7.0 Biological Resources - Wildlife

This chapter describes the environmental and regulatory setting for wildlife resources, as well as the environmental consequences associated with construction and operation of Project alternatives, including impacts and mitigation measures.

7.1 Environmental Setting

This section describes the wildlife resources evaluated in this Environmental Impact Statement/Report (EIS/R), including wildlife habitat types and special-status wildlife species. Fish species are discussed separately in Chapter 5.0, "Biological Resources – Fisheries."

7.1.1 Regional Setting

The Project area lies within the San Joaquin Valley, which comprises the southern portion of California's Central Valley. The San Joaquin Valley is bounded by the Sierra Nevada mountain range to the east, the Tehachapi Mountains to south, and the Coast Range to the west. With the exception of the Tulare Lake basin, the watersheds of the San Joaquin Valley drain into the San Joaquin River, which leads to the Sacramento-San Joaquin Delta and ultimately into the San Francisco Bay.

The San Joaquin River originates high in the Sierra Nevada. It rapidly descends and exits mountainous terrain in the area now occupied by Friant Dam. The river discharges to the valley floor near Gravelly Ford. Prior to agricultural development, the San Joaquin River and its main tributaries meandered across alluvial fans along the main axis of the San Joaquin Valley floor. The river distributed higher flows into a complex network of sloughs that branched off both sides of the river. It flowed through a flat, homogeneous topography and supported a limited riparian forest. The flat valley floor surrounding the riparian forest often took the form of extensive wetlands, dominated by tule marsh. Riparian forest zones were present along the margins of the primary river channel and were not very extensive (The Bay Institute 1998).

Near Mendota, the San Joaquin River merged with Fresno Slough, a wider and deeper waterway than the San Joaquin River. Fresno Slough was part of an intricate slough system that exchanged water between the Tulare Lake Basin and the San Joaquin River. Downstream from Mendota, the San Joaquin River flowed through a network of large slough channels traversing extensive riparian woodland, tule marshes, and backwater ponds until it joined with the Merced River. Downstream from this point, the floodplain was more confined and the river exhibited a highly sinuous pattern of rapid channel meander, which created a rich complex of oxbow lakes, backwater sloughs, ponds, and sand bars. In its lower sections just upstream from the Delta, the river formed low natural levees approximately 6 feet high (The Bay Institute 1998).

The San Joaquin River has changed dramatically since the early part of the 20th century. The river is now largely confined within constructed levees and bounded by agricultural and urban development, flows are regulated through dams and water diversions, and floodplain habitats have been fragmented and reduced in size and diversity (McBain and Trush 2002). As a result, wildlife habitat has substantially changed from historic conditions. The presence of Friant Dam reduces the frequency of scouring flows; consequently, the vegetation succession of riparian scrub to forest is no longer balanced by periodic loss of forest to the river because of erosion and appearance of new riparian scrub on sand and gravel bars. In addition, operation of Friant Dam has caused gradually declining flows in spring, which are periodically necessary to disperse seed of willows and cottonwoods, and establish seedlings of these riparian tree and shrub species. Drought conditions caused by diversions have also caused a loss of riparian vegetation in several reaches of the river, and urban and agricultural development has caused a gradual loss in the area available for riparian habitat (Bureau of Reclamation 1998).

Federal and State wildlife preserves have been established to conserve, protect, and enhance migratory waterfowl habitat and native ecological communities of the San Joaquin Valley. The Mendota Wildlife Area and the Alkali Sink Ecological Reserve are located approximately 4 miles to the south of the San Joaquin River at River Mile 210. The Alkali Sink Ecological Reserve is home to many sensitive species, including blunt-nosed leopard lizard, palmate-bracted bird's beak, and Hoover’s woolly star. The Mendota Wildlife Area, which is hydraulically connected to Fresno Slough, is home to numerous waterfowl and wading birds.

7.1.2 Project Area

The Project area contains 20 wildlife habitat types, including one tree-dominated, three shrub-dominated, five herbaceous-dominated, three aquatic, six developed, and two non-vegetated habitat types (Figure 7-1). The habitat types were classified by vegetative cover type, which is based on vegetation structure and plant species composition. For example, shrub-dominated communities were classified as scrub due to the structure of the vegetation and then further categorized as willow or riparian scrub depending on the dominant plant species present. Generally, the habitat types were defined following the California Wildlife-Habitat Relationships System (WHR) (WHR 2010). In some instances, habitats were defined following Holland (1986) or Moise and Hendrickson (2002), depending on what best represented the habitats within the Project area. Descriptions of each habitat type are provided below.

Table 7-1 lists the habitat types and their acreage within the Project area. Approximately 90 percent of the habitat within the Project area was confirmed through on-site surveys in 2010 and 2011, when Interim Flows had begun to modify 2009 conditions; however, due to restricted access, the remaining area was assessed using aerial photograph interpretation. Additional details regarding wildlife habitats (including survey methods and additional habitat descriptions) are available in the *Mendota Pool Bypass and Reach 2B Improvements Project Technical Memorandum on Environmental Field Survey Results* (San Joaquin River Restoration Program [SJRRP] 2011a).

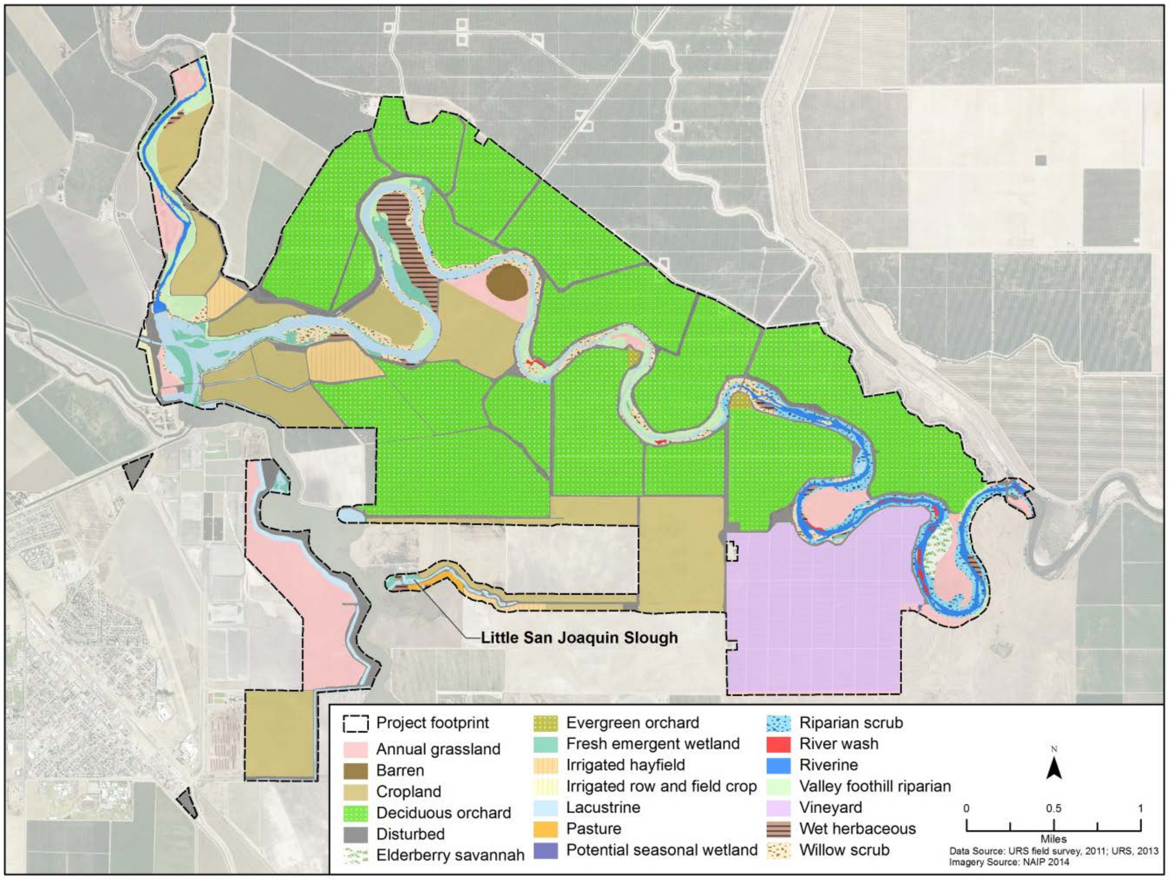

Figure 7-1.
Wildlife Habitat

Table 7-1.
Wildlife Habitat Types Mapped in the Project Area

Category	Habitat Type	Total Area (Acres)
Tree Dominated	Valley foothill riparian	153
Shrub Dominated	Elderberry savannah	23
	Riparian scrub	99
	Willow scrub	122
Herbaceous Dominated	Annual grassland	376
	Fresh emergent wetland	65
	Pasture	8
	River wash	8
	Wet herbaceous	69
Aquatic	Lacustrine	249
	Potential seasonal wetland	1
	Riverine	97

Table 7-1.
Wildlife Habitat Types Mapped in the Project Area

Category	Habitat Type	Total Area (Acres)
Developed	Cropland	896
	Irrigated hayfield	80
	Irrigated row and field crop	10
	Deciduous orchard	2,498
	Evergreen orchard	10
	Vineyard	624
Non-vegetated	Barren	25
	Disturbed	481
Total		5,894

Note: The total acreage value is calculated independently of the specific habitat acreage values; therefore, due to rounding, the value differs slightly from the sum of the habitat acres reported, which is 5,798 acres.

Tree-Dominated Habitats

Valley Foothill Riparian. As described by WHR (2010), valley foothill riparian habitat is characterized by mature riparian forest of winter deciduous trees that is generally associated with areas of floodplains and low-velocity flows with gravely or rocky soils. The typical dominant canopy species in this habitat, within the Project area, is Fremont cottonwood (*Populus fremontii*). Typical dominant subcanopy tree species include Goodding's black willow (*Salix gooddingii*), Oregon ash (*Fraxinus latifolia*), and blue elderberry (*Sambucus mexicana*). Typical understory shrub species include wild rose (*Rosa californica*), buttonbrush (*Cephalanthus occidentalis*), sandbar willow (*Salix exigua*), and, in some areas, California blackberry (*Rubus ursinus*). In the Project area, this habitat type primarily occurs in narrow bands between the river margins and croplands and therefore may be more similar to valley foothill riparian edge habitat (that is, habitat on the edge of a valley foothill riparian forest, as opposed to the interior). Accordingly, cover may be less dense than would be expected in the interior of a stand of valley foothill riparian forest, and the "forest" may appear less mature.

Shrub-Dominated Habitats

Elderberry Savannah. As described by Holland (1986), elderberry savannah habitat is characterized by a winter-deciduous shrub savannah dominated by blue elderberry (*Sambucus mexicana*) and an understory of nonnative grasses. The habitat is generally associated with alluvial soil and areas of floodplains. In natural stands this habitat typically succeeds into riparian vegetation. Typical understory species present in the Project area include tarweed (*Hemizonia* species), mustard (*Brassica* species), California wild rose (*Rosa californica*), and annual grasses.

Riparian Scrub. As described in Moise and Hendrickson (2002), riparian scrub habitat is characterized by a mix of semishrubby perennials and woody vines. In the Project area, some areas also include a layer of shrub-like trees, including tobacco tree (*Nicotiana glauca*), blue elderberry (*Sambucus mexicana*), buttonbrush (*Cephalanthus occidentalis*), sandbar willow (*Salix exigua*), and Goodding's black willow (*Salix gooddingii*). Common understory species include California wild rose (*Rosa californica*), mugwort (*Artemisia douglasiana*), jimson weed (*Datura* species), cocklebur (*Xanthium strumarium*), nettle (*Urtica dioica*), sunflower (*Helianthus annuus*), tarweed (*Hemizonia* species), mustard (*Brassica* species) and lupin (*Lupinus* species).

Riparian scrub is distinguished from willow scrub habitat, described below, by the fact that riparian scrub is dominated by multiple species (i.e., willow and non-willow riparian species), whereas willow scrub is dominated by stands of willow species. In the Project area, much of the riparian scrub occurs along highly channelized portions of the river or areas that are subject to frequent disturbance.

Willow Scrub. As described by Moise and Hendrickson (2002), willow scrub habitat is characterized by winter deciduous, shrubby, streamside willow thickets that are generally associated with areas subject to flooding or disturbance. Typical dominant species present in the Project area include Goodding's black willow (*Salix gooddingii*) and sandbar willow (*Salix exigua*). Typical understory species include wild rose (*Rosa californica*). In the Project area, much of the willow scrub occurs along sand and gravel bars and in small patches along the banks of the San Joaquin River.

Herbaceous-Dominated Habitats

Annual Grassland. As described by WHR (2010), annual grassland habitat is characterized by open grassland dominated by annual, nonnative grass species that are generally found on flat plains or rolling hills. Typical dominant grass species include wild oats (*Avena fatua*), soft chess (*Bromus hordeaceus*), ripgut brome (*Bromus diandrus*), red brome (*Bromus madritensis*), wild barley (*Hordeum marinum*), and foxtail fescue (*Vulpia myuros*). Common forbs typically associated with this habitat include broadleaf filaree (*Erodium botrys*), redstem filaree (*Erodium cicutarium*), turkey mullein (*Eremocarpus setigerus*), true clovers (*Trifolium* species), bur clover (*Medicago minima*), and prickly popcorn flower (*Cryptantha muricata*). Tarweed (*Hemizonia* species) is common in some grassland areas.

In the Project area, annual grassland habitat occurs in several places, including on a less disturbed piece of land in the eastern portion of the Project area, south of the San Joaquin River and adjacent to elderberry savannah and riparian scrub habitat. Other areas mapped as annual grassland typically had a strong ruderal vegetation component.

Fresh Emergent Wetland. As described by WHR (2010), fresh emergent wetland habitat is characterized by erect, rooted, herbaceous, water-intense plants most commonly found on level to gently rolling topography, in depressions or at the edge of rivers or lakes in areas that are flooded frequently. Common species on the upper margins of this habitat in the Project area include yerba mansa (*Anemopsis californica*) and on more alkali sites, saltgrass. Common species on more saturated sites include common cattail (*Typha latifolia*) and tule bulrush (*Scirpus acutus* var. *occidentalis*). Fresh emergent wetland habitat, in the Project area, primarily occurs along the margins of and sometimes as small "islands" within lacustrine habitats, including portions of the San Joaquin River, Fresno

Slough, and Little San Joaquin Slough. This habitat type may blend into the wet herbaceous habitat type, described below.

Pasture. As described by WHR (2010), pasture habitat is characterized by irrigated and grazed habitat that consists of a mix of perennial grasses and legumes that provide 100 percent canopy closure planted on flat and gently rolling terrain. Species occurring in this habitat type include Bermuda grass (*Cynodon dactylon*), white melilot (*Melilotus albus*), and ryegrasses (*Lolium* species). Various annual grasses are also present. This habitat type is present south of Little San Joaquin Slough.

Riverwash. As described by Moise and Hendrickson (2002), riverwash habitat is characterized by scoured banks and bars within or adjacent to the active river channel, without significant vegetative cover. In the Project area, this habitat type is present at a few locations along the San Joaquin River.

Wet Herbaceous. Wet herbaceous habitat is characterized by annual and perennial herbaceous vegetation growing in areas with a high water table or subject to frequent flooding. These areas are typically wetter than annual grassland but not wet enough to be classified as fresh emergent wetland. Vegetation is lower-growing than in riparian scrub or valley foothill riparian habitats. Common species occurring in this habitat type include white melilot (*Melilotus albus*), Indian dogbane (*Apocynum cannabinum*), Bermuda grass (*Cynodon dactylon*), ryegrasses (*Lolium* species), tarweed (*Hemizonia* species), and cocklebur (*Xanthium strumarium*). Wet herbaceous habitat in the Project area may blend into other riparian and wetland habitats.

Aquatic Habitats

Lacustrine. As described by WHR (2010), lacustrine habitat is characterized by inland depressions or dammed riverine channels containing standing water. Due to the presence of Mendota Dam, large portions of aquatic habitat in the Project area hold water throughout the summer.

Potential Seasonal Wetland. In one portion of the Project area where access has not been granted, two features have been identified from aerial photographs as potential seasonal wetlands. The features appear to be artificially inundated and may be more appropriately described as agricultural wetlands, but since access was not available the exact character of these features remains unknown.

Riverine. As described by WHR (2010), riverine habitat is characterized by intermittent or continually running water of rivers or streams. There are three zones in this habitat type: the open water zone, submerged zone and the shore zone. Riverine habitat is present upstream of the San Mateo Avenue crossing, where water visibly flows.[1] Fresh emergent wetland habitat is mapped separately from riverine habitat, although it may be within the shore or submerged zone as defined by WHR (2010).

[1] Flows observed during the habitat assessment upstream of the San Mateo Avenue crossing surveys are due to Interim Flows.

Developed Habitats

Developed habitats in the Project area consist of agricultural lands, which dominate the area and occur in most portions of the Project area outside of the lands immediately adjacent to the San Joaquin River. Developed habitats are described by WHR (2010) as follows.

Cropland. Cropland habitat is generally characterized by a variety of annual crops, typically grown as a monoculture, which is planted in spring and harvested in summer or fall. In the Project area, an effort was made to define cropland more specifically based on the type of crop, as described below. The more general cropland habitat type was used when a more specific habitat type could not be assigned, such as where agricultural fields were temporarily fallow (this category may include temporary land fallowing/crop idling acreage) or had recently been tilled in preparation for planting a new crop at the time of the habitat assessment surveys. Fallow fields may be regularly tilled or planted with cover crops, which differentiates them from barren habitat (described below). Croplands occur in the Project area both north and south of the river.

Irrigated Hayfield. Irrigated hayfield habitat is characterized by alfalfa fields and grass hayfields where plowing may occur annually but often is less frequent. Alfalfa is typically planted as a monoculture and usually exists unplowed for approximately 3 years or more. Grass hayfields are characterized by irrigated, intensively mowed and managed grass crops with nearly 100 percent cover. In addition, occasionally "native" hayfields are irrigated to enhance their productivity. Native hayfields may include introduced grasses and forbs, but they are managed less intensively and contain a variety of naturally occurring species as well. Irrigated hayfields are found in the western portion of the Project area and near Little San Joaquin Slough.

Irrigated Row and Field Crops. Irrigated row and field crop habitat is characterized by annual or perennial green vegetable crops such as asparagus, broccoli, lettuce, cucumbers, fruits from strawberries to melons, and root vegetables such as carrots, potatoes, and beets. Cotton is also grown as an irrigated row crop. Most of these crops are grown in rows and canopy cover varies from 100 percent to crops with significant bare areas. These crops are also managed in a crop rotation system. See Section 16.1 for a discussion of specific agricultural crops and tree fruits. Irrigated row and field crops occur near the Mendota Dam area.

Deciduous Orchard. Deciduous orchard habitat is characterized by deciduous trees that produce almonds, apples, apricots, cherries, figs, nectarines, peaches, pears, pecans, pistachios, plums, pomegranates, prunes, and walnuts. Deciduous orchards typically consist of a single species of deciduous trees planted in linear, uniformly spaced rows where the crowns typically touch. Orchards in the Project area were clearly managed to reduce understory growth at the time of the habitat assessment and therefore the typical understory of low-growing grasses, legumes, and other herbaceous plants was sparse or absent from this habitat type. See Section 16.1 for a discussion of specific agricultural crops and tree fruits. Deciduous orchards are found in the Project area both north and south of the river.

Evergreen Orchard. Evergreen orchard habitat is characterized by evergreen trees that produce avocados, dates, olives, and citrus fruits. Evergreen orchard habitat typically consists of evergreen trees planted in linear, uniformly spaced rows where crowns typically do not touch. Orchards in the Project area were managed to reduce understory growth at the time of the habitat assessment surveys and therefore the typical understory composed of low-growing grasses, legumes, and other herbaceous plants was sparse or absent from this habitat type. Evergreen orchards are found in the Project area near deciduous orchards at two river bends.

Vineyard. Vineyard habitat is characterized by a single species of vines, usually supported on wood and wire trellises of boysenberries, olallieberries, raspberries, or grapes planted in rows. Typically the ground under the vines is sprayed with herbicides to prevent growth of herbaceous plants, and the ground between the rows of vines is often kept open and grasses or other herbaceous plants may be planted or allowed to grow to control erosion. A vineyard is located in the southeastern portion of the Project area.

Non-vegetated Habitats

Barren. As described by WHR (2010), barren habitat is characterized by less than 2 percent total vegetation cover by herbaceous, desert, or non-wildland species and less than 10 percent cover by tree or shrub species. This habitat is limited to non-vegetated areas that have not been significantly disturbed but instead are naturally sparsely vegetated due to hydrology or other factors. This habitat does not include areas within an active river channel (Riverwash). A section of barren habitat is found in the Project area near one of the river bends.

Disturbed. As described by Moise and Hendrickson (2002), disturbed habitat is characterized by areas where it is unlikely or impossible to find significant native vegetation, which includes permanent roads or roads at least two lanes in width, canals, levees, structures and associated landscaping, parks, golf courses, active gravel mines or other areas maintained free of vegetation by regular disturbance. This habitat is present throughout the Project area in the form of roads and structures associated with agricultural activities.

7.1.3 Special-Status Wildlife Species

Special-status wildlife species are defined here as wildlife species that meet any of the following requirements.

- Federally-listed as endangered or threatened or proposed for Federal listing under the Federal Endangered Species Act (ESA) (50 Code of Federal Regulations [CFR] 17.11 [listed animals]).
- Federal candidates for possible future listing as threatened or endangered under the ESA (73 Federal Register [FR] 75176, December 10, 2008).
- State listed as endangered or threatened, proposed for State listing, or State candidate for listing under the California Endangered Species Act (CESA) (Cal. Code Regs., tit. 14, § 670.5).

- State fully protected (Fish & G. Code, §§ 3511 [birds], 4700 [mammals], 5050 [amphibians and reptiles]).
- U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern species (USFWS 2008).
- California Department of Fish and Wildlife (DFW) Species of Special Concern (DFW 2011).

A total of 36 special-status wildlife species were evaluated for their potential to occur in the Project area. The list of species evaluated was compiled based on a review of all California Natural Diversity Database (CNDDB) records from the Mendota Dam U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle, the eight surrounding quadrangles (Jamesan, Tranquillity, Coit Ranch, Firebaugh, Poso Farm, Firebaugh NE, Bonita Ranch, and Gravelly Ford), and the area within 10 miles of Reach 2B (DFW 2009), as well as a USFWS Sacramento Field Office species list for the Mendota Dam quadrangle (USFWS 2009), and the Audubon Society Important Bird Area species list for the nearby Mendota Wildlife Area (Audubon Society 2009). Based on these sources, relevant field observations, and the presence or absence of suitable habitat, each species was designated as having high, moderate, low, or no potential to occur within the Project area. Special-status wildlife with a moderate or high potential to occur[2] are summarized in Table 7-2. Federally- and State-listed, proposed, candidate and fully protected wildlife species are listed in Table 7-3. Special-status wildlife species that lack ESA or CESA listing status or State fully protected status are listed in Table 7-4. Details regarding suitable habitat for each of these special-status wildlife species and the designations regarding the potential to occur in the Project area are presented and further explained in Mendota Pool Bypass and Reach 2B Improvements Project *Technical Memorandum on Environmental Field Survey Results* (SJRRP 2011a).

Table 7-2.
Special-Status Wildlife Species with a Moderate or High Potential to Occur

Scientific Name	Common Name	Federal Status	State Status
Federally-Listed, State-Listed, and Fully Protected Wildlife Species			
Invertebrates			
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	FT	--
Reptiles			
Gambelia sila	blunt-nosed leopard lizard	FE	SE and FP
Thamnophis gigas	giant garter snake	FT	ST
Birds			
Buteo swainsoni	Swainson's hawk	MBTA	ST
Elanus leucurus	white-tailed kite	MBTA	FP
Grus canadensis tabida	greater sandhill crane	MBTA	FP
Agelaius tricolor	tricolored blackbird	BCC, MBTA	SE

[2] *Branchinecta* species are listed in Table 7-2 despite having a low potential to occur for reasons explained in Section 7.3.3, Impacts and Mitigation Measures.

Table 7-2.
Special-Status Wildlife Species with a Moderate or High Potential to Occur

Scientific Name	Common Name	Federal Status	State Status
Mammals			
Dipodomys nitratoides exilis	Fresno kangaroo rat	FE	SE
Other Special-Status Wildlife Species			
Reptiles			
Actinemys marmorata	western pond turtle	--	SSC
Anniella pulchra pulchra	silvery legless lizard	--	SSC
Masticophis flagellum ruddocki	San Joaquin coachwhip	--	SSC
Phrynosoma blainvillii	coast horned lizard	--	SSC
Birds			
Anser albifrons elgasi	greater white-fronted goose	MBTA	SSC
Asio flammeus	short-eared owl	MBTA	SSC
Athene cunicularia	burrowing owl	BCC, MBTA	SSC
Aythya americana	redhead	MBTA	SSC
Charadrius montanus	mountain plover	BCC, MBTA	SSC
Circus cyaneus	northern harrier	MBTA	SSC
Grus canadensis canadensis	lesser sandhill crane	MBTA	SSC
Lanius ludovicianus	loggerhead shrike	BCC, MBTA	SSC
Numenius americanus	long-billed curlew	BCC, MBTA	--
Pelecanus erythrorhynchos	American white pelican	MBTA	SSC
Xanthocephalus xanthocephalus	yellow-headed blackbird	MBTA	SSC
Mammals			
Eumops perotis californicus	western mastiff bat	--	SSC
Lasiurus blossevillii	western red bat	--	SSC
Taxidea taxus	American badger	--	SSC

U.S. Fish and Wildlife Service and Federal Listing Categories:
BCC = Bird of Conservation Concern
FE = Federally Listed as Endangered
FT = Federally Listed as Threatened
MBTA = Protected under the Migratory Bird Treaty Act

California Department of Fish and Wildlife State Listing Categories:
FP = Fully Protected
SE = State Listed as Endangered
SSC = Species of Special Concern
ST = State Listed as Threatened

Table 7-3.
Federally- and State-Listed or Fully Protected Wildlife Species

Scientific Name **Common Name**	**Federal/ State Status**	**Preferred Habitat**	**Potential to Occur in the Project area**
Invertebrates			
Branchinecta longiantenna longhorn fairy shrimp	FE/--	Found in vernal pools, particularly clear to turbid grass-bottomed pools and clear-water pools in sandstone depressions.	Low: No suitable habitat observed during habitat assessment surveys. Suitable habitat absent from Project area.
Branchinecta lynchi vernal pool fairy shrimp	FT/--	Found in vernal pools, particularly small, clear-water sandstone depression pools and grassy swale, earth slump, or basalt-flow depression pools.	Low: No suitable habitat observed during habitat assessment surveys. Suitable habitat absent from Project area.
Desmocerus californicus dimorphus valley elderberry longhorn beetle	FT/--	Elderberry shrubs with stem diameters of 2 to 8 inches. Species always found close to host plant. Larvae may remain in stems for up to 2 years.	High: Elderberry shrubs abundant in Project area. Old exit holes observed during protocol surveys.
Amphibians			
Ambystoma californiense California tiger salamander	FT/ST	Grasslands and understory of valley-foothill hardwood habitats. Require vernal pools or other seasonal water sources for breeding and mammal burrows or other underground refuges.	Low: Project area outside known current and historic range. No suitable habitat observed during habitat assessment surveys. Suitable habitat absent from Project area.
Rana draytonii California red-legged frog	FT/SSC	Pools with emergent vegetation, typically without predatory fish, and upland hibernacula, such as small mammal burrows or moist leaf litter.	Low: Assumed absent from the Project area and vicinity, based on current known distribution, presence of two invasive ranid frog species, and presence of invasive, predatory fish species.
Reptiles			
Gambelia sila blunt-nosed leopard lizard	FE/SE and FP	Sparsely vegetated alkali and desert scrub habitats, in areas of low topographic relief. Seek cover in mammal burrows, under shrubs or structures such as fence posts.	Moderate: No suitable habitat observed during habitat assessment surveys. Suitable habitat absent from Project area, with possible exception of unsurveyed land in southeast of the Project area.
Thamnophis gigas giant garter snake	FT/ST	Marshes, low-gradient streams, canals, and irrigation ditches with dense emergent vegetation, water persisting throughout the active period, open areas along water margins, and access to upland habitat for hibernation and escape from flooding.	High: Previously detected in Project area (DFW 2009). Suitable habitat observed in portions of the San Joaquin River affected by Mendota Dam, and in Fresno Slough.

Table 7-3.
Federally- and State-Listed or Fully Protected Wildlife Species

Scientific Name **Common Name**	**Federal/ State Status**	**Preferred Habitat**	**Potential to Occur in the Project area**
Birds			
Agelaius tricolor tricolored blackbird	BCC, MBTA/SE	Typically nests next to open water in freshwater marsh with extensive emergent or riparian vegetation. Breeding colonies also reported in grain fields. Forages in grasslands, wetland habitats, and some agricultural areas.	High: Observed along San Joaquin River corridor during a 19 May 2010 site visit.
Aquila chrysaetos golden eagle	MBTA, GBEPA/FP	Found in rolling hills, mountain areas, sage-juniper flats, or deserts. Forages in open areas with low vegetation. Nests on cliff faces or in large trees.	Low: No eagles or suitable eagle nesting habitat observed during habitat assessment survey. May occur during foraging or wintering but nesting not expected.
Buteo swainsoni Swainson's hawk	MBTA/ST	Nests in riparian areas, oak woodlands, and isolated and roadside trees close to grassland or agricultural foraging habitat.	High: Swainson's hawk nests previously documented in Project area (DFW 2009). Two pairs present in Project area during habitat assessment survey.
Coccyzus americanus occidentalis western yellow-billed cuckoo	FC, BCC, MBTA/SE	Large blocks of riparian habitats (particularly woodlands with willow and cottonwood) along floodplains of larger river systems. Dense understory foliage important.	Low: Project area located outside of current known range. Suitable habitat limited and not observed during habitat assessment survey. Not likely to occur due to extended absence from the region.
Elanus leucurus white-tailed kite	MBTA/FP	Prefers grasslands, oak woodlands, riparian scrub, and savannas. Forages in wetland and grassland areas.	High: Species observed in the Project area during valley elderberry longhorn beetle surveys.
Grus canadensis tabida greater sandhill crane	MBTA/FP	Nests in wet meadows and emergent marshes. Forages in wet meadows, marshes, freshwater margins, and less frequently grasslands and croplands.	High: Sandhill cranes observed flying nearby during valley elderberry longhorn beetle protocol survey –may be different subspecies. Likely an uncommon visitor during nonnesting season.
Riparia riparia bank swallow	MBTA/ST	Colonial nester primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine-textured/sandy soils near water to dig nest cavity.	Low: No suitable nesting habitat observed during habitat assessment survey. Suitable nesting habitat no longer present at historic Mendota Pool occurrence location.

**Table 7-3.
Federally- and State-Listed or Fully Protected Wildlife Species**

Scientific Name **Common Name**	**Federal/ State Status**	**Preferred Habitat**	**Potential to Occur in the Project area**
Vireo bellii pusillus Least Bell's vireo	FE/SE/ MBTA	Nests in riparian woodlands, especially willows and other shrubs, along low elevation riverine areas. Forages in riparian and adjacent uplands.	Low: No individuals were found during protocol surveys. Nearest known occurrence is San Luis Reservoir (approximately 55 miles northwest)
Mammals			
Ammospermophilus nelsoni Nelson's antelope squirrel	--/ST	Merced County south to Kings, Tulare and Kern counties, at elevations ranging from 200 to 1,200 feet. Dry, sparsely vegetated loam soils with widely scattered shrubs, forbs, and grasses in broken terrain with gullies and washes.	Low: Species not observed during habitat assessment survey, although California ground squirrels were observed. Project area is north of current range of this species.
Dipodomys nitratoides exilis Fresno kangaroo rat	FE/SE	Restricted to native grasslands in Fresno County within the San Joaquin Valley; nearly level, light, friable soils in chenopod scrub and grassland communities.	Moderate: Despite efforts to trap this species, it has not been detected at nearby sites where it was present in 1992. Kangaroo rat sign (e.g., tail drags, potential burrows) was observed in the Project area (primarily east and west loops), although 2011 trapping efforts within the Project area captured only Heermann's kangaroo rat.
Vulpes macrotis mutica San Joaquin kit fox	FE/ST	Grassland or grassy open stages with scattered shrubby vegetation; requires loose-textured sandy soils for burrowing; requires suitable prey base of small rodents.	Low: Although habitat potentially offering denning and foraging opportunities was observed during the habitat assessment survey, prior surveys in portions of the Project area have failed to confirm the presence of this species, and it is presumed extirpated in the area by USFWS (USFWS 2010).

U.S. Fish and Wildlife Service and Federal Listing Categories:
BCC = Bird of Conservation Concern
FC = Candidate for Federal Listing
FD = Federally Delisted
FE = Federally Listed as Endangered
FT = Federally Listed as Threatened
GBEPA = Protected under the Golden and Bald Eagle Protection Act
MBTA = Protected under the Migratory Bird Treaty Act

California Department of Fish and Game State Listing Categories:
FP = Fully Protected
SC = Candidate for State Listing
SE = State Listed as Endangered
SSC = Species of Special Concern
ST = State Listed as Threatened

Table 7-4.
Other Special-Status Wildlife Species

Scientific Name **Common Name**	**Federal/ State Status**	**Preferred Habitat**	**Potential to Occur in the Project area**
Amphibians			
Spea hammondii western spadefoot	--/SSC	Grassland and valley-foothill hardwood woodlands, vernal pools or seasonal wetlands are essential for egg laying.	Low: No suitable habitat observed during habitat assessment surveys. Suitable habitat absent from Project area.
Reptiles			
Actinemys marmorata western pond turtle	--/SSC	Ponds, marshes, rivers, streams, irrigation ditches, and vernal pools; with basking sites and suitable upland habit for egg laying.	High: Species observed in the Project area during habitat assessment survey, including likely nest.
Anniella pulchra pulchra silvery legless lizard	--/SSC	Sand dunes or sandy soil, with litter; also wooded stream edges, and occasionally desert-scrub. Bush lupine often indicates suitable conditions. Found in leaf litter, under rocks, logs, and driftwood.	High: Species known from immediately adjacent to the Project area and suitable habitat present at various locations in the Project area.
Masticophis flagellum ruddocki San Joaquin whipsnake	--/SSC	Open, dry, treeless areas, including grassland and saltbush scrub. Takes refuge in rodent burrows, under shaded vegetation, and under surface objects.	High: Recent nearby occurrences and suitable habitat present in the Project area.
Phrynosoma blainvillii coast horned lizard	--/SSC	Coastal sage, chaparral, and other brushy, shrubby vegetation habitats that provide a low shrub structure; Overwinters in small mammal burrows.	High: Recent nearby occurrences, suitable habitat and some native ant colonies present in the Project area.
Birds			
Accipiter cooperii Cooper's hawk	MBTA/WL	Typically found in patchy woodlands. Nests and forages near open water and wetland vegetation.	High: Observed along San Joaquin River corridor during habitat assessment survey.
Anser albifrons elgasi greater white-fronted goose	MBTA/SSC	Prefers moist and wet environments, including freshwater wetlands, croplands, and pastures. Breeds in Alaska.	High: Likely present during winter and migratory periods. August habitat assessment survey did not provide opportunity to observe this species.
Asio flammeus short-eared owl	MBTA/SSC	Open grasslands, prairies, dunes, irrigated fields, and wetlands. Nests on the ground in tall grass stands.	High: Observed along San Joaquin River corridor during habitat assessment survey and during valley elderberry longhorn beetle surveys.

Table 7-4.
Other Special-Status Wildlife Species

Scientific Name **Common Name**	**Federal/ State Status**	**Preferred Habitat**	**Potential to Occur in the Project area**
Athene cunicularia burrowing owl	BCC, MBTA/SSC	Open, dry, annual or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation, with small mammal burrows for nesting and roosting.	Moderate: Observed flying just north of the Project area. Suitable habitat is present within the Project area, but no sign of this species was observed during wildlife habitat assessment survey.
Aythya americana redhead	MBTA/SSC	Nests near freshwater emergent wetlands and areas of deep, open water.	Moderate: Although suitable habitat is present in the Project area, this species was not observed during the habitat assessment survey.
Charadrius montanus mountain plover	BCC, MBTA/SSC	Roosts and forages in short grasslands, freshly plowed fields, and bare ground with flat topography. Prefers fallow, grazed, or burned areas and alkali flats with burrowing rodents.	Moderate: Potential wintering and foraging habitat is present in the Project area.
Circus cyaneus northern harrier	MBTA/SSC	Nests and forages in open habitats including freshwater marshes and weedy edges of rivers and streams. Also found in agricultural areas such as pastures and some croplands.	High: Observed along San Joaquin River corridor during habitat assessment survey.
Falco columbarius merlin	MBTA/WL	Occurs in coast, grasslands, savannas, woodlands, coniferous forests, wetlands, and occasionally desert habitats. Requires dense tree stands near bodies of water.	High: Observed in Project area near Fresno Slough during valley elderberry longhorn beetle protocol surveys.
Grus canadensis canadensis lesser sandhill crane	MBTA/SSC	Forages in agricultural fields, pastures, and mowed to grazed grasslands. Roosts in shallow water within wetland habitats.	Moderate: Potential wintering and foraging habitat is present in the Project area.
Lanius ludovicianus loggerhead shrike	BCC, MBTA/SSC	Breeds in shrubland or open woodlands. Requires tall shrubs/trees for hunting perches and nests. Uses riparian edges in the Central Valley.	High: Observed along San Joaquin River corridor during habitat assessment survey.
Larus californicus California gull	MBTA/WL	Preferred inland habitat includes riverine, lacustrine, and cropland habitats.	Moderate: Potential wintering and foraging habitat is present in the Project area. Observed flying over the Project area.
Numenius americanus long-billed curlew	BCC, MBTA/WL	Winters in upland herbaceous areas and croplands.	High: Observed in the Project area during valley elderberry longhorn beetle surveys. Potential wintering and foraging habitat is present in the Project area.

