) (Le Doux 2007, cited in USFWS 2009e). Given that most occurrences of triple-ribbed milk-vetch are in barren areas, local plant associations do not appear to be an important factor for presence or absence.

General Distribution and Populations Trends

The general range of triple-ribbed milk-vetch includes the eastern San Bernardino Mountains/Whitewater Canyon area, Morongo Canyon, and the western part of the Little San Bernardino Mountains, with disjunct occurrences in the Orocopia (Barneby 1959) and Santa Rosa mountain ranges (see Figure SP-P18 in Appendix B), although the Orocopia occurrence is unvouchered (USFWS 2009e). Throughout the species' range, there are approximately 21 occurrences, of which, 19 are considered extant (CNPS 2011).

Other than the site-specific counts and population estimates for the approximately 18 extant occurrences for triple-ribbed milk-vetch, there are little data for population status and trends. For the 5-year review of the species, the USFWS estimated the known rangewide population to be less than 500 individuals, including source and deme populations and waifs (USFWS 2009e).

Reasons for Decline

The main anthropogenic threats to triple-ribbed milk-vetch that triggered the federal listing of the species in 1998 was bulldozing for maintenance of a gas pipeline and earth-moving activities along a stretch of Big Morongo Canyon to realign segments of a crude oil pipeline that had been exposed during winter storms in 1992–1993 (63 FR 53596–53615). It is considered to be under continuing threat from maintenance of the crude oil pipeline and from OHV use in the canyons. Its small population numbers make it vulnerable to stochastic events and anthropogenic events such as pipeline leaks (USFWS 2009e). New threats identified since the species' federal listing include wildland fire suppression activities, flooding, and climate change (USFWS 2009e). Amsberry and Meinke (2007) also identify exotic weed infestations resulting from increased vehicle and foot traffic as a potential threat to the species.

Rangewide, but outside the Plan Area, other potential threats include residential development of population location in East Deception Canyon and Lower Mission Creek, which may affect downstream habitat and facilitate OHV use (USFWS 2009e).

5.5.10.2 Habitat Characteristics

Triple-ribbed milk-vetch is characterized as generally occurring in Joshua tree woodland and Sonoran desert scrub (CDFW 2013; CNPS 2011). Throughout its range, it occurs at elevations of 1,300 to 4,000 feet (USFWS 2009e). Occurrences within the Plan Area occur at 2,300 to 3,700 feet. Populations are characterized as source populations, deme populations, and waifs. The focus of this description is habitat for source populations because they are considered the most important element for the species for conservation purposes. The deme populations and especially the waif populations that likely occur from seedlings washed downstream and downslope from source population are small and not self-sustaining and, therefore, are not as important for conservation and management. These sites are not the primary habitat for the species (Amsberry and Meinke 2007), and these small ephemeral populations likely do not contribute to long-term viability of the species. However, waifs in the Whitewater Canyon wash area are on an eroded talus of the same soil type that occurs in primary habitat for the source populations (Barrows, pers. comm., 2012).

The Wathier Landing source population occurs on an outcrop of metamorphic rock which is weathering into "unproductive-looking" gravelly soil at about 3,700 feet (White 2004). Triple-ribbed milk-vetch was not detected in surrounding granitic slopes or alluvial fans and washes (White 2004). The substrate where the plants were actually detected was largely bare of other species, but associated plants included giant needlegrass

(*Achnatherum coronatum*), California buckwheat (*Eriogonum fasciculatum*), desert ceanothus (*Ceanothus greggii*), tree poppy (*Dendromecon rigida*), bigberry manzanita (*Arctostaphylos glauca*), bitter snakewood (*Condalia globosa*), hairy yerba santa (*Eriodictyon trichocalyx*), and Mojave yucca (*Yucca schidigera*) (Amsberry and Meinke 2007; White 2004). The Catclaw Flat population was located on decomposed granite substrate on an exposed ridge at about 3,400 feet in association with the same plant species as the Wathier Landing site (Amsberry and Meinke 2007).

The unique soil association is a critical component of the species distribution, although the mechanism for that association is unclear. Little else grows on these soils, but whether it is the lack of competition, a unique chemical composition, or the appropriate level of erosion-disturbance that has fostered the plant soil association has yet to be understood. Where that soil occurs, or where similar soil outcrops occur, triple-ribbed milkvetch is often found. In Mission Creek, on these soil types, but in relatively flat terrain, this milkvetch has been observed primarily after a large disturbance (wildfire with firefighting related soil disturbance) (Barrows, pers. comm. 2012).

Triple ribbed milk-vetch generally occurs in dry washes, at the bases of canyon slopes, and on steep scree slopes (USFWS 2009). Generally, primary habitat for source populations in the Plan Area consists of rocky slopes and ridges that are mostly barren. Notably the two source populations are at the two highest elevations of all of the occurrences in the Plan Area, supporting the notion that the large source populations occur in upslope areas in the upper watersheds and the smaller deme populations and waifs occur at lower elevations in downstream washes and downslope (White 2004; USFWS 2009e).

5.5.10.3 Occurrence within Plan Area

Historically (i.e., prior to 1990), triple-ribbed milk-vetch was known from Whitewater and Morongo canyons in Riverside and San Bernardino counties and southeast to the Orocopia Mountains in Riverside County (63 FR 53596–53615).

As shown in Figure SP-P18 in Appendix B, there are about 21 recent occurrence locations for triple-ribbed milk-vetch in the Plan Area: Wathier Landing, Catclaw Flat, Mission Creek, Dry Morongo Canyon and Wash, Big Morongo Canyon, Long Canyon, Coyote Hole Spring, Key's Ranch (note that this site is unvouchered),and Orocopia Mountains. The characterization of the species' distribution is complicated by the fact that the occurrences appear to represent different types of populations: source populations, waifs, and deme populations (USFWS 2009e). Source populations are larger, permanent populations (i.e., up to several hundred individuals) typically located in the upper watershed areas. Waifs are scattered individuals in washes downstream of source populations. Deme populations are discrete or isolated groups

of waifs that may exhibit intra-population breeding but do not persist. Habitats associated with these population types are discussed in more detail in Habitat Requirements.

There are two recognized source populations in the Plan Area: Wathier Landing and Catclaw Flat. The Wathier Landing population, which is in the Mission Creek drainage just east of Wathier Landing, supported at least 300 aboveground individuals in 2004 (White 2004) and more than 300 adult individuals and many seedlings in 2005 (Amsberry and Meinke 2007). The Catclaw Flat occurrence was first discovered in 2005 about 2.5 miles from the Wathier Landing site and consisted of about 100 individuals, including seedlings (Amsberry and Meinke 2007). Both sites are conserved on private land owned by The Wildlands Conservancy (TWC).

The other occurrences in the Plan Area are considered waifs and deme populations that are not self-sustaining (USFWS 2009e). Besides the Wathier Landing and Catclaw Flat source populations, the largest documented population was in Big Morongo Canyon; this population numbered less than 50 individuals in 1993, but a survey of the site in 2005 failed to detect the species (CDFG 2012b). One large reproductive individual (but no seedlings) was found in 2005 on a slide of exposed, decomposed granite on the canyon wall in Big Morongo Canyon (Amsberry and Meinke 2007) within the BLM Big Morongo Canyon Reserve (CDFW 2013). Two waif individuals were detected in Long Canyon in Joshua Tree National Park in 2006 (CDFW 2013).

It should be noted that botanists suspect that more populations of triple-ridged milk-vetch exist on upland slopes in suitable habitat (e.g., rocky, exposed slopes and ridges), but the rugged terrain occupied by this species makes exploration difficult, and small plants tend to blend in with light-colored granitic substrates, making them hard to detect (Amsberry and Meinke 2007).

There are 81,251 acres of modeled suitable habitat for triple-ribbed milkvetch in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

5.6 Species Occurrence Database Summary

This section documents the approach used to develop the species occurrence database for the DRECP. This database was compiled from various sources to create a comprehensive database for special-status plant and wildlife species that have been recorded within the Plan Area and are covered under the Plan.

Data Sources

The following data sources were used in developing the DRECP species occurrence database:

- Audubon and Cornell Lab of Ornithology, eBird Database, May 3, 2011;
- Audubon golden eagle database, 2010;
- Audubon golden eagle eBird database, 2011;
- Bat localities from Pat Brown
- BLM, golden eagle nest location dataset (2012);
- BLM, Peirson's milk vetch monitoring program (2004-2005)
- BLM, El Centro Office, flat-tailed horned lizard occurrence database, 2006;
- BLM, flat-tailed horned lizard database, 2001;
- BLM, Ocotillo Wells Office. Flat-tailed horned lizard database, 2007;
- BLM, California Desert District. NECO occurrence Database, 1949–1998;
- BLM, California Desert District. Point observations of Coachella Valley milkvetch
- BLM, California Desert District. West Mojave (WEMO) animal, primarily bird, and plant sightings recorded by the biologist at the Ridgecrest and Barstow field offices, 1968–1996;
- BLM, California Desert District. WEMO baseline comprehensive dataset for sightings of animal species within the west Mojave boundary, 1956–2001;
- BLM, California Desert District. WEMO 1998 Mohave ground squirrel transect information by Ed LaRue and a team of biologists;
- BLM, California Desert District. WEMO location of bat roosts within the west Mojave planning boundary, 1978–1998;
- CalHERP Arroyo toad occurrences, http://www.californiaherps.com/, April 2012
- CDFW, CNDDB, November 2012;
- CDFW, Mohave ground squirrel positive Leitner points database;
- CDFW, Trapping Grid Mohave ground squirrel database, 2005;
- San Bernardino National Forest (SBNF). Spotted Owl Nest Sites.
- USFWS, Occurrence Information for Multiple Species within Jurisdiction of the Carlsbad Fish and Wildlife Office, January 25, 2011;

- USFWS, Condor Global Positioning System (GPS) database, 2011;
- USFWS, Peninsular bighorn sheep GPS database, unpublished;
- USFWS; Peirson's milk-vetch database; and
- Utah State, flat-tailed horned lizard database.