Table 7-4.
Other Special-Status Wildlife Species

Scientific Name **Common Name**	**Federal/ State Status**	**Preferred Habitat**	**Potential to Occur in the Project area**
Pandion haliaetus osprey	MBTA/WL	Found near large, open, fish-bearing waters. Nests and roosts on large tree, snags, and cliffs.	Moderate: Potential wintering and foraging habitat is present in the Project area.
Pelecanus erythrorhynchos American white pelican	MBTA/SSC	Forages in shallow inland waters such as marshes, canals and lake or river edges.	High: Observed at Mendota Pool during habitat assessment survey.
Phalacrocorax auritus double-crested cormorant	MBTA/WL	Found in riverine habitats within the Central Valley.	High: Observed at Mendota Pool during habitat assessment survey.
Plegadis chihi white-faced ibis (rookery site)	MBTA/WL	Forages in emergent freshwater wetlands and flooded croplands/pastures. Roosts in dense wetland vegetation.	Moderate: Observed flying over the Project area. Potential rookery and foraging habitat present in the Project area.
Xanthocephalus xanthocephalus yellow-headed blackbird	MBTA/SSC	Nests in marshes with tall emergent vegetation and areas of relatively deep water.	High: Observed along San Joaquin River corridor and Fresno Slough during valley elderberry longhorn beetle protocol surveys.
Mammals			
Eumops perotis californicus western mastiff bat	--/SSC	Roosts in crevices in cliff faces, high buildings, and tunnels; forages in arid, semi-arid habitat-coniferous and deciduous woodlands, coastal scrub, grasslands, and chaparral.	High: Although evidence of roosting habitat was not observed during the habitat assessment survey, may forage over much of the Project area.
Lasiurus blossevillii western red bat	--/SSC	Roosts primarily in trees, typically adjacent to open fields or streams, which are protected above and open below for foraging; prefers habitat edges and mosaics with trees.	High: May roost in trees in riparian habitat in the Project area, and may forage over much of the Project area.
Taxidea taxus American badger	--/SSC	Grasslands, savannas, and mountain meadows; require friable soils, and relatively open, uncultivated ground; requires suitable prey base of burrowing rodents.	Moderate: Although potentially suitable habitat is present in the Project area, no sign of this species was observed during the habitat assessment survey.

Key:

U.S. Fish and Wildlife Service and Federal Listing Categories:
BCC = Bird of Conservation Concern
FC = Candidate for Federal Listing
FD = Federally Delisted
FE = Federally Listed as Endangered
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MBTA = Protected under the Migratory Bird Treaty Act

California Department of Fish and Game State Listing Categories:
FP = Fully Protected
SC = Candidate for State Listing
SE = State Listed as Endangered
SSC = Species of Special Concern
ST = State Listed as Threatened
WL = Watch List

7.2 Regulatory Setting

7.2.1 Federal

The following subsections describe Federal laws and regulations governing the protection of wildlife resources.

Federal Endangered Species Act of 1973

The ESA (16 United States Code [USC] Sections 1531 to 1543) and subsequent amendments provide guidance for the conservation of Federally-listed species and the ecosystems on which they depend.

Prohibited Acts. Section 9 of the ESA prohibits the "take" of any fish or wildlife species listed under the ESA unless otherwise authorized by Federal regulations. The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 USC Section 1532:19). Two processes whereby take is allowed when it is incidental to an otherwise legal activity are described in Section 7 and Section 10, respectively. Section 9 of the ESA also prohibits the unlawful removal, damage or destruction of any endangered plant under Federal jurisdiction, or where in non-Federal areas, in knowing violation of any State law.

Interagency Consultation and Biological Assessments. Section 7 of the ESA provides a means for authorizing the "take" of threatened or endangered species by Federal agencies, and applies to actions that are conducted, permitted, or funded by a Federal agency. The statute requires Federal agencies to consult with the USFWS or National Marine Fisheries Service (NMFS), as appropriate, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for these species. If a proposed project "may affect" a listed species or destroy or modify critical habitat, the lead agency is required to prepare a biological assessment evaluating the nature and severity of the potential effect.

Habitat Conservation Plans. Section 10 of the ESA requires that non-Federal landowners obtaining an Incidental Take Permit from the USFWS for activities that might incidentally harm (or "take") endangered or threatened wildlife on their land. To obtain a permit, an applicant must develop a Habitat Conservation Plan that is designed to offset any harmful impacts the proposed activity might have on the species.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 USC Sections 661 to 667e et seq.) applies to any Federal project where any body of water is impounded, diverted, deepened, or otherwise modified. Project proponents are required to coordinate with USFWS and/or NMFS and the appropriate State wildlife agency.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA; USC Sections 703 to 712) makes it unlawful unless expressly authorized by permit pursuant to Federal regulations to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, offer for sale, sell, offer to purchase,

purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export at any time, or in any manner, any migratory bird, or any part, nest, or egg of any such bird."

This includes direct and indirect acts with the exception of harassment and habitat modification, which are not included unless they result in direct loss of birds, nests, or eggs. Most bird species occurring in California fall under the protection of the MBTA except those species that belong to the families not listed in any of the four treaties, such as wrentit (*Chamaea fasciata*), European starling (*Sturnus vulgaris*), California quail (*Callipepla californica*), ring-necked pheasant (*Phasianus colchicus*), and chukar (*Alectoris chukar*), among others less common in California. The MBTA is administered by USFWS Division of Migratory Bird Management.

The Migratory Bird Treaty Reform Act (Division E, Title I, Section 143 of the Consolidated Appropriations Act, 2005, Public Law 108–447) amends the MBTA (16 USC Sections 703 to 712) such that nonnative birds or birds that have been introduced by humans to the United States or its territories are excluded from protection under the Act. It defines a native migratory bird as a species present in the United States and its territories as a result of natural biological or ecological processes. This list excluded two additional species commonly observed in the United States, the rock dove (*Columba livia*) and domestic goose (*Anser domesticus*).

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC 668-668d, 54 Stat. 250) as amended, provides protection for the bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) by prohibiting the taking, possession, and commerce of such birds, their nests, eggs, or feathers unless expressly authorized by permit pursuant to Federal regulations.

Protection of Migratory Bird Populations (Executive Order 13186)

Executive Order 13186 directs each Federal agency taking actions that have or may have adverse impacts on migratory bird populations to work with the USFWS to develop a memorandum of understanding that would promote the conservation of migratory bird populations. This includes avoiding and minimizing adverse impacts on migratory bird resources when conducting agency actions, restoring and enhancing migratory bird habitats, and preventing or abating the pollution or detrimental alteration of the environment for the benefit of migratory birds.

7.2.2 State of California

The following subsections describe State laws and regulations governing the protection of biological resources.

California Endangered Species Act

The CESA (Fish & G. Code, §§ 2050 to 2085) establishes the State policy to conserve, protect, restore, and enhance threatened or endangered species and their habitats by protecting "all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, threatened with extinction and those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation." Animal species are listed by DFW as threatened or endangered, and plants are listed as rare, threatened, or endangered. However, only those plant species listed as threatened or endangered receive protection under the CESA.

The CESA mandates that State agencies do not approve a project that would jeopardize the continued existence of these species if reasonable and prudent alternatives are available that would avoid a jeopardy finding. There are no State agency consultation procedures under the CESA. For projects that would affect a species that is Federally- and State-listed, compliance with ESA satisfies the CESA if DFW determines that the Federal incidental take authorization is consistent with the CESA under Section 2080.1. For projects that would result in take of a species that is State listed only, the project sponsor must apply for a take permit, in accordance with Section 2081, subdivision (b).

Fully Protected Species

Four sections of the Fish and Game Code (§§ 3511, 4700, 5050, and 5515) list 37 fully protected species. These sections prohibit take or possession "at any time" of the species listed, with few exceptions, and state that "no provision of this code or any other law will be construed to authorize the issuance of permits or licenses to 'take' the species," and that no previously issued permits or licenses for take of the species "shall have any force or effect" for authorizing take or possession.

Bird Nesting Protections

Bird nesting protections in the Fish and Game Code (§§ 3503, 3503.5, 3511, and 3513) include the following.

- Section 3503 prohibits the take, possession, or needless destruction of the nest or eggs of any bird.
- Section 3503.5 prohibits the take, possession, or needless destruction of any nests, eggs, or birds in the orders Falconiformes (new world vultures, hawks, eagles, ospreys, and falcons, among others), or Strigiformes (owls).
- Section 3511 prohibits the take or possession of fully protected birds.
- Section 3513 prohibits the take or possession of any migratory nongame bird, or part thereof, as designated in the MBTA.

To avoid violation of the take provisions, it is generally required that project-related disturbance at active nesting territories be reduced or eliminated during the nesting cycle.

Lake and Streambed Alteration

Fish and Game Code section 1600 et seq. requires DFW to be notified before any project activity that would do any of the following.

- Substantially divert or obstruct the natural flow of any river, stream, or lake.
- Substantially change or use any material from the bed, channel, or bank of any river, stream, or lake.

- Deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake.

The Lake and Streambed Alteration notification requirement applies to work undertaken in or near a river, stream, or lake that flows at least intermittently through a bed or channel. This includes ephemeral streams, desert washes, and watercourses with subsurface flow. It may also apply to work undertaken in the floodplain. Preliminary notification and project review generally occur during the environmental process.

When an existing fish or wildlife resource may be substantially adversely affected, DFW proposes reasonable modifications to the project to protect the resources. These modifications, or conditions, are formalized in a Lake or Streambed Alteration Agreement that becomes part of the plans, specifications, and bid documents for the project.

Natural Communities Conservation Planning Act

This act was enacted to encourage broad-based planning to provide for effective protection and conservation of the State's wildlife resources while continuing to allow appropriate development and growth (Fish & G. Code, §§ 2800 to 2835). Natural Community Conservation Plans may be implemented, which identify measures necessary to conserve and manage natural biological diversity within the planning area, while allowing compatible and appropriate economic development, growth, and other human uses.

7.2.3 Regional and Local

The following subsections describe the regional and local regulations governing the protection of wildlife resources.

San Joaquin River Management Program

The San Joaquin River Management Program was authorized by Assembly Bill (AB) 3603 and signed by the governor on September 18, 1990. Specific issues addressed by San Joaquin River Management Program include flood protection, water supply, water quality, recreation, fisheries, and wildlife. San Joaquin River Management Program produced a report in 1995, outlining recommendations in the form of projects, studies, and acquisitions.

Central Valley Joint Venture

The Central Valley Joint Venture is a self-directed coalition consisting of 20 Federal and State agencies and private conservation organizations. This partnership directs its efforts toward the common goal of providing for the habitat needs of migrating and resident birds in the Central Valley of California. The Central Valley Joint Venture was established in 1988 as a regional partnership focused on the conservation of waterfowl and wetlands under the North American Waterfowl Management Plan. It has since broadened its focus to the conservation of habitats for other birds, consistent with major national and international bird conservation plans and the North American Bird Conservation Initiative. The Central Valley Joint Venture Implementation Plan (2006) has identified specific goals and objectives for conservation activities for waterfowl, shorebirds, waterbirds, and riparian songbirds.

Fresno County General Plan

The Open Space and Conservation Element of the Fresno County General Plan (Fresno County 2000) outlines several policies designed to protect wildlife and their habitat. These policies include the following.

- Policies OS-D.4 through OS-D.6 require the protection of wetlands, riparian areas, and the adjacent upland habitats.
- Policies OS-E.1 through OS-E.18 require the protection of wildlife habitats and movement and migration corridors through construction buffers, management practices, conservation plans, pest control, pesticide use monitoring, and conservation.

Madera County General Plan

The Madera County General Plan Policy Document (Madera County 1995) outlines several policies designed to protect wildlife and their habitat in the Agricultural and Natural Resources section of the plan. These policies include the following.

- Policies 5.D.4 through 5.D.6 require the protection of wetlands, riparian areas, and the adjacent upland habitats.
- Policies 5.E.1through 5.E.10 require the identification and protection of wildlife habitats, including habitat for rare, threatened, endangered, and indigenous species, through management practices, monitoring of pesticide use, ground squirrel control, environmental review processes, and conservation.

7.3 Environmental Consequences and Mitigation Measures

7.3.1 Impact Assessment Methodology

This section describes the methods used to evaluate potential impacts to wildlife resources. First described are the background reviews and field surveys which were used or conducted to identify wildlife resources that may be impacted by the Project. The specific methods that were used to determine Project impacts are then described.

Identification of Wildlife Resources in the Project Area

Wildlife resources potentially occurring in the Project area were identified through queries of existing databases and agency information and by field surveys. Three primary databases were reviewed to obtain special-status wildlife species occurrence data from within the Project area and vicinity: CNDDB (DFW 2009), USFWS Sacramento Field Office Species List (USFWS 2009), and Audubon Society Important Bird Area species list for the Mendota Wildlife Area (Audubon Society 2009). These and other sources of information used are described in detail in the Mendota Pool Bypass and Reach 2B Improvements Project *Technical Memorandum on Environmental Survey Results* (SJRRP 2011a, Section 3).

Wildlife habitat assessment surveys were conducted to identify and map habitats present within the Project area and to record direct and indirect wildlife observations. These surveys were conducted in the Project area from August 23 through 27, 2010. With the exception of developed agricultural areas, surveys were conducted on foot throughout portions of the Project area where access to private- or publicly-owned property had been granted, primarily parcels located south of the San Joaquin River. In developed agricultural areas and where foot surveys were not possible, either because vegetation was too dense or access was not granted, "windshield surveys" were done largely by a biologist observing from a car. For these windshield surveys, the field team used binoculars and a spotting scope to observe habitat features and wildlife from the public road. Approximately 90 percent of the habitat within the Project area was confirmed through on-site surveys.

Supplemental focused surveys were conducted for birds, valley elderberry longhorn beetle, and small mammals. A post-breeding season bird survey was conducted on August 26, 2010, and an early breeding season bird survey was conducted on March 3, 2011. Additional surveys were conducted in 2014. Protocol level surveys were conducted for valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) March 1, 2011 through March 4, 2011 and March 8, 2011 through March 9, 2011 according to the protocol established by USFWS in Conservation Guidelines for the Valley Elderberry Longhorn Beetle (USFWS 1999) in applicable areas with authorized site access. While these surveys provide an estimate for comparing alternatives, the area will need to be resurveyed for valley elderberry longhorn beetle as part of the permitting process. Small mammal trapping, focused on detection of Fresno kangaroo rat (*Dipodomys nitratoides exilis*), was conducted during summer 2011 in applicable areas with authorized site access.

Habitat data collected during the habitat assessment surveys were used in combination with existing data and aerial photograph interpretation to map wildlife habitats throughout the Project area. The habitat types were largely defined according to the California Wildlife-Habitat Relationships System (WHR 2010); however, certain habitats were also defined using Holland (1986) and Moise and Hendrickson (2002), where appropriate. Additional description of field surveys and habitat mapping are presented in the Mendota Pool Bypass and Reach 2B Improvements Project *Technical Memorandum on Environmental Survey Results* (SJRRP 2011a, Section 3).

The assessment of wildlife resources would be amended when access to the entire Project area is granted, or following additional surveys, should they be implemented before land acquisition. Surveys may determine that habitat for special-status species is not present in the Project area. For certain target species, protocol-level surveys may be conducted; if target species are not encountered, a species may be considered absent with agency approval. In these situations, impacts to those wildlife resources would not exist and implementation of the conservation measures for the protected species would no longer be required.

Impact Evaluation Methodology

The evaluation of potential impacts to wildlife resources used in the alternatives analysis is both quantitative and qualitative in nature. Wherever possible, quantitative analyses were used to determine the acres of potential habitat lost or altered for each special-status wildlife species as a result of the Project. Included in this analysis was direct habitat loss that would occur as a result of Project construction activities including grading, levee construction, and the placement of fill, and indirect habitat loss that would result from new hydrologic patterns that may over time alter existing vegetation and habitats.

To calculate these impacts, geographic information system data were used to create a master habitat layer, based on the wildlife habitat mapping effort described above, to estimate the location and area of potential habitat present within the Project area under existing conditions. Most species-specific impact calculations were generated by intersecting Project impact layers with the appropriate habitat types for each species. This methodology was used to generate impact numbers for each species for each alternative.

Species that were not analyzed using this methodology included valley elderberry longhorn beetle, blunt-nosed leopard lizard, giant garter snake, western pond turtle, and Fresno kangaroo rat. Impacts due to habitat loss for valley elderberry longhorn beetle were estimated based on a count of elderberry shrubs affected by each alternative. The analysis of blunt-nosed leopard lizard and Fresno kangaroo rat habitat loss included the results of species-specific habitat surveys. Habitat loss for giant garter snake and western pond turtle were assessed using the distribution of their aquatic habitats and an associated 200-foot upland buffer.

Potential impacts were also evaluated qualitatively for individual special-status wildlife species and potential wildlife habitat. Examples of impacts that were evaluated qualitatively include noise, motion and startle, dust, and changes in hydrology.

7.3.2 Significance Criteria

For impacts to wildlife resources, the thresholds of significance are based on Appendix G of the State California Environmental Quality Act (CEQA) Guidelines. Under National Environmental Policy Act (NEPA) Council on Environmental Quality (CEQ) Regulations, effects to wildlife resources were evaluated in terms of their context and intensity. The Project would result in a significant impact on wildlife resources if it would do any of the following.

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by DFW or USFWS.
- Interfere substantially with the movement of any native resident or migratory wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.

- Conflict with the provisions of an adopted habitat conservation plan, Natural Communities Conservation Plan, or other approved State, regional or local habitat conservation plans.

7.3.3 Impacts and Mitigation Measures

This section provides a project-level evaluation of direct and indirect effects of the Project Alternatives on wildlife resources. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential impacts compared to existing conditions to meet CEQA requirements. The analysis is organized by Project alternative with specific impact topics numbered sequentially under each alternative. With respect to wildlife, the environmental impact issues and concerns are:

1. Project Effects on Special-Status Invertebrate Species.
2. Project Effects on Special-Status Reptile Species.
3. Project Effects on Special-Status Bird Species.
4. Project Effects on Special-Status Mammal Species.
5. Project Effects on Wildlife Movement Corridors.
6. Long-term Habitat Improvement in Reach 2B.

Other wildlife-related issues covered in the Program Environmental Impact Statement/Report (PEIS/R) (SJRRP 2011b) are not covered here because they are programmatic in nature and/or are not relevant to the Project area.

Issues Eliminated from Further Analysis

Recovery Areas and Designated Critical Habitat. Recovery plans are non-regulatory documents developed by the USFWS to provide guidance for the recovery of threatened or endangered species. Recovery plans typically identify recovery or core areas that are important to the survival and recovery of a species. Critical habitat is a term defined and used in the ESA that refers to a specific geographic area that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

San Joaquin Kit Fox Recovery Area. The *Recovery Plan for the Upland Species of the San Joaquin Valley, California* (USFWS 1998) identifies recovery areas for the San Joaquin kit fox. These areas are mapped and named in the *San Joaquin Kit Fox (Vulpes macrotis mutica) 5-Year Review: Summary and Evaluation* (USFWS 2010). The Project area overlaps with Satellite Area 4: Western Madera County. Although the 5-Year Review states that the species is presumed to be extirpated from this area (locally extinct) (USFWS 2010), USFWS has indicated in Project-related correspondence that kit fox occur on, or directly adjacent to the Alkali Sink Ecological Reserve located approximately 2 miles south of the Project area (Raabe, pers. comm. 2015). Project surveys have failed to confirm the presence of this species in Project area and vicinity and Project activities are not expected to have any adverse impact to San Joaquin kit fox recovery areas. Therefore, conflicts with this recovery plan are not further addressed in this document.

Vernal Pool Recovery Area. The *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) identifies 16 vernal pool regions that contain 41 core areas, which are considered critical to the preservation and recovery of one or more vernal pool species addressed by the plan. The Project area overlaps with the San Joaquin Valley vernal pool region but does not overlap with any of the core areas. Project activities are not expected to have any impact to core vernal pool recovery areas; and therefore, this issue is not further addressed in this document.

Fresno Kangaroo Rat Critical Habitat. Critical habitat for the Fresno kangaroo rat was designated on January 30, 1985 (50 CFR 4222–4226). This critical habitat unit does not overlap with the Project area but is located less than 2 miles south. Project activities are not expected to have any impact to Fresno kangaroo rat critical habitat; and therefore, this issue is not further addressed in this document.

Habitat Conservation Plans. There are no adopted habitat conservation plans, Natural Communities Conservation Plan, or other approved State, regional, or local habitat conservation plans in the Project area. Therefore, Project activities would not conflict with any such plans and this issue is not further addressed in this chapter.

Other Local and Regional Plans. The Fresno County General Plan and the Madera County General Plan are described under Regulatory Setting in Section 7.2.3, Regional and Local. The policies identified in these plans to protect biological resources are consistent with requirements of other State and Federal regulations. Project activities would not conflict with these policies; therefore, local and regional plans are not further addressed in Section 7.3, Environmental Consequences.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration, augmentation of river flows (including Restoration Flows in Reach 2B up to the existing capacity of the reach, and reintroduction of salmon. The augmentation of flows would allow riparian vegetation to naturally re-establish on river banks, especially upstream of San Mateo Avenue crossing. Without the Project in Reach 2B, however, the proposed actions in other reaches would not achieve the Settlement goals. This section describes the impacts of the No-Action Alternative. The analysis is a comparison to existing conditions, as described in Section 7.1, Environmental Setting. No mitigation is required for No-Action.

Impact WILD-1 (No-Action Alternative): ***Project Effects on Special-Status Invertebrate Species.*** Under the No-Action Alternative, the Project would not be implemented and there would be no construction activities in the Project area. The continuation of Restoration Flows would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This would be a potentially beneficial effect on valley elderberry longhorn beetles, as increases in riparian vegetation would likely increase the number of elderberry shrubs, the beetle’s host plant. As a result, there would be a **beneficial** effect on special-status invertebrate species.

Impact WILD-2 (No-Action Alternative): ***Project Effects on Special-Status Reptile Species.*** Under the No-Action Alternative, the Project would not be implemented and there would be no construction activities in the Project area.

Currently, in the summer, the San Joaquin River arm of Mendota Pool extends to San Mateo Avenue, providing approximately 7 linear miles of slackwater habitat. Current management activities include drawing down Mendota Pool periodically (approximately every 2 years) during winter months for dam inspections and routing a portion of spring and early summer flood flows through Reach 2B. Although both of these activities could temporarily reduce prey base or habitat suitability for giant garter snake or western pond turtle, the margins of Mendota Pool areas near Mendota Dam and along the San Joaquin River arm are otherwise largely suitable for giant garter snake basking and foraging during most of their active period. Restoration Flows associated with the No-Action Alternative would provide flow along Reach 2B in summer months (approximately 45 cubic feet per second [cfs]) for all water year types except for critical years. This flow regime is not very different from flow through Reach 2B in recent years under Interim Flows. With the No-Action Alternative flows through Reach 2B would be limited by the existing channel capacity (additional flow would be routed through the Chowchilla Bypass), and would therefore be similar to Interim Flows.

Although changes in flow that affect water temperature and velocity in Reach 2B, particularly between Mendota Dam and San Mateo Avenue, could affect habitat suitability for giant garter snakes and western pond turtles and their prey along the river channel, the change from Interim Flows to Restoration Flows would be relatively small. These changes are not expected to affect the other special-status reptile species (blunt-nosed leopard lizard, silvery legless lizard, San Joaquin coachwhip, and coast horned lizard). The Program would implement Conservation Measure GGS-2, which includes restoration of giant garter snake habitat temporarily affected and compensation for giant garter snake habitat permanently affected (SJRRP 2011b, PEIS/R Table 2-7, page 2-65). In conclusion, there would be a **less than significant** impact to special-status reptiles.

Impact WILD-3 (No-Action Alternative): ***Project Effects on Special-Status Bird Species.*** Under the No-Action Alternative, the Project would not be implemented and there would be no construction activities in the Project area. The continuation of Restoration Flows would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This would provide greater foraging and nesting habitat for Swainson’s hawks, white-tailed kites, and short-eared owls. No special-status birds are expected to be adversely affected. As a result, there would be a **beneficial** effect on special-status birds.

Impact WILD-4 (No-Action Alternative): ***Project Effects on Special-Status Mammal Species.*** Under the No-Action Alternative, the Project would not be implemented and there would be no construction activities in the Project area. The continuation of Restoration Flows would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This would provide greater foraging and roosting habitat for western red bats and more foraging habitat for western mastiff bats. There would be no adverse effects to American badgers. As a result, there would be a **beneficial** effect on special-status mammals.

Impact WILD-5 (No-Action Alternative): ***Project Effects on Wildlife Movement Corridors.*** Under the No-Action Alternative, the Project would not be implemented and there would be no construction activities in the Project area. The continuation of Restoration Flows would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This would provide cover and forage for animals moving along the river course. It would also provide more habitat for migratory bird species that may use the area as a stopping point for seasonal migrations. As a result, there would be a **beneficial** effect on wildlife movement.

Impact WILD-6 (No-Action Alternative): ***Long-term Habitat Improvement in Reach 2B.*** Under the No-Action Alternative, Restoration Flows would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This would provide for long-term opportunities for habitat improvement in Reach 2B. As a result, there would be a **beneficial** effect on wildlife habitat.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would include construction of Project facilities including a Compact Bypass channel, a new levee system with a narrow floodplain encompassing the river channel, and the South Canal. Other key features include construction of the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, the South Canal bifurcation structure and fish passage facility, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure of the Chowchilla Bifurcation Structure. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

This alternative includes passive riparian habitat restoration and agricultural practices in the floodplain. It is assumed that over time wetland communities and a dense riparian scrubland would develop along the main channel and river banks, respectively. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur.

Table 7-5 summarizes potential habitat impacts by acreage for all vertebrate species with the potential to occur in the Project area. These acreages represent the worst-case scenario where all existing floodplain areas are assumed to be impacted. “Floodplain” primarily refers to the floodplain of the San Joaquin River and the acreage impacted under this category may be disturbed up to 3 years following construction, but is expected to eventually return to habitat. “Infrastructure” generally refers to area permanently converted to structures, levees, or roads. The borrow acreages refer to the maximum amount of habitat for each species that could be disturbed to take fill materials for levees. “Other” refers to construction staging areas, temporary access roads and other construction-related disturbances. Areas temporarily disturbed during construction would be restored to their previous contours, if feasible, and then seeded with a native vegetation seed mixture to prevent soil erosion. Some areas, such as borrow areas, may not be feasible to restore previous contours, but these areas would be smoothed and seeded (see Section 2.2.4).

Table 7-5.
Species Habitat Potentially Affected by Alternative A

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	Infrastructure	Borrow	Other
			(future habitat or agriculture)	(not future habitat)	(future habitat or agriculture)	
Reptiles						
Actinemys marmorata	western pond turtle	Upland	165	21	45	11
		Aquatic	112	16	43	19
		Wetland	18	4	3	2
Anniella pulchra pulchra	silvery legless lizard	Habitat	399	55	205	27
Gambelia sila	blunt-nosed leopard lizard	Habitat	4	13	0	0
Masticophis flagellum ruddocki	San Joaquin coachwhip	Habitat	139	27	200	3
Phrynosoma blainvillii	coast horned lizard	Habitat	210	41	201	3
Thamnophis gigas	giant garter snake	Upland	165	21	45	11
		Aquatic	112	16	43	19
		Wetland	18	4	3	2
Birds						
Agelaius tricolor	tricolored blackbird	Foraging	346	135	350	23
		Nesting	118	27	38	8
Anser albifrons elgasi	greater white-fronted goose	Foraging	210	26	53	21
Asio flammeus	short-eared owl	Foraging and Nesting	132	32	200	3
		Foraging	256	127	350	25
Athene cunicularia	burrowing owl	Foraging and Nesting	132	32	200	3
		Foraging	256	127	350	25
Aythya americana	Redhead	Foraging	180	20	48	19
		Nesting	30	6	5	2
Buteo swainsoni	Swainson's hawk	Foraging	476	160	350	29
		Nesting	261	36	5	23
Charadrius montanus	mountain plover	Foraging	388	159	350	28
Circus cyaneus	northern	Foraging	274	133	350	25

Table 7-5.
Species Habitat Potentially Affected by Alternative A

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	**Infrastructure**	**Borrow**	**Other**
			(future habitat or agriculture)	**(not future habitat)**	**(future habitat or agriculture)**	
	harrier	Nesting	208	35	205	6
Elanus leucurus	white-tailed kite	Foraging	489	162	350	31
		Nesting	261	36	5	23
Grus canadensis canadensis	lesser sandhill crane	Foraging	464	162	350	31
Grus canadensis tabida	greater sandhill crane	Foraging	464	162	350	31
Lanius ludovicianus	loggerhead shrike	Foraging	370	154	350	28
		Foraging and Nesting	18	5	0	0
Numenius americanus	long-billed curlew	Foraging	388	159	350	28
Pelecanus erythrorhynchos	American white pelican	Foraging	210	26	53	21
Xanthocephalus xanthocephalus	yellow-headed blackbird	Foraging	370	154	350	28
		Nesting	94	9	5	3
Mammals						
Dipodomys nitratoides exilis	Fresno kangaroo rat	Habitat	4	13	0	0
Eumops perotis californicus	Western mastiff bat	Foraging	528	173	350	41
Lasiurus blossevillii	Western red bat	Roosting and Foraging	727	118	350	44
Taxidea taxus	American badger	Habitat	139	27	200	3

Notes:
Floodplain = floodplain of the San Joaquin River (passive restoration and agricultural activities)
Infrastructure = structures, levees, or roads
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact WILD-1 (Alternative A): ***Project Effects on Special-Status Invertebrate Species.*** Compared to the No-Action Alternative, Alternative A could affect special-status invertebrate species, including valley elderberry longhorn beetle, due to construction-related activities and habitat modifications. Construction-related activities (including construction vehicle traffic, the temporary use of land for staging and access areas, noise, light, and vibration from construction activities, and other site-preparation activities such as grubbing, grading, tree removal, excavation, and driving off-road) in suitable habitat for valley elderberry longhorn beetle could result in mortality, injury, or harassment of adults, eggs, and juveniles of special-status invertebrates.

Elderberry shrubs were mapped at a number of locations within the Alternative A footprint in the riparian corridor along the river channel and in elderberry savannah habitat (SJRRP 2011a). Levee construction, removal, and protection; floodplain grading; and the placement of other Project infrastructure (e.g., South Canal bifurcation structure) would result in long-term habitat conversion or modification, including damage or removal of valley elderberry host plants and modifications to riparian scrub and elderberry savannah habitats that may support the species. The majority of shrubs that are potentially affected are in future floodplain areas (i.e., up to 479 shrubs). These areas would be allowed to return to natural habitats after Project construction is complete, which would provide suitable habitat for elderberry shrubs after construction is complete, especially along the main river channel banks where many of the elderberry shrubs occur now. A smaller number of shrubs are in habitats that would be converted to Project infrastructure or levees (51 shrubs in riparian areas and 9 shrubs in non-riparian areas). Conservation Measures VELB-1 and VELB-2 include pre-construction surveys for elderberry shrubs and beetle exit holes, avoidance of elderberry shrubs found in the Project area, and compensatory mitigation for shrubs unavoidable during construction (Table 2-8).

Long-term effects of Alternative A include passive riparian habitat restoration in the floodplain. The continuation of Restoration Flows in the expanded floodplain would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This could have a beneficial effect on valley elderberry longhorn beetles, as increases in riparian vegetation would likely increase the number of elderberry shrubs, the beetle’s host plant.

When comparing Alternative A to existing conditions, impacts to special-status invertebrate species would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Because implementation of Project conservation measures will compensate for potential impacts, and because the completed Project would provide habitat for elderberry shrubs, Project impacts are considered **less than significant**.

Impact WILD-2 (Alternative A): ***Project Effects on Special-Status Reptile Species.*** Compared to the No-Action Alternative, Alternative A could affect special-status reptile species (i.e., blunt-nosed leopard lizard, giant garter snake, western pond turtle, silvery legless lizard, San Joaquin coachwhip, and coast horned lizard) due to activities such as vehicle traffic, the temporary use of land for staging and access areas, noise, light, vibration, and other construction-related activities (e.g., grubbing, grading, tree removal, excavation, and driving off-road) that could alter reptile habitat and directly affect special-status reptile species. These direct effects on special-status reptiles could include mortality, injury, or harassment of adults, eggs, or juveniles as a result of construction activities in suitable habitat. Construction may also result in the destruction or degradation of habitat and the loss of nesting areas, burrows, or other refugia. Mortality, injury, or harassment may also occur if these species become trapped in open, excavated areas. Construction activities could result in temporary shifts in foraging patterns or territories and increased predation as a result of increased noise, light, infrastructure, and ground vibrations where suitable habitat is present.

Indirect effects on reptiles may include the inadvertent introduction of non-native invasive (noxious) weeds, which can reduce habitat suitability (see Chapter 6.0, “Biological Resources – Vegetation”). However, Conservation Measure INV-1 includes measures to monitor, control, and where possible eradicate invasive plant infestations during construction activities (see Table 2-8). Soil compaction, cutting, and the placement of fill in suitable habitat may indirectly affect special-status reptiles by temporarily prohibiting burrowing, or by changing the frequency of vegetative cover. Construction activities may attract opportunistic predators (e.g., ravens, feral cats, and raccoons) that may feed on special-status reptiles.

Direct effects include the conversion of one habitat type to another or to Project infrastructure. This could result in the loss of individual special-status reptiles and their habitats within the limits of disturbance. However, much of the affected habitat within the floodplain would be allowed to return to natural habitat following Project construction disturbance, and these areas would continue to provide suitable habitat for special-status reptiles (Table 7-5). Some areas with habitat for special-status reptiles would be temporarily affected during construction for construction staging or construction access. Borrow areas that provide suitable habitat for special-status reptiles could be temporarily affected. Project infrastructure would result in a small amount of loss or modification of wetland (e.g., Mendota Pool Dike) and upland habitats that may support special-status reptile species.

Implementation of Alternative A would directly affect a small amount of habitat identified as potentially suitable for blunt-nosed leopard lizard (Table 7-5). A small portion of the area affected would become natural habitat again upon Project completion, and a larger portion would be converted to Project infrastructure or levees. Construction could result in destruction of rodent burrows used by lizards for shelter. DFW lists the blunt-nosed leopard lizard as a fully-protected species. Direct take (killing or injuring) of individual lizards is prohibited. To comply with this level of protection, Conservation Measures BNLL-1 includes focused site visits and habitat assessment in potentially suitable habitat, and if necessary, protocol-level surveys, in coordination with USFWS and DFW (Table 2-8). If blunt-nosed leopard lizard were detected, measures to avoid direct take would be implemented before ground disturbing activities. Conservation Measure BNLL-2 requires that compensation for impacts to habitat for the species would be determined in coordination with USFWS and DFW. These conservation measures are designed to avoid any direct take of blunt-nosed leopard lizards.

The primary habitat of one of 13 remnant populations of giant garter snake is Mendota Wildlife Area, roughly 3 miles south of the Project area and hydraulically connected to Mendota Pool via Fresno Slough (SJRRP 2011a). Implementation of Alternative A would directly affect open water, upland, and emergent wetland habitat potentially used by giant garter snake (Table 7-5). Most of the habitat affected would be left to passively return to natural habitat upon Project completion. Some of the habitat would be temporarily affected by construction staging or access, and some of the habitat would be converted to Project infrastructure and levees. Although the exact location of the up to 350 acres of borrow has not been identified, potential borrow areas include some giant garter snake habitat; these areas would be avoided when feasible. Conservation Measure GGS-1 includes preconstruction surveys, avoidance of suitable giant garter snake habitat, restriction of ground disturbance in suitable habitat to the active season for giant garter snakes, and other measures to avoid and minimize harming giant garter snakes during construction (see Table 2-8). Conservation Measure GGS-2 includes restoration of giant garter snake habitat temporarily affected during construction.

Although construction may not directly affect certain areas of suitable habitat for giant garter snake, these areas may be indirectly affected by hydrologic changes in the San Joaquin River that would result from Project implementation. In the No-Action Alternative, much of the aquatic habitat in the Project area is maintained wet through much of the giant garter snake's summer active period by artificial impoundment of water behind Mendota Dam. The San Joaquin River arm of Mendota Pool extends to San Mateo Avenue in summer months, providing approximately 7 linear miles of slackwater habitat. Current management activities include drawing down Mendota Pool periodically during winter months and routing a portion of spring and early summer flood flows through Reach 2B; these management activities will continue under Alternative A. Although both of these activities could temporarily reduce prey base or habitat suitability for giant garter snake or western pond turtle, the margins of Mendota Pool areas near Mendota Dam and along the San Joaquin River arm are otherwise largely suitable for giant garter snake basking and foraging during most of their active period.

Project implementation would largely remove the San Joaquin arm of Mendota Pool. Alternative A would limit its extent to the Mendota Pool Dike; therefore, upstream aquatic conditions during the giant garter snake active period may vary over time and be a mix of slackwater, flowing water, and dry channel, which would likely be less suitable for giant garter snake than conditions currently found in Mendota Pool. Under Alternative A, the linear extent of the near-permanent slackwater habitat in the San Joaquin arm of Mendota Pool would be reduced to 0.6 mile. Although giant garter snakes would find suitable habitat in the Fresno Slough arm of Mendota Pool and may find some suitable habitat in the reconfigured river channel, compared to the No-Action Alternative, this would likely result in a reduction in potentially suitable habitat for giant garter snake. This could similarly affect western pond turtle, an aquatic turtle that is expected to prefer similar habitats in the Project area as giant garter snake. However, Conservation Measure GGS-2 includes compensation for the long-term loss of giant garter snake habitat at a ratio and in a manner determined through consultation with USFWS and DFW including specific measures such as the restoration and creation of suitable habitat (Table 2-8).

Long-term effects of Alternative A include passive restoration in the expanded floodplain. Floodplain habitat would include floodplain benches and floodplain channels inundated under high flow conditions (i.e., high flow channels) which would have lower velocities than the main channel (see Figure 2-3). This could provide some suitable habitat for giant garter snakes, western pond turtles, and their prey near the main channel of the river. Changes in flow regime that affect water temperature and velocity are not expected to affect the other special-status reptile species (blunt-nosed leopard lizard, silvery legless lizard, San Joaquin coachwhip, and coast horned lizard). However, these special-status reptiles could benefit from the conversion of agricultural lands to restored natural habitat.

When comparing Alternative A to existing conditions, impacts to special-status reptile species would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Temporary impacts during construction activities would vary spatially and occur intermittently within the overall construction timeframe for the entire Project, and most of the habitat for special-status reptiles affected would either be restored or remain as natural habitats at Project completion. Implementation of conservation measures would control or eradicate non-native invasive plants, which can negatively impact special-status reptiles. Conservation measures to avoid and minimize impacts, and/or to compensate for impacts, have been incorporated into the Project for blunt-nosed leopard lizard and giant garter snake. Avoidance, minimization, and compensation measures incorporated into the Project for giant garter snake would also benefit western pond turtle. Therefore, impacts to special-status reptile species are considered **less than significant**.

Impact WILD-3 (Alternative A): ***Project Effects on Special-Status Bird Species.*** Compared to the No-Action Alternative, Alternative A could affect special-status bird species (i.e., Swainson's hawk, white-tailed kite, greater sandhill crane, tricolored blackbird, greater white-fronted goose, short–eared owl, burrowing owl, redhead, mountain plover, northern harrier, lesser sandhill crane, loggerhead shrike, long-billed curlew, American white pelican, and yellow-headed blackbird) due to construction-related activities and habitat modifications. Direct effects of construction-related activities to special-status bird species include the potential mortality, injury or harassment of adults, juveniles, and nests due to construction vehicle traffic; the temporary use of land for staging and access areas; noise, light, and vibration from construction activities; and other site-preparation activities (i.e., grubbing, grading, tree removal, excavation, and driving off-road). Levee construction, removal, and protection, floodplain grading, and the placement of other Project infrastructure (i.e., South Canal bifurcation structure) would result in long-term conversion or modification of habitat that may support special-status bird species after construction is complete.

Almost all native bird species are protected broadly under the Migratory Bird Treaty Act. To avoid and minimize adverse effects to native birds, Conservation Measure MBTA-1 (Table 2-8) will restrict some Project activities to the non-breeding season. Conservation Measure MBTA-1 will also establish an Avian Protection Plan to further minimize and/or avoid adverse effects to native bird species. Direct effects on breeding raptor species would be avoided or minimized by implementation of Conservation Measures RAPTOR-1 and RAPTOR-2 (Table 2-8). These measures would restrict some construction activities to the non-breeding season to protect nests. If nests are found, a no-disturbance buffer would be established until birds have fledged. If any native trees suitable for raptor nesting are removed during Project activities, they would be replaced. Effects to riparian nesting birds would be avoided or minimized by Conservation Measure RNB-1 and

RNB-2. These measures require preconstruction surveys when riparian nesting birds are anticipated in the Project area, and construction avoidance and minimization measures.

Indirect effects of construction activities on birds may include creation of conditions in active work areas that attract opportunistic predators such as raccoons and domestic cats. Changes to vegetation type and structure, including the introduction of non-native invasive plant species, may decrease habitat suitability for foraging, nesting, or cover. Conservation Measure INV-1 (Table 2-8) would lessen the effects of invasive plant species by controlling and eradicating invasive plants where possible.

Implementation of Alternative A is likely to result in a combination of adverse effects as a result of construction, followed by long-term beneficial effects to special-status bird species. The placement of structures and levees would affect only a small proportion of habitat within the Project footprint (Table 7-5). Areas used for construction staging or access would be revegetated or returned to pre-project conditions; borrow areas would be disturbed during construction and revegetated at lower elevations (see Section 2.2.4). The analysis of effects to habitat for special-status bird species is based on species' association with specific habitats, but many of these species are capable of occurring across a variety of habitat types.

Implementation of Alternative A would affect habitat suitable for Swainson's hawk foraging and nesting (Table 7-5). To reduce the adverse effects of construction to Swainson's hawks, Conservation Measure SWH-1 requires preconstruction surveys for nesting Swainson's hawks. If nests are found, a no-disturbance buffer would be established until the nest is inactive. Most of the areas affected by Project activities would be passively returned to natural habitat, but a smaller portion would be converted to Project infrastructure or levees. Removal of foraging habitat or nesting trees will be compensated by establishing habitat suitable for foraging and nesting trees suitable for Swainson's hawks (Conservation Measure SWH-2, Table 2-8).

Burrowing owls require special consideration as, unlike other bird species addressed in this document, they live in underground burrows, making them particularly susceptible to ground disturbance, digging, and excavating. To protect burrowing owls and minimize effects, Conservation Measures BRO-1 and BRO-2 will be implemented (Table 2-8). These measures would decrease potential for adverse effects by avoiding work around active burrows. No-disturbance zones would be established around occupied burrows. Burrowing owls in the Project area would be passively relocated if they are not breeding. If occupied burrows are destroyed during construction, burrows outside of the active Project area would be enhanced or created to provide habitat for these birds.

Long-term effects of Alternative A include passive riparian habitat restoration in the floodplain. The continuation of Restoration Flows in the expanded floodplain would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This would provide greater foraging and/or nesting habitat for Swainson's hawks, white-tailed kites, and short-eared owls.

When comparing Alternative A to existing conditions, impacts to special-status bird species would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Implementation of Alternative A should eventually result in a long-term net increase in the type and diversity of aquatic and riparian microhabitats associated with the river system. Project construction would require significant modifications to the existing levees, which would result in the loss of riparian nesting and foraging habitat. These impacts would be mostly temporary, and most of the habitat suitable for special-status birds would be allowed to return to riparian floodplain habitats or restored at Project completion. Avoidance, minimization, and conservation measures incorporated into the Project are broadly protective, reducing impacts to nesting activity for essentially all native birds. Additional measures would reduce impacts to raptors, with special attention to Swainson's hawk and burrowing owl. Loss of Swainson's hawk nesting and foraging habitat would be compensated. With the inclusion of these conservation measures, project impacts to special-status bird species are considered **less than significant.**

Impact WILD-4 (Alternative A): ***Project Effects on Special-Status Mammal Species.*** Compared to the No-Action Alternative, Alternative A could affect special-status mammal species (Fresno kangaroo rat, western mastiff bat, western red bat, and American badger) due to construction-related activities and habitat modifications. Construction-related activities, including construction vehicle traffic; temporary use of land for staging and access areas; noise, light, and vibration from construction activities; and other site-preparation activities (i.e., grubbing, grading, tree removal, excavation, and driving off-road) in suitable habitat for special-status mammals could result in mortality, injury, or harassment of special-status mammal species. Levee construction, removal, and protection, and the placement of other Project infrastructure (i.e., South Canal bifurcation structure) would result in long-term habitat conversion or modification of habitats that may support these mammal species after construction is complete.

Construction activities may attract opportunistic predators that may prey on special-status mammals. Lighted construction areas could disorient species and disrupt nocturnal foraging activities. Ground disturbance could lead to the temporary loss of foraging and burrowing habitat. Most of the adverse effects associated with construction are considered temporary. For most of the special-status mammal species, much of the affected habitat would be passively returned to natural conditions following Project construction (Table 7-5). Borrow areas, staging areas and temporary access roads would be stabilized (e.g., revegetated) or returned to pre-project conditions and function as habitat following implementation of Alternative A.

Potential construction effects on western red bats and western mastiff bats would be a temporary loss or change of foraging and roosting habitat from disturbance. In order to minimize effects to special-status bats, avoidance and minimization measures are incorporated into the Project (Table 2-8). Conservation Measure BAT-1 includes surveys for locating bat roosts prior to construction activities and excluding bats from active work zones during appropriate seasons. Any roosts removed or damaged during construction will be replaced with agency-approved and suitable bat boxes (Conservation Measure BAT-2).

Potential Fresno kangaroo rat habitat quality and quantity would diminish with implementation of Alternative A due to construction activities, though the amount of potential habitat that would be affected by Project activities is small (Table 7-5). Three areas with potentially suitable habitat on the eastern end of Reach 2B of the San Joaquin River were surveyed for Fresno kangaroo rat and none were detected (SJRRP 2011a). Access for surveys was not available in all areas of potentially suitable habitat on the south side of the river and there is a low to moderate potential for the species to occur there. If present, indirect effects on Fresno kangaroo rat from temporary habitat conversion could include shifts in foraging patterns or territories, increased predation, and decreased reproductive success. Alteration and compaction of soils would render portions of the potentially suitable habitat less suitable for Fresno kangaroo rat burrowing. To minimize the potential adverse effects of construction, preconstruction transect surveys would be conducted to locate potential burrows for Fresno kangaroo rats. If burrows are found within 100 feet of the Project footprint, focused live trapping surveys would be conducted by qualified biologists using approved methodologies. If necessary, additional conservation may be developed with USFWS and DFW. Construction activities in potential habitat would be timed to occur during the non-breeding season (FKR-1, Table 2-8).[3] Implementation of Conservation Measure FKR-3 will compensate for any temporary or long-term loss of habitat or take of individuals.

Although there is a low potential for San Joaquin kit fox to occur in the Project area, Conservation Measure SJKF-1 will be implemented to identify potential dens, avoid occupied dens near construction areas, and if dens are located within the proposed work area, time construction activities to avoid the normal breeding season.

Long-term effects of Alternative A include passive riparian habitat restoration in the floodplain. The continuation of Restoration Flows in the expanded floodplain would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This would provide greater foraging and roosting habitat for western red bats and more foraging habitat for western mastiff bats.

When comparing Alternative A to existing conditions, impacts to special-status mammals would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Most of the project impacts would be limited to the duration of construction. Construction impacts would be temporary and would occur intermittently at discrete locations within the overall construction timeframe for the entire Project. Post-project conditions would passively return to natural habitats in much of the disturbed areas. Conservation measures that will be implemented for Alternative A are designed to minimize and avoid adverse impacts to special-status mammal species. With the inclusion of these measures, impacts of Alternative A to special-status mammals are considered **less than significant**.

Impact WILD-5 (Alternative A): ***Project Effects on Wildlife Movement Corridors.*** Compared to the No-Action Alternative, Alternative A could affect wildlife movement

[3] FKR-2 avoids disturbance to designated critical habitat for the species; there is no critical habitat for Fresno kangaroo rats within Reach 2B.

along migration corridors. Wildlife movement refers to localized, small distance movements made by animals within a home range; seasonal shifts for the purposes of locating food and water or breeding territory; larger dispersal movement of an individual between suitable habitats; and true trans-continental migrations. Many species, including most invertebrates, reptiles, and small mammals, are restricted to smaller distance migrations. A number of bird species (including Swainson's hawk, greater sandhill crane, greater white-fronted goose, redhead, mountain plover, northern harrier, lesser sandhill crane, loggerhead shrike, long-billed curlew, and American white pelican) make longer, seasonal migrations.

Construction activities such as vehicle traffic, the temporary use of land for staging and access areas, noise, light, vibration, and any other construction-related activities (e.g., grubbing, grading, tree removal, excavation, and driving off-road) may deter animals from using the area during migration. Construction may also result in the temporary destruction or degradation of habitat and the temporary loss of vegetated movement corridors. Direct mortality, injury, or harassment may also occur to species using the area for dispersal or migration. Construction activities may attract opportunistic predators (e.g., ravens, feral cats, and raccoons) that may feed on migrating species. Long-term construction effects include the conversion of small portions of a migration corridor to Project-related infrastructure, but also an overall expansion of habitat suitable for wildlife movement upon Project completion.

Only discrete subsections of the Project area would be under construction at any given time during the overall construction period, thereby reducing the severity of adverse effects associated with the creation of movement barriers. Wildlife would be able to move unobstructed through most of the Project area, particularly at night, throughout the duration of Project activities. In-channel construction activities will be limited to daylight hours during weekdays, leaving a nighttime and weekend periods available for wildlife movement along the river corridor (Conservation Measure EFH-2). Disturbance of riparian vegetation will also be avoided to the greatest extent practicable, as required by Conservation Measure EFH-1. Implementing Conservation Measure RHSNC-1 (Table 2-8) would minimize and avoid losses of riparian habitat. Implementing RHSNC-2 would compensate for any losses of riparian habitat or other sensitive natural communities.

Long-term effects of Alternative A include passive riparian habitat restoration in the floodplain. The continuation of Restoration Flows in the expanded floodplain would allow riparian vegetation to establish along previously bare banks of the San Joaquin River. This would provide cover and forage for animals moving along the river course. It would also provide more habitat for migratory bird species that may use the area as a stopping point for seasonal migrations. Post-project conditions would generally facilitate movement and provide habitat for many special-status species, including valley elderberry longhorn beetle, Swainson's hawk, white-tailed kite, tricolored blackbird, yellow-headed blackbird, and western red bat.

When comparing Alternative A to existing conditions, impacts to movement corridors would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Most of these impacts would be temporary and would occur intermittently within the overall construction timeframe for the entire Project. Most of the Project impacts would be limited to the duration of construction. Post-project conditions would return natural habitats to much of the disturbed areas and are expected to increase riparian vegetation, potentially improving conditions for migratory species. Impacts of Alternative A to movement corridors are considered **less than significant.**

Impact WILD-6 (Alternative A): ***Long-term Habitat Improvement in Reach 2B.*** Compared to the No-Action Alternative, Restoration Flows in Reach 2B would be conveyed through an expanded floodplain. Over time wetland communities would develop within the main channel and a dense riparian scrubland would develop along the main river channel banks. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur.

Passive riparian habitat restoration of the San Joaquin River would improve native floodplain and in-channel habitats, which would likely benefit native and potentially special-status species such as Swainson's hawk (*Buteo swainsoni*) and greater sandhill crane (*Grus canadensis tabida*). Benefits to native species would be realized through the re-introduction of perennial base flows as well as seasonal high flows in the river, which in turn would promote the establishment of riparian vegetation. Well-established native plant communities in the floodplain would support rich and diverse native flora, potentially including special-status plant species, and would provide foraging habitat and shelter for native wildlife species.

Alternative A supports the following wildlife habitat improvements:

- Restoring river-floodplain connectivity and longitudinal connectivity of riparian vegetation near the channel (without major breaks in the distribution of woody vegetation except where natural conditions prevent establishment of native trees or shrubs) that can provide cover and habitat for a variety of wildlife species.
- Creating or maintaining a combination of diverse habitats required by select wildlife species, such as species that depend on occurrence of aquatic, wetland or riparian, and upland habitats to meet various life stage requirements (e.g., western pond turtle, Swainson's hawk).
- Enhancing landscape connectivity between the river corridor and adjacent areas of ecological significance (e.g., wildlife refuges and other protected lands, biodiversity "hotspots," adjacent sloughs or tributary channels with existing riparian habitat, wildlife movement corridors, and natural preserves such as the Mendota Wildlife Area).

When comparing Alternative A to existing conditions, effects on long-term opportunities for habitat improvement in Reach 2B would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). According to habitat restoration estimates, Alternative A could provide up to 1,330 acres of wildlife habitat and up to 1,070 acres of special-status species habitat (areas not mutually exclusive) (SJRRP 2012, Attachment A). For many of these habitat types, this represents a 2- to 5-fold increase in habitat as compared to existing conditions. In general, implementation of Alternative A would cause a **beneficial** effect on wildlife habitat.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would include construction of Project features including a Compact Bypass channel, a new levee system with a wide, consensus-based floodplain encompassing the river channel, and the Compact Bypass Bifurcation Structure with fish passage facility. Other key features include construction of a fish passage facility at the San Joaquin River control structure of Chowchilla Bifurcation Structure, the re-route of Drive 10 ½ (across the Compact Bypass bifurcation structure), and removal of the San Mateo Avenue crossing. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

This alternative includes a mixture of active and passive riparian and floodplain habitat restoration and compatible agricultural activities in the floodplain. It is assumed that wetland communities and a dense riparian scrubland would develop along the main channel and river banks, respectively, and bands of other habitat types (wetland, scrub, grassland, and forest) would develop at higher elevations along the channel corridor. Plantings that are wetland species or borderline wetland species would be irrigated and managed as necessary during the establishment period.

Table 7-6 summarizes maximum habitat impacts by acreage for all vertebrate species with the potential to occur in the Project area. These acreages represent the worst-case scenario where all existing floodplain areas are assumed to be impacted.

Table 7-6.
Species Habitat Potentially Affected by Alternative B

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	Infrastructure	Borrow	Other
			(future habitat)	(not future habitat)	(future habitat or agriculture)	
Reptiles						
Actinemys marmorata	western pond turtle	Upland	170	14	47	2
		Aquatic	114	9	44	8
		Wetland	17	1	3	2
Anniella pulchra pulchra	silvery legless lizard	Habitat	414	53	206	9
Gambelia sila	blunt-nosed leopard lizard	Habitat	5	7	<0.5	<0.3
Masticophis flagellum ruddocki	San Joaquin coachwhip	Habitat	140	15	200	5

**Table 7-6.
Species Habitat Potentially Affected by Alternative B**

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	Infrastructure	Borrow	Other
			(future habitat)	(not future habitat)	(future habitat or agriculture)	
Phrynosoma blainvillii	coast horned lizard	Habitat	219	27	202	6
Thamnophis gigas	giant garter snake	Upland	170	14	47	2
		Aquatic	114	9	44	8
		Wetland	17	1	3	2
Birds						
Agelaius tricolor	tricolored blackbird	Foraging	389	51	350	10
		Nesting	120	13	38	3
Anser albifrons elgasi	greater white-fronted goose	Foraging	217	12	48	11
Asio flammeus	short-eared owl	Foraging and Nesting	135	16	200	5
		Foraging	301	46	350	5
Athene cunicularia	burrowing owl	Foraging and Nesting	135	16	200	5
		Foraging	301	46	350	5
Aythya americana	redhead	Foraging	187	10	44	9
		Nesting	30	2	4	2
Buteo swainsoni	Swainson's hawk	Foraging	523	62	350	11
		Nesting	274	38	6	4
Charadrius montanus	mountain plover	Foraging	435	62	350	10
Circus cyaneus	northern harrier	Foraging	321	48	350	5
		Nesting	208	18	204	8
Elanus leucurus	white-tailed kite	Foraging	534	65	350	13
		Nesting	274	38	6	4
Grus canadensis canadensis	lesser sandhill crane	Foraging	509	65	350	13
Grus canadensis tabida	greater sandhill crane	Foraging	509	65	350	13
Lanius ludovicianus	loggerhead shrike	Foraging	416	61	350	10
		Foraging and Nesting	20	1	<0.5	<0.2
Numenius americanus	long-billed curlew	Foraging	435	62	350	10
Pelecanus erythrorhynchos	American white pelican	Foraging	217	12	48	11
Xanthocephalus xanthocephalus	yellow-headed blackbird	Foraging	416	61	350	10
		Nesting	93	3	4	3

Table 7-6.
Species Habitat Potentially Affected by Alternative B

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	Infrastructure	Borrow	Other
			(future habitat)	(not future habitat)	(future habitat or agriculture)	
Mammals						
Dipodomys nitratoides exilis	Fresno kangaroo rat	Habitat	5	7	0	0
Eumops perotis californicus	Western mastiff bat	Foraging	585	85	350	14
Lasiurus blossevillii	Western red bat	Roosting and Foraging	829	116	350	24
Taxidea taxus	American badger	Habitat	140	15	200	5

Notes:

Floodplain = floodplain of the San Joaquin River (mixture of active and passive restoration and agricultural activities)

Infrastructure = structures, levees, or roads

Borrow = maximum amount disturbed to take fill materials for levees (reseeded)

Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact WILD-1 (Alternative B): *Project Effects on Special-Status Invertebrate Species.* Compared to the No-Action Alternative, Alternative B could affect special-status invertebrates. Construction-related effects on special-status invertebrate species would generally be the same as those described for Alternative A (see Impact WILD-1 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative B would use the Compact Bypass Bifurcation Structure to convey water from the San Joaquin River to Mendota Pool (and excludes the South Canal and associated levees). These infrastructure differences would result in effects on fewer elderberry shrubs, in comparison to Alternative A (i.e., one shrub in a riparian area and three shrubs in non-riparian areas). Up to 537 additional shrubs located in the future floodplain area are potentially affected. Conservation Measures VELB-1 and VELB-2 include pre-construction surveys for elderberry shrubs and beetle exit holes, avoidance of elderberry shrubs found in the Project area, and compensatory mitigation for shrubs unavoidable during construction (Table 2-8). Portions of the future floodplain areas would be allowed to return to natural habitats after Project construction is complete, which would provide suitable habitat for elderberry shrubs after construction is complete, especially along the main river channel banks where many of the elderberry shrubs occur now. Alternative B also features a wide, consensus-based floodplain and a mixture of active and passive restoration and floodplain compatible agricultural activities. These features would result in more riparian habitat over the long-term and presumably more valley elderberry longhorn beetle habitat than Alternative A.

Construction activity under Alternative B is expected to take 157 months; therefore, adverse effects of construction would occur over an approximately 2 years longer period as compared to Alternative A.

When comparing Alternative B to existing conditions, impacts to special-status invertebrates would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). Because these impacts would be temporary and would occur intermittently within the overall construction timeframe, and because conservation measures are in place to reduce, minimize, and compensate for impacts, they are considered **less than significant**.

Impact WILD-2 (Alternative B): ***Project Effects on Special-Status Reptile Species.*** Compared to the No-Action Alternative, Alternative B could affect special-status reptile species. Construction-related effects on special-status reptile species would generally be the same as those described for Alternative A (see Impact WILD-2 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative B would create a wide, consensus-based floodplain. This change would result in adverse effects on slightly less habitat for most special-status reptiles compared to Alternative A (see Table 7-6). Alternative B would affect nearly the same amount of potential habitat for blunt-nosed leopard lizard as Alternative A, but a smaller portion of the habitat affected would be converted to Project infrastructure than under Alternative A, potentially resulting in a smaller long-term effect on this species (if present). All adverse effects would be avoided and/or mitigated with implementation of the Conservation Measures BNLL-1 and BNLL-2 (Table 2-8). As a fully-protected species, direct take of blunt-nosed leopard lizards would be prohibited.

Alternative B would affect slightly less potential habitat for giant garter snake than Alternative A, and more of the potential habitat affected under Alternative B would remain as or be restored to natural habitats upon Project completion, resulting in a potentially reduced long-term effect on this species in comparison to Alternative A. Similar to Alternative A, measures would be implemented to minimize these adverse effects to special-status reptiles (see Impact WILD-2 [Alternative A] and Table 2-8).

The Mendota Pool control structure of the Compact Bypass Bifurcation Structure (Alternative B) would be in the same location as the Mendota Pool Dike (Alternative A). Therefore, both of these alternatives would provide equivalent amounts of slackwater habitat for giant garter snake in the San Joaquin River arm of Mendota Pool (see Impact WILD-2 [Alternative A]) following Project completion.

When comparing Alternative B to existing conditions, impacts to special-status reptiles would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). Because these impacts would occur intermittently within the overall construction timeframe, and conservation measures are in place to reduce, minimize, and compensate for impacts, they are considered **less than significant**.

Impact WILD-3 (Alternative B): ***Project Effects on Special-Status Bird Species.*** Compared to the No-Action Alternative, Alternative B could affect special-status bird species. Construction-related effects on special-status bird species would generally be the same as those described for Alternative A (see Impact WILD-3 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative B would create a wide, consensus-based floodplain. This change would result in adverse effects on slightly more habitat for most special-status birds than Alternative A (see Table 7-6). However, most of this habitat would remain as or be restored to native habitats upon Project completion. Similar to Alternative A, measures would be implemented to minimize adverse effects to special-status birds (see Impact WILD-3 [Alternative A] and Table 2-8).

The wide floodplain featured in Alternative B may provide more foraging and/or nesting habitat (compared to the narrow floodplain) for a number of species, including the Northern harrier, greater sandhill crane, Swainson's hawk, long-billed curlew, and short-eared owl, compared to both Alternative A and the No-Action Alternative. Under Alternative B, the floodplain and associated riparian habitat would include active restoration areas, whereas under Alternative A, passive restoration would depend on the availability of the existing seed bank and seed sources. Following construction of Alternative B Project components, wetland, floodplain, and riparian areas in the active restoration portion would be planted and irrigated until vegetation was established (see Chapter 2.0, "Description of Alternatives"). This could result in more rapid development of riparian habitat important to birds following construction.

When comparing Alternative B to existing conditions, impacts to special-status birds would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). Because the majority of these impacts would be temporary and would occur intermittently within the overall construction timeframe, because conservation measures are in place to reduce and minimize impacts, and because active restoration of riparian habitats would occur, they are considered **less than significant**.

Impact WILD-4 (Alternative B): ***Project Effects on Special-Status Mammal Species.*** Compared to the No-Action Alternative, Alternative B could affect special-status mammal species. Construction-related effects on special-status mammal species would generally be the same as those described for Alternative A (see Impact WILD-4 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative B would create a wide, consensus-based floodplain. The wide floodplain would generally affect more habitat for special-status mammals during construction, including areas near the river and at temporary staging areas, than Alternative A (see Table 7-6). However, most of this habitat would remain unchanged or be restored to natural habitats upon Project completion and less habitat would be converted to Project infrastructure. Similar to Alternative A, measures would be implemented to minimize these adverse effects to special-status mammals (see Impact WILD-4 [Alternative A] and Table 2-8). Following Project completion under Alternative

B, fewer acres of potential habitat for special-status mammals would be converted to infrastructure, as compared to Alternative A.

The wide floodplain featured in Alternative B may provide more foraging habitat (compared to the narrow floodplain in Alternative A or the No-Action Alternative) for bat species. Under this alternative, portions of the floodplain and associated riparian habitat would be actively restored. Following construction of Alternative B Project components, wetland, floodplain, and riparian areas in the active restoration portion would be planted and irrigated until vegetation is established (see Chapter 2.0, "Description of Alternatives").

When comparing Alternative B to existing conditions, impacts to special-status mammals would generally be the same as described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). Because impacts would be temporary and would occur intermittently within the overall construction timeframe, conservation measures are in place to reduce and minimize impacts, and active restoration of riparian habitats would occur, the impacts are considered **less than significant**.

Impact WILD-5 (Alternative B): ***Adverse Effects on Wildlife Movement Corridors.*** Compared to the No-Action Alternative, Alternative B could affect wildlife movement along migration corridors. Construction-related effects on migration corridors would generally be the same as those described for Alternative A (see Impact WILD-5 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative B would create a wide, consensus-based floodplain, which would provide a larger riparian corridor for movement. Project construction periods would be longer than Alternative A, but post-project conditions would most likely improve habitat for migrating species, especially because portions of the floodplain would be actively restored for Alternative B.

When comparing Alternative B to existing conditions, impacts to movement corridors would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). Most of these impacts would be temporary and would occur intermittently within the overall construction timeframe for the entire Project. Post-project conditions would return natural habitats to much of the disturbed areas and are expected to increase riparian vegetation, potentially improving conditions for migratory species. Impacts of Alternative B to movement corridors are considered **less than significant.**

Impact WILD-6 (Alternative B): ***Long-term Habitat Improvement in Reach 2B.*** Compared to the No-Action Alternative, Restoration Flows in Reach 2B would be conveyed through an expanded floodplain. Wetland communities would develop within the main channel, a dense riparian scrubland would develop along the main river channel banks, and bands of other habitat types (wetland, scrub, grassland, and forest) would develop at higher elevations along the channel corridor. The wetland, floodplain, and riparian areas in the active restoration portion would be planted following construction and then irrigated and managed as necessary during the establishment period.

Active riparian and floodplain habitat restoration would improve native floodplain and in-channel habitats, which would likely benefit native and potentially special-status species. Benefits to native species would be realized through the re-introduction of perennial base flows as well as seasonal high flows in the river, which in turn would promote the establishment of riparian vegetation. Well-established native plant communities in the floodplain would support rich and diverse native flora, potentially including special-status plant species, and would provide foraging habitat and shelter for native wildlife species.

When comparing Alternative B to existing conditions, effects on long-term opportunities for habitat improvement in Reach 2B would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). According to habitat restoration estimates, Alternative B could provide up to 1,870 acres of wildlife habitat and up to 1,640 acres of special-status species habitat (not mutually exclusive areas) (SJRRP 2012, Attachment A). For many of these habitat types, this represents a 3- to 9-fold increase in habitat as compared to existing conditions. In general, implementation of Alternative B would cause a **beneficial** effect on wildlife habitat.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would include construction of Project features including Fresno Slough Dam, a new levee system with a narrow floodplain encompassing the river channel, and the Short Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the Short Canal control structure and fish screen, the Chowchilla Bifurcation Structure fish passage facility, modification of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Similar to Alternative B, Alternative C includes active riparian and floodplain habitat restoration. It is assumed that wetland communities and a dense riparian scrubland would develop along the main channel and river banks, respectively, and bands of other habitat types (wetland, scrub, grassland, and forest) would develop at higher elevations along the channel corridor. The wetland, floodplain, and riparian areas would be planted following construction and then irrigated and managed as necessary during the establishment period.

Table 7-7 summarizes habitat impacts by acreage for all vertebrate species. These acreages represent the worst-case scenario where all existing floodplain areas are assumed to be impacted.

**Table 7-7.
Species Habitat Potentially Affected by Alternative C**

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	Infrastructure	Borrow	Other
			(future habitat)	(not future habitat)	(future habitat or agriculture)	
Reptiles						
Actinemys marmorata	western pond turtle	Upland	172	20	45	7
		Aquatic	146	17	41	25
		Wetland	29	7	3	7
Anniella pulchra pulchra	silvery legless lizard	Habitat	445	46	214	36
Gambelia sila	blunt-nosed leopard lizard	Habitat	6	9	0	0
Masticophis flagellum ruddocki	San Joaquin coachwhip	Habitat	158	14	200	11
Phrynosoma blainvillii	coast horned lizard	Habitat	238	26	202	15
Thamnophis gigas	giant garter snake	Upland	172	20	45	7
		Aquatic	146	17	41	25
		Wetland	29	7	3	7
Birds						
Agelaius tricolor	tricolored blackbird	Foraging	312	45	350	55
		Nesting	117	16	52	21
Anser albifrons elgasi	greater white-fronted goose	Foraging	262	27	45	33
Asio flammeus	short-eared owl	Foraging and Nesting	153	18	200	11
		Foraging	190	37	350	57
Athene cunicularia	burrowing owl	Foraging and Nesting	153	18	200	11
		Foraging	190	37	350	57
Aythya americana	redhead	Foraging	220	18	41	26
		Nesting	42	9	3	7
Buteo swainsoni	Swainson's hawk	Foraging	430	55	350	60
		Nesting	287	32	14	24
Charadrius montanus	mountain plover	Foraging	342	55	350	68
Circus cyaneus	northern harrier	Foraging	209	41	350	57
		Nesting	239	24	204	19
Elanus leucurus	white-tailed kite	Foraging	453	61	350	76
		Nesting	287	32	14	24
Grus canadensis canadensis	lesser sandhill crane	Foraging	429	61	350	76
Grus canadensis tabida	greater sandhill crane	Foraging	429	61	350	76
Lanius	loggerhead	Foraging	323	51	350	68

**Table 7-7.
Species Habitat Potentially Affected by Alternative C**

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	Infrastructure	Borrow	Other
			(future habitat)	(not future habitat)	(future habitat or agriculture)	
ludovicianus	shrike	Foraging and Nesting	20	4	0	0
Numenius americanus	long-billed curlew	Foraging	342	55	350	68
Pelecanus erythrorhynchos	American white pelican	Foraging	262	27	45	33
Xanthocephalus xanthocephalus	yellow-headed blackbird	Foraging	323	51	350	68
		Nesting	106	9	4	7
Mammals						
Dipodomys nitratoides exilis	Fresno kangaroo rat	Habitat	6	9	0	0
Eumops perotis californicus	Western mastiff bat	Foraging	524	70	350	72
Lasiurus blossevillii	Western red bat	Roosting and Foraging	754	110	350	48
Taxidea taxus	American badger	Habitat	158	14	200	11

Notes:
Floodplain = floodplain of the San Joaquin River (active restoration)
Infrastructure = structures, levees, or roads
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact WILD-1 (Alternative C): ***Project Effects on Special-Status Invertebrate Species.*** Compared to the No-Action Alternative, Alternative C could affect special-status invertebrate species. Construction-related effects on special-status invertebrate species would generally be the same as those described for Alternative A (see Impact WILD-1 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative C would use the river channel for Restoration Flow and the Short Canal to convey water from the San Joaquin River to Mendota Pool (and excludes the South Canal and associated levees). These infrastructure differences would result in effects on fewer elderberry shrubs, in comparison to Alternative A (i.e., one shrub in riparian areas and three shrubs in non-riparian areas). Up to 537 additional shrubs located in the future floodplain area are potentially affected. Conservation Measures VELB-1 and VELB-2 include pre-construction surveys for elderberry shrubs and beetle exit holes, avoidance of elderberry shrubs found in the Project area, and compensatory mitigation for shrubs unavoidable during construction (Table 2-8). Future floodplain areas would be allowed to return to natural habitats after Project construction is complete, which would provide suitable habitat for elderberry shrubs after construction is complete, especially along the main river channel banks where many of the elderberry shrubs occur now. Though both Alternatives A and C include plans for a narrow floodplain, Alternative C features active riparian and floodplain restoration and would not include agricultural or grazing use within the floodplain. Implementation of Alternative C would result in more riparian habitat over the long-term and potentially more valley elderberry longhorn beetle habitat than Alternative A.

Construction activity under Alternative C is expected to take 133 months, which is a similar duration as Alternative A.

When comparing Alternative C to existing conditions, impacts to special-status invertebrate species would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). Because unavoidable impacts would be compensated for through implementation of the Project conservation measures and because the completed Project would provide habitat for elderberry shrubs, the impacts are considered **less than significant**.

Impact WILD-2 (Alternative C): ***Project Effects on Special-Status Reptile Species.*** Compared to the No-Action Alternative, Alternative C could affect some special-status reptile species. Construction-related effects on special-status reptile species would generally be the same as those described for Alternative A (see Impact WILD-1 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative C would include the construction of the Fresno Slough Dam and the Short Canal. This change would result in adverse effects to slightly more habitats for special-status reptiles in areas near the river, compared to Alternative A (see Table 7-7). Under Alternative C, less habitat area would be converted to Project infrastructure for most special-status reptile species, with the exception of the aquatic and wetland habitats for the giant garter snake and the western pond turtle. Alternative C would use the river channel to convey Restoration Flows through Reach 2B (instead of a Compact Bypass). This method essentially removes the slackwater habitat for giant garter snake in the San Joaquin arm of Mendota Pool following Project completion. Whereas, Alternative A would retain a small portion of slackwater habitat between the Mendota Dam and the Mendota Pool Dike (see Impact WILD-2 [Alternative A]). Similar to Alternative A, measures would be implemented to minimize these adverse effects to special-status reptiles (see Impact WILD-2 (Alternative A) and Table 2-8).

Alternative C would affect nearly the same amount of potential habitat for blunt-nosed leopard lizard as Alternative A, but a larger portion of the habitat affected would be converted to Project infrastructure than under Alternative A, potentially resulting in a greater long-term effect on this species (if present). All adverse effects would be avoided and/or mitigated with implementation of the Conservation Measures BNLL-1 and BNLL-2 (Table 2-8). As a fully-protected species, direct take of blunt-nosed leopard lizards would be prohibited.

When comparing Alternative C to existing conditions, impacts to special-status reptiles would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). Because these impacts would be largely temporary, would occur intermittently within the overall construction timeframe, and because conservation measures are in place to reduce, minimize, and compensate for impacts, they are considered **less than significant.**

Impact WILD-3 (Alternative C): *Project Effects on Special-Status Bird Species.* Compared to the No-Action Alternative, Alternative C could affect special-status bird species. Construction-related effects on special-status bird species would generally be the same as those described for Alternative A (see Impact WILD-1 [Alternative A]), with several exceptions. Unlike Alternative A, Alternative C would include the construction of the Fresno Slough Dam and the Short Canal. This change would result in temporary adverse effects to more habitat for most special-status birds than Alternative A (see Table 7-7) but for most species, less of this habitat would be converted to Project infrastructure. Similar to Alternative A, measures would be implemented to minimize these adverse effects to special-status birds (see Impact WILD-3 (Alternative A) and Table 2-8).

Though both Alternatives A and C include plans for a narrow floodplain, Alternative C features active riparian and floodplain restoration and would not include agricultural or grazing use within the floodplain. Implementation of Alternative C would result in more riparian habitat, and thus available nesting habitat for Swainson's hawks, white-tailed kites, and short-eared owls. In comparison to Alternative A and the No-Action Alternative, post-project conditions may provide less foraging habitat for birds that use open, grassland or crop cover, including mountain plovers, loggerhead shrikes, long-billed curlews, and yellow-headed blackbirds.

When comparing Alternative C to existing conditions, impacts to special-status birds would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). Because the majority of these impacts would be temporary and would occur intermittently within the overall construction timeframe, conservation measures are in place to reduce and minimize impacts, and active restoration of riparian habitats would occur, they are considered **less than significant**.

Impact WILD-4 (Alternative C): *Project Effects on Special-Status Mammal Species.* Compared to the No-Action Alternative, Alternative C could affect special-status mammal species. Construction-related effects on special-status mammal species would generally be the same as those described for Alternative A (see Impact WILD-4 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative C would include the construction of the Fresno Slough Dam and the Short Canal. These changes would convert less habitat area for special-status mammals to Project infrastructure, though slightly more habitat area would be affected temporarily for most species (see Table 7-7). Similar to Alternative A, measures would be implemented to minimize these adverse effects to special-status mammals (see Impact WILD-4 [Alternative A] and Table 2-8).

Following construction of Alternative C Project components, wetland, floodplain, and riparian areas would be planted and irrigated until vegetation is established (see Chapter 2.0, "Description of Alternatives"). Though both Alternatives A and C include plans for a narrow floodplain, active restoration and restriction of agricultural or grazing use within the floodplain would result in more riparian habitat, which would be beneficial to the western red bat and the western mastiff bat.

When comparing Alternative C to existing conditions, impacts to special-status mammals would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). Because impacts would be temporary and would occur intermittently within the overall construction timeframe, conservation measures are in place to reduce and minimize impacts, and active restoration of riparian habitats would occur, the impacts are considered **less than significant**.

Impact WILD-5 (Alternative C): ***Adverse Effects on Wildlife Movement Corridors.*** Compared to the No-Action Alternative, Alternative C could affect wildlife movement along migration corridors. Construction-related effects on migration corridors would generally be the same as those described for Alternative A (see Impact WILD-5 [Alternative A]), with several exceptions.

Following construction of Alternative C Project components, wetland, floodplain, and riparian areas would be planted and irrigated until vegetation is established (see Chapter 2.0, “Description of Alternatives”). Though both Alternatives A and C include plans for a narrow floodplain, this active restoration and restriction of agricultural or grazing use within the floodplain would result in more riparian habitat, potentially providing better cover and forage for migrating wildlife.

When comparing Alternative C to existing conditions, impacts to movement corridors would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). Most of these impacts would be temporary and would occur intermittently within the overall construction timeframe for the entire Project. Post-project conditions would return natural habitats to much of the disturbed areas and are expected to increase riparian vegetation, potentially improving conditions for migratory species. Impacts of Alternative C to movement corridors are considered **less than significant.**

Impact WILD-6 (Alternative C): ***Long-term Habitat Improvement in Reach 2B.*** Compared to the No-Action Alternative, Restoration Flows in Reach 2B would be conveyed through an expanded floodplain. Wetland communities would develop within the main channel, a dense riparian scrubland would develop along the main river channel banks, and bands of other habitat types (wetland, scrub, grassland, and forest) would develop at higher elevations along the channel corridor. The wetland, floodplain, and riparian areas would be planted following construction and then irrigated and managed as necessary during the establishment period.

Active riparian and floodplain habitat restoration would improve native floodplain and in-channel habitats, which would likely benefit native and potentially special-status species. Benefits to native species would be realized through the re-introduction of perennial base flows as well as seasonal high flows in the river, which in turn would promote the establishment of riparian vegetation. Well-established native plant communities in the floodplain would support rich and diverse native flora, potentially including special-status plant species, and would provide foraging habitat and shelter for native wildlife species.

When comparing Alternative C to existing conditions, effects on long-term opportunities for habitat improvement in Reach 2B would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). According to habitat restoration estimates, Alternative C could provide up to 1,360 acres of wildlife habitat and up to 1,050 acres of special-status species habitat (not mutually exclusive areas) (SJRRP 2012, Attachment A). For many of these habitat types, this represents a 2- to 5-fold increase in habitat as compared to existing conditions. In general, implementation of Alternative C would cause a **beneficial** effect on wildlife habitat.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would include construction of Project features including Fresno Slough Dam, a new levee system with a wide floodplain encompassing the river channel, and the North Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the North Canal bifurcation structure, and the North Canal fish passage facility, removal of the San Joaquin River control structure of the Chowchilla Bifurcation Structure, removal of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Similar to Alternative A, Alternative D includes passive riparian habitat restoration and agricultural practices in the floodplain. It is assumed that over time wetland communities and a dense riparian scrubland would develop along the main channel and river banks, respectively. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, limited agricultural practices (e.g., pasture) would occur.