Attributes

All of the existing attributes included in the datasets provided by the various sources listed were retained in the DRECP species occurrence database (Dudek 2011). To maintain consistency across all compiled data sources, the species' scientific name and common name were updated where necessary if they differed from the names listed in *Special Animals* (CDFG 2011a) or *Special Vascular Plants, Bryophytes, and Lichens* (CDFG 2012c). A unique species code attribute was added to each dataset to easily compile and sort the same species across the various sources.

Additional attributes were added to reflect currency, validity, and precision status in order to consistently analyze data across the various datasets. These attributes were assigned to every record in the database according to the following:

- Data Currency – Records from before 1990 were coded as "Historic" and records from 1990 to the present were coded as "Current" in the "D_Currency" field. Records with no date are coded as "Unknown" in this field. For the purpose of the species profiles, the unknown records are treated the same as historic records.
- Validity – All of the records currently included in the database under the "D_Validity" field were coded as valid because each source is data published by a government agency or a non-government entity (e.g., Audubon Society, or a university) or individual considered to be highly credible. Additional data added to this database in the future that does not meet certain criteria for validity would be coded as invalid. However, some of the eBird data include the attribute "not valid and reviewed," indicating that eBird had rejected the record as a valid siting based on their screening criteria. Records with this attribute were not acknowledged in the species profiles.
- Precision – The "D_Precision" field provides a code signifying the level of data precision for each record. The precision coding generally follows the system used by the USFWS for their occurrence data.

Other Associated Data

There are several additional information sources related to species occurrences and distributions that are maintained separate from the DRECP species occurrence database:

- USFWS GPS tracking data. California condor and Peninsular bighorn sheep GPS tracking data is available separately but was not integrated into the occurrence database because these data represent recorded locations from transmitters on individuals, some of which record a location as frequently as every hour, which would misrepresent the number of actual occurrences in the Plan Area for these species.
- California Native Plant Society (CNPS). 2011. Plant occurrences by quad. This information was not included in the species occurrence database because it is not strictly a point occurrence database, but provides plant species occurrence by USGS 7.5-minute quadrangle. These data are available for use as an overlay or supplemental source for plant species.
- NECO Plan data. This information was not used in the species occurrence database because it is species distribution modeling, not observations. This information is available as a supplemental data source when working with these species.
- BLM, California Desert District. NECO Plan, rare plants, distribution, modeling. GIS data. March 1998.
- BLM, California Desert District. NECO Plan, sensitive wildlife, distribution, modeling. GIS data. March 1998.
- BLM, California Desert District. 2005. Elevation polygons for tortoise habitat, West Mojave Plan. March 2005.
- BLM, California Desert District. 2005. West Mojave Plan, Conservation Areas for Multiple Species. February 2005.
- BLM, California Desert District. 1998. Habitat and range characteristics for bighorn sheep within the west Mojave planning area boundary.

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6 ANTHROPOGENIC LAND USES AND INFLUENCES

Anthropogenic lands uses and influences differ in different parts of the Plan Area. In the western Mojave Desert, human disturbances primarily include urban and rural development, as well as agriculture. In other parts of the Mojave Desert, grazing, mining, military training, and other land uses are the primary disturbance factors (Webb et al. 2009). In the Sonoran Desert, substantial land has been converted to urban and rural uses and agriculture in eastern Riverside County in the Coachella Valley just west of the Plan Area, along the Colorado River in the Blythe area, and in Imperial County between the Salton Sea and the United States–Mexico border near Mexicali. There are also military uses in the Sonoran Desert. This section discusses these human disturbances, as well as rural and urban development within the desert, water conveyance, utilities and infrastructure, mining, and recreational uses.

6.1 Rural and Urban Development

Development in the Mojave Desert began with mining settlements connected by railroads and dispersed cattle and sheep ranches. Over the last 100 years, the human population in the Mojave Desert has increased significantly. In 2000, an estimated 2.36 million people resided in the Mojave Desert, of which, approximately 1 million were in California (Webb et al. 2009; Randall et al. 2010). Along with expansion of suburban areas across the southwestern U.S., several cities in the Mojave Desert, including the Lancaster–Palmdale, Victorville–Apple Valley–Hesperia, and Ridgecrest areas experienced a substantial rise in population after 1980 (Webb et al. 2009). Since then, many of the cities in the western Mojave Desert have doubled in size as people relocate from Los Angeles and other nearby urban centers; however, in many areas, the recession that began in 2008 has slowed the population growth rate (Randall et al. 2010). In 2009, the population estimate for the main population centers in the western Mojave Desert was more than 500,000 people, including approximately 145,800 people in Lancaster, 144,000 in Palmdale, and 110,900 in Victorville (U.S. Census Bureau 2011). The only population center of size in the Eastern Mojave Desert is Needles, with about 5,300 people.

The Sonoran Desert portion of the Plan Area is much less urbanized and the main population areas are associated with large-scale agricultural activities in the Imperial Valley. Most urban development in the Sonoran Desert has occurred in the Coachella Valley just west of the Plan Area. Agricultural development in Imperial County began in the early 1900s when the Alamo Canal was completed in 1901. Several additional expansions of water diversions to agricultural areas in California occurred in 1909, 1913, 1927, 1948, and 1957 and provided for population expansion (LCRMSCP 2004). According to the U.S. Census Bureau, in 2009, the population of Imperial County was

about 167,000 people, of which, about 122,780 (74%) live in the cities of El Centro, Brawley, Imperial, Calexico, and Holtville (U.S. Census Bureau 2011). These cities are all associated with the large-scale agricultural operations in Imperial County. Smaller population centers in the Sonoran Desert portion of the Plan Area include Blythe in Riverside County, with a population of about 21,300 people, and Borrego Springs in San Diego County, with a population of about 2,500 people.

Impacts of urban, rural, and agricultural development include direct habitat loss, degradation, and fragmentation (Randall et al. 2010). Degradation of surrounding natural desert landscapes can occur for several reasons. Public lands closer to urban areas are subject to greater anthropogenic impacts due to continued disturbance at the urban–desert interface and easy access by large numbers of people (Webb et al. 2009). Urban, rural, and agricultural development also can promote the spread of invasive non-native plants and other invasive species, as discussed in more detail in Section 6.9. The types of development, such as primarily rural or agricultural (e.g., horse properties, alfalfa fields, and other crops), versus more urbanized development, influence the type of non-native plants and other invasive species introduced into the desert (Webb et al. 2009).

The urban and suburban metropolitan areas in the western Mojave Desert and urban/agricultural areas of the Sonoran Desert are linked by highways, utility corridors, and railroads, which facilitate secondary roads and other vehicular routes to serve as these linkages. Urban, rural, and agricultural development also impact desert ecosystem processes by increasing the water and energy supply demands. The water and energy needs of desert urban areas are supported largely through imports via aqueducts, pipelines, transmission lines, and diesel-powered trucks and locomotives. These anthropogenic impacts are discussed in more detail below.

6.2 Transportation Corridors and Roadways

Major transportation corridors in the Mojave Desert include Interstate 15 (I-15) from Cajon Pass, through Barstow to Las Vegas; Interstate 40 (I-40) from Barstow to Needles; Highway 395 from Adelanto to the Owens Valley; Highway 58 from Mojave to Barstow; and Highway 14 from Palmdale to Highway 395 near Ridgecrest. Reflecting its less intense urban development, there are fewer major transportation corridors in the Sonoran Desert, but they include Interstate 10 (I-10) from the Coachella Valley to Blythe; Interstate 8 (I-8) from San Diego County to Yuma, Arizona; Highways 86 and 111 paralleling the Salton Sea south to the El Centro area; and Highway 78 from Brawley to Blythe.

Roads also directly impact wildlife through habitat loss and animal mortality and injury from vehicular collisions, especially to small rodents such as kangaroo rats and pocket

mice, as well as jackrabbits and reptiles and amphibians, which readily cross rural or two-lane paved roads and dirt roads. Roads may also influence wildlife movement patterns by creating physical barriers or filters to movement and fragmenting habitat (Meese et al. 2007; Webb et al. 2009). Many small desert animals do not or seldom cross four-lane roads (Pavlik 2008). Existing paved and dirt roads also provide takeoff points for both legal and illegal off-road activities, trash dumping, shooting, and vandalism that can damage the desert ecosystem.

6.3 Water Conveyance

In the Mojave Desert, water conveyance and storage primarily serves to sustain urban development, agriculture, and mining activities (Randall et al. 2010). Most of the water used in the Mojave Desert comes from the Colorado River Basin and Northern California. Owens Valley water was originally brought through the western Mojave Desert to the San Fernando Valley in 1913 via the Los Angeles Aqueduct. The California Aqueduct East Branch was completed in 1971 through the State Water Project (SWP), enabling the conveyance of Feather River water from Northern California to cities in the Western and South-Central Mojave Desert. Most of the water used by the Southern Nevada Water Authority (SNWA) comes from the Colorado River at Lake Mead. Groundwater withdrawals are also an important source of water for the Mojave Desert (Webb et al. 2009).

While outside sources of water, from Northern California, northern Nevada, and the Colorado River, are commonly used, these outside resources are utilized only after regional resources have been depleted or are close to depletion. Depletion of the local or regional water supply impact highly valued riparian areas and wildlife populations reliant upon these water sources (Webb et al. 2009). All of the major riparian systems in the Mojave Desert are threatened to some degree by water diversion and groundwater pumping. Even non-riparian vegetation communities can be negatively impacted when the water table drops below a certain threshold. In the Mojave Desert, water diversion is one of the five most commonly cited causes of species endangerment. In addition, aquifer contamination is a potential threat related to water use in the desert (Randall et al. 2010). In the Sonoran Desert portion of the Plan Area, water conveyance is primarily conducted by the IID, which diverts and transports approximately 3.1 million AF of Colorado River water to nine cities and nearly 500,000 acres of agricultural land in Imperial Valley (IID 2011). Water is conveyed from the Colorado River along the 82-mile All-American Canal that runs east to west along the United States–Mexico border and which distributes water to about 230 miles of main canals and 1,438 miles of lateral canals.