Table 7-8 summarizes habitat impacts by acreage for all vertebrate species with the potential to occur in the Project area. These acreages represent the worst-case scenario where all existing floodplain areas are assumed to be impacted.

Table 7-8.
Species Habitat Potentially Affected by Alternative D

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	Infrastructure	Borrow	Other
			(future habitat or agriculture)	(not future habitat)	(future habitat or agriculture)	
Reptiles						
Actinemys marmorata	western pond turtle	Upland	168	22	45	8
		Aquatic	146	23	42	25

Table 7-8.
Species Habitat Potentially Affected by Alternative D

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	Infrastructure	Borrow	Other
			(future habitat or agriculture)	(not future habitat)	(future habitat or agriculture)	
		Wetland	29	5	3	9
Anniella pulchra pulchra	silvery legless lizard	Habitat	431	65	207	29
Gambelia sila	blunt-nosed leopard lizard	Habitat	6	9	0	0
Masticophis fla-gellum ruddocki	San Joaquin coachwhip	Habitat	149	19	200	9
Phrynosoma blainvillii	coast horned lizard	Habitat	225	36	202	9
Thamnophis gigas	giant garter snake	Upland	168	22	45	8
		Aquatic	146	23	42	25
		Wetland	29	5	3	9
Birds						
Agelaius tricolor	tricolored blackbird	Foraging	365	156	350	46
		Nesting	141	17	25	22
Anser albifrons elgasi	greater white-fronted goose	Foraging	259	32	46	33
Asio flammeus	short-eared owl	Foraging and Nesting	144	22	200	50
		Foraging	277	146	350	9
Athene cunicularia	burrowing owl	Foraging and Nesting	144	22	200	9
		Foraging	277	146	350	50
Aythya americana	redhead	Foraging	217	25	42	25
		Nesting	42	7	3	9
Buteo swainsoni	Swainson's hawk	Foraging	508	169	350	50
		Nesting	281	46	7	19
Charadrius montanus	mountain plover	Foraging	421	169	350	59
Circus cyaneus	northern harrier	Foraging	297	150	350	50
		Nesting	230	27	204	18
Elanus leucurus	white-tailed kite	Foraging	532	173	350	68
		Nesting	281	46	7	19
Grus canadensis canadensis	lesser sandhill crane	Foraging	507	173	350	68
Grus canadensis tabida	greater sandhill crane	Foraging	507	173	350	68

Table 7-8.
Species Habitat Potentially Affected by Alternative D

Scientific Name	Common Name	Habitat Type	Maximum Impacted Area (acres)			
			Floodplain	**Infrastructure**	**Borrow**	**Other**
			(future habitat or agriculture)	**(not future habitat)**	**(future habitat or agriculture)**	
Lanius ludovicianus	loggerhead shrike	Foraging	401	165	350	59
		Foraging and Nesting	20	4	0	0
Numenius americanus	long-billed curlew	Foraging	421	169	350	59
Pelecanus erythrorhynchos	American white pelican	Foraging	259	32	46	33
Xanthocephalus xanthocephalus	yellow-headed blackbird	Foraging	401	165	350	59
		Nesting	105	8	4	9
Mammals						
Dipodomys nitratoides exilis	Fresno kangaroo rat	Habitat	6	9	0	0
Eumops perotis californicus	Western mastiff bat	Foraging	573	194	350	59
Lasiurus blossevillii	Western red bat	Roosting and Foraging	1054	237	350	40
Taxidea taxus	American badger	Habitat	149	19	200	9

Notes:
Floodplain = floodplain of the San Joaquin River (passive restoration and agricultural activities)
Infrastructure = structures, levees, or roads
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact WILD-1 (Alternative D): ***Project Effects on Special-Status Invertebrate Species.*** Compared to the No-Action Alternative, Alternative D could affect special-status invertebrate species. Construction-related effects on special-status invertebrate species would generally be the same as those described for Alternative A (see Impact WILD-1 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative D would use the river channel for Restoration Flows and the North Canal to convey water from the San Joaquin River to Mendota Pool. These infrastructure differences would result in fewer effects on elderberry shrubs, in comparison to Alternative A (i.e., 13 shrubs from riparian areas and 3 shrubs from non-riparian areas). Up to 523 additional shrubs located in the future floodplain area are potentially affected. Conservation Measures VELB-1 and VELB-2 include pre-construction surveys for elderberry shrubs and beetle exit holes, avoidance of elderberry shrubs found in the Project area, and compensatory mitigation for shrubs unavoidable during construction (Table 2-8). The future floodplain area would be allowed to return to natural habitats after Project construction is complete, which would provide suitable habitat for elderberry shrubs after construction is complete, especially along the main river channel banks where many of the elderberry shrubs occur now.

Construction activity under Alternative D is expected to take 158 months, therefore, adverse effects of construction would occur over an approximately 2 year longer period compared to Alternative A. Alternatives A and D both allow for agricultural or grazing use within the floodplain.

When comparing Alternative D to existing conditions, impacts to special-status invertebrate species would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to the No-Action Alternative). Because unavoidable impacts would be compensated for through implementation of the Project conservation measures and because the completed Project would provide habitat for elderberry shrubs, the impacts are considered **less than significant**.

Impact WILD-2 (Alternative D): *Project Effects on Special-Status Reptile Species*. Compared to the No-Action Alternative, Alternative D could affect some special-status reptile species. Construction-related effects on special-status reptile species would generally be the same as those described for Alternative A (see Impact WILD-1 [Alternative A]), with several exceptions.

The features of Alternative D would displace more habitat for silvery legless lizards. Habitats converted to Project infrastructure would be less for the other special-status reptile species, excepting the aquatic and wetland habitats for the giant garter snake and the western pond turtle (see Table 7-8). Alternative D would use the river channel to convey Restoration Flows through Reach 2B (instead of a Compact Bypass). This method essentially removes the slackwater habitat for giant garter snake in the San Joaquin arm of Mendota Pool following Project completion (see Impact WILD-2 [Alternative A]). Similar to Alternative A, measures would be implemented to minimize adverse effects to special-status reptiles (see Impact WILD-2 [Alternative A] and Table 2-8).

Alternative D would potentially affect slightly less total habitat for blunt-nosed leopard lizard than Alternative A and less of the habitat affected would be converted to Project infrastructure. All adverse effects would be avoided and/or mitigated with implementation of the Conservation Measures BNLL-1 and BNLL-2 (Table 2-8). As a fully-protected species, direct take of blunt-nosed leopard lizards would be prohibited.

Construction activity under Alternative D is expected to take 158 months, therefore, adverse effects of construction would occur over an approximately 2 year longer period compared to Alternative A.

When comparing Alternative D to existing conditions, impacts to special-status reptiles would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to the No-Action Alternative). Because these impacts would be largely temporary, would occur intermittently within the overall construction timeframe, and conservation measures are in place to reduce, minimize, and compensate for impacts, they are considered **less than significant.**

Impact WILD-3 (Alternative D): ***Project Effects on Special-Status Bird Species*****.** Compared to the No-Action Alternative, Alternative D could affect special-status bird species. Construction-related effects on special-status bird species would generally be the same as those described for Alternative A (see Impact WILD-1 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative D would include the construction of the Fresno Slough Dam and the North Canal. These changes would result in adverse effects to more habitat for all of the special-status birds in areas near the river, than Alternative A (see Table 7-8). For a few of these species (including the nesting habitats of burrowing owls, tricolored blackbirds, short-eared owls, and northern harriers), less of this habitat would be converted to long-term infrastructure. Similar to Alternative A, measures would be implemented to minimize these adverse effects to special-status birds (see Impact WILD-3 (Alternative A) and Table 2-8).

Both Alternatives A and D allow for agricultural or grazing use within the floodplain. In comparison to Alternative A (narrow floodplain), post-project conditions of Alternative D (wide floodplain) may provide more foraging habitat for birds that use open, grassland or crop cover, including mountain plovers, loggerhead shrikes, long-billed curlews, and yellow-headed blackbirds.

Construction activity under Alternative D is expected to take 158 months, therefore, adverse effects of construction would occur over an approximately 2 year longer period compared to Alternative A.

When comparing Alternative D to existing conditions, impacts to special-status birds would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to the No-Action Alternative). Because the majority of these impacts would be temporary and would occur intermittently within the overall construction timeframe, conservation measures are in place to reduce and minimize impacts, and active restoration of riparian habitats would occur, they are considered **less than significant**.

Impact WILD-4 (Alternative D): ***Project Effects on Special-Status Mammal Species.*** Compared to the No-Action Alternative, Alternative D could affect special-status mammal species. Construction-related effects on special-status mammal species would generally be the same as those described for Alternative A (see Impact WILD-4 [Alternative A]), with several exceptions.

Unlike Alternative A, Alternative D would include the construction of the Fresno Slough Dam and North Canal. More habitat for special-status mammal species would be disturbed by construction activities near the river, though less habitat for American badgers and Fresno kangaroo rats would be converted to Project infrastructure (see Table 7-8). Similar to Alternative A, measures would be implemented to minimize these adverse effects to special-status mammals (see Impact WILD-4 [Alternative A] and Table 2-8).

Construction activity under Alternative D is expected to take 158 months, therefore, adverse effects of construction would occur over an approximately 2 year longer period compared to Alternative A.

When comparing Alternative D to existing conditions, impacts to special-status mammals would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to the No-Action Alternative). Because these impacts would be temporary and would occur intermittently within the overall construction timeframe, conservation measures are in place to reduce and minimize impacts, and active restoration of riparian habitats would occur, the impacts are considered **less than significant**.

Impact WILD-5 (Alternative D): ***Adverse Effects on Wildlife Movement Corridors*.** Compared to the No-Action Alternative, Alternative D could affect wildlife movement along migration corridors. Construction-related effects on migration corridors would generally be the same as those described for Alternative A (see Impact WILD-5 [Alternative A]), with several exceptions**.**

Alternative A includes plans for a San Mateo Avenue crossing. In Alternative D, this crossing would be removed. This would not alter bird movement, but the crossing may provide a way for other terrestrial species to cross the river. Compared to the No-Action Alternative, the restoration of a riparian corridor would facilitate movement and provide habitat for many special-status species, including valley elderberry longhorn beetles, Swainson's hawks, white-tailed kites, tricolored blackbirds, yellow-headed blackbirds and western red bats.

When comparing Alternative D to existing conditions, impacts to movement corridors would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to the No-Action Alternative). Most of these impacts would be temporary and would occur intermittently within the overall construction timeframe for the entire Project. Post-project conditions would return natural habitats to much of the disturbed areas and are expected to increase riparian vegetation, potentially improving conditions for migratory species. Impacts of Alternative D to movement corridors are considered **less than significant.**

Impact WILD-6 (Alternative D): ***Long-term Habitat Improvement in Reach 2B.*** Compared to the No-Action Alternative, Restoration Flows in Reach 2B would be conveyed through an expanded floodplain. Over time wetland communities would develop within the main channel and a dense riparian scrubland would develop along the main river channel banks. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, limited agricultural practices (e.g., pasture) would occur.

Passive riparian habitat restoration of the San Joaquin River would improve native floodplain and in-channel habitats, which would likely benefit native and potentially special-status species such as Swainson's hawk and greater sandhill crane. Benefits to native species would be realized through the re-introduction of perennial base flows as well as seasonal high flows in the river, which in turn would promote the establishment of riparian vegetation. Well-established native plant communities in the floodplain would support rich and diverse native flora, including potentially special-status plant species, and would provide foraging habitat and shelter for native wildlife species.

When comparing Alternative D to existing conditions, effects on long-term opportunities for habitat improvement in Reach 2B would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to the No-Action Alternative). According to habitat restoration estimates, Alternative D could provide up to 1,900 acres of wildlife habitat and up to 1,630 acres of special-status species habitat (not mutually exclusive areas) (SJRRP 2012, Attachment A). For many of these habitat types, this represents a 3- to 9-fold increase in habitat as compared to existing conditions. In general, implementation of Alternative D would cause a **beneficial** effect on wildlife habitat.

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8.0 Climate Change and Greenhouse Gas Emissions

This chapter describes the environmental and regulatory setting for climate change and greenhouse gas emissions, as well as the environmental consequences associated with the construction and operation of Project alternatives, including impacts and mitigation measures.

8.1 Environmental Setting

8.1.1 Greenhouse Gases

Radiation from the sun is the primary source of energy keeping the earth warm enough for life. Solar radiation enters the earth's atmosphere, a portion of the radiation passes through the atmosphere and is absorbed by the earth's surface (this is primarily radiation in the visible portion of the electromagnetic spectrum), a portion is reflected back toward space, and a portion is absorbed by the upper atmosphere. The radiation absorbed by the earth heats the earth's surface which then emits infrared radiation. Since the earth has a much lower temperature than the sun, it emits longer wavelength radiation.[1]

Certain gases in the earth's atmosphere, classified as greenhouse gases (GHGs), play a critical role in determining the earth's surface temperature. GHGs have strong absorption properties at wavelengths that are emitted by the earth. As a result, radiation that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This phenomenon, known as the "greenhouse effect," is responsible for maintaining a habitable climate on Earth.

Prominent GHGs contributing to the greenhouse effect are water vapor, carbon dioxide (CO_2), methane, ozone, nitrous oxide (N_2O), and fluorinated compounds (chlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride). Human-caused emissions of these GHGs in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a warming trend of the earth's climate, known as global climate change or global warming. Global temperatures have increased over the past 50 years and it is unlikely that the increase can be explained without the contribution of GHGs from human activities (Intergovernmental Panel on Climate Change [IPCC] 2014).

Although preliminary research has also found localized effects from GHGs, climate change is largely a global problem. GHGs pollutants have global implications, unlike criteria air pollutants and toxic air contaminants, which are pollutants of regional and local concern. Whereas pollutants with localized air quality effects have relatively short

[1] The wavelength at which a body emits radiation is proportional to the temperature of the body.

atmospheric lifetimes (e.g., about 1 day), GHGs have long atmospheric lifetimes (1 year to several thousand years). GHGs persist in the atmosphere for long enough time periods to be dispersed around the globe. CO_2 is one of the major human contributed GHGs. Of the total annual human-caused CO_2 emissions, less than 45 percent is sequestered (removed from the atmosphere and stored) through ocean uptake, uptake by northern hemisphere forest regrowth, and other terrestrial sinks. The remaining human-caused CO_2 emissions remain stored in the atmosphere (IPCC 2014, Ballantyne et al. 2012).

The atmosphere and the oceans are reaching their capacity to absorb CO_2 and other GHGs, without significantly changing the Earth's climate. The increase in GHGs in the Earth's climate is projected to affect a wide range of issues and resources, including sea-level rise, flooding, water supply, agricultural and forestry resources, and energy demand. California's Climate Change Portal (www.climatechange.ca.gov) states:

> *Climate change is expected to have significant, widespread impacts on California's economy and environment. California's unique and valuable natural treasures - hundreds of miles of coastline, high value forestry and agriculture, snow-melt fed fresh water supply, vast snow and water fueled recreational opportunities, as well as other natural wonders - are especially at risk.*

In addition, the IPCC, in the section of its Fifth Assessment Report by Working Group II, "Climate Change 2014: Impacts, Adaptation, and Vulnerability" (IPCC 2014; released March 31, 2014), specific to North America (Chapter 26), stated in part:

> *North American ecosystems are under increasing stress from rising temperatures, CO_2 concentrations, and sea-levels, and are particularly vulnerable to climate extremes (very high confidence). Climate stresses occur alongside other anthropogenic influences on ecosystems, including land-use changes, non-native species, and pollution, and in many cases will exacerbate these pressures (very high confidence) [26.4.1; 26.4.3]. Evidence since the Fourth Assessment Report (IPCC 2007) highlights increased ecosystem vulnerability to multiple and interacting climate stresses in forest ecosystems, through wildfire activity, regional drought, high temperatures, and infestations (medium confidence) [26.4.2.1; Box 26-2]; and in coastal zones due to increasing temperatures, ocean acidification, coral reef bleaching, increased sediment load in run-off, sea level rise, storms, and storm surges (high confidence) [26.4.3.1].*

California has already been affected by climate change: sea-level rise, increased average temperatures, more extreme hot days and increased heat waves, fewer shifts in the water cycle, and increased frequency and intensity of wildfires. Higher sea levels can result in increased coastal erosion (which may have a secondary effect, such as uncovering shoreline hazards), more frequent flooding from storm surges, increased property damage, and reduced waterfront public access options. Other projected climate change impacts in California include: decreases in the water quality of surface waterbodies, groundwater, and coastal waters; decline in aquatic ecosystem health; lowered profitability for water-intensive crops; changes in species and habitat distribution; and impacts to fisheries (California Regional Assessment Group 2002). These effects are expected to increase with rising GHG levels in the atmosphere.

The quantity of GHGs that it takes to cause a change in climate is not precisely known; however, the quantity is enormous. The estimated global annual emission of anthropogenic GHGs was 46 billion metric tons in 2010 (U.S. Environmental Protection Agency [EPA] 2014a). Of this, agriculture was estimated to contribute about 11.5 percent, or about 5.3 billion metric tons of GHGs (Food and Agriculture Organization of the United Nations 2014). This compares with the estimated emissions from California of 0.453 billion metric tons or about 1 percent of the global emissions (California Air Resources Board [ARB] 2014a). Emissions of GHGs contributing to global climate change are attributable in large part to human activities associated with the burning of fossil fuels, industrial/manufacturing, transportation, and agricultural sectors, as well as land use change (EPA 2014a).

California is the 15th largest emitter of CO_2 in the world (California Air Resources Board [ARB] 2011). California produced 451.6 teragrams (Tg; or million metric tons) of CO_2 equivalents[2] (CO_2e) in 2010 (ARB 2013). The five major fuel consuming sectors contributing to CO_2 emissions from fossil fuel combustion are transportation, electricity generation, industrial, residential, and commercial. Combustion of fossil fuel in the transportation sector was the single largest source of California's GHG emissions, accounting for 38 percent of total GHG emissions in California. This sector was followed by the electric power sector (including both in-state and out-of-state sources) at 21 percent and the industrial sector at 19 percent (ARB 2013).

Methane is a highly potent GHG that results from off-gassing (the release of chemicals from nonmetallic substances under ambient or greater pressure conditions) largely associated with agricultural practices, landfills, and wetlands. CO_2 sinks, or reservoirs, include vegetative growth (which convert CO_2 to biomass) and the ocean, which absorbs CO_2 through photosynthesis by phytoplankton and dissolution, respectively, two of the most common processes of CO_2 sequestration (EPA 2014b).

Agriculture activities contributed 32.4 Tg CO_2e or 7 percent of California emissions. Of the 32.4 Tg CO_2e, agricultural emissions from crop growing and harvesting (including soil management and rice cultivation) accounted for 10 Tg CO_2e (ARB 2013). The remainder was mainly due to enteric fermentation for livestock and manure management (Figure 8-1).

The Project would involve changes to agriculture, wetlands, and riparian zones. The basic GHG emissions associated with these land use and management types is described below.

[2] CO_2e is a measurement used to account for the fact that different GHGs have different potential to retain infrared radiation in the atmosphere and contribute to the greenhouse effect. This potential, known as the global warming potential (GWP) of a GHG, is dependent on the lifetime, or persistence, of the gas molecule in the atmosphere. Expressing emissions in CO_2e takes the contributions of all GHG emissions to the greenhouse effect and converts them to a single unit equivalent to the effect that would occur if only CO_2 were being emitted.

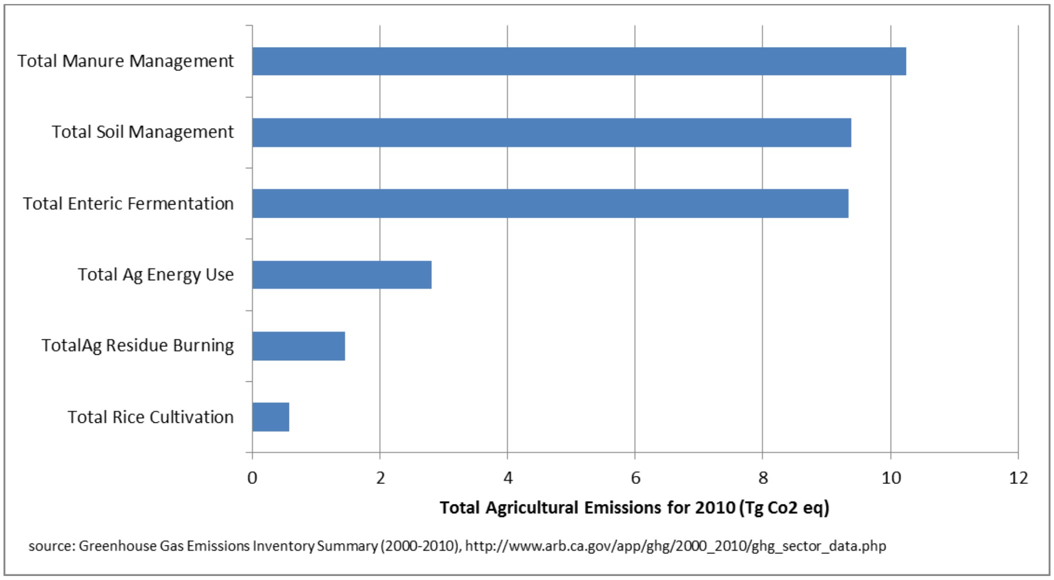

Figure 8-1.
2010 Estimated Breakdown of Agricultural GHG Sources for California

Agricultural soils emit N_2O, but act as net sinks for CO_2. In the United States, agricultural soils have accounted for approximately 75 percent of N_2O emissions and 5 percent of total emissions in 2012 (EPA 2014b). While total N_2O emissions are much lower than CO_2 emissions, N_2O is approximately 300 times more powerful than CO_2 at trapping heat in the atmosphere. Estimated emissions from agricultural soils were 306.6 Tg CO_2e in 2012 (EPA 2014b).

Nitrous oxide is produced naturally in soils through the microbial processes of nitrification and denitrification. A number of agricultural activities increase mineral Nitrogen (mineral N) availability in soils, thereby increasing the amount available for nitrification and denitrification, and ultimately the amount of N_2O emitted. These activities increase soil mineral N either directly or indirectly. Management practices that add or lead to greater release of direct emissions include fertilization, application of manure and other organic materials, deposition of manure on soils by domesticated animals in pastures, rangelands, and paddocks, production of N-fixing crops and forages, retention of crop residues, and drainage and cultivation of organic cropland soils (i.e., soils with a high organic matter content, for example peat soils as found in the Delta). Other agricultural soil management activities, including irrigation, drainage, tillage practices, and fallowing of land, can influence N mineralization in soils and thereby affect direct emissions. Mineral N is also made available in soils through decomposition of soil organic matter and plant litter, as well as asymbiotic fixation of N from the atmosphere, and these processes are influenced by agricultural management through impacts on moisture and temperature regimes in soils. Indirect emissions of N_2O occur through two pathways: (1) volatilization and subsequent atmospheric deposition of applied/mineralized N, and (2) surface runoff and leaching of applied/mineralized N into groundwater and surface water (Massy and Ulmer 2010, EPA 2014b).

Soils contain both organic and inorganic forms of carbon. Soil organic carbon stocks are the main source and sink for atmospheric CO_2 in most soils and account for about 1 percent of the total net CO_2 flux in the United States (EPA 2014b). In agricultural soils, mineral and organic soils sequester approximately four times as much carbon as is emitted from these soils through liming and urea fertilization. Net carbon uptake is largely due to a reduction in summer fallow areas in semi-arid areas, the adoption of conservation tillage practices, and application of organic fertilizers to agriculture lands. Although CO_2 is sequestered in agricultural soils, the amount of CO_2 uptake is small compared to CO_2e emitted as N_2O.

Wetlands are one of the largest natural sources of GHGs and are the major natural source of methane due to high rates of methanogenesis enabled by the presence of anaerobic soils (Altor and Mitsch 2006). Wetland plants uptake CO_2, which is converted to biomass and stored in organic soils. This storage of carbon in organic soils has resulted in a large carbon pool. The creation of wetlands can result in either a net increase or decrease in GHGs depending upon the time frame of interest and the characteristics of the wetland. On a mole for mole basis,[3] methane is a much more potent GHG than is CO_2. Over a 100-year time frame, it has about 21 times as much global warming potential (GWP)[4] as CO_2. Over shorter time frames, it has an even greater GWP due to the lifetime of methane in the atmosphere. Methane is oxidized to CO_2 and carbon monoxide (CO) in about 10 years. So in general, a wetland can initially be considered a net GHG source and over time as more carbon is sequestered in organic soils a net GHG sink. The time required for the wetland to change from a net source to a net sink depends upon the ratio of carbon emitted as methane to carbon sequestered as CO_2. Whiting and Chanton (2001) studied the rate of sequestration of carbon and the rate of methane emission from several different types of wetlands. Their data showed that the wetlands they studied would be net sources for 20 years, some sources and some sinks after 100 years, and all sinks after 500 years. However, estimates of the GWP have increased since their study, so their results can be considered as low estimates.

Riparian zones that are oxic (contain oxygen) are net sinks for methane and sources of N_2O. Aerated soil contains methanotrophic bacteria that use methane as their carbon source. N_2O is produced in riparian soils primarily through decomposition of soil organic matter and plant litter, as well as asymbiotic fixation of N from the atmosphere. Tanzosh (2005) studied two watersheds in Ohio, each of which contained upland agricultural land, riparian grassland and riparian forest. Her results showed that the riparian grassland had the greatest GWP, but was only slightly more than the upland sites. The forested areas had the smallest GWP. However, carbon can be sequestered in riparian soils if the conditions are advantageous. This would occur when the conditions are right for the formation of soils that incorporate carbon into the soil matrix so it is available for plant use. If the rate of plant growth is large it is possible for the sequestration to exceed the carbon emitted as GHGs.

[3] A mole is a unit of measurement used to express an amount of chemical substance (i.e., 6.022×10^{23} molecules).

[4] GWP is the potential to retain infrared radiation in the atmosphere and contribute to the greenhouse effect over a specified time period (e.g., 100 years).

8.1.2 Temperature, Precipitation, and Runoff

Historical Climate

The historical climate of the Central Valley is characterized by hot, dry summers and cool, damp winters. Summer daytime temperatures can reach 90 degrees Fahrenheit (°F) with occasional heat waves bringing temperatures exceeding 115°F. The majority of precipitation occurs from mid-autumn to mid-spring. In winter, temperatures below freezing may occur, but snow is rare in the valley lowlands and foothills. During the growing season, relative humidity is characteristically low; in the winter, humidity is usually moderate to high, and ground fog may form.

The inter-annual variability of the Central Valley climate is strongly influenced by conditions occurring in the Pacific Ocean, including the El Nino Southern Oscillation and the existence of a semi-permanent high-pressure area in the northern Pacific Ocean. Although variable, the average mean-annual temperature has increased by approximately 2°F during the course of the 20th century for both the Sacramento River Basin and the San Joaquin River Basin.

Streamflow in the Sacramento River and San Joaquin River basins has also varied considerably from year to year and is varied geographically. Runoff is generally greater during the winter and spring months, with winter runoff generally originating from rainfall-runoff events and spring to early summer runoff generally supported by snowmelt from the Sierra Nevada. Historical changes in climate have resulted in declining spring runoff and a corresponding increase in winter runoff.

Future Projections

Climate change is a complex phenomenon that results in changes to several different aspects of the climate. One of the major impacts of climate change is an increase in average temperature. The average air temperature in the Project area and vicinity is projected to increase from almost 4°F to over 6°F by the end of the century (2070-2090 period) compared to the baseline conditions (1961-1990) (Cal-Adapt 2012). This increase in temperature is expected to result in changes in precipitation patterns. Depending upon the assumptions and climate models used for a particular study, both wetter and drier conditions have been projected (Brekke et al. 2004, Pacific Northwest Research Station 2005, PRBO Conservation Science 2011). Overall, Cal-Adapt projects a possible decrease in the average annual precipitation of 0 to 2 inches in the Project area and vicinity. Climate change may result in changes to the pattern of snowfall in the mountains above Friant Dam, leading to less overall water storage in the mountains. Cal-Adapt projects that the April snow water equivalent in the mountains above Friant Dam could decrease by 80 to 90 percent in the lower elevations and 30 to 40 percent at the upper elevations by the year 2100 (Cal-Adapt 2012b). This would result in less spring and summer runoff into Millerton Reservoir than at present.

Climate modeling groups have produced hundreds of simulations of past and future climates for the IPCC Fourth Assessment Report. The World Climate Research Programme Working Group on Coupled Modelling helped to coordinate these activities through the Coupled Model Intercomparison Project Phase 3. These model results were organized into a website hosted by the Lawrence Livermore National Laboratory (LLNL) and others (LLNL 2013). The U.S. Department of the Interior, Bureau of Reclamation (Reclamation), working with others, generated gridded (1/8 degree [°] by 1/8°, latitude by longitude) climate projections using these data. These projections were developed through support from the Reclamation WaterSMART Basin Studies Program as part of the West-Wide Climate Risk Assessments activity (Reclamation 2011). These projections consist of 16 different Global Climate Models and three different CO_2 emission scenarios from the IPCC Fourth Assessment Report. For several of the projections, results were provided using different initial conditions for a total of 112 different projections (the results of climate projection modeling are sensitive to the initial conditions used in the models). From these climate projections potential changes in hydrology were computed for three future decades: 2020s (water years 2020 to 2029), 2050s (water years 2050 to 2059) and 2070 (water years 2070 to 2079) from the reference 1990s' decade (water years 1990 to 1999). The reference 1990s is from the ensemble of simulated historical hydroclimates, not from the observed 1990s data.

Future Runoff Projections

The gridded model output was used to estimate runoff from watersheds covering the major Reclamation basins and the Western United States (Reclamation 2011). Runoff results for the San Joaquin River at Friant Dam (Figure 8-2) show the change in total annual runoff into Millerton Reservoir relative to the total annual runoff in the 1990 decade. For the period 2010 to 2050 the total annual runoff is expected to decrease to about 90 to 95 percent of the 1990 decade. By the end of the century the total annual runoff is expected to decrease to between 75 to 80 percent of the 1990 decade. This analysis is based on the median projection from 112 model outputs (Reclamation 2011). It should be noted that the variability between model results is large with the coefficient of variability (standard deviation divided by the mean) equal to about 1.

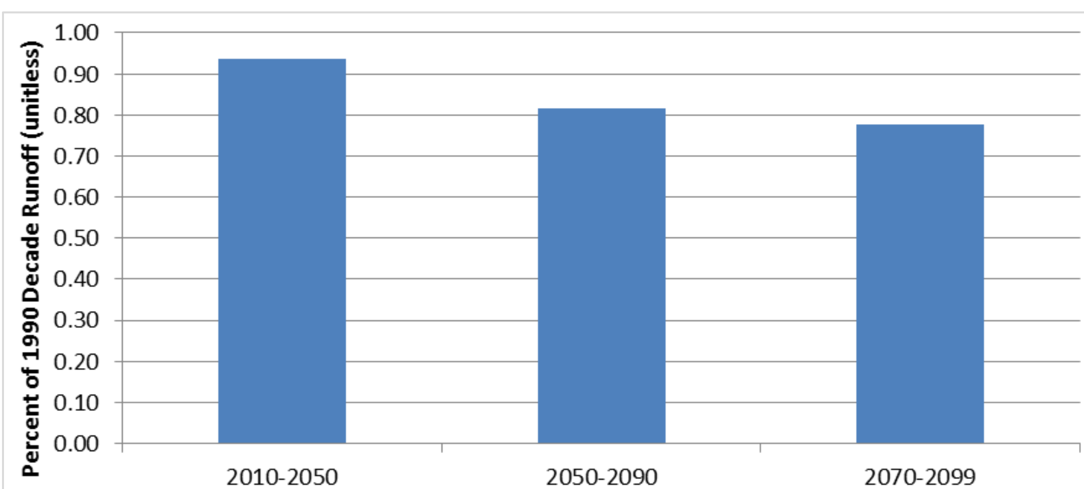

Figure 8-2.
Change in the Total Runoff into Millerton Reservoir Relative to 1990 Decade

In addition to the decrease in runoff, the timing of the runoff is expected to change. Figure 8-3 shows ensemble-median mean-monthly values (heavy lines) for the 1990s, 2020s, 2050s, and 2070s for the San Joaquin River at Friant Dam, and the decadal-spread of mean-monthly runoff for the 1990s (grey shaded area) and 2070s (magenta shaded area) where spread is bound by the ensemble's 5th to 95th percentile values for each month (the purple shaded area is where the spreads overlap). The spread shown in the figure does not represent the expected range in flows, but the uncertainty in the future projections. In general, in the future there would be more runoff in winter/spring (January to April) and less runoff in the summer (May to July). The change in inflows is small in the 2020 decade; the 2020 values are within the uncertainty of the 1990 and 2020 decades' data, so little effect would be expected on the timing of inflows during that period. By the 2070 decade, the results show a noticeable drop in runoff during the spring/summer period though there is a large uncertainty in the model predictions. Regardless, the operation of the larger dams in the San Joaquin River system, primarily Friant Dam, would determine the timing of summer flows in the San Joaquin River.

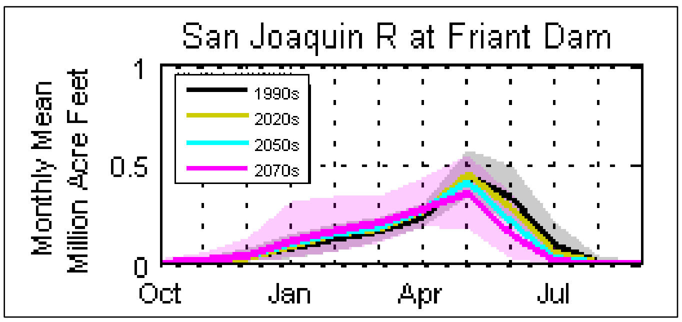

Figure 8-3.
Changes in Runoff to Friant Dam from 1990s to 2070s based on Analysis of 112 Different Combinations of Global Climate Models and Emission Scenarios

Future Water Temperature

The increase in air temperature due to climate change has the potential to increase water temperatures in the San Joaquin River. An estimate of the scale of the effect of increased air temperature on water temperature was made by estimating the equilibrium temperature of the water with and without climate change. The equilibrium temperature is the water temperature where there is zero net heat exchange between the water and its surroundings. If the meteorology conditions were constant for several days to a week or so, depending upon the depth of water and the meteorology, the river water temperature would eventually equal the equilibrium temperature. However, since the meteorology conditions are never constant, the water temperature tends to "chase" the equilibrium temperature, lagging its increase in the spring in summer as solar radiation and air temperature increases and in the fall and winter when solar radiation and air temperature decreases. The calculation of equilibrium temperature follows the procedures described in Bogan, Mohseni, and Stefan (2003) with the following assumptions:

- Cloud cover is zero.
- Wind speed is zero.
- No precipitation.
- Surface albedo = 0.31.

Figure 8-4 compares the equilibrium water temperature to measured water temperature in the San Joaquin River below the Chowchilla Bypass. Solar radiation and air temperature data for the calculation were obtained for the California Irrigation Management Information System (CIMIS) Station 7, Firebaugh/Telles (CIMIS 2013). Observed water temperature data were obtained for the California Data Exchange Center [CDEC] database for Station San Joaquin River below Bifurcation (SJB) (CDEC 2013). The observed water temperature lags the equilibrium temperature by 10 to 15 degrees centigrade (°C) (18 to 27°F), but can be almost 30°C (54°F) lower in the summer.

Figure 8-5 shows the increase in equilibrium water temperature, using the same 2012 data described above, for the cases of a 2, 4 and 6°C (3.6, 7.2 and 10.8°F) increase in air temperature.

In the winter the increase in equilibrium temperature is less than the increase in air temperature. However, in the summer the increase is greater indicating that summer water temperatures would be affected more than winter/spring water temperatures. This is driven by the increase in atmospheric long-wave radiation. Atmospheric radiation is modeled as a function of air temperature to the fourth power so increases in high air temperatures have a greater effect on water temperatures than increases in lower air temperatures. Note, that the actual increase in water temperature will likely be less than the increase in equilibrium temperatures shown in Figure 8-5 as the results shown in Figure 8-5 do not include cloud cover and wind speed which has the effect of lowering temperatures. Regardless, there is likely to be an increase in water temperature in Reach 2B due to climate change. The relative (to air temperature) increase will be small in the spring, but larger in the summer.

As the existing climate throughout California changes over time, the ranges of various plant, fish, and wildlife species could shift or be reduced, depending on the favored temperature and/or moisture regimes of each species. In the Project area, changes in vegetation, fish, and wildlife would depend, in part, upon water temperature, the amount of available water, and the available seed bank.