Water diversions and groundwater pumping may facilitate alterations that encourage the invasion of non-native plants into riparian areas. These activities reduce the availability of moisture to native obligate phreatophytes (deep-rooted plants that obtain water from a permanent ground supply), which require almost constant contact with free water compared to the non-native tamarisk (*Tamarix* spp.), which can withstand periods of drought (see discussion on non-native species in Section 6.9). Water diversions and groundwater can also result in soil salinization, which can inhibit the growth of native plants. Water management practices that create more stable hydrology also promote tamarisk invasion since young plants are less tolerant of repeated flooding than native cottonwood (*Populus fremontii*) and willows (*Salix* spp.). Higher abundance of non-native riparian species, such as tamarisk, can lead to reductions in the diversity and abundance of riparian-dependent wildlife, increased soil salinity, exacerbation of over-bank flooding and channel incision and channel erosion, increased frequency and magnitude of wildfire, and reduced forage availability and water access for wildlife and livestock (Dudley 2009).

6.4 Utilities and Infrastructure

Industrial-scale electrical power plants generate electricity that is transmitted through transmission lines that extend across the Mojave and Sonoran deserts to urban centers. Substantial energy development has occurred in the western Mojave Desert. For example, The USFWS identified 22 energy power plants constructed within or near the range of the Mohave ground squirrel alone in the western Mojave Desert region (76 FR 62214–62258).

Increased development of utility-scale electrical generation plants in the desert requires additional transmission lines to distribute the electricity generated. The construction, operation, and maintenance of these transmission lines and associated access roads and other infrastructure impact desert ecological processes by causing habitat loss, degradation, and fragmentation (Randall et al. 2010).

Transmission lines and energy generation facilities require construction of access roads that disrupt soils, uproot plants, and fragment habitat. Soil disturbance also facilitates the invasion of non-native plants, as discussed in more detail in Section 6.9. However, the narrow strips of utility corridors may require less time to recover from disturbance compared to areas that are more broadly disturbed given the proximity of seed sources and dispersers (Webb et al. 2009). Transmission lines can be associated with increased fire risk under certain conditions (Randall et al. 2010).

A number of other known and potential adverse effects of energy generation facilities, including solar, wind, and geothermal facilities, have been identified, including dust and dust suppression (e.g., chemical suppressants); noise; light pollution; altered

microclimates, topography, and drainage; pollution and hazardous materials; water consumption; and collisions with turbines and other facilities (e.g., towers) (BLM and DOE 2010; Cryan 2011; Hunt et al. 1998; Lovich and Ennen 2011).

Utilities have an impact on wildlife species in the desert as well. Transmission towers can serve as perching and nesting sites for common ravens, and provide ideal vantage points for hunting and resting sites to conserve energy. The towers facilitate their capacity to prey on newly hatched desert tortoises and other small animal species. Structures such as transmission lines, wind turbines, and power towers, also pose a direct threat to flying birds and bats from strikes and collisions. Routine maintenance and repair operations along transmission corridors can also result in collisions between wildlife and patrol and maintenance vehicles. Because many of these facilities are remote, utilities and infrastructure development can be accompanied by associated infrastructure and access roads that facilitate public access to otherwise remote and hard-to-reach areas.

6.5 Grazing

In the Mojave Desert, livestock grazing occurs both on privately owned land and on several large livestock allotments located on BLM and USFS lands. Grazing animals in the desert include cattle, sheep, horses, and feral burros (Randall et al. 2010). Grazing was introduced in the desert regions following the Gold Rush years in the mid-1800s and by the turn of the century, tens of thousands of cattle and sheep and smaller numbers of horses were grazing in the California deserts (Pavlik 2008). Livestock numbers peaked during World War II and then began declining. By 1968, public lands supported approximately 138,000 sheep and 25,000 cattle, and by 1980, these numbers had been reduced to about 60,000 sheep and 10,000 cattle (Pavlik 2008).

Direct impacts of grazing include removal and trampling of native vegetation and soil disturbances; heavy grazing can result in little or no vegetation (Randall et al. 2010; Webb et al. 2009). Unmanaged grazing can alter the plant cover, biomass, composition, structure, productivity, and succession of native vegetation communities, including introduction and facilitation of non-native species. Modification of native vegetation communities and soils in turn affects sensitive plants and terrestrial and aquatic wildlife species that depend on relatively undisturbed conditions.

Grazing can cause erosion and damage to sensitive soils or soil compaction, especially when concentrated near stock tanks or wells (Randall et al. 2010; Webb et al. 2009). Overgrazing can also destroy biological soil crusts, which undergo nitrogen fixation and act as important agents of nitrogen input into desert ecosystems. Therefore, destruction of biological soil crusts can negatively impact desert fertility and take hundreds of years to

recover (Webb et al. 2009). In addition, soil disturbance promotes invasion by non-native plants, which increases the risk of fire (Randall et al. 2010).

6.6 Mining

Some of the first non-Indian settlers in California's desert regions were miners in the 1800s. Steamboat trade increased along the Colorado River during the Gold Rush years in the 1860s and the first large influx of miners into the Mojave Desert occurred in the 1850s. The Hardrock Mining Law of 1872 essentially provided miners free rein over the extraction of minerals (Webb et al. 2009). Resources that have been extracted from the Mojave Desert, for example, include borates, talc, copper, lead, zinc, coal, calcite, tungsten, strontium, uranium, precious metals (e.g., gold and silver), gem-quality non-metals, and building materials (e.g., sand, gypsum, cinders, decorative rock, and gravel) (Randall et al. 2010). There are still many active mining operations and many more abandoned mines in the Plan Area (Shumway et al. 1980; BLM and DOE 2010).

Mining can have several negative impacts on desert ecosystems. Primarily, mining causes surface disturbances and results in damage to desert soils and the destruction of fragile soil biological crusts, which can cause erosion and negatively affect water and air quality. Strip and open pit mining are the most visibly destructive to terrestrial habitat. Mining access roads destroy and fragment habitat in a manner similar to transmission line access roads. Mining facilitates invasion of non-native plants with open-pit mines and abandoned material sites providing ideal disturbance conditions for invasion, such as altered soil morphology (Randall et al. 2010).

Mining can also impact local water resources because many mining operations require large amounts of water for processing. Water use can range into the millions of gallons per day, potentially resulting in groundwater overdraft. Gravel and sand mining can severely alter natural hydrology since these types of mining occur in desert washes, mountain foothills, and alluvial fans and alter the infiltration of water into groundwater aquifers (Randall et al. 2010).

6.7 Military Uses

The California desert regions support several military installations and training areas, including from north in the Mojave Desert to south in the Sonoran Desert: Naval Air Weapons Station, China Lake; National Training Center, Fort Irwin; Edwards Air Force Base, Edwards; Marine Corps Logistics Base, Barstow; Marine Corps Air Ground Combat Center, Twentynine Palms; portions of Bob Stump Training Complex; Chocolate Mountain

Aerial Gunnery Range; and Naval Air Facility, El Centro (OPR 2006). Department of Defense (DOD) lands cover approximately 2,935,641 acres of the Plan Area.

Military training activities include ground troop activities, tracked vehicles, bombing strikes, and other explosives. The resultant military training, maneuvers, and bombing practice can have impacts on desert ecosystem processes. The effects of the original maneuvers conducted almost 70 years ago are still visible as soil erosion, surface scarring, and vegetation removal (Pavlik 2008). Relocation of desert tortoise during the expansion of Fort Irwin resulted in high desert tortoise mortality and the site has fewer tortoises than adjacent monitoring areas (Pavlik 2008; Randall et al. 2010). Despite the impacts of military uses on desert ecosystems, they can also benefit the desert ecosystem by restricting public access and buffering military installations against encroaching developments (Randall et al. 2010).

6.8 Off-Highway Vehicle Uses

In the desert southwest, off-highway vehicle (OHV) recreation became increasing popular in recent decades (Brooks and Lair 2009). Prior to 1980, almost all of the 12.1 million acres of BLM land in the desert was open to various intensities of OHV use (Pavlik 2008). Under the California Desert Conservation Area (CDCA) Plan, BLM lands have been classified by the types and intensity of motorized vehicle use authorized for the area. BLM lands in the Plan Area are designated as “open,” “limited,” or “closed” for vehicle use. The first sanctioned Barstow-to-Vegas off-road race occurred in 1967, and by 1975 attracted more than 3,000 riders, after which BLM no longer issued a permit for the race due to the potential for extensive environmental damage. In California, the number of OHV users increased by 108% between 1985 and 2002. There are more than 500,000 registered OHVs in Southern California within a few hours’ drive of the desert regions (Pavlik 2008). Current uses range from localized casual recreation to highly organized, well-funded, competitive off-road racing traversing hundreds of miles of public land (Randall et al. 2010). Motor-dependent backcountry recreation in the Plan Area is also important to OHV users and organized groups; this involves OHV travel to more remote destinations or trailheads for a variety of outdoor recreation activities, such as dispersed camping, rock-hounding, visiting historical sites, hunting, fishing, equestrian uses, and day-touring. These opportunities generally exist in areas and routes of travel designated under the CDCA Plan as “limited” for vehicle use. OHV trails are dirt roads generally less than 4 meters (13 feet) wide that are typically not bladed, filled, or otherwise improved (Brooks and Lair 2009). Along unmaintained roads such as jeep trails, topsoil may be in place and emergent perennial shrubs and grasses may grow up within the roadbed (Brooks and Lair 2009).

OHV use is an important recreational use that affects desert ecosystem processes when considered collectively, especially where trails are dense and occupy a large portion of the landscape (Webb et al. 2009). Although many individual OHV trails may have low travel frequency, even minimal vehicular passes can cause significant surface disruption, including soil compaction, alteration of soil composition, and destruction of biological crusts and natural desert pavement (Webb et al. 2009; Randall et al. 2010). Disturbed soils can lead to greater wind and water erosion as well as facilitate the invasion of non-native plant species, which increase fire risk, especially since OHVs can emit sparks (a potential source of fire ignition). OHV use also affects the desert ecosystem by altering hydrology and water runoff patterns, vegetation, and wildlife movement, and contributes to habitat loss and fragmentation (Brooks and Lair 2009; Randall et al. 2010).

OHV use can directly impact wildlife species through mortality from OHV collisions and indirectly impact wildlife through noise and dust generation. The low-frequency noise emitted by OHVs may affect the central auditory system of species such as kangaroo rats that have evolved sensitive hearing to detect predators, potentially resulting in direct injury or indirectly by increased predation. Studies have found reduced density and biomass of reptiles, small mammals, and plants in OHV use areas (Randall et al. 2010). Even playas, which are generally devoid of vegetation and wildlife use except when flooded, are subject to damage by OHVs and other vehicles. OHV use on playas damage the eggs of crustaceans such as fairy shrimp (*Branchinecta* spp.) and tadpole shrimp (*Triops* spp.).

6.9 Non-Native and Other Invasive Species

As noted previously, many of the land uses and anthropogenic impacts promote the invasion of the desert native communities by non-native species through various mechanisms. Non-native plants have been recorded in the California deserts as early as 1735 based on the presence of red-stemmed filaree (*Erodium cicutarium*) in woodrat middens near Death Valley, but trained botanist John Frémont made no notes of weeds or other nondesert plants during his travels in the desert regions in 1844, indicating that non-native species were yet not prevalent at the time (Pavlik 2008). There are currently about 232 taxa (10%) in the California deserts that are non-native (Baldwin et al. 2002), of which, about 27 are considered to be noxious weeds (Pavlik 2008). The early proliferation of non-native species was associated with agriculture and grazing, introducing non-native species such as tumbleweed (*Amaranthus albus*), Russian thistle (*Salsola tragus*), goosefoot (*Chenopodium murale*), and annual beard grass (*Polypogon monspeliensis*) (Pavlik 2008). Cheatgrass (*Bromus tectorum*), a contaminant of wheat, was widespread in arid western lands by the 1930s (Pavlik 2008).

As discussed previously, several types of modern human activities and land uses in the desert regions can promote invasions of non-native species, including paved and dirt roads and OHV activities that disturb soils and create trails; access roads and edges around utilities around mines; military activities; and grazing. Common weeds and non-native grasses associated with paved and dirt roads, trails, and other linear disturbances in desert regions include Russian thistle, tumbleweed, Sahara mustard (*Brassica tournefortii*), London rocket (*Sisymbrium ireo*), tansy mustard (*Descurainia* spp.), short-pod mustard (*Hirschfeldia incana*), fiddleneck (*Amsinckia tessellata*), red-stemmed filaree, Mediterranean grass (*Schismus barbatus* and *S. arabicus*), red brome, and cheatgrass (in the Great Basin Desert) (Brooks and Lair 2009; Pavlik 2008). Sahara mustard, in particular, has become one of the most invasive species in the desert landscape (Holt and Barrows 2013). Invasive plant species are common in desert wetland and riparian communities; approximately 20% of the plant species in the Mojave River are non-native (Dudley 2009, Table 6.1). Most of the invasive species in Mojave Desert wetlands and riparian areas are low-growing herbaceous species, and include sweet clovers (*Melilotus* spp.), pepperweed (*Lepidium* spp.), dock (*Rumex* spp.), annual beard grass, sow thistle (*Sonchus* spp.), and Bermuda grass (*Cynodon dactylon*) (Dudley 2009).

The most pernicious and widespread invasive species in desert riparian systems is tamarisk (also called salt cedar), which invades arroyos and streambeds (Dudley 2009; Pavlik 2008). It is common along the Mojave and Amargosa rivers in the Mojave Desert (Dudley 2009; Pavlik 2008) and along the lower Colorado River (Pavlik 2008), as well as other scattered areas throughout the Plan Area. Tamarisk is extremely drought tolerant and has explosive reproduction, providing it a competitive advantage over many native riparian species, such as cottonwoods and willows.

Desert regions also support several non-native wildlife species that can degrade native habitats, compete for resources with native species, and increase predation pressure on native species. These include American bullfrog, a voracious omnivore known to prey on Amargosa pupfish and many other native species, house sparrow, European starling, which compete with native birds for nest cavities, house mouse, burros (*Equus asinus*), and horses (*E. caballus*) (Pavlik 2008).

Other species that are native to North America that were formerly absent from or uncommon in desert areas have increased in abundance in association with human activities and land uses, and thus are considered to be “invasive” species. Common ravens have had a substantial impact on small desert tortoises (USFWS 2008). Common ravens take advantage of transmission structures for nesting, perching, resting, and foraging. Ravens are also attracted to other human subsidies, such as garbage from landfills and trash containers; water from sewage ponds and municipal areas; and nesting sites on

billboards, bridges, and buildings (USFWS 2008). Coyotes, which prey on adult tortoises, also are attracted to landfill, where coyote populations can increase (USFWS 2008). Brown-headed cowbirds (*Molothrus ater*), which have increased in Southern California in association with grazing and other agricultural activities, parasitize the nests of endangered species nesting in the lower Colorado River and other riparian habitats in the Plan Area, including southwestern willow flycatcher and least Bell's vireo, as well as other neotropical migrants such as yellow warbler, although this species may be resistant to the demographic effects of brood parasitism (Heath 2008).

7 CONSERVATION AND MANAGEMENT FACTORS AND ISSUES

This section provides a summary of information gathered to date regarding landscape, natural communities, and species relationships for the 37 proposed Covered Species and 2 Planning Species. These relationships are presented in the context of key landscape issues, key ecological process issues, and potential environmental stressors and threats, and how they are related to the 37 proposed Covered Species and 2 Planning Species. Assembly and presentation of this information in the context of process, landscape and natural community issues, known or potential stressors/threats, and species relationships are a necessary foundation for development of biological goals and objectives and identification of avoidance and minimization measures, best management practices (BMPs), conservation actions, and mitigation measures for the preferred conservation strategy. Data and information will continue to be assembled for these factors for the 37 proposed Covered Species and 2 Planning Species.

This section summarizes key conservation factors for the proposed DRECP Covered and Planning Species by (1) natural communities; (2) landscape factors; (3) ecological processes; and (4) known or potential environmental stressors and threats. The main purpose of this discussion is to guide setting conservation goals and objectives at the appropriate landscape, natural community, and species levels, with acknowledgement that these levels are interrelated; i.e., landscape conservation goals would also provide for conservation of many natural communities and species. Where a landscape goal may not adequately meet a natural community or species goal, additional goals at these levels may be needed.

For **key landscape issues**, the main factors are the species' distribution (e.g., narrow range vs. broad) and the role of landscape connectivity in maintaining populations in the Plan Area. For each Covered and Planning Species, the key landscape issues are identified in terms of the distribution of the species in the Plan Area and the likely habitat connectivity issues. For example, Parish's daisy (*Erigeron parishii*) is endemic to carbonate substrates in the Big Bear/Holcomb Valley. From a landscape perspective, the main conservation issue is maintaining this endemic species within its restricted range. Connectivity for this species, if relevant, likely would operate at the sub-regional scale (i.e., a limited set of definable local habitat connections such as across pebble plain archipelagos for the Parish's daisy). For some species that may have very limited movement, such as California black rail (*Laterallus jamaicensis coturniculus*), habitat connectivity may operate at a local scale between contiguous suitable habitat patches. In contrast, golden eagle (*Aquila chrysaetos*) is widely distributed and highly mobile and able to access widely disjunct habitat areas. The main "connectivity" issue for this species is maintaining safe migration routes across a broad landscape. This

connectivity issue applies to several of the highly mobile migratory bird species and bats. For bighorn sheep, the habitat connectivity issues are regional (i.e., intermountain) and relate both to suitable habitat and physical obstacles such as roads, canals, and fencing.

For **key ecological process issues**, the ecological processes important for maintaining suitable habitat for Covered and Planning Species are identified (e.g., aeolian processes for dune species, hydrology for wetland species, precipitation for plants, or special microhabitat factors such as soil structure and nest cavities). For plants, the pollinators and/or dispersers are identified where possible because stressors or threats at the ecological-process scale may affect pollinators and dispersers in a way that could adversely affect the Covered and Planning Species. For example, climate change may alter the availability of prey for western yellow-billed cuckoo (*Coccyzus americanus occidentalis)* by decoupling the predator–prey relationship. Based on common sets of ecological processes for the Covered and Planning Species, goals and objectives can be identified at the ecological-process scale that address several of the species (e.g., sand transport and maintaining hydrology).

Potential environmental stressors and threats are identified based on a review of the literature, as summarized in the Covered and Planning Species profiles (Appendix B). Stressors or threats that are known or potentially related to ecological processes or landscape issues are identified. For example, key ecological processes for desert tortoise include soil and forage conditions and burrow temperatures that affect incubation temperature and sex determination. Grazing, recreation, other anthropogenic activities (including military land use), invasive plants, wildfire, and climate change are all related to maintaining ecological processes. "Non-permanent" activities that disturb soils and burrow habitats (e.g., through direct crushing or compaction) include grazing, recreation, and military operations. Factors that affect forage quality include grazing, invasive plants, wildfires, and climate change (note that these factors are not mutually exclusive but rather may be interactive). In addition to impacts on forage quality, climate change may also affect burrow temperatures and alter sex ratios. Desert tortoise is also sensitive to regional-scale habitat fragmentation. It should be noted that the potential adverse effect of habitat fragmentation is only specifically listed where it appears in the literature as a potential threat to a species. As a general principle of conservation biology, it can be assumed that habitat fragmentation has an adverse effect on most species, except perhaps highly vagile habitat generalists.

7.1 Natural Communities

7.1.1 California Forest and Woodland Communities

Table 7-1 lists key landscape and ecological processes, as well as ecological stressors and forest and woodland-associated species. The landscape issues include maintaining habitats

for seasonal migrations (e.g., western red bat). As discussed in Section 4.2.1, California forest and woodland communities comprise only approximately 0.4% of the Plan Area. These landscape and ecological processes are mainly affected by stressors such as logging, wildfires, and climate change (i.e., drought and drought-related diseases such as bark beetle infestations). Covered and Planning Species associated with California forests and woodlands are listed in Table 7-1.