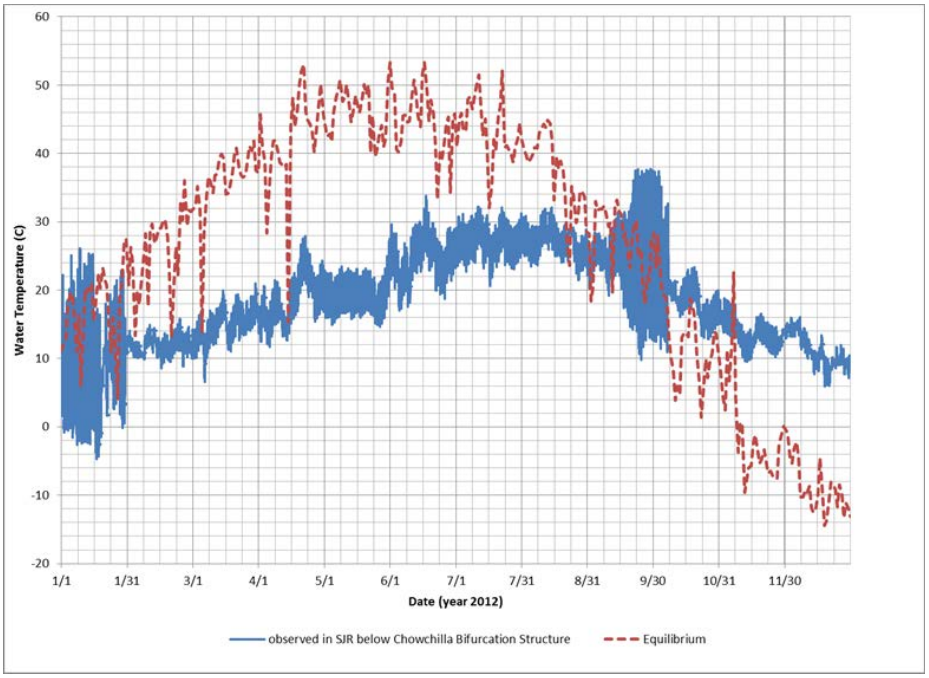

Figure 8-4.
Comparison between Measured and Equilibrium Water Temperatures in Reach 2B for Calendar Year 2012

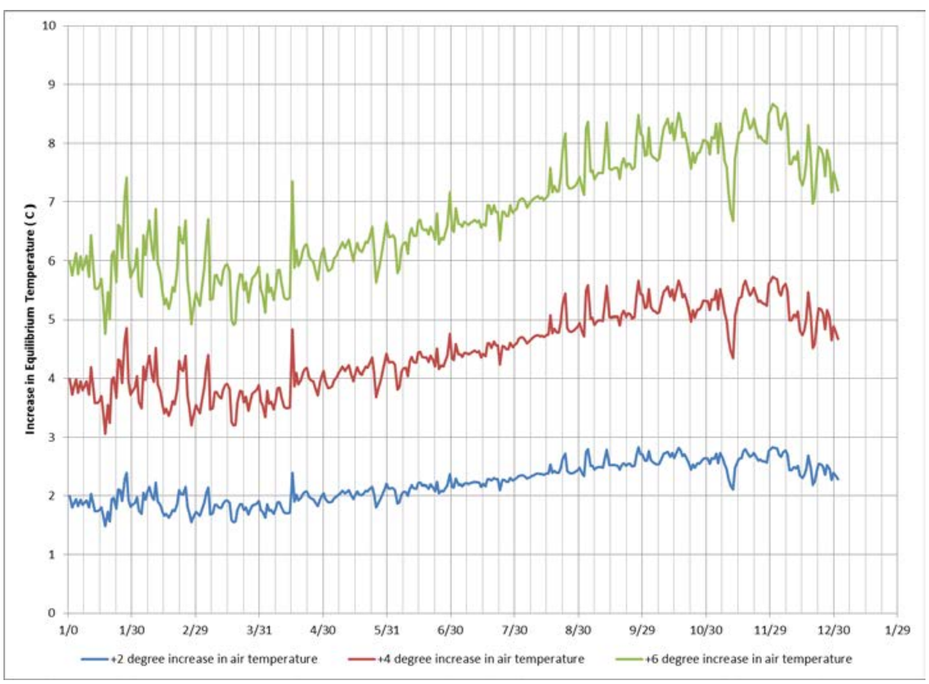

Figure 8-5.
Increase in Equilibrium Water Temperature for a Range of Increases in Air Temperature

8.2 Regulatory Setting

8.2.1 Federal

Climate change and GHG emission reductions are a concern at the Federal level. Laws and regulations, as well as plans and policies, address global climate change issues. This section summarizes key Federal regulations relevant to the Project.

EPA Endangerment and Cause and Contribute Findings

On December 7, 2009, the EPA Administrator signed two distinct findings regarding GHGs under Section 202(a) of the Federal Clean Air Act (CAA):

- *Endangerment Finding:* the current and projected concentrations of the six key GHGs— CO_2, methane, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride—in the atmosphere threaten the public health and welfare of current and future generations.
- *Cause or Contribute Finding:* the combined emissions of these well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution, which threatens public health and welfare.

This endangerment finding was challenged and in *Massachusetts v. U.S. Environmental Protection Agency, et al*., 549 U.S. 497, the United States Supreme Court ruled that GHG does fit within the CAA's definition of a pollutant, and that the EPA has the authority to regulate GHG. Therefore, the endangerment finding by the EPA stands.

EPA Mandatory Greenhouse Gas Reporting Rule

On September 22, 2009, the EPA released its final GHG Reporting Rule. The reporting rule is a response to the Federal fiscal year 2008 Consolidated Appropriations Act (H.R. 2764; Public Law 110-161), that required the EPA to develop "… mandatory reporting of GHGs above appropriate thresholds in all sectors of the economy…." The reporting rule applies to most entities that emit 25,000 metric tons of CO_2e ($MTCO_2e$) or more per year. Since 2010, facility owners have been required to submit an annual GHG emissions report with detailed calculations of facility GHG emissions. The reporting rule also mandates recordkeeping and administrative requirements in order for the EPA to verify annual GHG emissions reports.

Council on Environmental Quality Guidance

On February 18, 2010, the White House Council on Environmental Quality (CEQ) released draft guidance regarding the consideration of GHG in National Environmental Policy Act (NEPA) documents for Federal actions. The draft guidelines include a presumptive threshold of 25,000 $MTCO_2e$ emissions from a proposed action to trigger a quantitative analysis. The CEQ has not established when GHG emissions are "significant" for NEPA purposes; rather, it poses the question to the public (CEQ 2010).

Executive Order 13514

Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, signed on October 5, 2009, establishes "an integrated strategy towards sustainability in the Federal Government and makes reduction of GHG emissions a priority for Federal agencies." Federal fleets would reach this vision by reducing fleet GHG emissions through reduced petroleum consumption. In March 2011, the CEQ issued instructions for implementing climate change adaptation planning in accordance with EO 13514.

Department of the Interior Climate Change Policy

The Department of the Interior has established a climate change impacts policy, which provides the following guidance:

- Ensure that climate adaptation plans are grounded in the best available science and understanding of climate change risks, impacts, and vulnerabilities, incorporating traditional knowledge where available.
- Consider climate change when developing or revising management plans, setting priorities for scientific research and assessments, and making major investment decisions.
- Use well-defined and established approaches, as appropriate, for managing through uncertainty, including: (1) vulnerability assessments, (2) scenario planning, (3) adaptive management, and (4) other risk management or structured decision making approaches.

8.2.2 State of California

Various statewide initiatives to reduce the State's contribution to GHG emissions have raised awareness that, even though the various contributors to and consequences of global climate change are not yet fully understood, global climate change is under way, and there is a real potential for severe adverse environmental, social, and economic effects in the long term.

Executive Order S-3-05

Executive Order (EO) S-3-05, which was signed by Governor Schwarzenegger in 2005, proclaims that California is vulnerable to the impacts of climate change. It declares that increased temperatures could reduce the Sierra's snowpack, further exacerbate California's air quality problems, and potentially cause a rise in sea levels. To combat those concerns, the EO established total GHG emission targets. Specifically, emissions are to be reduced to the 2000 level by 2010, the 1990 level by 2020, and to 80 percent below the 1990 level by 2050.

The EO directed the Secretary of the California Environmental Protection Agency (Cal/EPA) to coordinate a multi-agency effort to reduce GHG emissions to the target levels. The Secretary will also submit biannual reports to the governor and State legislature describing: progress made toward reaching the emission targets, impacts of global warming on California's resources, and mitigation and adaptation plans to combat these impacts. To comply with the EO, the Secretary of the Cal/EPA created the California Climate Action Team made up of members from various State agencies and commissions. The California Climate Action Team released its first report in March 2006. The report proposed to achieve the targets by building on voluntary actions of California businesses, local governments, and the community, as well as through State incentive and regulatory programs. The latest of these reports, *Climate Action Team Report to Governor Schwarzenegger and the California Legislature*, was published in December 2010 (Cal/EPA 2010).

As a result of the thorough scientific analysis collected in these biennial reports, the comprehensive Climate Adaptation Strategy was released in December 2009 after extensive interagency coordination and stakeholder input. The California Natural Resources Agency (CNRA), in coordination with other State agencies, has updated the 2009 California Climate Adaptation Strategy. The *Safeguarding California Plan* (CNRA 2014) augments previously identified strategies in light of advances in climate science and risk management options (see http://resources.ca.gov/climate/safeguarding/).

Executive Order B-30-15

EO B-30-15 was signed by Governor Brown in April 2015. This EO establishes a California greenhouse gas reduction target of 40 percent below 1990 levels by 2030. This target is in line with levels needed in the U.S. to limit global warming below 2 degrees Celsius and will also facilitate reaching the ultimate goal of reducing emissions 80 percent under 1990 levels by 2050. The EO also specifically addresses the need for climate adaptation and directs State government to:

- Incorporate climate change impacts into the State's Five-Year Infrastructure Plan.
- Update the Safeguarding California Plan - the state climate adaption strategy - to identify how climate change will affect California infrastructure and industry and what actions the state can take to reduce the risks posed by climate change.
- Factor climate change into State agencies' planning and investment decisions.
- Implement measures under existing agency and departmental authority to reduce greenhouse gas emissions.

The Global Warming Solutions Act of 2006

In 2006, California passed the California Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32; Health & Saf. Code, § 38500 et seq., or AB 32). AB 32 further details and puts into law the mid-term GHG emissions reduction target established in EO S-3-05 to reduce statewide GHG emissions to 1990 levels by 2020. AB 32 also identifies the ARB as the State agency responsible for the design and implementation of emissions limits, regulations, and other measures to meet the target.

The statute presents the schedule for each step of the regulatory development and implementation process. In accordance with the AB 32 statutory requirements, the ARB published a list of early-action GHG emissions reduction measures by June 30, 2007.

Prior to January 1, 2008, the ARB also identified the current level of GHG emissions by requiring statewide reporting and verification of GHG emissions from emitters and identified the 1990 levels of California GHG emissions. By January 1, 2010, the ARB adopted regulations to implement the early-action measures.

In December 2007, the ARB approved the 2020 emissions limit (1990 emissions level) of 427 million $MTCO_2e$ of GHGs. The 2020 target requires the reduction of 80 million $MTCO_2e$, or approximately 16 percent below the State's projected "business-as-usual" 2020 emissions of 507 million $MTCO_2e$.

Also in December 2007, the ARB adopted mandatory reporting and verification regulations pursuant to AB 32. The regulations became effective January 1, 2009, with the first reports covering 2008 emissions; the regulations were updated in 2012, and the updates became effective in 2013. The mandatory reporting regulations require reporting for major facilities that generate more than 10,000 $MTCO_{2e}$ per year. The ARB has met all of the statutorily mandated deadlines for promulgation and adoption of regulations.

Scoping Plan

On December 11, 2008, pursuant to AB 32, the ARB adopted the Climate Change Scoping Plan (Scoping Plan). This plan outlines how emissions reductions would be achieved from significant sources of GHGs via regulations, market mechanisms, and other actions. Six key elements, outlined in the Scoping Plan, are identified below to achieve emissions reduction targets:

- Expanding and strengthening existing energy efficiency programs, including building and appliance standards.
- Achieving a statewide renewable energy goal of 33 percent.
- Developing a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system.
- Establishing targets for transportation-related GHG emissions for regions throughout California, and pursuing policies and incentives to achieve those targets.
- Adopting and implementing measures pursuant to existing State laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard.
- Creating targeted fees, including a public goods charge on water use, fees on high global warming potential gases, and a fee to fund the administrative costs of the State's long-term commitment to AB 32 implementation.

The Scoping Plan also recommended 39 measures that were developed to reduce GHG emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving our natural resources, and ensuring that the impacts of the reductions are equitable and do not disproportionately impact low-income and minority communities. These measures also put the State on a path to meet the long-term 2050 goal of reducing California's GHG emissions to 80 percent below 1990 levels.

To comply with AB 32 requirements for scoping plan updates, the ARB adopted the First Update to the AB 32 Scoping Plan in May 2014. The First Update defines the ARB's climate change priorities for the next 5 years and evaluates the alignment of long-term GHG reduction strategies with other State policy priorities areas.

8.2.3 Regional and Local

San Joaquin Valley Air Pollution Control District Guidance and Policy

The San Joaquin Air Pollution Control District (SJVAPCD) has established policies and guidance relating to GHG emissions from projects undergoing the California Environmental Quality Act Process (CEQA) process. On December 17, 2009, the SJVAPCD adopted the *Guidance for Valley Land-use Agencies in Addressing GHG Emission Impacts for New Projects under CEQA* to assist other lead agencies in establishing their own process for determining significance of project GHG impacts. The SJVAPCD also adopted the *District Policy – Addressing GHG Emission Impacts for Stationary Source Projects under CEQA when Serving as the Lead Agency* for its own use when serving as a lead agency. In support of the guidance document and policy, SJVAPCD also prepared a staff report, *Climate Change Action Plan: Addressing Greenhouse Gas Emissions under the California Environmental Quality Act*, which evaluates different approaches to assessing significance for GHG emission impacts (SJVAPCD 2009).

The guidance and policy rely on the use of performance based standards, otherwise known as Best Performance Standards, to assess significance of project specific GHG emissions on global climate change during the environmental review process, as required by CEQA. Lead agencies adopting this guidance as policy for addressing GHG impacts under CEQA would require that all projects with increased GHG emissions implement the Best Performance Standards, or otherwise demonstrate that project GHG emissions have been reduced by at least 29 percent from business-as-usual, to determine that a project would have a less than significant impact. The SJVAPCD has not established Best Performance Standards for construction or restoration projects.

8.3 Environmental Consequences and Mitigation Measures

8.3.1 Impact Assessment Methodology

This section focuses on the contribution of the Project alternatives to the buildup of GHGs in the atmosphere, which has been shown to contribute to climate change. It is unlikely that any single project by itself could have a significant impact on the environment with respect to GHGs. However, the cumulative effect of human activities has been clearly linked to quantifiable changes in the composition of the atmosphere, which has in turn been shown to be the main cause of global climate change.

The Project would emit GHGs from off-road construction equipment and worker vehicle trips associated with construction-related activities. Project operations would also result in GHG emissions, but only from worker vehicle trips to provide maintenance and operational support for the Project. The principal GHGs associated with the Project would be CO_2 and methane. The GHG emissions were quantified using the *Informal Guidance for California Department of Water Resources (DWR) Grantees: GHG Assessment for CEQA Purpose*.

Direct GHG emissions from construction equipment exhaust were estimated using the same models used for estimating criteria pollutant emissions (i.e., Roadway Construction Emissions Model [RoadMod], which incorporates ARB's In-Use Offroad 2011 Emission Inventory Model for off-road equipment and Emission Factors Modeling Software [EMFAC] for on-road mobile sources). These models only provide emission factors for CO_2 and methane. CO_2e emissions were estimated by multiplying the CO_2 and methane emission by their respective GWP factors. N_2O emissions are small and their exclusion has no material impact on the overall calculation of GHG emissions.

Indirect GHG emissions associated with electricity and water use are not quantified as these would be minimal compared to the amount of emissions from offroad equipment and onroad vehicles. At this time, there is not anticipated to be any substantial use of equipment powered by electricity for construction or operations.

GHG emissions associated with changes in carbon sequestration due to land use changes have been addressed in a qualitative manner for wetlands, discussing some of the anticipated outcomes based on evolving scientific studies, and a quantitative manner for growth of riparian habitat, based on ARB's estimates for carbon sequestration.

8.3.2 Significance Criteria

GHG Construction Threshold

As discussed previously, the SJVAPCD has provided guidance for evaluating significance of GHG emissions that is intended to assist lead agencies in addressing GHG impacts for CEQA purposes, but the determination of significant impacts are ultimately within the purview of the lead agency. The SJVAPCD guidance on assessing significance relies on Best Performance Standards and demonstration of GHG reductions compared to business as usual conditions. Best Performance Standards have not been established for construction projects.

As lead agency under CEQA, the CSLC evaluates projects on a case-by-case basis when determining whether or not project GHG impacts are significant. For this project, the CSLC recommends that construction GHG emissions be amortized over the life of the project (assumed to be equivalent to the 49-year lease period), and compared to a quantitative significance threshold of 10,000 $MTCO_2$e per year to determine the significance of project GHG impacts from construction. The CSLC developed this recommendation based on their consideration of several California Air Quality Management District (AQMD) and Air Pollution Control District (APCD) significance thresholds for large construction projects.[5]

For NEPA effects, the CEQ quantitative analysis trigger level of 25,000 $MTCO_2$e per year is a useful indicator for long-term actions with annual emissions, but a methodology

[5] There is no specific value used for a significance threshold among different air districts. For example, the South Coast Air Quality Management District uses the 10,000 $MTCO_{2e}$ per year threshold for significance, but the SJVAPCD only specifies a zero equivalency value (which is much smaller). Also note that some agencies use their own values, for example the DWR climate action plan specifies a 25,000 $MTCO_{2e}$ per year threshold for construction.

to evaluate short-term construction emissions is not provided. Therefore, the methodology and significance threshold used to determine CEQA significance of construction GHG emissions is also used to determine NEPA effects in this analysis.

GHG Operational Threshold

The SJVAPCD guidance on assessing significance relies on Best Performance Standards and demonstration of GHG reductions compared to business as usual conditions. Best Performance Standards have not been established for operations and maintenance of restoration projects.

The SJVAPCD has adopted a Zero Equivalency Policy for Greenhouse Gases, which establishes a level below which GHG emissions are considered equivalent to zero for SJVAPCD permitting purposes. GHG emissions of 230 $MTCO_2e$ per year or less are considered to be zero for SJVAPCD permitting purposes. The SJVAPCD has not adopted this level as a significance threshold, but rather as an approved GHG emissions level that would be considered equivalent to zero.

To determine NEPA effects associated with project operations, the annual operational emissions will be compared to the CEQ quantitative analysis trigger level of 25,000 $MTCO_2e$ per year.

8.3.3 Impacts and Mitigation Measures

This section provides a Project-level evaluation of direct and indirect effects of the Project Alternatives on climate change and GHG emissions. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential impacts compared to existing conditions to meet CEQA requirements. The analysis is organized by Project alternative with specific impact topics numbered sequentially under each alternative. With respect to climate change and GHG emissions, the environmental impact issues and concerns are:

1. Impacts from GHG Emissions Associated with Project Construction.
2. Impacts from GHG Emissions Associated with Project Operation.
3. Changes in Land Use that Result in a Net Change in GHG Emissions.

The following analysis considers the Project’s contribution to climate change and GHG emissions in the context of the cumulative condition. Other climate change and GHG emissions-related issues covered in the Program Environmental Impact Statement/Report (PEIS/R) (SJRRP 2011) are not covered here because they are programmatic in nature and/or are not relevant to the Project area.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration in other reaches, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these Program-level activities would not achieve Settlement goals. This section describes the impacts of the No-Action

Alternative. The analysis is a comparison to existing conditions, and no mitigation is required for No-Action.

Impact CC-1 (No-Action Alternative): *Impacts from GHG Emissions Associated with Project Construction*. Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed. Therefore there would be no GHG emissions associated with construction of the Project. There would be **no impact**.

Impact CC-2 (No-Action Alternative): *Impacts from GHG Emissions Associated with Project Operation*. Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed. Therefore there would be no GHG emissions associated with operation of the Project. There would be **no impact**.

Impact CC-3 (No-Action Alternative): *Changes in Land Use that Result in a Net Change in GHG Emissions*. Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed. There would be no Project-related land use changes. Therefore, there would be **no impact.**

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would include construction of Project facilities including a Compact Bypass channel, a levee system with a narrow floodplain encompassing the river channel, and the South Canal. Other key features include construction of the Mendota Pool dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, and the South Canal bifurcation structure with fish passage facility and fish screens, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure of the Chowchilla Bifurcation Structure. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

Impact CC-1 (Alternative A): *Impacts from GHG Emissions Associated with Project Construction*. Compared to No-Action, Alternative A would directly emit GHG emissions as a result of construction activities associated with the Project. These direct emissions from offroad construction equipment and onroad vehicles were quantified. (Full details of the methodology used to quantify emissions are contained in Chapter 4.0, “Air Quality.” The construction offroad equipment schedule was provided by DWR.) GHG emissions associated with the operation of the equipment were estimated using statewide emission factors. Emissions associated with hauling of material to the Project area were estimated using EMFAC. Table 8-1 shows the GHG emissions associated with construction under each of the Action Alternatives.

As shown in Table 8-1, the amortized GHG emissions associated with construction of the Project is below the significance threshold of 10,000 $MTCO_2e$ per year under each alternative.

Furthermore, implementation of Mitigation Measures AQ-1A and AQ-1B to reduce criteria pollutant emissions from construction equipment and hauling trucks, respectively, could result in GHG emission co-benefits and further reduce GHG emissions below significance thresholds. The potential magnitude of these co-benefits would be highly depend on the specific measures applied, as well as the extent to which these measures are applied (e.g., the percentage of the equipment and vehicle fleet mitigated). For example, the use of alternative fuels such as liquefied natural gas (LNG) or compressed natural gas (CNG) in material hauling trucks could reduce GHG emissions by up to 14 percent compared to diesel (see Tables 8-2 and 8-3). If this strategy was applied to all material hauling truck activity during construction, total GHG emissions could be reduced by up to approximately 65,200 $MTCO_2e$.

Implementation of Mitigation Measure AQ-1C may also result in GHG reduction co-benefits through the funding of emissions reductions programs through a voluntary emissions reduction agreement with SJVAPCD, although any potential GHG co-benefit would be dependent on the type of reduction programs funded. As such, there is not enough information to estimate the potential magnitude of GHG reduction co-benefits from implementing Mitigation Measure AQ-1C (if any).

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Therefore, impacts from construction GHG emissions under Alternative A would be **less than significant**.

Table 8-1.
Total Project GHG Emissions

Year	$MTCO_2e$ per Year			
	Alternative A	Alternative B	Alternative C	Alternative D
Year 1	9,955	10,034	9,955	10,034
Year 2	30,390	30,518	30,390	30,518
Year 3	29,853	29,500	29,853	29,500
Year 4	25,611	27,837	25,611	27,837
Year 5	24,818	34,530	15,294	26,833
Year 6	72,809	67,323	47,319	47,319
Year 7	73,411	67,310	47,245	47,245
Year 8	73,097	66,997	46,587	46,587
Year 9	72,538	67,211	45,343	45,343
Year 10	65,690	49,541	NA	NA
Total $MTCO_2e$ Emissions	478,172	450,801	297,597	311,216
$MTCO_2e$ Emissions Amortized over Project Lifetime ($MTCO_2e$ per Year)	9,759	9,200	6,073	6,351

Notes: Amortized emissions assume a project life of 49 years (based on a 49-year lease period).
GHG = greenhouse gases
$MTCO_2e$ = metric tons of carbon dioxide equivalents

Table 8-2.
GHG Emissions from Fuel Combustion in Vehicles

Fuel Type	Fossil Carbon Intensity (gCO2e/MJ)	Energy Economy Ratio Adjustment for Vehicle Efficiencies	Adjusted Percent Reduction in Carbon Intensity Compared to Diesel
Diesel	74.9	1	--
Liquefied Natural Gas (LNG)	58.5	0.9	-13%
Compressed Natural Gas (CNG)	57.73	0.9	-14%

Source: California Air Resources Board 2009a, 2009b, 2012
GHG = greenhouse gases
gCO2e/MJ = grams of carbon dioxide equivalent per megajoule

Table 8-3.
Potential GHG Reductions from Use of CNG Trucks

Alternative	Total MTCO2e for Truck Trips	MTCO2e Reduction
Alternative A	454,395	-65,251
Alternative B	427,924	-61,449
Alternative C	275,441	-39,553
Alternative D	288,500	-41,428

Key:
CO2e = carbon dioxide equivalents
CNG = compressed natural gas
GHG = greenhouse gases
$MTCO_2e$ = metric tons of carbon dioxide equivalents

Impact CC-2 (Alternative A): ***Impacts from GHG emissions Associated with Project Operation*****.** Compared to the No-Action, Alternative A would incur GHG emissions associated with routine maintenance and operations of the Project upon completion. Table 8-4 shows the GHG emissions associated with the operational phases of the Action Alternatives. The operational GHG emissions are less than 10 $MTCO_2e$ per year. These emissions are a conservative estimate because the GHG emissions in future years would decrease due to improvements in emissions from onroad vehicles. The operational GHG emissions under Alternative A would be below the CEQ analysis trigger level of 25,000 $MTCO_2e$ per year.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). The operational GHG emissions for Alternative A would be less than the zero equivalency level of 230 $MTCO_2e$ per year. Therefore, GHG emissions associated with Project operation for Alternative A would be **less than significant**.

Table 8-4.
Total Operational GHG Emissions

Alternative	$MTCO_2e$ per Year
Alternative A	5.21
Alternative B	5.21
Alternative C	5.21
Alternative D	5.02

Notes:
$MTCO_2e$ = metric tons of carbon dioxide equivalents
GHG = greenhouse gases

Impact CC-3 (Alternative A): ***Changes in Land Use that Result in a Net Change in GHG Emissions.*** Compared to the No-Action Alternative, the Project would create new floodplain areas within Reach 2B. In the area where levees are set back, there would be a change in land use from agriculture to riparian and wetland. Although wetlands can act as both a source and a sink for GHGs, growth of riparian habitat can increase carbon sequestration and reduce total GHG emissions.

Managed agriculture can be a major source of N_2O emissions, a highly potent GHG. Wetlands can be a source of methane, a potent GHG, but they also can sequester carbon. Whether wetlands are a net source or sink of GHG depends upon many factors including the time frame of interest and the characteristics of the wetland.

Altor and Mitsch (2006) looked at how intermittent versus continuous inundation of a wetland affected methane production. Their study concluded that intermittently flooded wetlands emitted significantly less methane than continuously flooded wetlands when the wetland was allowed to dry between flood events. Importantly, they observed that intermittently flooded wetlands emitted less methane when they were flooded then wetlands that are always flooded. In Reach 2B, most wetland areas are expected to be intermittently flooded and therefore may not be significant producers of methane. In addition, wetlands would become net sinks for carbon over the long term.

According to habitat restoration estimates, Alternative A could provide up to 100 acres of valley foothill riparian habitat, 200 acres of riparian scrub, and 390 acres of willow scrub in the Project area (SJRRP 2012, Attachment A). Assuming that new growth of riparian or shrub habitat can sequester approximately 44.3 $MTCO_2e$ per acre over the long-term (e.g., 100 years) (ARB 2014b), Alternative A could provide up to a 31,000 $MTCO_2e$ reduction. Wetland and riparian zones would likely result in a substantial decrease in GHG emissions relative to continued managed agriculture over the long term.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Therefore, compared to existing conditions, the Alternative A is expected to result in a **beneficial** effect.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would include construction of Project features including a Compact Bypass channel, a levee system with a wide, consensus-based floodplain encompassing the river channel, and the Compact Bypass Bifurcation Structure with fish passage facility and fish screens. Other key features include construction of a fish passage facility at the San Joaquin River control structure of Chowchilla Bifurcation Structure, the re-route of Drive 10 ½ (across the Compact Bypass bifurcation structure), and removal of the San Mateo Avenue crossing. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

Impact CC-1 (Alternative B): ***Impacts from GHG Emissions Associated with Project Construction*****.** Refer to Impact CC-1 (Alternative A). Potential construction impacts of Alternative B would be similar to the potential construction impacts of Alternative A except that the amortized GHG emissions associated with construction under Alternative B would be lower than Alternative A, as shown in Table 8-1. Construction GHG emissions under Alternative B would have a **less than significant** impact. Additionally, potential GHG emission reduction co-benefits from implementation of Mitigation Measures AQ-1A, AQ-1B, and AQ-1C would be similar to the potential co-benefits under Alternative A.

Impact CC-2 (Alternative B): ***Impacts from GHG emissions Associated with Project Operation*****.** Refer to Impact CC-2 (Alternative A). Potential operational impacts of Alternative B would be similar to the potential operational impacts of Alternative A. There would be a **less than significant** impact.

Impact CC-3 (Alternative B): ***Changes in Land Use that Result in a Net Change in GHG Emissions*****.** Refer to Impact CC-3 (Alternative A). Potential impacts of Alternative B would be similar to potential impacts of Alternative A. According to habitat restoration estimates, Alternative B could provide up to 340 acres of riparian scrub, 110 acres of valley foothill riparian habitat, and 500 acres of willow scrub in the Project area (SJRRP 2012, Attachment A). Assuming that new growth of riparian or shrub habitat can sequester approximately 44.3 MTCO2e per acre (ARB 2014b), Alternative B could provide up to a 42,000 MTCO2e reduction. This would result in a **beneficial** effect.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would include construction of Project features including Fresno Slough Dam, a levee system with a narrow floodplain encompassing the river channel, and the Short Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the Short Canal control structure and fish screen, the Chowchilla Bifurcation Structure fish passage facility, modification of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Impact CC-1 (Alternative C): ***Impacts from GHG Emissions Associated with Project Construction*****.** Refer to Impact CC-1 (Alternative A). Potential construction impacts of Alternative C would be similar to the potential construction impacts of Alternative A except that the amortized GHG emissions associated with construction under Alternative C would be lower than Alternative A, as shown in Table 8-1. Construction GHG emissions under Alternative C would have a **less than significant** impact. Additionally, potential GHG emission reduction co-benefits from implementation of Mitigation Measures AQ-1A, AQ-1B, and AQ-1C would be similar to the potential co-benefits under Alternative A.

Impact CC-2 (Alternative C): ***Impacts from GHG emissions Associated with Project Operation*****.** Refer to Impact CC-2 (Alternative A). Potential operational impacts of Alternative C would be similar to the potential operational impacts of Alternative A. There would be a **less than significant** impact.

Impact CC-3 (Alternative C): ***Changes in Land Use that Result in a Net Change in GHG Emissions*****.** Refer to Impact CC-3 (Alternative A). Potential impacts of Alternative C would be similar to potential impacts of Alternative A. According to habitat restoration estimates, Alternative C could provide up to 200 acres of riparian scrub, 100 acres of valley foothill riparian habitat, and 470 acres of willow scrub in the Project area (SJRRP 2012, Attachment A). Assuming that new growth of riparian or shrub habitat can sequester approximately 44.3 MTCO2e per acre (ARB 2014b), Alternative C could provide up to a 34,000 MTCO2e reduction. This would result in a **beneficial** effect.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would include construction of Project features including Fresno Slough Dam, a levee system with a wide floodplain encompassing the river channel, and the North Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the North Canal bifurcation structure with fish passage facility and fish screens, removal of the San Joaquin River control structure of the Chowchilla Bifurcation Structure, removal of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Impact CC-1 (Alternative D): ***Impacts from GHG Emissions Associated with Project Construction*****.** Refer to Impact CC-1 (Alternative A). Potential construction impacts of Alternative D would be similar to the potential construction impacts of Alternative A except that the amortized GHG emissions associated with construction under Alternative D would be lower than Alternative A, as shown in Table 8-1. Construction GHG emissions under Alternative D would have a **less than significant** impact. Additionally, potential GHG emission reduction co-benefits from implementation of Mitigation Measures AQ-1A, AQ-1B, and AQ-1C would be similar to the potential co-benefits under Alternative A.

Impact CC-2 (Alternative D): ***Impacts from GHG emissions Associated with Project Operation*****.** Refer to Impact CC-2 (Alternative A). Potential impacts of Alternative D would be similar to potential impacts of Alternative A. There would be a **less than significant** impact.

Impact CC-3 (Alternative D): ***Changes in Land Use that Result in a Net Change in GHG Emissions*****.** Refer to Impact CC-3 (Alternative A). Potential impacts of Alternative D would be similar to potential impacts of Alternative A. According to habitat restoration estimates, Alternative D could provide up to 340 acres of riparian scrub, 110 acres of valley foothill riparian habitat, and 580 acres of willow scrub in the Project area (SJRRP 2012, Attachment A). Assuming that new growth of riparian or shrub habitat can sequester approximately 44.3 MTCO2e per acre (ARB 2014b), Alternative D could provide up to a 45,000 MTCO2e reduction. This would result in a **beneficial** effect.

9.0 Cultural Resources

This chapter describes the environmental and regulatory settings of cultural resources, as well as environmental consequences and mitigation, as they pertain to implementation of the Mendota Pool Bypass and Reach 2B Improvements Project (Project) alternatives. The discussion below includes descriptions of cultural resource conditions and the potential impacts of the Project alternatives on cultural resources for the area represented by the Project. The discussion in this section is supported by archaeological and historical architectural technical reports (Byrd et al. 2009) prepared for the Project, as well as for the Program Environmental Impact Statement/Report (PEIS/R) (SJRRP 2011), and the Native American ethnographic report (Davis-King 2009) prepared for the San Joaquin River Restoration Program (SJRRP). These reports are not publically available documents, as they contain confidential information on the location of sensitive cultural resources.

9.1 Environmental Setting

Cultural resources are defined as prehistoric and historic-era archaeological sites, Traditional Cultural Properties, Sites of Religious and Cultural Significance, and architectural properties (e.g., buildings, bridges, and structures). This definition includes historical properties as defined by the National Historic Preservation Act (NHPA). For the purposes of the discussion below, the term "Project area" refers to all areas that may be directly or indirectly affected by implementing Project actions. For the purposes of compliance with Section 106 of the NHPA, this area is identical to the "Area of Potential Effects" (APE).

A Programmatic Agreement (PA) is being developed among U.S. Department of the Interior, Bureau of Reclamation (Reclamation), the State Historic Preservation Office (SHPO) and consulting parties, including Native American Tribes, for compliance with Section 106 of the NHPA as it pertains to the Program. The PA would provide an overall framework for conducting the Section 106 process, including specific mitigation and review protocol, during the course of this Project as well as the entire SJRRP.

9.1.1 Regional Setting

The Project area lies within the central portion of the San Joaquin Valley, the southern extension of California's Great Central Valley. The source of the San Joaquin River is along the crest of the high Sierra Nevada, between Yosemite and Kings Canyon national parks. The river descends through high glacial valleys and then steep canyons before it enters the Central Valley north of Fresno. The San Joaquin River is the southernmost drainage that typically flows north to the Sacramento-San Joaquin Delta and San Francisco Bay. In wet years, the Kings River and even the Kern River overflow Tulare and Buena Vista lakes, respectively, and flow northward to join the San Joaquin.

Elevation within the Project area is approximately 150 feet near Mendota Pool where the San Joaquin River turns and beings flowing northward (Byrd et al. 2009).

Geology and Geomorphology

The central area and eastern side of the San Joaquin Valley is dominated by a complex intermingling of basin deposits that dominate the valley floor, and large alluvial fans that issue from the foothills of the Sierra Nevada and extend across the valley. This geomorphic contact is a geologically and seismically active area, and this activity has had a direct effect on surface geomorphology, deposition, and soils.

Due to the dynamic nature of California's landscape, archaeological sites deposited over approximately the last 13,500 years (roughly the time that humans are known to have lived in California) have been subject to numerous geomorphic processes. These processes have buried, destroyed, or left these sites intact on the surface. Within the San Joaquin Valley, geomorphic processes include response of alluvial fan deposition to changing climate, fluctuating river courses and related floodplain deposition, response of lakes (e.g., Tulare, Buena Vista) to climate, and response of the San Joaquin River to sea-level rise and upstream effects of the formation of the San Joaquin Delta. All of these factors have likely affected the differential preservation of archaeological sites on the surface, which hampers efforts to accurately assess the effects of the Project solely through archaeological reconnaissance surveys that are necessarily limited to investigation of the modern ground surface.

In general, most Pleistocene-age landforms have little potential for harboring buried archaeological resources, as they developed prior to human migration into North America (ca. 13,500 years before the present [B.P.]). However, Pleistocene surfaces buried below younger Holocene deposits do have a potential for containing archaeological deposits. Holocene alluvial deposits may contain buried soils (paleosols) that represent periods of landform stability before renewed deposition. The identification of paleosols within Holocene-age landforms is of particular interest because they represent formerly stable surfaces that have a potential for preserving archaeological deposits. See Section 18.1 on paleontological resources that may be present in the Project area, which are, conversely, primarily limited to Pleistocene or older landforms.

Vegetation

Extensive marshes once surrounded the lakes, sloughs, and rivers of the San Joaquin Valley. Before the historic period, their size varied seasonally and episodically, depending on larger environmental trends. Plants such as tules (*Scirpus lacustris*), growing as tall as 10 to 12 feet, covered the entire range of the wetlands. On drier ground, vegetation consisted of sagebrush (*Artemesia* species), greasewood (*Purshia tridentate*), saltbush (*Atriplex* species), and various bunchgrasses. Few trees inhabited the area except for along river channels, and included cottonwood (*Populus fremontii*), sycamore (*Platanus racemosa*), and willow (*Salix* species). Wildlife abounded in the lake and marshlands where large numbers of migratory ducks and geese joined thousands of year-round aquatic birds. Freshwater mussel (*Margaritifera margaritifera*), fish, and turtles were abundant, along with pronghorn antelope (*Antilocapra americana*), tule elk (*Cervus elaphus*), and winter herds of mule deer (*Odocoileus hemionus*). The area was also home to plentiful numbers of rabbit (*Sylvilagus* species), black-tailed hare (*Lepus californicus*), and valley quail (*Lophortyx californica*) (Wallace 1978). The variety of wildlife in the San Joaquin Valley was typical for an area characterized by an arid to semi-arid climate, defined by hot summers and mild winters.

Cultural Setting

The following briefly discusses the archaeological record, the historical context, and the ethnographic context for the Project area. These contexts provide the basis for defining and ultimately evaluating any resources identified during the course of the investigation conducted for the purposes of this project.

Prehistoric Era

Prehistoric archaeological investigations have been limited within the San Joaquin River area of the Central Valley, and this area is considered by many to be one of the least understood regions in California with respect to prehistoric conditions (Moratto 1984, Riddell 2002, Rosenthal et al. 2007). As a result, archaeologists working in this area have been forced to borrow chronologies from nearby areas, particularly the foothills to the west (the eastern foothills of the Diablo Range) and to the east (the western slope of the Sierra Nevada) (Olsen and Payen 1969). These investigations of the western Sierra Nevada foothills have resulted in the formulation of local chronologies, notably the Chowchilla River/Buchanan Reservoir sequence.

Native American prehistoric occupation of the region began near the end of Pleistocene (circa 13,500 years ago) and continued until Spanish contact (in the late 1700s) (Rosenthal et al. 2007). Terminal Pleistocene (13,500 to 11,600 years ago) occupation in the region is represented by wide-ranging, mobile hunters and gatherers who periodically exploited large game. Throughout California, the prehistoric conditions of the Terminal Pleistocene are minimally represented and poorly understood. However, there is a probable Terminal Pleistocene site near Tulare Lake at the southern end of the Central Valley, and isolated artifacts dating to this era have been recovered within this area (Moratto 1984:81-82, Riddell and Olsen 1969).

Evidence of early Holocene (11,600 to 7,700 years ago) human settlement is only rarely encountered in the Central Valley (Rosenthal et al. 2007). Infrequent early Holocene sites in the foothills appear to have been seasonally occupied and include a robust ground stone assemblage focused on the processing of nuts. The lack of documented Central Valley early Holocene sites is undoubtedly due to sedimentation that has buried paleosurfaces of the time period (Rosenthal and Meyer 2004).

In the foothills, middle Holocene (7,700 to 3,800 years ago) sites are dominated by expedient cobble tools, likely used for various purposes including grinding, chopping, and pounding. Preserved plant remains from these sites are mainly represented by acorns and pine nuts. As with early Holocene sites, the relative lack of middle Holocene evidence in the Central Valley is due in large part to the archaeological record being buried by later sedimentation. Well-dated sites of this age in the Central Valley are typically discovered in buried contexts.

By 4,500 years ago, distinctive lowland and upland adaptive patterns emerged in the region (Rosenthal et al. 2007). Throughout the late Holocene (after 3,800 years ago) the Central Valley was characterized by a complex socioeconomic strategy focused on riverine and marsh resources and extremely elaborate material culture (Moratto 1984). Notable attributes included dart points, mortars and pestles; use of acorns and pine nuts; new fishing technologies and extensive exploitation of fisheries; basketry and cordage; ceramic items; diverse personal paraphernalia of stone, bone and shell; and large, formal cemetery areas.