7.1.2 Chaparral and Coastal Scrub Communities

Table 7-1 lists the key landscape and ecological processes, as well as ecological stressors and chaparral and coastal scrub-associated species. Landscape issues primarily relate to sub-regional habitat connectivity that allow for movement and dispersal of species that are relatively sedentary (i.e., species that do not make long-distance dispersal or migration movements between disjunct regions) and/or have small home ranges. As discussed in Section 4.2.2, the Plan Area includes several chaparral and coastal scrub vegetation types. These chaparral and coastal scrub communities depend on landscape-level habitat integrity to ensure that key ecological processes are maintained (e.g., soils, forage quality, precipitation). These landscape and ecological processes are potentially affected by the stressors identified in Table 7-1, including stressors that affect chaparral and coastal scrub vegetation structure, composition, successions, and conversions to other types (e.g., invasive plants, wildfire, fire suppression, flooding, grazing). Covered and Planning Species associated with chaparral and coastal scrub communities are listed in Table 7-1.

7.1.3 Desert Conifer Woodland Communities

Table 7-1 lists key landscape and ecological processes, as well as ecological stressors and woodland-associated species. The landscape issues include sub-regional habitat connectivity. As discussed in Section 4.2.3, the desert conifer woodland communities comprise 1.3% of the Plan Area. These woodlands depend on landscape-level habitat integrity to ensure that key ecological processes such as hydrology are maintained. These landscape and ecological processes are potentially affected by the stressors identified in Table 7-1 (e.g., logging, habitat loss and degradation, wildfire, recreation, grazing, invasive plants, climate change, competition with other plants). Covered and Planning Species associated with desert conifer woodlands are listed in Table 7-1.

7.1.4 Desert Outcrop and Badlands

Table 7-1 lists key landscape and ecological processes, as well as ecological stressors and species associated with desert outcrop and badlands. The landscape issues include regional and local habitat connectivity. As discussed in Section 4.2.4, approximately 8.3% of the Plan

Area is covered by North American warm desert bedrock cliff and outcrop. These rocky, barren, and unvegetated areas depend on sub-regional habitat integrity to ensure that soil integrity is maintained (e.g., texture and openness), particularly for plant species. These landscape and ecological processes are potentially affected by the stressors identified in Table 7-1, including stressors that affect soil integrity and structure (e.g., habitat loss and fragmentation, climate change, invasive species, wildfire, recreation, mining, grazing, and other human activities). Covered and Planning Species associated with desert outcrop and badlands are listed in Table 7-1.

7.1.5 Desert Scrub Communities

Table 7-1 lists the key landscape and ecological processes, as well as ecological stressors and desert scrub-associated species. Landscape issues primarily relate to sub-regional habitat connectivity that allow for movement and dispersal of species that are relatively sedentary (i.e., species that do not make long-distance dispersal or migration movements between disjunct regions) and/or have small home ranges. As discussed in Section 4.2.5, desert scrub communities are diverse and comprise the majority of the Plan Area. These desert scrub communities depend on landscape-level habitat integrity to ensure that key ecological processes are maintained (e.g., soils, forage quality, precipitation, cactus stands). These landscape and ecological processes are potentially affected by the stressors identified in Table 7-1, including stressors that affect desert scrub vegetation structure, composition, successions, and conversions to other types (e.g., invasive plants, wildfire, fire suppression, flooding, grazing). Covered and Planning Species associated with desert scrub communities are listed in Table 7-1.

7.1.6 Dune Communities

Table 7-1 lists key landscape and ecological processes, as well as ecological stressors and dune-associated species. The landscape issues include regional and local habitat connectivity. As discussed in Sections 2.1.3 and 4.2.6, the Plan Area includes a large number of distinct dune systems. These dunes depend on landscape-level habitat integrity to ensure that aeolian processes are maintained (e.g., upwind sand sources and sand transport corridors). Local connectivity within the dune systems are also important to maintain their integrity and function as a dynamic system, and to ensure dispersal of plant and wildlife species and accommodate population expansions and contractions related to aeolian processes, stabilization, pollinators, etc. These landscape and ecological processes are potentially affected by the stressors identified in Table 7-1, including stressors that affect sand transport and deposition (e.g., physical obstacles, conversion of sand sources, other soil disturbances such as grazing and off-highway vehicles (OHVs), non-native plants

that may stabilize soils, and climate change that may bring about hydrological alterations). Covered and Planning Species associated with dunes are listed in Table 7-1.

7.1.7 Grassland Communities

Table 7-1 lists key landscape and ecological processes, as well as ecological stressors and species associated with grasslands. Landscape issues primarily relate to sub-regional habitat connectivity that allow for movement and dispersal of sedentary, low-mobility species. Some species associated with grasslands (e.g., burrowing owl, golden eagle) are highly mobile and do not depend on regional-scale habitat connectivity. As discussed in Section 4.2.7, the Plan Area includes a small amount of grassland communities (approximately 1.1%), primarily consisting of California annual and perennial grassland. Grasslands depend on landscape-level habitat integrity to ensure that soil integrity is maintained (e.g., texture, openness, burrows), which is important for both grassland-associated plant and wildlife species. These landscape and ecological processes are potentially affected by the stressors identified in Table 7-1, including stressors that affect soil characteristics or grassland species composition or structure (e.g., habitat loss and fragmentation, climate change, invasive plants, wildfire, grazing, trampling, recreation, other human activities, pesticides, and contaminants). Covered and Planning Species associated with grasslands are listed in Table 7-1.

7.1.8 Riparian Community

Table 7-1 lists key landscape and ecological processes, as well as ecological stressors and riparian-associated species. The landscape issues include regional and local habitat connectivity. As discussed in Sections 2.1.4 and 4.2.8, the Plan Area is generally characterized by insubstantial surface waters and flows are extremely scarce and unpredictable. However, major hydrologic features in the Plan Area, including the lower Colorado River, Salton Sea, Owens River, Owens Lake, Mojave River, and Amargosa River, as well as other minor features described in Section 2.1.4, contribute to the development and maintenance of riparian communities in the Plan Area. Riparian communities depend on landscape-level habitat integrity to ensure that hydrologic processes are maintained (e.g., surface and groundwater hydrology, geomorphology and sediment transport, soils saturation and structure, flooding regimes, and precipitation). Local connectivity within riparian areas is also important to maintain habitat connectivity and adequate patch sizes for species (e.g., minimum territories for nesting birds). These landscape and ecological processes are potentially affected by the stressors identified in Table 7-1, including stressors that affect natural hydrological regimes and water quality (e.g., hydrological and geomorphological alterations, invasive plant species, pesticides and contaminants, wildfire). Covered and Planning Species associated with riparian communities are listed in Table 7-1.

7.1.9 Wetland Communities

Table 7-1 lists key landscape and ecological processes, as well as ecological stressors and wetlands-associated species. The landscape issues include regional and local habitat connectivity. As discussed in Section 2.1.4.9, the Plan Area includes approximately 606,071 acres of wetlands identified by the NWI in the Plan Area, including freshwater emergent wetland, freshwater forested/shrub wetland, freshwater pond, as well as lake, riverine, and other wetland types. As discussed in Section 4.2.9, wetland communities cover approximately 4.5% of the Plan Area on the land cover map (Figure 4-1) and include several vegetation types as well as open water, playas, and lacustrine areas. Wetlands depend on landscape-level habitat integrity to ensure that hydrologic processes are maintained (e.g., surface and groundwater hydrology). Local connectivity within wetlands is also important to support habitat for resident wetland species. Sub-regional habitat connectivity is important to provide stopover habitats for migrants and winter residents, but wetland areas do not have to be connected for many migrating avian species. Landscape and ecological processes are potentially affected by the stressors identified in Table 7-1, including those affecting natural hydrologic regimes and water quality (e.g., habitat loss and degradation, pesticides and organochlorines, climate change, invasive plants). Covered and Planning Species associated with wetlands are listed in Table 7-1.

7.1.10 Other Land Covers

7.1.10.1 Agriculture

Table 7-1 lists key landscape and ecological processes, as well as ecological stressors and species associated with agriculture. As discussed in Section 4.2.10.1, approximately 3.2% of the Plan Area consists of agriculture, which is concentrated in three main regions: the Imperial Valley south of the Salton Sea; the Palo Verde Valley in the Blythe region; and the Antelope Valley in the western Mojave Desert. The quality of habitat provided by agriculture depends on appropriate hydrology/irrigation (including seasonal variation) and prey availability. These factors are potentially affected by the stressors identified in Table 7-1, including stressors that affect water quality and prey availability (e.g., pesticides and contaminants, reduced prey availability). Covered and Planning Species associated with agriculture are listed in Table 7-1.

Table 7-2 summarizes the same key conservation factors and issues shown in Table 7-1 but is organized by Covered and Planning Species.

Table 7-1
Summary of Conservation and Management Factors for
DRECP Covered and Planning Species Based on Natural Communities

Natural Community	Vegetation Types	Key Landscape Issues	Key Ecological Processes	Ecological Stressors	Associated Species
California Forest and Woodlands	• California broadleaf forest and woodland • Californian evergreen coniferous forest and woodland • California montane conifer forest	• Seasonal migration	• Precipitation • Hydrology	• Logging • Habitat loss and degradation • Wildfire • Recreation (OHVs) • Grazing • Invasive plants • Climate change • Competition with other plants	• Bakersfield cactus • Bighorn sheep • California condor • Golden eagle • Mojave tarplant • Pallid bat • Parish's daisy • Tehachapi slender salamander • Townsend's big -eared bat
Chaparral and Coastal Scrub	• California mesic chaparral • California pre-montane chaparral • California xeric chaparral • Central and south coastal California seral scrub • Central and southern Californian coastal sage scrub • Western Mojave	• Sub-regional habitat connectivity	• Bare areas with little soil • Soil conditions related to burrows and diggability • Forage quality • Precipitation	• Habitat loss and fragmentation • Invasive plants • Climate change • Wildfire • Fire suppression • Flooding • Grazing • Trampling (wild horses, burros) • Recreation (OHVs, vehicle parking) • Other human activities (dumping, military	• Alkali mariposa-lily • Bighorn sheep • Burrowing owl • California condor • California leaf-nosed bat • Golden eagle • Mojave tarplant • Pallid bat • Townsend's big-eared bat

Table 7-1
Summary of Conservation and Management Factors for
DRECP Covered and Planning Species Based on Natural Communities

Natural Community	Vegetation Types	Key Landscape Issues	Key Ecological Processes	Ecological Stressors	Associated Species
	and western Sonoran Desert borderland chaparral			activities) • Competition for nest cavities • Competition with other plants	
Desert Conifer Woodlands	• Great Basin pinyon - juniper woodland	• Sub-regional habitat connectivity	• Precipitation • Hydrology	• Logging • Habitat loss and degradation • Wildfire • Recreation (OHVs) • Grazing • Invasive plants • Climate change • Competition with other plants	• Bendire's thrasher • Golden eagle • Parish's daisy • Bighorn sheep • Mojave tarplant • Pallid bat
Desert Outcrop and Badlands	• North American warm desert bedrock cliff and outcrop	• Sub-regional habitat connectivity	• Soil integrity (texture, openness)	• Habitat loss and fragmentation • Climate change • Invasive species • Wildfire • Recreation (OHVs) • Mining • Other human activities (dumping)	• Burrowing owl • California condor • Golden eagle • Pallid bat

Table 7-1
Summary of Conservation and Management Factors for DRECP Covered and Planning Species Based on Natural Communities

Natural Community	Vegetation Types	Key Landscape Issues	Key Ecological Processes	Ecological Stressors	Associated Species
Desert Scrub	• Arizonan upland Sonoran desert scrub • Intermontane deep or well-drained soil scrub • Intermontane seral shrubland • Inter-mountain dry shrubland and grassland • Inter-mountain big sagebrush shrubland and steppe • Lower bajada and fan Mojavean-Sonoran desert scrub • Mojave and Great Basin upper bajada and toeslope • Shadscale-saltbush cool	• Sub-regional habitat connectivity	• Bare areas with little soil • Soil conditions related to burrows and diggability • Sandy soils on alluvial fans and basins • Forage quality • Precipitation • Cactus stands (primarily large columnar cacti)	• Habitat loss and fragmentation • Invasive plants • Climate change • Wildfire • Fire suppression • Flooding • Grazing • Trampling (wild horses, burros) • Recreation (OHVs, vehicle parking) • Other human activities (dumping, military activities) • Competition for nest cavities • Competition with other plants	• Agassiz's desert tortoise • Alkali mariposa-lily • Bakersfield cactus • Barstow woolly sunflower • Bendire's thrasher • Bighorn sheep • Burro deer[1] • Burrowing owl • California condor • California leaf-nosed bat • Desert cymopterus • Desert kit fox[1] • Flat-tailed horned lizard • Gila woodpecker • Golden eagle • Little San Bernardino Mountains linanthus • Mohave ground squirrel • Mojave fringe-toed lizard • Mojave monkeyflower • Mojave tarplant • Pallid bat • Parish's daisy • Swainson's hawk

Table 7-1
Summary of Conservation and Management Factors for
DRECP Covered and Planning Species Based on Natural Communities

Natural Community	Vegetation Types	Key Landscape Issues	Key Ecological Processes	Ecological Stressors	Associated Species
	semi-desert scrub • Southern Great Basin semi-desert grassland				• Triple-ribbed milk-vetch
Dunes	• North American warm desert dunes and sand flats	• Sub-regional habitat connectivity • Local habitat connectivity	• Aeolian processes • Accumulated sand microhabitat • Stabilized or partially stabilized sand dunes • Precipitation • Pollination	• Sand transport alteration • Grazing • Recreation (OHVs and associated development, trampling) • Invasive plants • Climate change, hydrological alterations	• Burro deer[1] • Desert kit fox[1] • Flat-tailed horned lizard • Little San Bernardino Mountains linanthus • Mojave fringe-toed lizard • Pallid bat •
Grasslands	• California Annual and Perennial Grassland • California annual forb/grass vegetation	• Sub-regional habitat connectivity	• Soil integrity (texture, openness, burrows)	• Habitat loss and fragmentation • Climate change • Invasive plants • Wildfire • Grazing • Trampling (wild horses) • Recreation (OHVs) • Other human activities	• Agassiz's desert tortoise • Bakersfield cactus • Bendire's thrasher • Bighorn sheep • Burrowing owl • California condor • Golden eagle • Mountain plover • Pallid bat

Table 7-1
Summary of Conservation and Management Factors for DRECP Covered and Planning Species Based on Natural Communities

Natural Community	Vegetation Types	Key Landscape Issues	Key Ecological Processes	Ecological Stressors	Associated Species
				(dumping) • Pesticides and contaminants	• Swainson's hawk • Tricolored blackbird
Riparian	• Madrean warm semi-desert wash woodland/ scrub • Mojavean semi-desert wash scrub • Riverine • Sonoran-Coloradan semi-desert wash woodland/scrub • Southwestern North American riparian evergreen and deciduous woodland • Southwestern North American riparian/wash scrub	• Local habitat connectivity (within stream) • Sub-regional habitat connectivity (stopover habitats for migrants and sub-regional dispersers)	• Surface and ground water hydrology • Geomorphology and sediment transport (including banks habitats) • Saturated soils (along creeks, swales, and intermittent creeks) • Soil structure • Natural flooding regimes • Water quality • Prey base and availability • Nest cavities • Old growth xeric woodlands • Precipitation • Pollination	• Habitat loss and degradation • Hydrological and geomorphological alterations (dams (including beaver dams on Mojave River), channelization, diversions) • Invasive plant species (tamarisk, giant reed, ice plant, pampas grass) • Pesticides and contaminants (water quality and prey impacts) • Climate change • Grazing • Recreation (OHVs, fishing, camping, waterplay)	• Bakersfield cactus • Bighorn sheep • Burro deer[1] • California black rail • California leaf-nosed bat • Desert kit fox[1] • Desert pupfish • Gila woodpecker • Least Bell's vireo • Little San Bernardino Mountains linanthus • Mohave tui chub • Mojave tarplant • Owens pupfish • Owens tui chub • Swainson's hawk • Tehachapi slender salamander • Townsend's big-eared bat • Tricolored blackbird • Western yellow-billed

Table 7-1
Summary of Conservation and Management Factors for DRECP Covered and Planning Species Based on Natural Communities

Natural Community	Vegetation Types	Key Landscape Issues	Key Ecological Processes	Ecological Stressors	Associated Species
				• Mining (sand, gravel and recreational gold mining) • Competition for nest cavities • Wildfire • Meadow succession to uplands • Competition with upland plants	cuckoo • Willow flycatcher (including southwestern) • Yuma clapper rail
Wetlands	• Arid west freshwater emergent marsh • Californian warm temperate marsh/seep • Intermountain Basins alkaline-saline shrub wetland • North American warm desert alkaline scrub and herb playa and wet flat	• Local habitat connectivity for residents • Sub-regional habitat connectivity (stopover habitats for migrants and winter residents)	• Surface and ground water hydrology • Daily and season water fluctuations • Water quality	• Habitat loss and degradation • Pesticides and organochlorines • Climate change • Invasive plants	• Alkali mariposa-lily • Barstow woolly sunflower • California black rail • Desert cymopterus • Desert kit fox[1] • Desert pupfish • Greater sandhill crane • Mohave tui chub • Owens pupfish • Owens tui chub • Owens Valley checkerbloom • Pallid bat • Tricolored blackbird

Table 7-1
Summary of Conservation and Management Factors for
DRECP Covered and Planning Species Based on Natural Communities

Natural Community	Vegetation Types	Key Landscape Issues	Key Ecological Processes	Ecological Stressors	Associated Species
	• Open water • Playa • Southwestern North American alkali marsh/seep vegetation • Southwestern North American salt basin and high marsh • Lacustrine				• Yuma clapper rail
Agriculture	• Agriculture	—	• Hydrology/irrigation • Prey availability	• Pesticides and other contaminants • Reduced prey availability	• Burrowing owl • Greater sandhill crane • Mountain plover • Pallid bat • Swainson's hawk • Tricolored blackbird

Notes:
[1] Planning Species (no take authorization required); includes burro deer and desert kit fox.

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
Covered Species				
Amphibians/Reptiles				
Agassiz's desert tortoise	• Desert scrub • Grasslands	• Widespread throughout Plan Area • Sub-regional and regional habitat connectivity throughout range in Plan Area • Movement affected by incompatible land uses and available refuge (mainly suitable burrow sites)	• Soil conditions (soil diggability) suitable for burrows • Forage quality • Temperature and reproduction	• Habitat loss and fragmentation (development and agriculture)[3] • Predation (ravens, dogs, coyotes) • Disease • Grazing[2] • Recreation (OHVs)[2] • Other human activities (military activities, collecting, trash and garbage) • Wildfires[2] • Invasive plants[2] • Climate change[2]
Flat-tailed horned lizard	• Dunes • Desert scrub	• Endemic to southeastern California within three regional populations (Coachella Valley; the west side of the Salton Sea/Imperial Valley; and the east side of the Imperial Valley) • Sub-regional habitat connectivity (populations sub-divided by I-8 and I-10)	• Stabilized sand dunes (species tends to avoid active and unstable wind-blown dunes)	• Habitat loss and/or degradation (agriculture, urban, highways, canals, railroads, military activities, utilities, and geothermal, oil, gas, and wind energy)[2] • Recreation (OHVs)[2] • Predation • Mining (mineral extraction) • Invasive plants[2] • Wildfire[2] • Pesticides and contaminants • Grazing (cattle)[2]

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
Mojave fringe-toed lizard	• Dunes • Desert scrub	• Restricted to deposits of loose sand; as a result its distribution is discontinuous throughout its range • Endemic to the Mojave and Sonoran deserts of Southern California and western Arizona	• Predation • Rodent burrows for protection from predators and thermal protection • Potentially competition for food with the zebra-tailed lizard • Sand movement	• OHVs • Disruption of the natural movement of sand caused by roads, windbreaks, and other man-made alterations • Habitat loss caused by urban development
Tehachapi slender salamander	• Riparian • California forest and woodlands	• Endemic to two distinct population segments: Caliente Creek drainage and Tehachapi Mountains • Local habitat connectivity within each distinct population (the two distinct population segments are geographically isolated)	• Talus and rocky slopes and moist habitats • Precipitation	• Climate change (especially prolonged drought)[2] • Development and road construction • Mining • Grazing[2] • Flood control projects[2] • Feral pigs[2]