Around 2,300 years ago, large populations began concentrating in major settlements along the San Joaquin River. Material culture included large dart points, mortars and pestles, milling stones, and bone spear points. Subsistence was concentrated on hunting and fishing and, based on secondary evidence, included hard seeds, with more limited use of acorns. Wide-ranging trade networks are documented and a non-egalitarian social organization and ascribed status may have emerged. With extended occupation at key settlements, large mounded villages were created. By approximately 1,000 years ago, population density had increased significantly, with noted developments in material culture including bow and arrow technology and new types of items of personal adornment.

Native Peoples at the Time of European Contact

At the time of contact with European settlers, the Project area was occupied by the Northern Valley Yokuts, who had lived in the region for some 4,500 years (Kroeber 1925; Latta 1977; Powers 1877; Wallace 1978). The Yokuts were hunter-gatherers who divided themselves into named tribes, each with a dialect, territory, and discrete settlements. Each tribe was politically autonomous and occupied a permanent area, usually on high ground along a major drainage course. The San Joaquin River and its main eastern tributaries formed the core of the Northern Valley Yokuts' homeland. Settlements west of the river tended to be in the foothills, concentrated along watercourses.

According to fragmentary information, the Yokuts exploited local subsistence resources from principal villages located on or near the San Joaquin River and other major streams (Cook 1955, 1960; Wallace 1978). Villages were composed of large, semisubterranean, round or oval dwellings. Some of the more major establishments also included larger communal dance houses. These villages were supported to a large extent by the riverine resources and by a variety of terrestrial plants, most importantly, oak trees for their acorns. Occupation was essentially sedentary, with dispersals occurring only seasonally for the acquisition of particular resources (Wallace 1978). Trade was focused along the river, where tule rafts were used for transportation. The Yokuts reportedly traded dogs to their Miwok neighbors in exchange for baskets and blankets. They acquired abalone and mussel shells from the coast and obsidian from the eastern slope of the Sierra Nevada.

Yokut populations at the time of Spanish contact have been estimated at about 41,000, with perhaps 5,000 living along the east side of the valley between the Merced and Kings rivers (Cook 1955). These numbers dropped drastically as native people here and throughout California were decimated by European and Euro-American diseases in the early 19th century and by the tremendous influx of nonnative people during the local gold-mining period from the mid-19th and into the 20th centuries (Wallace 1978). Today there are still several bands of Yokuts Indians living in the San Joaquin Valley, though none are known to practice the traditional, pre-contact way of life.

Historic Era

For some time only sporadic interaction took place between Native Californians and Europeans (Beck and Haase 1974, Clough and Secrest 1984, Hayes 2007). The first Spanish expedition into the San Joaquin Valley was led by Pedro Fages in 1772 who sought a new route between San Diego and Monterey. In the 1820s, the objective of inland expeditions had changed from scouting new mission sites to punitive forays against the San Joaquin Valley Indians, both Yokuts and Miwoks. The Indians had engaged in sorties on missions, towns, and ranchos to steal livestock for food and transportation since the early 1800s. A cycle of raids and reprisals across the coastal mountains continued until American settlers took up permanent residence in the valley in the mid-1840s (Beck and Haase 1974, Broadbent 1974, Cook 1976).

While Mexican troops engaged in punitive expeditions against the San Joaquin Valley tribes, American trappers and explorers made their first journeys into the region. The first was Jedediah S. Smith in 1827. Other trappers from the Hudson’s Bay Company passed through the Central Valley, as well as Kit Carson and Peter Ogden Skene. Perhaps the most famous explorer in the region at this time was John C. Fremont who was in the vicinity in 1844 (Clough and Secrest 1984, Fremont 1852, Smith 1977). Fremont also remarked on the abundance of wild horses on the west side of the San Joaquin River, and the difficulty of travel because of the swampy terrain and sloughs.

Two small Spanish settlements developed in the Project area near Fresno Slough in the early decades of the 1800s, called *Pueblo de Las Juntas* and *Rancho de los Californios* (California Ranch) (Clough and Secrest 1984, Wallace 1978). Officially sanctioned colonial settlement of the San Joaquin Valley began in the 1840s when the Mexican government issued its first land grants to individuals who petitioned for land. Two Mexican ranchos were successfully patented at the northwest end of the Project area on the west side of the San Joaquin River (Rancho Sanjon de Santa Rita and Orestimba Rancho), and a third claim in the foothills near Friant was rejected (Rancho Rio del San Joaquin).

In response to the gold rush, Americans quickly built a line of towns and roadside stations north and south across the 250-mile floor of the San Joaquin Valley, with Stockton as the central distributing point (Moehring 2004). The few towns in the Project area established during the second half of the nineteenth century all have their origins as favorable places to cross the San Joaquin River. A few were later sustained by agriculture or industry. For example, the settlement at the current site of Friant, on the San Joaquin River just below the Friant Dam, began as a ferry crossing on the San Joaquin River around 1854. Beginning in the early 20th century, gravel mining emerged as a major industry in the vicinity of Friant; several companies opened mines and the town benefitted economically. Boom times came with the construction of Friant Dam in the 1940s and gravel mines have continued to operate into recent years.

During the 1870s, the Central Pacific Railroad, and later the Southern Pacific Railroad, spawned a network of some 50 railroad stations, of which 24 became railroad town sites. About eight of these town sites became strategic trading centers stretching from Stockton south to Bakersfield; among them were towns in and near the Project area at Merced (1871), Sycamore (1872), and Fresno (1872). The modern day town of Herndon, about 10 miles northwest of downtown Fresno on the banks of the San Joaquin River, was originally known as Sycamore and had its start as a railroad station stop on Southern Pacific's rail line along the east side of the San Joaquin Valley. Other early settlements emerged in the Central Valley more as a consequence of the Stockton-Los Angeles Road and Butterfield Overland Stage Company line, which ran between the major urban centers of the state. For example, the town of Firebaugh to the north of the Project area on the San Joaquin River began in 1852 when a ferry was built at the site; it later had a toll road from the river crossing and a stage route also passed through Firebaugh.

Gold in the southern Sierra Nevada Foothills attracted the first large influx of settlers to what is now Madera, Merced, and Fresno counties beginning in 1849. Towns like Millerton, now under Millerton Lake, were established at this time. Soon thereafter, settlers began to occupy the eastern San Joaquin Valley in this area. These were luckless miners and newcomers who recognized the agricultural potential of the valley and the need for food in the mining camps. Numerous individuals purchased land and established ranches on the vast and largely vacant plains by the mid-1850s. Although private ranches of several hundred acres existed, much of the land was unreserved public domain and cattle grazed freely on an open range from the Sierra Nevada Foothills to the Coast Range.

Livestock ranching grew and prospered into the late 1860s. A large number of immigrants from the Ohio Valley and Missouri settled in the San Joaquin Valley during this era; many drove cattle with them across the plains from the Midwest. Along with their cattle, they brought with them the Anglo ranching traditions from the Midwest characterized by favoring European breeds, keeping fenced pastures, raising hay for winter feed, maintaining mixed herds of dairy cows and beef cattle, practicing selective breeding, and employing Anglo cowboys and ranch hands. Immigrants also established farms on the plains between the foothills and San Joaquin River lowlands where they primarily raised wheat during the 1860s and 1870s.

The need for water to irrigate the arid San Joaquin Valley became a priority for the economic development of Central Valley towns, especially those laid out along Southern Pacific's railroad track. In 1873, the California State Legislature passed a "No Fence Law," which established agriculture's dominance over ranching. By the late 1880s small-scale irrigated agriculture was in the ascendancy and irrigation companies, colonies, and districts were formed to help promote agriculture, for which the first canals were completed in the 1870s. Passage of the Wright Act in 1887 provided a legal mechanism for landowners to create public irrigation districts and finance major irrigation works to divert water from the major streams flowing west from the Sierra. Successful irrigation enterprises, including land colonies, in the Central Valley allowed specialty crop agriculture to flourish and redefined the region's economy (Tinkham 1923). While crops such as grapes continued to be common in the early 20th century, the small farm tradition established by the agricultural colonies began to fade.

Early agriculture on the lower part of the Project area was dominated by the huge cattle ranching operation conducted by Henry Miller and Charles Lux. Miller and Lux developed massive ranching and farming operations on their property along the San Joaquin River (downstream from Mendota), including 140,000 acres in Madera County, more than 150,000 acres in Fresno County, and more than 250,000 acres in Merced County. Miller and Lux also became owners of a host of related subsidiary businesses, including stores, banks, hotels, irrigation systems, and public utilities. Miller and Lux were also pioneers in making use of a large-scale industrial labor force employed in a rural and agricultural setting.

Some of the oldest and most important irrigation works constructed within the Project area were built west of the San Joaquin River in 1871. The central unit of this vast canal and ditch system, constructed by Miller and Lux, was the so-called “Main Canal” of the San Joaquin and Kings River Canal and Irrigation Company. The Main Canal was the first canal built in Fresno County and one of the earliest large irrigation canals in California (W.W. Elliot and Co. 1882). The Main Canal was unique in that it required large amounts of capital and engineering skill, and irrigated thousands of acres. Its construction and success contributed to the 19th century agricultural development on the west side of the San Joaquin Valley (Jackson et al. 1990, Harding 1960, Pisani 1984). Miller and Lux also built the Dos Palos and Temple Slough canals by 1882 from the west bank of the San Joaquin. Over time, canals became increasingly important and extensive.

Irrigation districts started in California after passage of the Wright Act in 1887, which allowed for public tax-supported and democratically controlled irrigation districts. Progressive legislation passed in 1911 through 1913 increased State supervision over district organization and financing and made investing in irrigation district bonds more attractive. Demand for agriculture products also grew around this time and remained high throughout World War I. These conditions contributed to a flurry of district formation in California and to the formation of the Fresno Irrigation District and the Madera Irrigation District.

The Central Valley Project (CVP) was devised by the State, and ultimately built by the Federal government, to resolve California’s chronic water shortage problem. Studies undertaken between 1927 and 1931 resulted in a plan calling for a vast system of canals, massive dams, and reservoirs throughout the state, including most of what became the CVP (Hundley 1992). In 1935, Reclamation was charged with construction of the CVP, which was completed in the early 1950s (Hundley 1992). Reclamation designed the CVP as five fundamental units, operating as an integrated system: Shasta Dam, the Delta-Mendota Canal (DMC), Friant Dam, the Madera and Friant-Kern canals, and the Contra Costa Canal. The core of the system involved the coordinated operation of the other four units for the purpose of delivering Sacramento River water to the arid San Joaquin Valley.

Other water-related projects also flourished in the 20th century. These include the San Joaquin Hatchery, which is situated 1 mile below the Friant Dam, and extensive levee construction to minimize flooding. Major levee construction efforts to minimize flooding along the lower San Joaquin River were related to statewide flood control efforts. In 1913, with formation of the Sacramento and San Joaquin Drainage District, the San Joaquin River and its tributaries also came under jurisdiction of a Federal flood control plan (Bonte 1931). Flood control works on the San Joaquin River in the Project area did not begin to take shape until after World War II when the California State Reclamation Board began purchasing easements and rights-of-way for large overflow areas along the San Joaquin River. In 1955, the State created the Lower San Joaquin Levee District, which acted as a liaison with the U.S. Army Corps of Engineers, the California State Reclamation Board, and California Department of Water Resources (DWR) regarding construction of the Lower San Joaquin River Flood Control Project. Important aspects of the Lower San Joaquin River Flood Control Project include the Chowchilla Bypass, the Eastside Bypass, and the Mariposa Bypass, all of which were completed by 1966 (California State Reclamation Board 1966).

Throughout the historic era, transportation was an important focus of infrastructure development. Over time, foot travel and transportation by horse or stage coach gave way to river, railroad, and ultimately automobile travel. In the early decades of the 20th century the popularity of the automobile led to road improvements and a new State road building program. The main arterial along the eastside of the valley became the Golden State Highway in 1913 and then State Route 99.

9.1.2 Resources in the Project Area

The results presented below are adapted from the *Historic Properties Survey Report, Mendota Pool Bypass and Reach 2B Improvements Project* (Reclamation 2011).

Record Search and Surveys

To establish to what extent the Project footprint has been previously inventoried and what previously recorded resources exist within the areas that might be affected by the individual Project options and the alternatives for the Project, three record searches were conducted: November 2009 (RS#09-439), December 2009 (RS#09-479), and April 2010 (RS#10-173).

All of the literature searches were performed by the South San Joaquin Valley Information Center. The information center staff accessed the records for the Mendota, Firebaugh, and Tranquility U.S. Geological Survey 7.5-minute quadrangles, including a 1-mile radius around the Project footprint. The following references were also reviewed:

- National Register of Historic Places (NRHP) (2010).
- California Register of Historical Resources (CRHR) (2010).
- Office for Historic Preservation Historic Property Directory.
- California State Historical Landmarks (1996 and updates).
- California Inventory of Historic Resources (1976 and updates).

- California Points of Historical Interest (1992 and updates).
- California Department of Transportation's State and Local Bridge Survey (1986 and updates).
- Historical maps, including General Land Office Plat Maps.

In addition to the above references, the recently prepared sensitivity study for the entire SJRRP, *Cultural Resources Sensitivity Study and Research Design for the San Joaquin River Restoration Program, Fresno, Madera, Merced, and Stanislaus Counties, California* (Byrd et al. 2009), was also reviewed given its use in the preparation of the PEIS/R (SJRRP 2011) and its extensive information related to establishing the geoarchaeological[1] sensitivity and relevant cultural resource literature for the Project area.

Previous Survey Coverage

Each of the archaeological surveys reported by the Information Center, that are within or intersect the Project area, are small with respect to the actual acreage surveyed, and are all more than 5 years old, which tends to diminish their reliability (i.e., surveys greater than 5 years of age are typically viewed as dated and resurvey is required due to the potential for changed field conditions). The survey designation, year, and record search number are provided in Table 9-1. According to Byrd et al. (2009), only 6 percent of the area that represents Reach 2 has been previously surveyed. As a result, much of this region is not well known archaeologically.

In addition to the above reports, two recent studies have been conducted within the Project area. DWR prepared both reports in order to clear a proposed geotechnical analysis of potentially impacting unknown cultural resources. The surveys conducted in the vicinity of two of the proposed bore locations did identify cultural deposits potentially related to CA-FRE-45 and CA-FRE-106 (see below) (Gilbert 2011a; Gilbert 2011b). No additional evaluation of the deposits was conducted; however, all proposed geotechnical activities were moved to other locations to avoid potential impacts or effects to these deposits.

Table 9-1.
Previously Conducted Surveys within Project Area

Survey Designation	Year Accomplished	Records Search Number
FR 142	1997	RS#10-173
FR 148	1997	RS#09-439
FR 169	1969	RS#10-173
FR 265 (MA 108)	1998	RS#10-173
FR 388 (MA 897)	1980	RS#09-439
FR 775	1992	RS#09-439

[1] Geoarchaeology refers to the study of landscape change over time and the relative potential for archaeological sites to be either buried or destroyed by geomorphic processes.

Table 9-1.
Previously Conducted Surveys within Project Area

Survey Designation	Year Accomplished	Records Search Number
FR 2164	2004	RS#10-173
FR 2200	2005	RS#10-173
MA 48	1997	RS#10-173
MA 49	1997	RS#10-173
MA 116	1975	RS#09-439
MA 119 (FR 804)	1988	RS#10-173
MA 302	1982	RS#10-173
MA 331	1995	RS#10-173
MA 915	2002	RS#09-439

Key:
Survey Designation: FR= Fresno County; MA = Madera County
RS# = record search number;

Previously Recorded Cultural Resources

The previously recorded resources are tabulated in Table 9-2. Prior studies have led to the recording of six resources within the Project area. These include four archaeological sites, Mendota Dam, and a portion of Columbia Canal. Two of the known archaeological sites are located within the proposed river floodplain, one site is located within a potential borrow area, and one site is a generalized location approximately 2 square miles that has minimal overlap with the southeastern end of the Project area.

Table 9-2.
Previously Recorded Cultural Resources within Project Area

Site	Primary Number	Year Recorded	Site Type	Record Search Number
CA-FRE-45	P-10-000045	6/18/1939	Prehistoric	RS#10-173
CA-FRE-106	P-10-000106	2/1/1952	Prehistoric	RS#10-173
CA-FRE-563	P-10-000563	1/16/1975	Prehistoric	RS#09-439, RS#10-173
CA-MAD-301[1]	P-20-000301[1]	2/2/1975	Prehistoric	RS#09-439
Mendota Dam	P-10-003200	10/2/1997	Dam	RS#10-173
Columbia Canal	P-20-002383	12/11/2000	Canal	RS#09-439, RS#09-479

Notes:
[1] "Site" was recorded on the basis of hearsay; no field verification is represented in the site record.

With the exception of the Mendota Dam, the record searches did not identify any previously recorded resources that were previously determined eligible for the NRHP or CRHR. The prehistoric sites identified in the records search are predominantly old recordings of what were likely large habitation sites, but, even at the time of recordation, the majority of the site material had been heavily disturbed by some combination of development, farming, or alluvial processes.

Native American Communication

Information received from the Native American Heritage Commission on December 9, 2009, and December 23, 2009, indicates that no information pertaining to Native American cultural resources within the Project area was found in a review of the sacred lands file. The letters included a list of 14 individuals or organizations who should be contacted with regard to the proposed undertaking, and who may have information regarding cultural resources in the area. Letters were sent to each contact on November 30, 2010. One response has been received to date from Jerry Brown of the Chowchilla Tribe of Yokuts. Mr. Brown expressed interest in participating in any discussions regarding identified archaeological resources, if any.

Project-level Cultural Surveys

At the time of the cultural resources surveys in August 2010, access to privately owned property had been granted to only a portion of the Project area. Access had been granted primarily to parcels south of the San Joaquin River, and only limited access was available north of the river. The Project area represents about 5,360 acres. Due to the lack of access to much of the northern half of the Project area, as well as portions of the southern half, about 2,020 acres (38 percent) of the Project area has been subjected to survey to date. A team of four archaeologists conducted the survey using 20-meter transect intervals. Areas that were wet herbaceous habitat or seasonal wetland, especially within the North Loop oxbow (River Mile 207.7), were more cursorily surveyed due to a lack of surface visibility.

Archaeological Resources

With the exception of a single obsidian isolate, no archaeological resources were identified during the course of the surveys conducted for this EIS/R. The majority of the parcels were under some form of agriculture and therefore visibility of the surface varied from fair to good. The parcels were planted as orchards and vineyards, and consisted of riparian habitat along the banks of the river. None of the previously recorded prehistoric sites were relocated. In each case, the identified resource was described as almost destroyed or soon to be destroyed at the time of record. Furthermore, most of the sites were recorded over 40 years ago. Given the intensity of farming in the area, as well as a highly active riverine system nearby, an intact surface manifestation of cultural activity that was previously recorded is unlikely to have persisted to the present day. The isolated obsidian flake identified during field surveys for the current Project is likely a re-deposited artifact from one of the numerous sites located nearby and could lack any context to a known deposit or site.

Nevertheless, as indicated by Byrd et al. (2009) and SJRRP (2010), the potential for buried archaeological resources is high throughout the Project area. The alluvial environment near the San Joaquin River would generally have a high potential to contain buried archaeological sites. This is because large portions of the Central Valley are covered by Late Holocene landforms that include floodplain deposits laid down beginning about 4,000 years ago and continuing into the historic period. Even sites a few hundred years old may be buried (Gilbert 2011a, Byrd et al. 2009). Indeed, the subsurface analysis conducted by Gilbert (2011a; 2011b) suggested that at least two locations within the Project area may contain intact subsurface deposits associated with the recorded locations of CA-FRA-45 and CA-FRA-106.

Architectural Resources

An historical architecture survey and evaluation program was conducted for the Project area in 2010 by JRP Historical; the following results are summarized from this report (SJRRP 2010). This survey has included a field check of all previously evaluated resources, and the SJRRP has prepared the appropriate recordation documents, either as an update or as a new Department of Parks and Recreation 523 form, to verify current conditions and previous evaluations.

Table 9-3 below summarizes the historical architectural findings for those resources identified within the Project area and list their status codes, which describe their eligibility to the NRHP and/or CRHR (SJRRP 2010). Of the 13 built environment resources identified within the Project area, five have been previously evaluated for the NRHP. None of the other eight newly identified resources were found to be eligible for the NRHP or CRHR.

The Mendota Dam was determined eligible for the NRHP and is listed in the CRHR. Constructed in 1917, the Mendota Dam is significant, presumably at the State level, under Criterion A, for its association with the Miller and Lux Company's irrigation works in the Central Valley. The DMC appears individually eligible for the National Register (and California Register) under Criterion A, presumably at the State level of significance, within the context of development, construction, and operation of the CVP. The period of significance was identified from 1945 to 1951, its period of construction. Both the Mendota Dam and DMC are considered historic resources under the California Environmental Quality Act (CEQA).

Table 9-3.
Property Status Under the National Register and California Register

Name/Address	Year Built	County	APN	OHP Status Code
Properties Determined Eligible or Previously Found to Appear Eligible for the National Register and California Register				
Mendota Dam	1917	Fresno; Madera	N/A	2S2
Delta-Mendota Canal	1946-1951	Fresno	N/A	3S
Properties Determined Not Eligible for the National Register or California Register				
Columbia Canal and Ridge Ditch	ca. 1880s; 1891-1924	Madera	N/A	6Z, 6Y
Main Canal	1872	Fresno	N/A	6Z, 6Y
Outside Canal	1900	Fresno	N/A	6Z, 6Y
Properties that Appear Not Eligible for the National Register or California Register as a Result of the Current Study				
643 North San Mateo Avenue	ca. 1962-1970s	Fresno	013-040-25S	6Z
San Joaquin River and Fresno Slough Levees	1947-1955	Fresno; Madera	N/A	6Z

Table 9-3.
Property Status Under the National Register and California Register

Name/Address	Year Built	County	APN	OHP Status Code
Mowry Canal	ca. 1910	Fresno	N/A	6Z
Mowry Ranch	ca. 1950-1968	Fresno	013-020-28	6Z
3614-3618 Bass Avenue	1961-1965	Fresno	013-020-40	6Z
Helm Ditch	ca. 1899-1913	Fresno	N/A	6Z
Bass Avenue	1957-1961	Fresno	013-020-14ST	6Z
Main Firebaugh Canal (Intake Canal)	1919-1929	Fresno	N/A	6Z

APN = assessor's parcel number
ca. = circa
OHP = Office for Historic Preservation
N/A = not applicable
Status Code 2S2 = Individual property determined eligible for National Register by a consensus through Section 106 process. Listed in the California Register.
Status Code 3S = Appears eligible for National Register as an individual property through survey evaluation.
Status Code 6Y = Determined ineligible for National Register by consensus through Section 106 process – Not evaluated for California Register or Local Listing.
Status Code 6Z = Found ineligible for National Register, California Register or Local designation through survey evaluation.

9.2 Regulatory Setting

Under Federal and State law, effects to significant cultural resources (e.g., archaeological remains, historic-period structures, and traditional cultural properties) must be considered as part of the environmental analysis of a proposed project. Criteria for defining significant cultural resources are included in 36 Code of Federal Regulations (CFR) Part 63 (Determinations of Eligibility for Inclusion in the NRHP); the NHPA of 1966, as amended (16 United States Code [USC] 470 et seq.); and CEQA. In addition, 36 CFR 800 outlines the compliance process for Section 106 of the NHPA.

9.2.1 Federal

National Historic Preservation Act (36 CFR Part 800 Implementing Regulations Section 106)

The NHPA of 1966 is the primary Federal legislation which outlines the Federal government’s responsibility to cultural resources. More specifically, Section 106 of the NHPA and its implementing regulations located at 36 CFR Part 800, outline the Federal government’s responsibility in identifying and evaluating cultural resources. Other applicable Federal cultural resources laws and regulations that could apply include, but are not limited to, the Native American Graves Protection and Repatriation Act, and the Archaeological Resources Protection Act.

Section 106 of the NHPA requires the Federal government to take into account the effects of an undertaking on cultural resources listed on or eligible for listing on the NRHP and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment. Those resources that are on or eligible for inclusion in the NRHP are referred to as historic properties. The 36 CFR Part 800 regulations describe the Section 106 process. They outline the steps the Federal agency takes to identify cultural resources and the level of effect that the proposed undertaking will have on historic properties. An undertaking is defined as any "…project, activity or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including:

- Those carried out by or on behalf of the agency.
- Those carried out with federal assistance.
- Those requiring a federal permit, license, or approval.
- Those subject to state or local regulation administered pursuant to a delegation or approval by a Federal agency [Section 301(7) 16 USC 470w(7)]."

It is the initiating of an undertaking that begins the Section 106 process. Once an undertaking is initiated the Federal agency must first determine if the action is the type of action that has the potential to affect historic properties. If the action is the type of action that has the potential to affect historic properties, the Federal agency must: 1) identify the area APE, 2) determine if historic properties are present within that APE, 3) determine the effect that the undertaking will have on historic properties, and 4) consult with the SHPO to seek concurrence on Federal agencies findings. In addition, the Federal agency is required through the Section 106 process to consult with Indian Tribes concerning the identification of sites of religious or cultural significance, and to consult with individuals or groups who are entitled to be consulting parties or have requested to be consulting parties. If the undertaking will result in adverse effects to historic properties, these adverse effects must be resolved in consultation with the SHPO and other parties identified during the Section 106 process before the undertaking can proceed to implementation.

Historical significance is assessed by applying the NRHP criteria as defined by 36 CFR Part 60.4. Historic properties need to possess both historical significance and integrity to be considered eligible for inclusion in the NRHP. If a property has historical significance but does not retain sufficient integrity, the property will not be considered eligible for inclusion in the NRHP. Conversely, if a property has maintained a high degree of integrity but has no historical significance, then it will also not be considered a historic property.

NRHP guidelines describe historical significance as the "quality of significance in American history, architecture, archeology, engineering and culture" that is "present in districts, sites, buildings, structures, and objects." Properties eligible for the NRHP can be significant on a national, state, or local level and must meet at least one of the following historical significance criteria:

- Criterion A: Properties that are associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B: Properties that are associated with the lives of persons significant in our past.
- Criterion C: Properties that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D: Properties that have yielded or may be likely to yield, information important in prehistory or history.

Integrity is determined by applying the seven aspects of integrity to the historic resource: location, design, setting, materials, workmanship, feeling, and association. A resource will possess several, if not most, of the seven aspects of integrity to convey the historical significance of the resource.

Section 101(d)(6)(A) of the NHPA allows properties of traditional religious and cultural importance to a Native American tribe to be determined eligible for NRHP inclusion. In addition, a broader range of Traditional Cultural Properties are also considered and may be determined eligible for or listed in the NRHP. Traditional Cultural Properties are places associated with the cultural practices or beliefs of a living community that are rooted in that community's history may be eligible because of their association with cultural practices or beliefs of living communities that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community. In the NRHP programs, "culture" is understood to mean the traditions, beliefs, practices, lifeways, arts, crafts, and social institutions of any community, be it an Indian tribe, a local ethnic group, or the nation as a whole.

Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act (25 USC § 3001 to 3013, 43 CFR Part 10) sets provisions for the removal and inadvertent discovery of human remains and other cultural items on Federal and tribal lands. The Native American Graves Protection and Repatriation Act clarifies the ownership of human remains and sets forth a process for repatriation of human remains and associated funerary objects and sacred religious objects to the Native American tribes or tribes likely to be lineal descendants or culturally affiliated with the discovered remains or objects.

Archaeological Resources Protection Act

The Archaeological Resources Protection Act (16 USC § 470aa-mm) sets forth requirements that must be met before Federal authorities can issue a permit to excavate or remove any archeological resource on Federal or Indian lands. The curation requirements of artifacts, other materials excavated or removed, and the records related to the artifacts and materials are also described.

Executive Order 13007 (Indian Sacred Sites) and April 29, 1994, Executive Memorandum

EO 13007 requires that Federal agencies with land management responsibilities accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners. This EO further requires that those agencies avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies also must maintain the confidentiality of sacred sites. Other requirements stipulate that the agencies provide reasonable notice of proposed actions or land management policies that may restrict future access to or ceremonial use of sacred sites, or that may adversely affect the physical integrity of sacred sites. The agencies must comply with the April 29, 1994, executive memorandum, "Government-to-Government Relations with Native American Tribal Governments."

Reclamation received information from Native American Heritage Commission about which Native American groups would be interested in Project actions. Reclamation mailed letters requesting their comments on November 30, 2010. Also, these Native American groups were notified of the public scoping meetings and are included in the distribution list for this EIS/R. Reaching out to Native American groups, including the groups that participated in scoping and review of this EIS/R, demonstrates that Reclamation has complied with EO 13007. If an Indian sacred site is encountered within the Project area, measures will be implemented to prevent any restriction of access or effect on the site's physical integrity. Continued compliance with this EO would be demonstrated through implementation of mitigation measures, as needed.

9.2.2 State of California

Under CEQA, the lead agency must consider potential effects to important or unique cultural resources. While the language is somewhat different between NHPA and CEQA, the definitions of eligible properties and of adverse impacts are essentially the same. Evaluations under CEQA consider a resource's potential eligibility for inclusion in the CRHR.

California Register of Historical Resources

California Public Resources Code section 5024.1 establishes the CRHR. The register lists all properties considered to be significant historical resources in the State. The CRHR includes all properties listed or determined eligible for listing on the NRHP, including properties evaluated under Section 106 of the NHPA. The criteria for listing are similar as those of the NRHP. CEQA section 21084.1 requires a finding of significance for substantial adverse changes to historical resources and defines the term "historical resources." CEQA section 21083.2 and State CEQA Guidelines section 15064.5, subdivision (c) provide further definitions and guidance for archaeological sites and their treatment.

California Native American Graves Protection and Repatriation Act

The California Native American Graves Protection and Repatriation Act (Health & Saf. Code, § 8010 et seq.) establishes a State repatriation policy intent that is consistent with and facilitates implementation of the Federal Native American Graves Protection and Repatriation Act. The act strives to ensure that all California Indian human remains and cultural items are treated with dignity and respect, and encourages voluntary disclosure and return of remains and cultural items by publicly funded agencies in California.

Executive Order B-10-11

EO B-10-11 was signed by Governor Brown on September 9, 2011. This EO establishes the role and responsibilities of the Governor's Tribal Advisor and directs State agencies and departments under the Governor's executive control to communicate and consult with Federally recognized tribes, other California Native Americans, and representatives of tribal governments to provide meaningful input into the development of legislation, regulations, rules, and policies on matters that may affect tribal communities.

Assembly Bill 52

AB 52, signed on September 25, 2014, amends CEQA, creates a new category of environmental resources: "tribal cultural resources," and imposes new requirements for consultation for projects that may affect a tribal cultural resources (Public Resources Code sections 5097.94, 21073, 21074, 21080.3.1, 21080.3.2, 21082.3, 21083.09, 21084.2, and 21084.3).

9.2.3 Local and Regional

There are no known regional or local plans or policies related to cultural resources.

9.3 Environmental Consequences and Mitigation Measures

9.3.1 Impact Assessment Methodology

To assess impacts to cultural resources, historic properties and potential buried archaeological resources within the Project area were identified (see Section 9.1.4). A search for historic properties within the Project area was conducted (SJRRP 2010). This step was intended to provide a baseline for comparison to Project alternatives and to initiate the Section 106 process between Reclamation and SHPO. Cultural surveys were also conducted in the Project area using 20-meter transect intervals, where access to private- or publicly-owned property had been granted.

To assess impacts to identified cultural resources within the Project area, the construction and operation of the Project was evaluated relative to the identified historic properties and potential buried archaeological resources to determine the potential for adverse effects to those resources. For example, Project actions that require ground disturbance have the potential to cause adverse effects to archaeological resources and Project actions that cause physical destruction or visual setting alterations have the potential to cause adverse effects to the built environment.

9.3.2 Significance Criteria

Federal Criteria

National Environmental Policy Act

Pursuant to National Environmental Policy Act (NEPA) regulations (40 CFR 1500–1508), Project effects are evaluated based on the criteria of context and intensity. Context means the affected environment in which a proposed project occurs. The severity of the impact is examined in terms of the type, quality, and sensitivity of the resource involved; the location and extent of the impact; the duration of the impact (short- or long-term); and other considerations of context. Intensity means the degree or magnitude of a potential effect where the effect is determined to be negligible, moderate, or substantial.

Pursuant to NEPA, in considering whether an action may "significantly affect the quality of the human environment," an agency must consider, among other things, the unique characteristics of the geographic area such as proximity to historic or cultural resources (40 CFR 1508.27, subd. [b][3]), and the degree to which the action may adversely affect districts, sites, linear features, landscapes, buildings, structures, or objects listed, or eligible for listing, in the NRHP or may cause loss or destruction of significant scientific, cultural, or historical resources (40 CFR 1508.27 subd. [b][8]).

National Historic Preservation Act (16 USC Section 470 et seq.)

The NHPA establishes the Federal government policy on historic preservation and the programs including the NRHP, through which this policy is implemented. Under the NHPA, significant cultural resources, referred to as historic properties, include any prehistoric or historic district, site, building, structure, object, or landscape included in, or eligible for inclusion in, the NRHP. Historic properties also include resources determined to be National Historic Landmarks, which are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting United States heritage. A property is considered historically significant if it meets one of the NRHP criteria and retains sufficient historic integrity to convey its significance. This act also established the Advisory Council on Historic Preservation, an independent agency responsible for implementing Section 106 of NHPA by developing procedures to protect cultural resources included in, or eligible for inclusion in, the NRHP. Regulations are published in 36 CFR Part 60 and 63, and 36 CFR Part 800.

Section 106 affords the Advisory Council on Historic Preservation and SHPO, as well as other consulting parties, a reasonable opportunity to comment on any undertaking that would adversely affect historic properties listed in or eligible for NRHP listing.[2] SHPO administers the national historic preservation program at the State level, review NRHP nominations, maintain data on historic properties that have been identified but not yet nominated, and consult with Federal agencies during Section 106 review.

[2] Mitigation required under Section 106 has the potential to bring significant impacts to less than significant levels for NEPA/CEQA.

The NRHP uses the National Register eligibility criteria (36 CFR 60.4) to evaluate significance. The criteria for evaluation are as follows:

- Properties that are associated with events that have made a significant contribution to the broad patterns of our history.
- Properties that are associated with the lives of persons significant to our past.
- Properties that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master; or that possess high artistic values; or that represent a significant and distinguishable entity whose components may lack individual distinction.
- Properties that have yielded, or may be likely to yield, information important in prehistory or history.

Section 101(d)(6)(A) of the NHPA allows properties of traditional religious and cultural importance to a Native American tribe to be determined eligible for NRHP inclusion. In addition, a broader range of Traditional Cultural Properties are also considered and may be determined eligible for or listed in the NRHP. Traditional Cultural Properties are places associated with the cultural practices or beliefs of a living community that are rooted in that community's history may be eligible because of their association with cultural practices or beliefs of living communities that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community. In the NRHP programs, "culture" is understood to mean the traditions, beliefs, practices, lifeways, arts, crafts, and social institutions of any community, be it an Indian tribe, a local ethnic group, or the nation as a whole.

State Criteria

State CEQA Guidelines section 15064.5 provides specific guidance for determining the significance of impacts on historic and unique archaeological resources. Under CEQA, these resources are called historical resources whether they are of historic or prehistoric age. CEQA section 21084.1 defines historical resources as those listed, or eligible for listing, in the CRHR, or those listed in the historical register of a local jurisdiction (county or city). NRHP-listed historic properties located in California are considered historical resources for the purposes of CEQA and are also listed in the CRHR. The CRHR criteria for listing such resources are based on, and are very similar to, the NRHP criteria. CEQA section 21083.2 and State CEQA Guidelines section 15064.5, subdivision (c) provide further definitions and guidance for archaeological sites and their treatment. Section 15064.5 also prescribes a process and procedures for addressing the existence of, or probable likelihood, of Native American human remains, as well as the accidental discovery of any human remains within the Project area. This includes consultations with appropriate Native American tribes.

Guidelines for the implementation of CEQA define procedures, types of activities, persons, and public agencies required to comply with CEQA. CEQA section 21083.2 defines "unique archaeological resources" as "any archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

- Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information.
- It has a special and particular quality, such as being the oldest of its type or the best available example of its type.
- Is directly associated with a scientifically recognized important prehistoric or historic event."

CEQA section 21084.1 also further defines "adverse effect" on a historical resource as "a project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment." CEQA defines substantial adverse change in the significance of a resource as the physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of the resource is materially impaired (State CEQA Guidelines, § 15064.5, subd. (b)(1)). The significance of a historical resource is considered to be materially impaired when a project demolishes or materially alters in an adverse manner those characteristics that convey its historical significance and that justify its inclusion on an historical resource list (State CEQA Guidelines, § 15064.5, subd. (b)(2)).

9.3.3 Impacts and Mitigation Measures

This section provides an evaluation of the long-term and temporary effects of the Project alternatives on cultural resources. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential impacts compared to existing conditions to meet CEQA requirements. With respect to cultural resources, the environmental impact issues and concerns are:

1. Effects on Archaeological Resources from Ground Disturbing Activities during Construction.
2. Effects on Historical Properties Listed or Eligible for Listing in the National or California Register.
3. Effects on Cultural Resources during the Operations and Maintenance Phase of the Project.

Other cultural-related issues covered in the PEIS/R are not covered here because they are programmatic in nature and/or are not relevant to the Project area. These issues include disturbance or destruction of cultural resources around Millerton Lake and disturbance or destruction of cultural resources along the San Joaquin River downstream from the Merced River.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these Program-level activities would not achieve Settlement goals. The potential effects of the No-Action Alternative are described below.

The analysis is a comparison to existing conditions, and no mitigation is required for No-Action.

Impact CUL-1 (No-Action Alternative): *Effects on Archaeological Resources from Ground Disturbing Activities during Construction.* Similar to existing conditions, Project features would not be developed in the No-Action Alternative and therefore Project construction activities would not occur. There would be **no impact**.

Impact CUL-2 (No-Action Alternative): *Effects on Historical Properties Listed or Eligible for Listing in the National or California Register.* Mendota Dam was determined eligible for the NRHP and is listed in the CRHR, while DMC has been recommended as eligible to NRHP (see Section 9.1.2). Changes to Mendota Dam and the DMC as a result of the Project-level actions would not occur. There would be **no impact**.