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
Birds				
Bendire's thrasher	• Desert conifer woodlands • Desert scrub • Grasslands	• Highly mobile/able to access disjunct nesting and foraging habitats • Migration and dispersal routes	• None identified in literature	• Habitat loss and/or degradation[2] • Habitat conversion (urban development, agriculture, military operations) • Grazing[2] • Recreation (OHVs) [2] • Cowbird parasitism • Competition with curve-billed thrashers (*Toxostoma curvirostre*)and northern mockingbirds (*Mimus polyglottos*)
Burrowing owl	• Grasslands • Chaparral and coastal scrub • Desert scrub • Desert outcrop and badlands • Agriculture • Developed and disturbed areas	• Highly mobile/able to access disjunct nesting and foraging habitats • Migration and dispersal routes	• Suitable burrow sites (e.g., ground squirrel burrows) and prey	• Habitat conversion (urban and non-compatible agriculture, flood control) • Collisions (vehicles, wind turbines) • Pesticides and other contaminants • Invasive plants[2] • Climate change[2] • Rodent controls (especially ground squirrels) • Predation by dogs and cats
California black rail	• Wetlands • Riparian	• Local habitat connectivity (including uplands and open water) between riparian marshes and wet	• Marsh and wet meadow with surface water or high ground water	• Habitat loss and degradation (marsh habitat loss from control of seeps along irrigation canals) [2] • Hydrological alteration (surface and

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
		meadows (movement by running or short distance swimming) • Potential dispersal between disjunct habitat, but undocumented	levels and low daily water fluctuations	subsurface hydrology, including daily fluctuations) [2] • Climate change[2] • Invasive plants (tamarisk) [2] • Predation (non-native rats, cats, and red fox)
California condor	• Chaparral and coastal scrub • Desert scrub • Grasslands • California forest and woodlands • Desert outcrop and badlands	• Highly mobile/able to access disjunct foraging, nesting, and roosting areas • Traditional flight corridors (?)	• None identified in literature	• Contaminants (lead contamination of food resources, ingestion of microtrash and other contaminants such as antifreeze) • Collisions and electrocutions (power lines, towers, and other tall structures) • Other human activities (disturbances of nesting and historic roosting areas, attraction to human activities due to habituation)
Gila woodpecker	• Desert scrub • Riparian	• Restricted to lower Colorado River and Brawley areas • Capable of short-distance seasonal movements (non-migratory) • Sub-regional habitat connectivity	• Riparian woodlands, old growth xeric woodlands, and uplands with large, columnar cacti • Hydrology	• Habitat loss and/or degradation (agriculture, urban, development, water diversions) [2] • Competition (European starlings) [2] • Invasive plants (tamarisk) [2] • Wildfires[2] • Climate change[2]
Golden eagle	• California forest and	• Highly mobile/able to access disjunct foraging,	• None identified in literature	• Human activities (disturbance of nest sites) • Collisions and/or electrocutions (towers,

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
	woodlands • Desert conifer woodlands • Chaparral and coastal scrub • Desert scrub • Grasslands • Desert outcrop and badlands	nesting, and roosting areas • Seasonal migration patterns		power lines, wind turbines, and other structures and vehicles) • Contaminants (lead contamination of prey) • Wildfires (impacts on prey densities)
Greater sandhill crane	• Wetlands • Agriculture	• Sandhill cranes are winter visitors to the Plan Area at the Central Valley and the lower Colorado River Valley.	• Hydrology • Suitable roost sites	• Disturbance from farm activities and hunting • Collision with power lines • Habitat degradation and destruction • Shortage of good roosting sites near foraging areas with grain fields • Lack of management and control over agricultural crops that provide winter foraging • Destruction of roost sites by past and proposed dredging and channelization projects along the lower Colorado River • Conversion of croplands from grain to crops that do not provide good foraging for cranes
Least bell's vireo	• Riparian	• Highly mobile/able to access disjunct resource areas	• Hydrology (surface and ground water) • Geomorphology	• Habitat loss and/or degradation[2] • Hydrological and geomorphological

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
		• Migration routes	(e.g., sediment transport and deposition) • Natural flood disturbance regimes	alterations[2] • Invasive plants (tamarisk, giant reed, pampas grass)[2] • Grazing[2] • Recreation (OHVs)[2] • Climate change[2] • Cowbird parasitism • Predation (Argentine ants, domestic and feral cats, and other mesopredators)
Mountain plover	• Grasslands • Agriculture	• Sub-regional habitat connectivity	• Soil integrity (texture, openness, burrows) • Hydrology/irrigation • Prey availability	• Habitat loss and/or degradation[2] • Insecticides/pesticides • Farm equipment mortalities • Predation (birds, mammals, reptiles) • Extreme weather conditions • Hunting (while in flocks; not a current conservation concern)
Swainson's hawk	• Grasslands • Riparian • Agriculture • Desert scrub	• Highly mobile/able to access disjunct foraging habitats and nesting habitat in Antelope Valley • Migration routes	• Hydrology/riparian systems	• Nesting and foraging habitat conversion • Insecticides/pesticides • Wildfire[2] • Climate change[2] • Recreation (OHVs)[2] • Human disturbances • Interactions/competition with ravens

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
Tricolored blackbird	• Riparian • Wetlands • Agriculture • Grasslands	• Largely endemic to California, more than 90% of the population occurs in the state with more than 75% of the breeding population found in the Central Valley in any given year	• Predation	• Loss and degradation of habitat as a result of human activities • Agricultural expansion and operations (i.e., harvesting and plowing fields) • Predation • Poisons and contaminants
Western yellow-billed cuckoo	• Riparian	• Highly mobile/able to access disjunct nesting habitat • Migration routes	• Large, contiguous blocks of dense riparian habitat • Hydrology	• Nesting habitat loss and/or degradation (agriculture, urban) [2] • Hydrological alteration (groundwater pumping) [2] • Invasive plants (tamarisk) [2] • Pesticides • Collisions with windows • Climate change (including decoupling of predator–prey relationships) [2]
Willow flycatcher (including southwestern)	• Riparian	• Highly mobile/able to access disjunct nesting and foraging habitats • Migration routes	• Hydrology (surface and ground water)	• Habitat loss and fragmentation2 • Altered hydrology and geomorphology (dams and reservoirs, water diversion and groundwater pumping, channelization, flood control) [2] • Invasive plants (tamarisk, giant reed) [2] • Wildfire[2] • Grazing[2]

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
				• Climate change[2] • Cowbird parasitism
Yuma clapper rail	• Riparian • Wetlands	• Primarily limited to lower Colorado River and Salton Sea in Plan Area, with potential disjunct occurrences at Harper Dry Lake and Ash Meadows National Wildlife Refuge • Sub-regional habitat connectivity • Migration routes(?); migratory activity is unclear	• Hydrology (surface and ground water) • Seasonal flooding/scouring • Timing of prey availability (crayfish)	• Habitat loss and modification (damming, channelization, and bank stabilization) [2] • Hydrological alteration (e.g., fluctuating water levels) [2] • Mesopredators (e.g., raccoon) • Contaminants (e.g., selenium)
Fish				
Desert pupfish	• Wetlands • Riparian (shallow water of desert springs, small streams, and marshes)	• Occurs in desert springs, marshes, and tributary streams of the lower Gila and Colorado River drainages in Arizona, California, and Mexico	• Hydrology • Predation, competition, and behavioral interference from non-native fish and invasive snails • Natural weather patterns influence	• Introduction of exotic fish species and invasive snails • Modifications to the water conveyance facilities used for irrigating and draining agricultural lands • Application of agricultural pesticides • Dewatering of some natural spring habitats by groundwater pumping

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
			cycles of expansion and contraction	
Mohave tui chub	• Wetlands • Riparian (Lacustrine ponds/pools)	• Restricted to refugia at China Lake Naval Air Weapons Station, Camp Cady, the Lewis Center, Soda Springs, and Morning Star Mine	• Hydrology • Water quality and quantity • Adaptation to lacustrine conditions rather than riverine • Tapeworms • Predation, competition, and habitat alteration from non-native plants and wildlife	• The present threatened destruction, modification, or curtailment of its habitat or range • Other natural or man-made factors affecting its continued existence (hybridization, introduction of non-native or transplanted species, predation, or competition) • Overdraft of Mojave River • A parasitic Asian tapeworm was found in Lake Tuendae • Non-native plant and wildlife species • Inadequacy of existing regulatory mechanisms
Owens pupfish	• Wetlands (warm, clear, shallow aquatic habitat) • Riparian	• Restricted to the Owens Valley portion of the Owens River in Mono and Inyo counties, California and spring outflows on the periphery of Owens Lake • Small, isolated populations	• Predation and competition from non-native species • Hydrology • Habitat alteration from emergent vegetation	• Non-native predators • Habitat modification for water diversions that altered Owens River flows • Cattail encroachment and other emergent vegetation • Extinction from stochastic (random) demographic, genetic, and catastrophic environmental events because populations are small and isolated • Groundwater pumping

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
Owens tui chub	• Wetlands (low-velocity waters) • Riparian	• Endemic to the Owens Basin (Owens Valley, Round Valley, and Long Valley) of Inyo and Mono counties, California • Small, isolated populations	• Predation and competition from, and hybridization with, non-native aquatic predators and other tui chub subspecies and hybrids • Requires aquatic vegetation and gravel substrates for spawning • Hydrology and water quality • Alteration of aquatic habitat by invasive emergent plants • Disease	• Extensive habitat destruction and modification • Invasive emergent plants that alter aquatic habitat • Non-native invasive predators • Poor water quality • Inappropriate water quantity (including overdrafting of the aquifer in the Owens Valley Groundwater Basin area) • Disease • Inadequacy of existing regulatory mechanisms • Vulnerability and loss of genetic diversity resulting from small isolated populations
Mammals				
Bighorn sheep	• Grasslands • Chaparral and coastal scrub • Desert scrub • Riparian • Desert conifer	• Relatively high mobility between mountain ranges • Inter-mountain connectivity for dispersal • Contiguous habitat for	• Water resources near escape terrain to support reproduction • Available nutritious forage to support	• Habitat loss and/or degradation[2] • Climate change (primarily drought, which reduces available water resources and nutritious forage during reproduction)[2] • Invasive plants (tamarisk)[2] • Disease