Impact CUL-3 (No-Action Alternative): *Effects on Cultural Resources during the Operations and Maintenance Phase of the Project.* Under the No-Action Alternative, operations would continue similar to current operations and increased flows. Maximum channel conveyance would be limited to the existing capacity in Reach 2B. Therefore, there would be no new types of impacts to cultural resources (archaeological sites, historic-era structural resources, and traditional cultural properties/areas of concern). Archaeological sites within and immediately adjacent to the San Joaquin River would continue to be potentially impacted by Friant Dam releases and downstream diversions during ongoing operations under the No-Action Alternative. The scale of these events would continue to vary greatly interannually, with the most damage to resources occurring during occasional wet years with major flood events. Cultural resources outside of the existing levee alignment would continue to be potentially degraded by agricultural activities. This impact would be **potentially significant**. No mitigation is required for No-Action.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would entail construction of Project facilities including a Compact Bypass channel, a new levee system encompassing the river channel with a narrow floodplain, and the South Canal. Other key features include construction of the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, and the South Canal bifurcation structure and fish passage facility, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

Impact CUL-1 (Alternative A): *Effects on Archaeological Resources from Ground Disturbing Activities during Construction.* Compared to the No-Action Alternative, archaeological sites could be subject to adverse effects during construction activities under Alternative A. Soil excavation or compaction resulting from the use of heavy machinery on the construction site itself or in staging areas may affect the integrity of artifact-bearing deposits associated with known and as-yet undiscovered archaeological sites. Project alternatives entail a large amount of soil “borrowing” (as described in

Chapter 2, Section 2.2.4) from areas surrounding the San Joaquin River, which is a sensitive area for archaeological resources, particularly for buried deposits.

Adverse effects could occur to known archaeological resources as a result of ground disturbing activities, including soil borrowing. Cultural resources surveys conducted in the Project area prior to geotechnical activities have revealed buried cultural deposits at CA-FRA-45 and CA-FRA-106 (Gilbert 2011a; Gilbert 2011b). These deposits have not been evaluated for NRHP or CRHR eligibility. Additional buried elements could exist in these locations.

Adverse effects could also occur near the river channel. The alluvial deposits adjacent to the river are considered highly sensitive for buried archaeological resources. Unknown or unrecorded archaeological resources that are not observable when conducting standard surface archaeological inspection may exist within the Project area. Construction-related ground disturbance in areas that could contain unknown archaeological resources could cause substantial adverse changes in the significance of historical resources, unique archaeological resources, or historic properties. Currently about 38 percent of the Project area has been inventoried for archaeological resources. It is estimated that a large number of cultural resources would be documented within this reach after full inventory efforts (Byrd et al. 2009).

Compared to existing conditions, Alternative A would result in greater impacts to cultural resources as described in the preceding paragraphs. Construction of the Project could result in possible substantial effects on known or unknown archaeological deposits from ground-disturbing construction operations associated with the Project. This would cause substantial adverse changes in the significance of an archaeological resource pursuant to the NHPA (36 CFR Part 800) and is therefore considered an adverse effect under Section 106. Construction-related ground disturbance in areas that could contain unknown historical resources or properties could cause adverse changes in the significance of archaeological resources pursuant to State CEQA Guidelines section 15064.5. This impact would be **potentially significant**.

Mitigation Measure CUL-1A (Alternative A): ***Comply with Section 106 of the NHPA or Equivalent.*** Reclamation will comply with Section 106 of the NHPA during subsequent site-specific studies as access is granted to the large area of unsurveyed lands within the Project area for which permission to enter was not granted. Reclamation must comply with Public Resources Code sections 5024 and 5024.5, which require Federal agencies to confer with SHPO before implementing any project with the potential to affect historical resources listed in or potentially eligible for inclusion in the NRHP or registered as or eligible for registration as a State historical landmark.

Site-specific environmental reviews will be conducted before all ground-disturbing activities. The following mitigation measures, consisting of inventory, evaluation, and treatment processes, will be conducted by Reclamation as part of the environmental reviews to ensure compliance with Section 106 of the NHPA or Public Resources Code sections 5024 and 5024.5, as applicable. Coordination will continue with the relevant Native American tribes in the area, as necessary to complete these compliance processes.

Implementation Action: Inventory, evaluation, and treatment processes will be implemented during subsequent site-specific studies and as access is granted. These measures include conducting cultural resources surveys of portions of the Project area that have not been surveyed, planning activities to avoid known cultural resources, evaluating the significance of resources that cannot be avoided, and developing treatment process for significant resources.

- *Conduct cultural resources surveys of portions of the Project area that have not been surveyed.* Before any ground disturbance takes place in the Project area (including areas of ancillary activities, such as staging areas and access routes), cultural resource surveys covering the Project area will be conducted to locate and record cultural resources. Where appropriate, subsurface discovery efforts also will be undertaken to identify buried archaeological sites.
- *Plan activities to avoid known cultural resources.* Before carrying out ground-disturbing activities, areas that have been delineated as containing cultural resources will be demarcated, and all ground-disturbing or related activities will be planned to avoid these areas.
- *Evaluate significance of resources that cannot be avoided.* If cultural resources cannot be avoided through careful planning of the activities associated with the Project, additional research or test excavation (as appropriate) will be undertaken to determine whether the resources are significant.
- *Develop treatment process to mitigate effects of Project upon significant resources.* Impacts on significant resources that cannot be avoided will be mitigated in a manner that is deemed appropriate for the particular resource. Mitigation for significant resources may include, but are not limited to, data recovery, public interpretation, performance of a Historic American Building Survey or Historic American Engineering Record, or preservation by other means.

Location: In Project areas with subsequent site-specific studies and where additional access is granted.

Effectiveness Criteria: Successful compliance with Section 106 of the NHPA or Public Resources Code sections 5024 and 5024.5, as applicable.

Responsible Agency: Reclamation.

Monitoring/Reporting Action: Reclamation would report to SHPO and the consulting parties.

Timing: Site-specific environmental reviews will be conducted prior to ground-disturbing activities. Coordination will continue with the relevant Native American tribes in the area, as necessary to complete compliance processes.

Mitigation Measure CUL-1B (Alternative A): ***Conduct Subsurface Testing and/or Archaeological Monitoring in Proximity to Identified Sites or Areas of Sensitivity.*** Ground-disturbing activities that have the potential to affect archaeological resources may occur in areas that have been identified as either the location of a known archaeological site, or in as an area known to be sensitive for the presence of buried cultural resources. Implementation of the following measures would reduce potential impacts to known archaeological sites and areas of sensitivity.

Implementation Action: Prior to Project implementation, subsurface geoarchaeological testing will be conducted in areas where ground-disturbing construction activities are proposed in native sediments/soils near known archaeological resources, as well as any areas of proposed disturbance in areas identified by Byrd et al. (2009) as having high or very high sensitivity for buried archaeological resources, in order to rule-out the presence of buried archaeological resources within the Project's areas of subsurface disturbance. If subsurface testing is determined not to be feasible and/or the results of testing are inconclusive, an archaeological monitor approved by Reclamation and/or CSLC staff will be present during all ground-disturbing activities in those same areas described above.

In the event that cultural resources are exposed during construction, the monitor will be empowered to temporarily halt activities in the immediate vicinity of the discovery while it is evaluated for significance. If, in consultation with interested parties, it is determined that the cultural resources exposed are significant archaeological resources, and if Project activities cannot feasibly avoid the resource, additional measures will be implemented (see Mitigation Measures CUL-1C and CUL-1D below). Where necessary, Reclamation will seek Native American input and consultation.

Location: Construction areas with ground-disturbing activities occurring in native sediments/soils near known archaeological resources, as well as any areas of proposed disturbance in areas determined to be highly or very highly sensitive for buried archaeological resources by Byrd et al. (2009) or a subsequent Project-specific geoarchaeological sensitivity analysis.

Effectiveness Criteria: Performance tracking of this mitigation measure is based upon successful implementation and the approval of the documentation by SHPO and appropriate consulting parties.

Responsible Agency: Reclamation.

Monitoring/Reporting Action: Geoarchaeological testing will occur prior to, and/or archaeological monitoring will occur during, specified ground-disturbing activities. Reclamation will report to SHPO and the consulting parties.

Timing: Geoarchaeological testing will occur prior to ground disturbing activities. Active archaeological monitoring, as necessary, will occur throughout the duration of these specific ground-disturbing activities.

Mitigation Measure CUL-1C (Alternative A): *Halt Work in the Event of an Archaeological Discovery.* If any cultural resources are discovered during ground-disturbing activities, all work in the immediate vicinity of the resources will be halted, and an archaeologist approved by Reclamation and/or CSLC staff will assess the significance of the find. If the discovery is determined to be significant, work may proceed on other parts of the Project area while avoidance or mitigation alternatives are being developed and carried out.

Implementation Action: Reclamation will prepare and implement an Archaeological Treatment Plan, which will be developed in coordination with interested parties. This plan will include an approach for addressing unanticipated discoveries and will detail the specific procedures to be followed if archaeological materials are found during construction.

Reclamation will notify California State Lands Commission (CSLC) staff if the find is a cultural resource on lands under the jurisdiction of the CSLC. Reclamation will comply with all applicable rules and regulations promulgated by CSLC with respect to cultural resources in submerged lands.

If human remains are encountered, Reclamation will comply with applicable laws and regulations regarding notification and disposition of the remains. If the coroner determines that the remains are Native American, the coroner would notify the Native American Heritage Commission under Health and Safety Code section 7050.5 and Reclamation and/or CSLC staff would ensure that the discovery is treated in accordance with the provisions of Public Resources Code section 5097.98, subdivisions (a)-(d).

If any find is determined to be significant, Reclamation and/or CSLC staff, the Project archaeologist, and interested parties will determine the appropriate avoidance measures. All significant cultural materials recovered will be—as necessary and at the discretion of the Project archaeologist and with input from Native American representatives—subject to scientific analysis, professional museum curation,[3] and documentation according to current professional standards. In considering any suggested mitigation proposed to mitigate impacts on historic properties, historical resources, or unique archaeological resources, a determination will be made on whether avoidance is feasible in light of factors such as the nature of the find, Project design, costs, and other considerations.

[3] Curation is management and care of collections according to standard professional practice, which may include inventorying, accessing, labeling, cataloging, identifying, evaluating, documenting, storing, maintaining, periodically inspecting, and/or conserving original collections.

If, in consultation with interested parties, it is determined that a significant archaeological resource is present and that the resource could be adversely affected, one of the following actions may be followed, as feasible:

- If prudent and feasible, redesign the Project to avoid any adverse effect on the significant archaeological resource.
- Implement Mitigation Measure CUL-1D, Intentional Site Burial for Site Preservation.
- Implement an archaeological data recovery program (ADRP). If the circumstances warrant an ADRP, a data recovery program will be conducted. The scope of the ADRP will be determined together with the Project archaeologist and interested parties. The archaeologist will prepare a draft ADRP, which would identify the scientific/historical research questions that are applicable to the expected resource, the data classes the resource is expected to possess, and how the expected data classes would address the applicable research questions. Destructive data recovery methods will not be applied to portions of the archaeological resources not impacted by the Project.

Location: Active construction areas during ground-disturbing activities.

Effectiveness Criteria: Performance tracking of this mitigation measure will be based on successful implementation and approval of documentation by SHPO and appropriate consulting parties.

Responsible Agency: Reclamation and CSLC.

Monitoring/Reporting Action: Reclamation and/or CSLC staff will report to SHPO and the consulting parties.

Timing: Mitigation will be ongoing over the construction timeframe.

Mitigation Measure CUL-1D (Alternative A): ***Plan an Intentional Site Burial Preservation in Place.*** If Project engineering concludes that avoidance is not feasible, a process to determine whether the site can be preserved through intentional site burial will be considered. When complete avoidance is not possible, preservation-in-place is the preferred form of mitigation for a “historical resource of an archaeological nature” because it retains the relationships between artifact and context and may avoid conflicts with groups associated with the site, pursuant to Public Resources Code section 15126.4, subdivision (b)(3)(A). The process presented in overview here will be specified in detail in the Archaeological Treatment Plan.

Implementation Action: To intentionally bury a site, it will be necessary to conduct test excavations to determine the vertical and horizontal extent of the identified resources. If excavations have not yet been conducted for the purpose of evaluating the site for eligibility in accordance with section 106 of the NHPA, an archaeologist approved by Reclamation and/or CSLC staff will conduct a formal excavation of the site to delineate the site boundaries and to determine the site's eligibility for the CRHR or NRHP.

If the site is found to be eligible or potentially eligible, and if avoidance is not feasible, then consideration will be given to intentional site burial. The Project archaeologist will, in consultation with interested parties, delineate the site boundaries, and prepare and implement a design plan to dictate the conditions of the intentional site burial according to the recommendations discussed in the National Park Service Technical Brief Number 5, *Intentional Site Burial: A Technique to Protect Against Natural or Mechanical Loss* (Thorne 1991).

Among the requirements of an effective capping design, the mechanical process of burying the site must be designed in a manner that ensures that the site matrix is protected during the placement process. Preconstruction testing can be used to determine the construction equipment and fill material load limits that are allowable without causing compression or warpage of the artifact and feature components of the site.

If the preconstruction testing determines that compression or warpage of the site is probable and that site capping would not reduce effects to less-than-significant levels, additional mitigation, such as data recovery, would be necessary. Furthermore, if it is determined that the engineering requirements of the Project at the location of the site prohibit the effective avoidance of the site or if the surrounding conditions prohibit the protection or preservation of the archaeological components, data recovery may be the only feasible mitigation (see Mitigation Measure CUL-1C, above). In addition, Reclamation and/or CSLC staff will make provisions to monitor the site after the burial process is complete.

Location: Active construction areas in the event of an archaeological discovery where avoidance is not feasible and capping can be designed to effectively minimize Project effects to the discovery.

Effectiveness Criteria: Performance tracking of this mitigation measure will be based on successful implementation and the approval of the documentation by SHPO and appropriate consulting parties.

Responsible Agency: Reclamation and CSLC.

Monitoring/Reporting Action: Reclamation and/or CSLC staff will make provisions with the archaeologist to monitor the site after the burial process is complete. Reclamation and/or CSLC staff will report to SHPO and the consulting parties.

Timing: Mitigation will occur in the event of an archaeological discovery where avoidance is not feasible and would be ongoing over the construction timeframe.

Mitigation Measure CUL-1E (Alternative A): ***Avoid Soil Borrowing in the Vicinity of Known Archaeological Resources.*** Reclamation will design the Project soil borrowing activities to avoid adverse effect on known archaeological resources, to the extent feasible. Known archaeological resources will be delineated and avoided during construction. Mitigation Measures CUL-1B, CUL-1C, and CUL-1D will also be implemented, as needed.

Implementation Action: If feasible, Reclamation will design the Project soil borrowing activities to avoid any adverse effect on known archaeological resources, such as CA-FRA-45 and CA-FRA-106, both of which are considered potentially significant historical resources. (Mitigation Measures CUL-1B, CUL-1C, and CUL-1D will also be implemented, as needed.) At least 90-days prior to proposed borrowing activities, an archaeologist approved by Reclamation and/or CSLC staff will determine the extent of known resource near borrow areas through a presence or absence testing program using augers or test pits. The Project archaeologist will then cordon the site boundaries in a manner that restricts construction equipment or personnel from entering the site.

Location: Within the vicinity of known archaeological resources, including CA-FRA-45 and CA-FRA-106.

Effectiveness Criteria: Avoidance of areas within delineated site boundaries.

Responsible Agency: Reclamation and CSLC.

Monitoring/Reporting Action: Reclamation and/or CSLC staff will report to SHPO and the consulting parties.

Timing: At least 90-days prior to proposed borrowing activities.

Implementation of Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, and CUL-1E would decrease impacts on archaeological resources. Impacts after mitigation would be **less than significant** for Alternative A.

Impact CUL-2 (Alternative A): ***Effects on Historic Properties Listed or Eligible for Listing in the National or California Register.*** Under Alternative A, Mendota Dam and the DMC would not be modified by Project construction activities. Operations of Mendota Dam and DMC would be similar to the No-Action Alternative because these facilities are operated to make water deliveries which would not be affected by Alternative A.

Compared to existing conditions, these historic properties would remain unchanged. This alternative would have **no impact** to historic properties or historical resources of the built environment (architectural resources) that are listed or eligible for listing in the National or California Register.

Impact CUL-3 (Alternative A): ***Effects on Cultural Resources during the Operations and Maintenance Phase of the Project.*** Compared to the No-Action Alternative, the increased channel conveyance capacity, increased floodplain area, and floodplain and channel grading associated with Alternative A, in combination with flood flows and

Restoration Flows, could allow opportunities for new impacts to cultural resources (archaeological sites, historic-era structural resources, and traditional cultural properties/areas of concern). Alternative A would include a new levee system encompassing the river channel and additional floodplain areas that would typically have been disturbed by prior agricultural activities. Although there is a potential for increased erosion on the floodplain due to flood flows and Restoration Flows, velocities would decrease as water inundates more of the floodplain. Highly erodible areas would be reinforced by the Project (such as areas below concrete structures and at river bends) and water velocities and erosional forces are expected to be negligible in areas away from the main channel. Therefore, flood flows and Restoration Flows would not cause significant impacts to cultural resources in previously undisturbed areas that are located on the floodplain and outside of the main channel. Archaeological sites within and adjacent to the San Joaquin River would continue to be exposed to Friant Dam releases during ongoing operations, but higher flows would be distributed over the floodplain.

When comparing Alternative A to existing conditions, impacts to cultural resources on the floodplain would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). This impact would be **less than significant**.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Key features of Alternative B include construction of a new levee system to establish a bypass channel to northeast of the existing river channel, Compact Bypass Bifurcation Structure, Mendota Pool Control Structure, and re-route of Drive 10 ½. No construction activities are proposed at or near Mendota Dam, which falls outside the Project boundary under Alternative B. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

Impact CUL-1 (Alternative B): ***Effects on Archaeological Resources from Ground Disturbing Activities during Construction.*** Refer to Impact CUL-1 (Alternative A). Potential impacts of Alternative B would be the same as potential impacts of Alternative A. This impact would be **potentially significant**.

Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, and CUL-1E (Alternative B): ***Comply with Section 106 of the NHPA or Equivalent, Conduct Archaeological Monitoring in Proximity to Identified Sites or Areas of Sensitivity, Halt Work in the Event of an Archaeological Discovery, Plan an Intentional Site Burial Preservation in Place,*** **and** ***Avoid Soil Borrowing in the Vicinity of Known Archaeological Resources.*** Refer to Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, and CUL-1E (Alternative A). The same measures would be used here. This impact would be **less than significant** after mitigation.

Impact CUL-2 (Alternative B): ***Effects to Historical Properties Listed or Eligible for Listing in the National or California Register.*** Refer to Impact CUL-3 (Alternative A). Potential impacts of Alternative B would be the same as potential impacts of Alternative A. There would be **no impact**.

Impact CUL-3 (Alternative B): ***Effects on Cultural Resources during the Operations and Maintenance Phase of the Project.*** Refer to Impact CUL-4 (Alternative A). Potential impacts of Alternative B would be the same as potential impacts of Alternative A. This impact would be **less than significant**.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Key features of Alternative C include construction of new fish passage facilities at Mendota Dam, grade control structures downstream of Mendota Dam, a new Fresno Slough Dam, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Impact CUL-1 (Alternative C): ***Effects on Archaeological Resources from Ground Disturbing Activities during Construction.*** Refer to Impact CUL-1 (Alternative A). Potential impacts of Alternative C would be the same as potential impacts of Alternative A. This impact would be **potentially significant**.

Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, and CUL-1E (Alternative C): ***Comply with Section 106 of the NHPA or Equivalent, Conduct Archaeological Monitoring in Proximity to Identified Sites or Areas of Sensitivity, Halt Work in the Event of an Archaeological Discovery, Plan an Intentional Site Burial Preservation in Place,*** **and** ***Avoid Soil Borrowing, or other Ground Disturbing Activity in the Vicinity of Known Archaeological Resources.*** Refer to Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, and CUL-1E (Alternative A). The same measures would be used here. This impact would be **less than significant** after mitigation.

Impact CUL-2 (Alternative C): ***Effects to Historical Properties Listed or Eligible for Listing in the National or California Register.*** In comparison to the No-Action Alternative, Alternative C would include construction of a fish ladder at Mendota Dam and modification in Mendota Dam operations. This would cause physical changes to the Mendota Dam due to the addition of a fish ladder. Alternative C would also cause a small realignment to a section of the DMC where it transitions into Mendota Pool. An inlet canal is proposed at this transition location that would take water from the upstream side of the proposed Fresno Slough Dam, run north adjacent to the west side of the San Joaquin River, and connect to the Main Canal and Helm Ditch just west of their current intakes. This would cause only a minor physical change to the DMC. Because this alternative proposes physical changes to the Mendota Dam, which is eligible for listing as a historic property under Section 106 and is a historical resource listed in the California Register, a substantial adverse change or adverse effect could occur to this resource.

While the physical alterations of Mendota Dam required for the Project may not destroy the resource, it may change the resource such that it would no longer convey its significance; hence, this would be considered a substantial adverse change to the resource. While the significance of the resources is more related to its association with early irrigation public works in the Central Valley, rather than its architectural distinction, the alterations proposed may diminish the capacity of the resource to resemble its historic period of significance.

When comparing Alternative C to existing conditions, impacts to architectural resources would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to the No-Action Alternative). This would be a **potentially significant** impact.

Mitigation Measure CUL-2 (Alternative C): ***Follow the Secretary of the Interior's Standards for the Treatment of Historic Properties.*** Alterations to historical buildings or structures will conform to the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (Weeks and Grimmer 1995). Where new structures are required as elements of improved fish passage, such as the new proposed fish ladder at Mendota Dam, designs that are compatible with the overall character of the historic property are preferred. This includes the continuation of the existing character through the use of materials as well as consistent use of color and placement which reduces overall visual effects. This mitigation measure would reduce impacts on significant historical buildings and structures to a **less-than-significant** level.

> **Implementation Action:** Alterations to historical buildings or structures would conform to the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (Weeks and Grimmer 1995).
>
> **Location:** Construction activities at Mendota Dam.
>
> **Effectiveness Criteria:** Secretary of the Interior's Standards are met.
>
> **Responsible Agency:** Reclamation and CSLC.
>
> **Monitoring/Reporting Action:** Reclamation and/or CSLC staff will report to SHPO and the consulting parties.
>
> **Timing:** Prior to and during construction activities at Mendota Dam.

Impact CUL-3 (Alternative C): ***Effects on Cultural Resources during the Operations and Maintenance Phase of the Project.*** Refer to Impact CUL-4 (Alternative A). Potential impacts of Alternative C would be the same as potential impacts of Alternative A. This impact would be **less than significant**.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Key features of Alternative D include construction of new fish passage facilities at Mendota Dam, grade control structures downstream of Mendota Dam, Fresno Slough Dam, Main Canal and Helm Ditch relocations, and the North Canal. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Impact CUL-1 (Alternative D): ***Effects on Archaeological Resources from Ground Disturbing Activities during Construction.*** Refer to Impact CUL-1 (Alternative A). Potential impacts of Alternative D would be the same as potential impacts of Alternative A. This impact would be **potentially significant**.

Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, and CUL-1E (Alternative D): ***Comply with Section 106 of the NHPA or Equivalent, Conduct Archaeological Monitoring in Proximity to Identified Sites or Areas of Sensitivity, Halt Work in the Event of an Archaeological Discovery, Plan an Intentional Site Burial Preservation in Place,*** **and** ***Avoid Soil Borrowing, or other Ground Disturbing Activity in the Vicinity of Known Archaeological Resources.*** Refer to Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, and CUL-1E (Alternative A). The same measures would be used here. This impact would be **less than significant** after mitigation.

Impact CUL-2 (Alternative D): ***Effects to Historical Properties Listed or Eligible for Listing in the National or California Register.*** Refer to Impact CUL-3 (Alternative C). Because this alternative proposes changes to the Mendota Dam, a historic property under Section 106 and a historical resource listed in the California Register, this may cause substantial adverse change or adverse effects to this resource. This impact would be **potentially significant**.

Mitigation Measure CUL-2 (Alternative D): ***Follow the Secretary of the Interior's Standards for the Treatment of Historic Properties.*** Refer to Mitigation Measure CUL-2 (Alternative C). The same measure would be used here. This impact would be **less than significant** after mitigation.

Impact CUL-3 (Alternative D): ***Effects on Cultural Resources during the Operations and Maintenance Phase of the Project.*** Refer to Impact CUL-4 (Alternative A). Potential impacts of Alternative D would be the same as potential impacts of Alternative A. This impact would be **less than significant**.

10.0 Environmental Justice

Environmental justice is generally defined as:

> *"The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies" (U.S. Department of Energy 1997).*

The purpose of the environmental justice analysis is to determine whether disproportionately high and adverse environmental and economic effects would be realized by minority and/or low-income populations with implementation of projects, programs, or policies. To facilitate this analysis, information on the demographic and social characteristics of the population in the Project area has been collected to determine the extent to which minority and/or low-income populations exist in the region. This information is presented in Section 10.1. Section 10.2 presents the regulatory setting applicable to environmental justice. In Section 10.3, the anticipated environmental and socioeconomic impacts of the Project are assessed in the context of environmental justice populations of concern.

10.1 Environmental Setting

This section describes the demographic and socioeconomic characteristics of populations potentially affected by the Project, which serve as the foundation of the environmental justice analysis. The geographic area considered for the environmental justice analysis covers the two counties within which Reach 2B is located (i.e., Fresno and Madera counties, hereinafter referred to as the two-county region). It also includes the three census tracts (CT) in proximity to Reach 2B (i.e., CT 39, CT 83.01, and CT 4). The location of these census tracts are shown on Figure 10-1.

Environmental justice focuses on minority and low-income populations, and therefore topics addressed include race and ethnicity and relevant economic indicators of social well-being, including income and poverty. In addition, based on the strong connection between the Project area and the agricultural industry, information on these environmental justice parameters is also presented for local agricultural workforce.

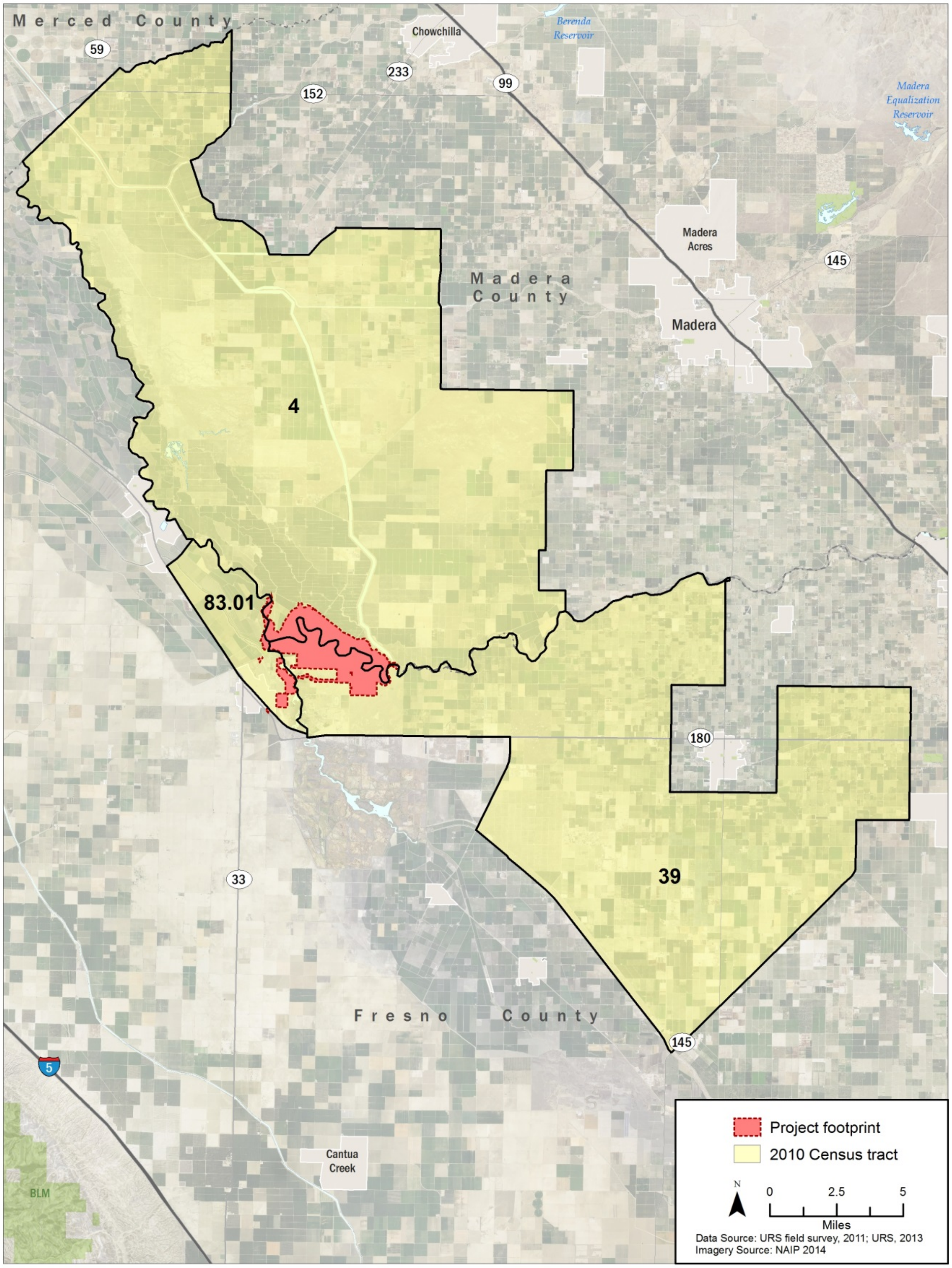

Figure 10-1.
Census Tracts near Reach 2B

The social and demographic characteristics of the Project area were evaluated to determine if any environmental justice communities of concern exist locally. This is determined based on the comparison of select social and demographic parameters for the Project area relative to the State, which serves as the reference population. If the minority or low-income populations are "meaningfully greater" in the region relative to this reference population, or where the proportion exceeds 50 percent of the total population, then an environmental justice community of concern is assumed to be present.

10.1.1 Social and Demographic Characteristics

Race and Ethnicity (Minority Populations)

The Council on Environmental Quality (CEQ 1997) defines a minority as persons who identify themselves as *Black/African American*, *Asian*, *Native Hawaiian or Other Pacific Islander*, and *American Indian or Alaska Native*. For the purposes of this analysis, the definition of minority also extends to other nonwhite categories of race, which include *Some Other Race* and *Two or More Races*. The CEQ guidance also identifies persons of *Hispanic* ethnicity, regardless of race, as part of minority populations (CEQ 1997). Hispanic origin is considered to be an ethnic category separate from race, according to the U.S. Census. These definitions apply here even though the minority populations within the State when combined are greater than 50 percent (as shown in Table 10-1 below).

Table 10-1 displays the potentially affected minority groups within the Project area based on the most recent decennial census data from the U.S. Census Bureau. The category "total minority" includes all residents except non-Hispanic whites, who are not considered minorities. As shown, the State and both Fresno and Madera counties have a minority population exceeding 50 percent. Together, the two-county region contains a minority population of 66.5 percent. The three CTs within the Project area also exceed 50 percent, with a joint minority population of 83.3 percent. In fact, CT 83.01 in Fresno County has an exceptionally high proportion of minorities (97.7 percent). Further, the CTs and two-county region both have a higher minority population compared to the State. These data suggest that the Project area and vicinity is considered an environmental justice community of concern from the perspective of race and ethnicity.

Table 10-2 presents the racial and ethnic composition of farm operators within the two-county region and State based on the most recent census of agriculture from the U.S. Department of Agriculture. Information on the race and ethnicity of farm operators at the CT level is not available. The farm operator is the person who runs the farm, making the day-to-day management decisions. The operator could be an owner, hired manager, cash tenant, share tenant, and/or a partner. As shown, the majority of farm operators in the two-county region are white (69.3 percent), which is representative of patterns in the State as a whole. There are slightly higher proportions of farm operators identifying as Asian and Hispanics in the two-county region compared to the State.

Table 10-1.
Race and Ethnicity of Local Population, 2010

Geo-graphic Area	Total Population	Race							Hispanic Origin		Total Minority [b]
		White	Black or African-American	American Indian	Asian	Native Hawaiian/ Pacific Islander	Some Other Race	Two or More Races	White Alone, Non-Hispanic	All Races, Hispanic [a]	
Fresno County	930,450	515,145	49,523	15,649	89,357	1,405	217,085	42,286	304,522	468,070	625,928
	100.0%	55.4%	5.3%	1.7%	9.6%	0.2%	23.3%	4.5%	32.7%	50.3%	67.3%
CT 39	5,804	3,257	26	209	94	0	2,005	213	1,633	4,008	4,171
	100.0%	56.1%	0.4%	3.6%	1.6%	0.0%	34.5%	3.7%	28.1%	69.1%	71.9%
CT 83.01	5,989	3,028	58	71	55	5	2,572	200	140	5,782	5,849
	100.0%	50.6%	1.0%	1.2%	0.9%	0.1%	42.9%	3.3%	2.3%	96.5%	97.7%
Madera County	150,865	94,456	5,629	4,136	2,802	162	37,380	6,300	57,380	80,992	93,485
	100.0%	62.6%	3.7%	2.7%	1.9%	0.1%	24.8%	4.2%	38.0%	53.7%	62.0%
CT 4	1,288	798	11	12	4	1	412	50	412	851	876
	100.0%	61.8%	0.6%	1.1%	2.2%	0.4%	29.1%	4.9%	38.7%	56.6%	61.3%
Total CT's	13,081	7,083	95	292	153	6	4,989	463	2,185	10,641	10,896
	100.0%	54.1%	0.7%	2.2%	1.2%	0.0%	38.1%	3.5%	16.7%	81.3%	83.3%
Two-County Region	1,081,315	609,601	55,152	19,785	92,159	1,567	254,465	48,586	361,902	549,062	719,413
	100.0%	56.4%	5.1%	1.8%	8.5%	0.1%	23.5%	4.5%	33.5%	50.8%	66.5%
State	37,253,956	21,453,934	2,299,072	362,801	4,861,007	144,386	6,317,372	1,815,384	14,956,253	14,013,719	22,297,703
	100.0%	57.6%	6.2%	1.0%	13.0%	0.4%	17.0%	4.9%	40.1%	37.6%	59.9%

Source: U.S. Census Bureau 2010

Notes:

[a] The term “Hispanic” is an ethnic category and can apply to members of any race, including respondents who self-identified as “white.” The total numbers of Hispanic residents for each geographic region are tabulated separately from the racial distribution by the U.S. Census Bureau. Hispanic information is taken from U.S. Census Bureau 2010, while data regarding race are taken from U.S. Census Bureau 2010, Table P7.

[b] “Total minority” is the aggregation of all non-white racial groups with the addition of all Hispanics, regardless of race. Total minority information is taken from U.S. Census Bureau 2010, with the total for “Not Hispanic or Latino: White alone” subtracted from the total population.

Key: % = percent, CT = Census Tract

Table 10-2.
Race and Ethnicity of Farm Operators, 2012

Geo-graphic Area	Total Farm Operators	White	Black or African-American	American Indian	Asian	Native Hawaiian / Pacific Islander	More Than One Race	All Race, Hispanic
Fresno County	10,378	6,964	52	140	1,499	36	71	1,616
	100.0%	67.1%	0.5%	1.3%	14.4%	0.3%	0.7%	15.6%
Madera County	2,715	2,106	15	24	234	8	8	320
	100.0%	77.6%	N/A	0.9%	8.6%	0.3%	0.3%	11.8%
Two-county Region	13,093	9,070	67	164	1,733	44	79	1,936
	100.0%	69.3%	0.5%	1.3%	13.2%	0.3%	0.6%	14.8%
California	137,510	111,141	526	1,761	7,474	455	1,030	15,123
	100.0%	80.8%	0.4%	1.3%	5.4%	0.3%	0.7%	11.0%

Source: USDA 2014, Census of Agriculture

Notes:

"Total Minority" cannot be computed from the data provided by the U.S. Department of Agriculture (USDA) Agricultural Census, as a tabulation of "White Alone, Non-Hispanic" farm operators is not provided.

Key:
% = percent
USDA = U.S. Department of Agriculture

Table 10-3 presents the racial and ethnic composition of laborers and helpers within the Project area based on the most recent Equal Employment Opportunity Tabulation data from the U.S. Census. Information on the race and ethnicity of laborers and helpers at the CT level is not available. The category "laborers and helpers" generally includes farm laborers, but may also include other manual labor sectors as part of the total. This category excludes construction personnel, which are captured under a different category by the U.S. Census Bureau. As shown, Hispanics comprise the largest proportion of laborers in each geographic area. The proportion of Hispanic laborers and helpers in the two-county region (86.4 percent) is higher to that in the State (71.3 percent). A similar pattern is found when evaluating all minority groups. The proportion of total minorities in this component of the workforce is 90.9 percent in the two-county region compared to 80.8 percent in the State.

Socioeconomic Indicators of Well-Being (Low-Income Populations)

For this analysis, persons with income below the poverty threshold established by the U.S. Census Bureau are considered low-income populations. Table 10-4 presents the median household income, per capita income, and proportion of individuals living below the poverty threshold for the Project area based on the most recent American Community Survey 5-year estimate from the U.S. Census Bureau. Any poverty rate which is at least double the statewide poverty rate is considered meaningfully greater for the purposes of this environmental justice analysis.

Table 10-3.
Race and Ethnicity of Laborers and Helpers, 2006-2010 Estimate

Geographic Area	Total Laborers and Helpers	Race (Not Hispanic or Latino)							All Race, Hispanic [a]	Total Minority [b]
		White	Black or African-American	American Indian	Asian	Native Hawaiian/ Pacific Islander	Some Other Race	Two or More Races		
Fresno County	46,120	4,085	580	130	1,160	0	295	160	39,710	42,035
	100.0%	8.9%	1.3%	0.3%	2.5%	0.0%	0.6%	0.4%	86.1%	91.2%
Madera County	10,145	1,045	100	10	40	0	10	34	8,905	9,099
	100.0%	10.3%	1.0%	0.1%	0.4%	0.0%	0.1%	0.3%	86.1%	88.0%
Two-county Region	56,265	5,130	680	140	1,200	0	305	194	48,615	51,134
	100.0%	9.1%	1.2%	0.2%	2.1%	0.0%	0.5%	0.3%	86.4%	90.9%
California	870,025	167,320	29,900	3,085	34,505	3,205	4,765	6,985	620,260	702,705
	100.0%	19.2%	3.4%	0.4%	4.0%	0.4%	0.5%	0.8%	71.3%	80.8%

Source: U.S. Census Bureau 2012 (EEO Tabulation 2006-2010)

Notes:

[a] The term "Hispanic" is an ethnic category and can apply to members of any race, including respondents who self-identified as "white."

[b] "Total minority" is the aggregation of all non-white racial groups with the addition of all Hispanics, regardless of race.