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
	woodlands • California forest and woodlands	seasonal movements • Movement limited by manmade physical barriers (e.g., roads, canals, fencing, incompatible land uses) and water resources	reproduction	• Development (fencing, aboveground canals, and highways and freeways that obstruct movement)[3] • Other human activities (OHVs, noise, aircraft, and pets) • Predation (mountain lions, coyotes, and bobcats)
California leaf-nosed bat	• Mines and caves • Riparian • Chaparral and coastal scrub • Desert scrub	• In California, the California leaf-nosed bat occurs in the desert regions of eastern San Bernardino (i.e., excluding the western Mojave region), Riverside, and San Diego counties and all of Imperial County • Desert riparian communities are very spatially limited resources that are used by a large number of bat species	• Inter-specific competition • Management of desert riparian communities, including hydrology and species composition, is important for maintaining a diverse bat community	• Disturbances of roost sites due to human entrance, mine closures, and mine reactivation • Loss and degradation of desert riparian habitats • Development of golf courses and residential housing • Pesticides • Wind energy facilities
Mohave ground squirrel	• Desert scrub	• Endemic to Western Mojave • Sub-regional connectivity, including dispersal	• None identified in literature	• Habitat loss and fragmentation (urban, agriculture, military, energy, and transportation)[3] • Recreation (OHVs)[2]

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
		habitat		• Grazing (cattle and sheep) [2] • Invasive plants[2] • Climate change (especially prolonged drought) [2] • Predation (cats, dogs, and ravens) • Rodenticides/pesticides
Pallid bat	• All land covers (except developed and disturbed)	• Widespread throughout the western United States • Inhabits rocky outcrops, cliffs, and spacious crevices with access to open habitats for foraging	• Day roost selection, fidelity, and lability (flexibility) and social roosting • Ectoparasites • Foraging and food partitioning mechanisms • Lighting • Predation	• Disturbances of roost sites through vandalism, extermination, and destruction of buildings and recreational activities • Pesticides and heavy metals • Habitat modification or degradation (i.e., conversion to agriculture, prescribed fires, wildfires) • Predation by urban-related predators • Wind energy facilities
Townsend's big-eared bat	• Abandoned mines • California forest and woodlands • Riparian • Chaparral and coastal scrub	• In the U.S., it occurs in a continuous distribution in all of the western states and east into western South Dakota, northwestern Nebraska, southwestern Kansas, western Oklahoma, and western Texas	• Inter-specific competition • Lighting may affect predator–prey relationships among bats	• Human disturbances of roost sites • Reduced foraging habitat from agricultural conversion • Pesticides • Wind energy facilities

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
Plants				
Alkali mariposa-lily	• Chaparral and coastal scrub • Desert Scrub • Wetlands		• Hydrology (periodic natural inundation)	• Urbanization and road construction • Grazing and trampling • Hydrological alternations and water diversions that lower the water table • Military operations • Dumping • Grading
Bakersfield cactus	• Grasslands • Riparian • Desert scrub • California forest and woodlands	• Restricted to a limited area of central Kern County near Bakersfield in the southern San Joaquin Valley	• Competition with non-native grasses for water • Pollination	• Residential and urban as well as oil development • OHVs • Sand mining • Competition from non-native grasses • Climate change • Air pollution (including elevated nitrogen deposition) • Loss of pollinators • Flooding • Loss of genetic diversity
Barstow woolly sunflower	• Desert scrub • Wetlands	• Endemic to the west-central Mojave Desert • Sub-regional habitat connectivity	• Bare areas with little soil that frequently contain a shallow subsurface caliche layer	• Development activities (energy and housing, highway and road improvements, pipelines) • Grazing (sheep) [2] • Recreation (OHVs) [2] • Mining • Other human activities (dumping) [2]

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
Desert cymopterus	• Desert scrub • Wetlands (playas)	• Primarily Rogers Dry Lake, Harper Dry Lake, Cuddeback Dry Lake, and Superior Dry Lake basins • Sub-regional habitat connectivity (?)	• Sandy soils on alluvial fans and basins and stabilized sand fields • Precipitation	• Habitat loss and fragmentation[3] • Development (oil, gas, utilities, renewable energy) [2] • Recreation (OHVs) [2] • Grazing (sheep) [2] • Climate change[2] • Invasive non-native plants
Little San Bernardino Mountains linanthus	• Desert scrub • Riparian • Dunes	• Restricted to the mouth of Dry Morongo Canyon near the City of Desert Hot Springs and the north side of Joshua Tree National Park south of State Highway 62 in the Little San Bernardino Mountains and from Whitewater Canyon in the eastern San Bernardino Mountains to Palm Springs	• Hydrology • Competition for resources from invading non-native species	• Urbanization • OHV use • Flood control activities • Illegal dumping • Invasive non-native species • Increased fire frequency • Groundwater loss • Soil erosion
Mojave monkeyflower	• Desert scrub	• Endemic to west-central Mojave Desert, primarily Barstow southeast to Newberry Springs and northeast of Victorville	• Precipitation • Pollination and dispersal	• Development (solar, wind, and roads) • Mining • Grazing[2] • Invasive plants[2] • Habitat fragmentation/potential inbreeding

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
		• Sub-regional habitat connectivity		• Climate change[2] • BLM land exchanges
Mojave tarplant	• Riparian • Chaparral and coastal scrub • Desert scrub • California forest and woodlands • Desert conifer woodlands	• Primarily occurs in southeastern Sierra Nevada range in Kern County and possible Red Rock Canyon • Sub-regional habitat connectivity(?); discontinuous populations may already be relictual	• Hydrology/seasonally saturated clay and silty soils (seeps and along grassy swales and intermittent creeks) • Precipitation • Pollination (?)	• Hydrological alterations[2] • Recreation (OHVs—trampling/crushing and soils disturbance)[2] • Climate change[2] • Grazing (livestock trampling at water sources)[2] • Development • Road maintenance
Owens Valley checkerbloom	• Wetlands	• Endemic to southern Owens Valley • Local habitat connectivity among alkali meadow and spring communities scattered along about 125 kilometers of the Owens River drainage	• Moist alkaline meadows and seeps and chenopod (saltbush) scrub • Fine, sandy loam with alkaline crusts • Pollination	• Hydrological alteration (diversion of Owens River and groundwater pumping)[2] • Climate change[2] • Grazing (cattle)[2] • Competition (rhizomatous grass species and upland rubber rabbitbrush)[2] • Meadow succession[2] • Invasive plants (Russian olive, knapweed)[2]
Parish's daisy	• California forest and woodlands • Desert conifer woodlands	• Mostly endemic to calcareous slopes of San Bernardino Mountains, with a few collections from granitic areas of	• Carbonate alluvium • Pollination	• Mining (limestone) (including dust)[2] • Lighting (pollinators and seed dispersers) • Recreation (camping, firewood collection, and dust generation)[2]

Table 7-2
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Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
	• Desert scrub	eastern San Bernardino Mountains and quartz monzonite areas in the Little San Bernardino Mountains • Local habitat connectivity		• Fire suppression[2] • Climate change[2] • Energy development • Road and residential development
Triple-ribbed milk-vetch	• Desert scrub	• Limited to western portion of Plan Area in Wathier Landing, Catclaw Flat, upper Mission Creek, Dry Morongo Creek, Big Morongo Canyon (two occurrence locations), Long Canyon, and Key's Ranch (unvouchered) • Sub-regional habitat connectivity	• Barren rocky slopes and ridges • Precipitation (?) • Pollination/dispersal (deme populations, waifs) (?)	• Development (construction/maintenance of gas and oil pipelines, residential) • Recreation (OHVs) [2] • Fire suppression[2] • Flooding[2] • Climate change[2]
Planning Species				
Mammals				
Burro deer	• Riparian • Dunes • Desert scrub	• Seasonal migration • High mobility/relatively large home ranges • Distribution of water sources • Connectivity between	• Competition from non-native grazing animals	• Habitat loss and degradation (urban and energy development, agriculture) [2] • Invasive plants (tamarisk, non-native pasture plants) [2] • Recreation (OHVs) • Hydrologic alterations (flood control)

Table 7-2
Summary of Key Conservation Factors for DRECP Covered and Planning Species based on Natural Communities, Landscape, Ecological Processes, and Environmental Stressors/Threats

Species	Natural Community[1]	Key Landscape Issues	Key Ecological Processes Issues	Known or Potential Environmental Stressors and Threats
		riparian and mountain habitats		• Mining operations • Vehicle collisions • Poaching • Drowning in canals • Competition from non-native grazing animals • Overstocking and competition from cattle, domestic sheep, and goats
Desert kit fox	• Desert scrub • Wetlands (playas) • Riparian (washes) • Dunes (marginal habitat)	• Mobile with relatively large home ranges • Suitable den site availability	• Prey availability, which is likely variable spatially and temporally • Competition and predation from coyotes	• Habitat loss and fragmentation (development, roads, recreation, and grazing)[3] • Recreation (OHVs, shooting)[2] • Predator and rodent controls/rodenticide poisoning • Expansion and increased abundance of coyotes (predation and competition) • Disease (canine distemper) • Vehicle collisions • Military training and noise

Notes:
1 Natural community information based on the DRECP Land Cover map vegetation types, which are aggregated communities based on the National Vegetation Classification Standard (Groups and Macrogroups). Where expert-based species habitat distribution models have been developed for a species, the natural communities listed are based on the selected vegetation types used for these models. Where expert-based models were not developed for a species, natural communities list are based on literature as summarized in the species profile.
2 Potential ecological processes stressor
3 Potential landscape issue
(?) = unknown issue

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