Key:
% = percent

Table 10-4.
Income and Poverty, 2008-2012 Estimate

Geographic Area	Median Household Income	Per Capita Income	Population Below Poverty Threshold	
Fresno County	$45,741	$20,391	230,768	24.8%
CT 39	$34,135	$15,630	1,436	31.2%
CT 83.01	$34,607	$10,282	2,007	33.4%
Madera County	$47,937	$18,474	31,780	21.1%
CT 4	$33,750	$18,247	183	16.8%
Total CT's[1]	$34,164	$14,720	3,627	27.7%
Two-County Region[1]	$46,839	$19,433	262,548	24.3%
State of California	$61,400	$29,551	5,710,735	15.3%

Source: U.S. Census Bureau 2013, 2008-2012 American Community Survey 5-year estimates

Notes:

[1] Poverty rates calculated based on weighted population (relative to the percent population of each CT in the Total CT's and relative to the percent population of each county in the Two-County Region)

Key: % = percent

Overall, the two-county region contains a greater percentage of people living in poverty relative to the State (24.3 percent versus 15.3 percent, respectively); this does not exceed the threshold for this analysis. However, CT 39 and CT 83.01 in Fresno County have a meaningfully-greater proportion of people living below the poverty threshold at 31.2 percent and 33.4 percent, respectively. These data suggest that the Project area and vicinity is considered an environmental justice community of concern from the perspective of socioeconomic indicators.

Table 10-5 presents median annual wage information for farm-related occupations within the Project area based on recent data from the California Employment Development Department. As shown, the median wage for all farm-related occupations is $19,504 in Fresno County and $19,416 in Madera County. Both figures are less than the county-wide median wage for all industries ($41,852 and $43,956, respectively) and median wage earnings across the State ($52,630). All categories of agricultural workers earn less than the statewide average except for graders and sorters.[1] The information presented in Table 10-5 shows that median incomes in the farming industry are lower than the median income for all industries, with some less-skilled agricultural workers earning substantially less than regional averages.

[1] Comparable data for Agricultural Inspectors, Graders and Sorters, and Agricultural Workers, Other for Madera County were not available.

Table 10-5.
Agricultural Workers Median Annual Wages, 2012 (1st Quarter)

Geographic Area	Farming, Fishing, and Forestry Occupations-Overall	First-Line Supervisors	Agricultural Inspectors	Graders and Sorters	Equipment Operators	Farmworker (Crop, Nursery, Greenhouse)	Farmworker (Farm and Ranch Animals)	Agricultural Workers, Other	Median Wage, All Industries
Fresno County	$19,504	$31,512	$41,275	$19,847	$19,836	$18,821	$21,368	$38,584	$41,852
Madera County	$19,416	$30,158	$23,755	--	$22,064	$18,639	$20,249	--	$43,956
California	$20,944	$43,598	$47,283	$19,594	$24,150	$19,551	$25,672	$28,725	$52,630

Source: California EDD 2012
Key:
-- = data not available

10.1.2 Long-term Challenges for Agricultural Lands

Future water demand in the Central Valley is affected by a number of growth and land use factors, including population growth, planting decisions by farmers, and size and type of urban landscapes. Future population growth and development density will determine the extent of the urban landscape and encroachment into agricultural lands. The *California Water Plan* (Department of Water Resources 2013) has evaluated several growth and climate change scenarios and predicts an increase in urban water demand associated with increased population growth, a decrease in agricultural water demand due to a reduction in irrigated crop acreage (and due to an increase in water conservation measures for agriculture), and a decrease in agricultural supply reliability in the Central Valley. The Central Valley could experience increased fallowing of agricultural lands and an associated decrease in farm-related occupations, which could affect environmental justice communities. How these trends would apply specifically to Reach 2B is unknown.

10.2 Regulatory Setting

This section describes the Federal, State, regional, and local regulatory setting related to environmental justice.

10.2.1 Federal

Federal laws and regulations pertaining to environmental justice in the Project area are summarized briefly below.

Executive Order 12898

In 1994, President Clinton issued Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1994)*. EO 12898 requires each Federal agency to achieve environmental justice as part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects, including social or economic effects, of programs, policies, and activities on minority and low-income populations of the United States.

Council on Environmental Quality Guidance

The CEQ prepared *Environmental Justice Guidance under the National Environmental Policy Act* to assist Federal agencies in meeting their environmental justice commitments under the National Environmental Policy Act (NEPA). This guidance provides the following definition of the terms “minority” and “low income community” in the context of environmental justice analysis. Minority individuals are members of the following population groups: American Indian or Alaskan Native, Asian or Pacific Islanders, Black, and Hispanic. A low income community is one found to be below the poverty thresholds from the U.S. Census Bureau. CEQ has oversight for the Federal government’s compliance with EO 12898 and NEPA process, with the U.S. Environmental Protection Agency (EPA) serving as the lead agency responsible for implementation of the EO.

Environmental Compliance Memoranda No. ECM 95-3

The U.S. Department of the Interior, Office of Environmental Policy and Compliance (1995) confirms the requirement of EO 12898 for the U.S. Department of the Interior to consider impacts on minority and low-income populations and communities. A letter responding to an earlier request by the Secretary of the Interior states, "[H]enceforth, all environmental documents should specifically analyze and evaluate the impacts of any proposed projects, actions or decisions on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risks of those decisions."

10.2.2 State of California

State laws and regulations pertaining to environmental justice are discussed below.

Senate Bill 115

California was the first state to define environmental justice with Senate Bill (SB) 115. The bill defines environmental justice as "the fair treatment of people of all races, cultures and income with respect to development, adoption and implementation of environmental laws, regulations and policies." SB 115 added this language to California Government Code section 65040.12 and to Division 34 of the Public Resources Code relating to environmental quality. It also established the Governor's Office of Planning and Research as the coordinating agency for State programs and requested that the California Environmental Protection Agency (Cal/EPA) establish a model environmental justice policy for its boards, departments, and offices (California Resources Agency, undated).

California State Lands Commission Environmental Justice Policy

The California State Lands Commission (CSLC) pledges though its environmental justice policy to continue and enhance its processes, decisions, and programs with environmental justice as an essential consideration. It defines "environmental justice" in a manner consistent with the State as "the fair treatment of people of all races, cultures and income with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies." This definition is consistent with the Public Trust Doctrine principle that the management of trust lands is for the benefit of all of the people. The purpose of the environmental justice policy is to ensure that environmental justice is an essential consideration in the CSLC's processes, decisions and programs and that all people who live in California have a meaningful way to participate in these activities. Implementation of CSLC's environmental justice policy is similar to implementation of environmental justice under the NEPA process.

10.2.3 Regional and Local

There are no known regional or local plans or policies related to environmental justice.

10.3 Environmental Consequences and Mitigation Measures

10.3.1 Impact Assessment Methodology

This section describes the approach used to conduct the assessment of potential effects related to environmental justice. This assessment utilizes information on the demographic and social characteristics of the Project area to determine whether there are minority or low-income populations that could be disproportionately and adversely affected by the Project alternatives. The identification of minority and low-income populations in the Project area is based on a comparison of select social and demographic characteristics, including race, per capita income and poverty rates, of communities that would be affected by the Project (e.g., city of Mendota) with a reference population (the State). Minority or low-income populations in the Project area that are meaningfully greater in proportion than in the reference population are considered environmental justice populations of concern.

The minority and low-income populations prevalent in the Project area have been evaluated in the context of the potential for adverse socioeconomic and environmental effects of the Project to determine if they would be disproportionately affected. The evaluation of environmental justice effects on minority and low-income populations considers the magnitude and timing of economic and environmental impacts and the nexus between such impacts and the affected populations, including their extent of use of affected resources, such as resources that support subsistence living.

10.3.2 Disproportionately High and Adverse Criteria

Under NEPA, an analysis of environmental justice effects is required; however, there is no standard set of criteria for evaluating environmental justice impacts. Under the California Environmental Quality Act (CEQA), economic and social impacts are not considered significant effects on the environment; therefore, there is no guidance on assessing environmental justice effects in the State CEQA Guidelines Appendix G. For this analysis, the Project would result in an environmental justice impact if it would result in any of the following:

- An impact on the natural or physical environment that substantially and adversely affects a minority population, low-income population, or Indian tribe disproportionately relative to the general population. Such effects may include ecological, cultural, and human health impacts from environmental hazards.
- An economic or social impact on the human environment that substantially and adversely affects a minority population, low-income population, or Indian tribe disproportionately relative to the general population. Such effects may include reductions in income and employment opportunities.
- Physical impacts on resources, such as fish and wildlife, which are used for subsistence consumption.

If an impact remains significant after all mitigation is implemented, then the impact is included in the environmental justice analysis, and the equity of the impact across the Project area population is determined. In instances where the location of the impact could be described, the demographic characteristics of the surrounding area were assessed to determine whether a minority or low-income population meaningfully greater than the proportion of minority and/or low-income residents in the general population was present. “Meaningfully greater” populations were interpreted to be either 50 percent of the total population of the geographic unit or simply “greater” than any other population group within the surrounding, larger geography (which provides for a more conservative analysis). Otherwise, the environmental justice analysis is evaluated at a broader, more regional scale. Potentially significant and unavoidable impacts and significant and unavoidable impacts are identified in other chapters of this Environmental Impact Statement/Report (EIS/R).

10.3.3 Impacts and Mitigation Measures

This section describes a project-level evaluation of potential impacts to environmental justice communities of concern in the Project area from impacts on the natural or physical environment (ecological, cultural, and human health impacts). The primary impacts of the Project alternatives that factor in the environmental justice analysis are associated with removing agricultural lands from production and Project construction and operations expenditures, which affect socioeconomic conditions throughout the regional economy. This section includes analyses of potential effects relative to No-Action conditions in accordance with NEPA. This methodology will serve to address the State policies explained in Section 10.2.2. The analysis is organized by Project alternative with specific impact topics numbered sequentially under each alternative. With respect to environmental justice, the relevant issues and concerns are:

1. Effects on Environmental Justice Communities of Concern from Removal of Land from Agricultural Production.
2. Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Agricultural Production.
3. Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Project Construction and Operations.
4. Effects on Environmental Justice Communities of Concern from Conversion of Designated Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts.
5. Effects on Environmental Justice Communities of Concern due to Conflicts with Adopted Land Use Plans, Goals, Policies, and Ordinances
6. Effects on Environmental Justice Communities of Concern from Construction-Related Emissions of Criteria Air Pollutants and Precursors and Exposure of Sensitive Receptors to Substantial Concentrations of Toxic Air Contaminants.
7. Effects on Environmental Justice Communities of Concern from Physical Impacts on Resources Used for Subsistence Consumption (Fish and Wildlife).
8. Effects on Environmental Justice Communities of Concern from Inadequate or Reduced Emergency Access

There are other environmental justice-related issues covered in the Program Environmental Impact Statement/Report (PEIS/R) that are not covered here because they are not relevant to the Project area.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the San Joaquin River Restoration Program (SJRRP) would be implemented, including habitat restoration, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these activities would not achieve the Settlement goals. The analysis of environmental justice effects of the No-Action Alternative is based on a comparison to existing conditions.

Impact EJ-1 (No-Action Alternative): ***Effects on Environmental Justice Communities of Concern from Removal of Land from Agricultural Production*****.** Under the No-Action Alternative, there would not be any land removed from agricultural production to accommodate the Project. Therefore, compared to existing conditions, a substantial decrease in the quantity of agricultural lands in the Project area would be unlikely, the No-Action Alternative would result in continued agricultural production, and local agricultural operations would continue to employ farm laborers and provide labor income to these workers, who are typically of Hispanic origin and generally part of the low-income population in the region. Disproportionately high and adverse effects on minority and low-income populations **would not occur** under the No-Action Alternative.

Impact EJ-2 (No-Action Alternative): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Agricultural Production*****.** As described in Impact EJ-1 (No-Action Alternative), there would likely be little to no land removed from agricultural production under the No-Action Alternative. Therefore, compared to existing conditions, there would be no change and local farms would continue to make expenditures in the local economy to support their operations, thereby generating economic benefits throughout Fresno and Madera counties, as measured by economic output, labor income, and jobs. Some of these regional benefits would accrue to minority and low-income populations residing in the two-county region. Disproportionately high and adverse effects on minority and low-income populations **would not occur** under the No-Action Alternative.

Impact EJ-3 (No-Action Alternative): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Project Construction and Operations*****.** Under the No-Action Alternative, the Project would not be implemented and there would not be any construction- and operations-related expenditures or employment supported by the Project that would generate economic benefits in the two-county region. There would be no change compared to existing conditions. Disproportionately high and adverse effects on minority and low-income populations **would not occur** under the No-Action Alternative.

Impact EJ-4 (No-Action Alternative): ***Effects on Environmental Justice Communities of Concern from Conversion of Designated Farmland to Nonagricultural Uses and***

Cancellation of Williamson Act Contracts. Under the No-Action Alternative, the Project would not be implemented and there would not be any Project-related conversion of designated farmland to non-agricultural uses or cancellation of Williamson Act contracts that would affect agricultural workers which are disproportionately racial and/or ethnic minorities relative to State demographics. There would be no change compared to existing conditions as a result of Project-related activities. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur** under the No-Action Alternative.

Impact EJ-5 (No-Action Alternative): *Effects on Environmental Justice Communities of Concern due to Conflicts with Adopted Land Use Plans, Goals, Policies, and Ordinances*. Under the No-Action Alternative, the Project would not be implemented and there would not be Project-related conflicts with adopted land use plans, goals, policies, and ordinances that would affect agricultural workers, which are disproportionately racial and/or ethnic minorities relative to State demographics. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur** under the No-Action Alternative.

Impact EJ-6 (No-Action Alternative): *Effects on Environmental Justice Communities of Concern from Construction-related Emissions of Criteria Air Pollutants and Precursors and Exposure of Sensitive Receptors to Substantial Concentrations of Toxic Air Contaminants.* Under the No-Action Alternative, the existing regulatory framework would likely minimize adverse effects from emission of criteria air pollutants and precursors in localized areas. Local regulations that require dust abatement and criteria pollutant emissions reduction during construction are expected to reduce these impacts. However, there could be residual significant and unavoidable impacts from construction activities within the San Joaquin Valley Air Basin (SJVAB) that are unrelated to the Project, and regional effects could disproportionately affect low-income groups. If the SJVAB remains in nonattainment status for criteria air pollutants, then health impacts associated with poor air quality could affect low-income residents with less access to health care. Disproportionately high and adverse effects on minority and low-income populations **could occur**.

Impact EJ-7 (No-Action Alternative): *Effects on Environmental Justice Communities of Concern from Physical Impacts on Resources Used for Subsistence Consumption (Fish and Wildlife).* Under the No-Action Alternative, the Project would not be implemented and there would not be any Project-related physical changes on resources that would affect subsistence consumers which are disproportionately racial and/or ethnic minorities relative to State demographics. There would be no change compared to existing conditions as a result of Project-related activities. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur** under the No-Action Alternative.

Impact EJ-8 (No-Action Alternative): *Effects on Environmental Justice Communities of Concern from Reduced Inadequate or Emergency Access*. Under the No-Action Alternative, the Project would not be implemented and there would not be changes in emergency access that would affect agricultural workers, which are disproportionately racial and/or ethnic minorities relative to State demographics. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur** under the No-Action Alternative.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

All of the Project alternatives, including Alternative A, would entail habitat restoration activities in conjunction with an expanded floodplain and widened levee alignment, as well as new Project facilities that promote fish passage through Reach 2B. The Project would result in adverse impacts on agricultural resources (refer to Chapter 16, "Land Use Planning and Agricultural Resources") and generate both socioeconomic impacts associated with losses in agricultural production and benefits attributed to construction and operations spending (refer to Chapter 21, "Socioeconomics and Economics").

Impact EJ-1 (Alternative A): ***Effects on Environmental Justice Communities of Concern from Removal of Land from Agricultural Production.*** Compared to No-Action, Alternative A would permanently remove approximately 1,180 acres of agricultural land from production and 580 acres of cropland would likely be shifted to livestock grazing. Additional agricultural land would also be temporarily taken out of production affected during the multi-year construction period. Under Alternative A, termination of agricultural production on lands within the Project area would result in lower demand for farm labor. It is anticipated that 40 farm-level jobs and $1.8 million in annual labor income would be permanently lost when agricultural land is removed from production under Alternative A; temporary effects during construction are relatively minor. As described above, the agricultural labor force predominantly consists of workers of Hispanic origin with relatively low incomes. As a result, the adverse effects on local agricultural operations would be realized by an environmental justice community of concern in the Project area. Therefore, disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative A.

Impact EJ-2 (Alternative A): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Agricultural Production.*** Compared to No-Action, Alternative A would result in a decline in regional economic activity in the two-county region, namely losses in economic output (or production), labor income and jobs, in conjunction with decreased agricultural production in the Project area. Considering the inter-industry linkages between the agricultural sector and other sectors of the regional economy (i.e., "ripple" or multiplier effects), the total economic impacts in Fresno and Madera counties attributed to decreased agricultural production in the Project area include annual losses of 75 jobs and $3.1 million in labor income over the long term under Alternative A. While the direct economic impacts would primarily occur in the agricultural sector, as described in Impact EJ-1 (Alternative A), the regional economic impacts would be more widespread, affecting a range of industries, including agricultural-support and other businesses linked to agriculture. As such, the regional economic impacts would affect a cross-section of the local population, which has a relatively high proportion of minority and low-income residents. However, it is difficult to predict the extent to which these adverse effects would be realized by minority and/or low-income populations living in the region. As a result of impacts on regional economic conditions, disproportionately high and adverse effects on minority and low-income populations in the region **could occur** under Alternative A.

Impact EJ-3 (Alternative A): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Project Construction and Operations*.** Compared to No-Action, Alternative A would benefit the regional economy based on construction and operations expenditures that would generate increases in economic output, labor income and jobs based on inter-industry linkages among affected sectors in the economy. Within the two-county region, construction activity is expected to support a total of approximately 293 jobs and $19.7 million in labor income annually over the construction period under Alternative A. Over the long term, operations expenditures would support about $705,000 in labor income annually and 14 jobs in the region. The direct short-and long-term economic benefits would primarily occur in construction-related sectors, while the regional economic benefits would affect a wide range of industries. Accordingly, the increase in economic activity would benefit a cross-section of the local population, which is characterized by a relatively-high proportion of minority and low-income residents as described above. However, it is difficult to predict the extent to which these beneficial employment and income effects would be realized by minority and/or low-income populations living in the region. Disproportionately high and adverse effects on minority and low-income populations **would not occur** under Alternative A.

Impact EJ-4 (Alternative A): ***Effects on Environmental Justice Communities of Concern from Conversion of Designated Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts.*** Proposed land use conversions associated with Alternative A would be inconsistent with local policies that call for the agricultural productivity of designated Farmland to be preserved and Williamson Act contracts to be maintained to the extent possible. The conversion of designated Farmland and cancellation of Williamson Act contracts could occur in the Project area. This significant and unavoidable impact is not expected to disproportionately affect specific geographic concentrations of low-income populations or minority groups because the effects would be distributed. However, the agricultural workers affected by reduced acreage of farmland are disproportionately racial and/or ethnic minorities relative to State demographics. The percentage of low-income agricultural workers who work in this area is also high. Therefore, disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative A.

Impact EJ-5 (Alternative A): ***Effects on Environmental Justice Communities of Concern due to Conflicts with Adopted Land Use Plans, Goals, Policies, and Ordinances*.** Proposed land use conversion in the Project area would conflict with adopted land use plans, goals, policies, and ordinances of affected jurisdictions. To recognize and minimize adverse effects on agricultural land use and zoning, Project proponents would notify Fresno and Madera County planning agencies of inconsistencies in designations and applicable polices for the affected areas. The population affected by land use conversion includes only one or two residences, which is too few for a disproportionately high and adverse effect. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur**.

Impact EJ-6 (Alternative A): ***Effects on Environmental Justice Communities of Concern from Construction-related Emissions of Criteria Air Pollutants and Precursors and Exposure of Sensitive Receptors to Substantial Concentrations of Toxic Air Contaminants.*** The existing regulatory framework would minimize adverse effects from emission of criteria air pollutants and precursors near the Project area. However, there could be residual significant and unavoidable impacts from construction activities within the SJVAB, and regional and local effects could disproportionately affect low-income groups. If the SJVAB remains in nonattainment status for criteria air pollutants, then health impacts associated with poor air quality could regionally affect low-income residents with less access to health care. Project-related construction could affect local minority and low-income sensitive receptors. Disproportionately high and adverse effects on minority and low-income populations **could occur**.

Impact EJ-7 (Alternative A): ***Effects on Environmental Justice Communities of Concern from Physical Impacts on Resources Used for Subsistence Consumption (Fish and Wildlife).*** In Reach 2B, the primary resource for subsistence consumption is fishing in Mendota Pool and the river just downstream of Mendota Dam. Alternative A would not make physical changes to the portion of Mendota Pool that is publically accessible and typically used for fishing opportunities. Compared to the No-Action Alternative, the effects of Alternative A would be the same. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur** under Alternative A.

Impact EJ-8 (Alternative A): ***Effects on Environmental Justice Communities of Concern from Inadequate or Reduced Emergency Access*.** Project alternatives would create temporary or permanent roadway discontinuities at Drive 10 ½ and/or the San Mateo Avenue crossing that could reduce emergency response times to private property north of the river. The potentially affected population includes residences and agricultural workers. Agricultural workers would be able to flee potential dangers such as brush fires and use alternative evacuation routes. Response times to residences north of the river near the crossings could be affected; however, the number of residences is too few for a disproportionately high and adverse effect. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur**.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B proposes habitat restoration activities in conjunction with an expanded floodplain and widened levee alignment, as well as new Project facilities that promote fish passage through Reach 2B. The Project would result in adverse impacts on agricultural resources (refer to Chapter 16, “Land Use Planning and Agricultural Resources”) and generate both socioeconomic impacts associated with losses in agricultural production and benefits attributed to construction and operations spending (refer to Chapter 21, “Socioeconomics and Economics”).

Impact EJ-1 (Alternative B): ***Effects on Environmental Justice Communities of Concern from Removal of Land from Agricultural Production*.** Alternative B would generally have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-1 (Alternative A) for more details. Compared to No-Action, Alternative B would permanently remove approximately 1,032 acres of agricultural land from production, and additional agricultural land would also be temporarily taken out of production affected during the multi-year construction period. In the context of environmental justice, it is anticipated that approximately 46 farm-level jobs and $2.1 million in annual labor income would be permanently lost under Alternative B, which would be realized predominantly by Hispanic workers characterized by low income levels. Therefore, disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative B.

Impact EJ-2 (Alternative B): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Agricultural Production*****.** Alternative B would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-2 (Alternative A) for more details. Compared to No-Action, Alternative B would adversely affect the regional economy based on reductions in agricultural production in the Project area. Agricultural production losses under Alternative B would result in total losses of 93 jobs and $3.8 million annually over the long term throughout Fresno and Madera counties, which are characterized by relatively large numbers of minority and/or low-income populations; therefore, the regional economic impacts anticipated with the Project could adversely affect minority and/or low-income populations residing in the region. As a result, disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative B.

Impact EJ-3 (Alternative B): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Project Construction and Operations*****.** Alternative B would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-3 (Alternative A) for more details. Compared to No-Action, Alternative B would generate regional economic benefits based on new spending on construction and operations activities associated with the Project. Within the two-county region, construction activity is expected to support a total of approximately 244 jobs and $16.1 million in labor income annually over the construction period. In addition, operations expenditures would support about $600,000 in labor income annually and 12 jobs over the long term. The regional economic benefits of Project construction and operations anticipated under Alternative B would benefit local residents in Fresno and Madera counties, which are characterized by relatively large numbers of minority and/or low-income populations. As a result, disproportionately high and adverse effects on minority and low-income populations **would not occur** under Alternative B.

Impact EJ-4 (Alternative B): ***Effects on Environmental Justice Communities of Concern from Conversion of Designated Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts.*** This analysis and conclusion is the same as Impact EJ-4 (Alternative A). The conversion of designated Farmland and cancellation of Williamson Act contracts would occur in the Project area and agricultural workers affected by the reduced acreage of farmland are disproportionately racial and/or ethnic minorities relative to State demographics. Disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative B.

Impact EJ-5 (Alternative B): *Effects on Environmental Justice Communities of Concern due to Conflicts with Adopted Land Use Plans, Goals, Policies, and Ordinances*. Alternative B would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-5 (Alternative A) for more details. Disproportionately high and adverse effects on minority and low-income populations **would not occur**.

Impact EJ-6 (Alternative B): *Effects on Environmental Justice Communities of Concern from Construction-related Emissions of Criteria Air Pollutants and Precursors and Exposure of Sensitive Receptors to Substantial Concentrations of Toxic Air Contaminants.* This analysis and conclusion is the same as Impact EJ-4 (Alternative A). Regional and local effects could disproportionately affect minority and low-income populations. Disproportionately high and adverse effects on minority and low-income populations **could occur**.

Impact EJ-7 (Alternative B): *Effects on Environmental Justice Communities of Concern from Physical Impacts on Resources Used for Subsistence Consumption (Fish and Wildlife).* In Reach 2B, the primary resource for subsistence consumption is fishing in Mendota Pool and the river just downstream of Mendota Dam. Alternative B would not make physical changes to the portion of Mendota Pool that is publically accessible and typically used for fishing opportunities. Compared to the No-Action Alternative, the effects of Alternative B would be the same. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur** under Alternative B.

Impact EJ-8 (Alternative B): *Effects on Environmental Justice Communities of Concern from Reduced Inadequate or Emergency Access*. Alternative B would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-8 (Alternative A) for more details. Disproportionately high and adverse effects on minority and low-income populations **would not occur**.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C proposes habitat restoration activities in conjunction with an expanded floodplain and widened levee alignment, as well as new Project facilities that promote fish passage through Reach 2B. The Project would result in adverse impacts on agricultural resources (refer to Chapter 16, “Land Use Planning and Agricultural Resources”) and generate both socioeconomic impacts associated with losses in agricultural production and benefits attributed to construction and operations spending (refer to Chapter 21, “Socioeconomics and Economics”).

Impact EJ-1 (Alternative C): *Effects on Environmental Justice Communities of Concern from Removal of Land from Agricultural Production*. Alternative C would generally have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-1 (Alternative A) for more details.

Compared to No-Action, Alternative C would permanently remove approximately 1,520 acres of agricultural land from production, and additional agricultural land would also be temporarily taken out of production affected during the multi-year construction period. In the context of environmental justice, it is anticipated that approximately 37 farm-level jobs and $1.7 million in annual labor income would be permanently lost under Alternative C, which would be realized predominantly by Hispanic workers characterized by relatively low income levels. Therefore, disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative C.

Impact EJ-2 (Alternative C): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Agricultural Production*.** Alternative C would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-2 (Alternative A) for more details. Compared to No-Action, Alternative C would adversely affect the regional economy based on reductions in agricultural production in the Project area. Agricultural production losses under Alternative C would result in total losses of 67 jobs and $2.7 million annually over the long term throughout Fresno and Madera counties, which are characterized by relatively large numbers of minority and/or low-income populations; therefore, the regional economic impacts anticipated with the Project could adversely affect minority and/or low-income populations residing in the region. As a result, disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative C.

Impact EJ-3 (Alternative C): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Project Construction and Operations*.** Alternative C would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-3 (Alternative A) for more details. Compared to No-Action, Alternative C would generate regional economic benefits based on new spending on construction and operations activities associated with the Project. Within the two-county region, construction activity is expected to support a total of approximately 287 jobs and $18.1 million in labor income annually over the construction period. In addition, operations expenditures would support about $557,000 in labor income annually and 11 jobs over the long term. The regional economic benefits of Project construction and operations anticipated under Alternative C would benefit local residents in Fresno and Madera counties, which are characterized by relatively large numbers of minority and/or low-income populations. As a result, disproportionately high and adverse effects on minority and low-income populations **would not occur** under Alternative C.

Impact EJ-4 (Alternative C): ***Effects on Environmental Justice Communities of Concern from Conversion of Designated Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts.*** This analysis and conclusion is the same as Impact EJ-4 (Alternative A). The conversion of designated Farmland and cancellation of Williamson Act contracts would occur in the Project area and agricultural workers affected by the reduced acreage of farmland are disproportionately racial and/or ethnic minorities relative to State demographics. Disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative C.

Impact EJ-5 (Alternative C): *Effects on Environmental Justice Communities of Concern due to Conflicts with Adopted Land Use Plans, Goals, Policies, and Ordinances*. Alternative C would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-5 (Alternative A) for more details. Disproportionately high and adverse effects on minority and low-income populations **would not occur**.

Impact EJ-6 (Alternative C): *Effects on Environmental Justice Communities of Concern from Construction-related Emissions of Criteria Air Pollutants and Precursors and Exposure of Sensitive Receptors to Substantial Concentrations of Toxic Air Contaminants.* This analysis and conclusion is the same as Impact EJ-4 (Alternative A). Regional and local effects could disproportionately affect minority and low-income populations. Disproportionately high and adverse effects on minority and low-income populations **could occur**.

Impact EJ-7 (Alternative C): *Effects on Environmental Justice Communities of Concern from Physical Impacts on Resources Used for Subsistence Consumption (Fish and Wildlife).* In Reach 2B, the primary resource for subsistence consumption is fishing in Mendota Pool and the river just downstream of Mendota Dam. Alternative C would change the extent of Mendota Pool, limiting it to Fresno Slough with the Fresno Slough Dam. The area at Mendota Dam would typically have run of the river conditions and fishing regulations used to protect endangered salmon would be enforced in the area. However, subsistence fishing could still continue in Mendota Pool and Fresno Slough, which would remain accessible at nearby Mendota Pool Park. Compared to the No-Action Alternative, the effects of Alternative C would be less than substantial. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur** under Alternative C.

Impact EJ-8 (Alternative C): *Effects on Environmental Justice Communities of Concern from Reduced Inadequate or Emergency Access*. Alternative C would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-8 (Alternative A) for more details. Disproportionately high and adverse effects on minority and low-income populations **would not occur**.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D proposes habitat restoration activities in conjunction with an expanded floodplain and widened levee alignment, as well as new Project facilities that promote fish passage through Reach 2B. The Project would result in adverse impacts on agricultural resources (refer to Chapter 16, "Land Use Planning and Agricultural Resources") and generate both socioeconomic impacts associated with losses in agricultural production and benefits attributed to construction and operations spending (refer to Chapter 21, "Socioeconomics and Economics").

Impact EJ-1 (Alternative D): *Effects on Environmental Justice Communities of Concern from Removal of Land from Agricultural Production*. Alternative D would generally have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-1 (Alternative A) for more details.

Compared to No-Action, Alternative D would permanently remove approximately 1,290 acres of agricultural land from production and 960 acres of cropland would be shifted to livestock grazing. Additional agricultural land would also be temporarily taken out of production affected during the multi-year construction period. In the context of environmental justice, it is anticipated that approximately 56 farm-level jobs and $2.6 million in annual labor income would be permanently lost under Alternative D, which would be realized predominantly by Hispanic workers characterized by relatively low income levels. Therefore, disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative D.

Impact EJ-2 (Alternative D): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Agricultural Production*.** Alternative D would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-2 (Alternative A) for more details. Compared to No-Action, Alternative D would adversely affect the regional economy based on reductions in agricultural production in the Project area. Agricultural production losses under Alternative D would result in total losses of 103 jobs and $4.3 million annually over the long term throughout Fresno and Madera counties, which are characterized by relatively large numbers of minority and/or low-income populations; therefore, the regional economic impacts anticipated with the Project could adversely affect minority and/or low-income populations residing in the region. As a result, disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative D.

Impact EJ-3 (Alternative D): ***Effects on Environmental Justice Communities of Concern from Changes in Regional Activity Attributed to Project Construction and Operations*.** Alternative D would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-3 (Alternative A) for more details. Compared to No-Action, Alternative D would generate regional economic benefits based on new spending on construction and operations activities associated with the Project. Within the two-county region, construction activity is expected to support a total of approximately 258 jobs and $15.8 million in labor income annually over the construction period. In addition, operations expenditures would support about $564,000 in labor income annually and 11 jobs over the long term. The regional economic benefits of Project construction and operations anticipated under Alternative D would benefit local residents in Fresno and Madera counties, which are characterized by relatively large numbers of minority and/or low-income populations. As a result, disproportionately high and adverse effects on minority and low-income populations **would not occur** under Alternative D.

Impact EJ-4 (Alternative D): ***Effects on Environmental Justice Communities of Concern from Conversion of Designated Farmland to Nonagricultural Uses and Cancellation of Williamson Act Contracts.*** This analysis and conclusion is the same as Impact EJ-4 (Alternative A). The conversion of designated Farmland and cancellation of Williamson Act contracts would occur in the Project area and agricultural workers affected by the reduced acreage of farmland are disproportionately racial and/or ethnic minorities relative to State demographics. Disproportionately high and adverse effects on minority and low-income populations **could occur** under Alternative D.

Impact EJ-5 (Alternative D): ***Effects on Environmental Justice Communities of Concern due to Conflicts with Adopted Land Use Plans, Goals, Policies, and Ordinances*****.** Alternative D would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-5 (Alternative A) for more details. Disproportionately high and adverse effects on minority and low-income populations **would not occur**.

Impact EJ-6 (Alternative D): ***Effects on Environmental Justice Communities of Concern from Construction-related Emissions of Criteria Air Pollutants and Precursors and Exposure of Sensitive Receptors to Substantial Concentrations of Toxic Air Contaminants.*** This analysis and conclusion is the same as Impact EJ-4 (Alternative A). Regional and local effects could disproportionately affect minority and low-income populations. Disproportionately high and adverse effects on minority and low-income populations **could occur**.

Impact EJ-7 (Alternative D): ***Effects on Environmental Justice Communities of Concern from Physical Impacts on Resources Used for Subsistence Consumption (Fish and Wildlife).*** In Reach 2B, the primary resource for subsistence consumption is fishing in Mendota Pool and the river just downstream of Mendota Dam. Alternative D would change the extent of Mendota Pool, limiting it to Fresno Slough with the Fresno Slough Dam. The area at Mendota Dam would typically have run of the river conditions and fishing regulations used to protect endangered salmon would be enforced in the area. However, subsistence fishing could still continue in Mendota Pool and Fresno Slough, which would remain accessible at nearby Mendota Pool Park. Compared to the No-Action Alternative, the effects of Alternative D would be less than substantial. Therefore, disproportionately high and adverse effects on minority and low-income populations **would not occur** under Alternative D.

Impact EJ-8 (Alternative D): ***Effects on Environmental Justice Communities of Concern from Reduced Inadequate or Emergency Access*****.** Alternative D would have similar effects on environmental justice communities of concern as described for Alternative A; refer to Impact EJ-8 (Alternative A) for more details. Disproportionately high and adverse effects on minority and low-income populations **would not occur**.

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11.0 Geology and Soils

This chapter describes the environmental and regulatory settings for geology and soils, including mineral resources (sand, gravel, rock, gold, oil, and natural gas), erosion, sedimentation, and geomorphic processes. The chapter includes a discussion of existing geology and soils conditions and the potential impacts of the Project alternatives on geology and soils along the San Joaquin River from the Chowchilla Bifurcation Structure to approximately 2 miles below Mendota Dam. The Project area comprises the area that could be directly or indirectly affected by the Project. The Project area is located in Fresno and Madera counties, near the town of Mendota, California.

11.1 Environmental Setting

Because of the regional-scale nature of earth resources, the geology and soils characteristics addressed in this section are described in a regional context, referring to geologic and geomorphic provinces, physiographic regions, or other large-scale areas, as appropriate.

11.1.1 Geology

The various geologic processes active in California over millions of years have created many geologically and geomorphically different areas, called geomorphic provinces. The upper San Joaquin River lies in the Sierra Nevada Province and lower San Joaquin River and the Project area are in the Central Valley Province (California Geological Survey [CGS] 2002a).

The upper San Joaquin River is located in the central portion of the Sierra Nevada Province at its boundary with the eastern edge of the Central Valley Province. The Sierra Nevada Province encompasses the Sierra Nevada Mountains, and comprises primarily intrusive rocks, including granite and granodiorite,[1] with some metamorphic rocks that formed due to contact at depth with the intruding igneous rocks. Extrusive rocks also occur. Evidence of previous episodic volcanic activity within the San Joaquin River watershed includes discontinuous Pliocene to Pleistocene deposits observed within the middle fork of San Joaquin River, the Miocene deposits within the vicinity of Millerton Lake, and the Pleistocene Friant Pumice found downstream of Friant Dam (Wakabayashi and Sawyer 2001, Huber 1981, McBain & Trush 2002).

The Sierra Nevada Province is a tilted fault block nearly 400 miles long, with a high, steep multiple-scarp east face and a gently sloping west face that dips beneath the Central Valley Province (CGS 2002a). The central Sierra Nevada has a complex history of uplift and erosion. The greatest uplift tilted the entire Sierra Nevada block to the west. The high

[1] Granodiorite is an igneous rock similar to granite, but contains more plagioclase (calcium and sodium) feldspar than potassium feldspar and has more dark minerals.

elevation of the Sierra Nevada Mountains leads to the accumulation of snow, including the Pleistocene glaciation responsible for shaping much of the range. Snowmelt in the Sierra Nevada feeds the San Joaquin River and its major tributaries, including those upstream from Friant Dam as well as the Merced, Tuolumne, Stanislaus, and Mokelumne rivers and other tributaries downstream from the Merced River confluence. These large rivers and their smaller tributaries cut through the granitic rocks present in the upper San Joaquin River watershed, and through intrusive and extrusive rock formations and sedimentary and metamorphosed rocks farther to the west. The metamorphic bedrock in these watersheds contains gold-bearing veins in the northwest-trending Mother Lode that are not present in the more southerly watershed of the upper San Joaquin River (CGS 2002b).

The Central Valley Province encompasses the Central Valley, an alluvial plain about 50 miles wide and 400 miles long in the central part of California, stretching from just south of Bakersfield northward to Redding. The San Joaquin Valley makes up approximately the southern half of the Central Valley Province and is drained by the San Joaquin River. The Sacramento Valley makes up the northern half of the Central Valley Province and is drained by the Sacramento River. The San Joaquin River and its tributaries flow out of the Sierra Nevada Province into the Central Valley, depositing sediments on alluvial fans, in riverbeds, on floodplains, and on wetlands of the Central Valley Province. The Central Valley Province is characterized by alluvial deposits and continental and marine sediments deposited almost continually since the Jurassic Period (CGS 2002b). Quaternary age[2] alluvium is identified and mapped at the ground surface throughout the entire Project area and vicinity (Figure 11-1).

Alternating marine and continental deposits of Tertiary age underlie much of the Central Valley Province, including the San Joaquin Valley (Page 1986). The more recent Quaternary Period was characterized by continental sedimentary deposition. Tertiary and Quaternary continental formations in the San Joaquin Valley are composed of alluvial deposits of gravel, sand, silt, and clay and contain lenses of clay and silt comprising lacustrine, marsh, and floodplain deposits. These Tertiary and Quaternary deposits are of varying thickness, in some instances, thousands of feet thick (Page 1986). Continental formations (i.e., Mehrten, Kern River, Laguna, San Joaquin, Tulare, Tehama, Turlock, Riverbank, and Modesto Formations) make up the major aquifer(s) of the San Joaquin Valley (Ferriz 2001, Page 1986).

[2] The Quaternary Period, our current period in the geologic time scale, is divided into two epochs: the Pleistocene (2.588 million years ago to 11.7 thousand years ago) and the Holocene (11.7 thousand years ago to today).

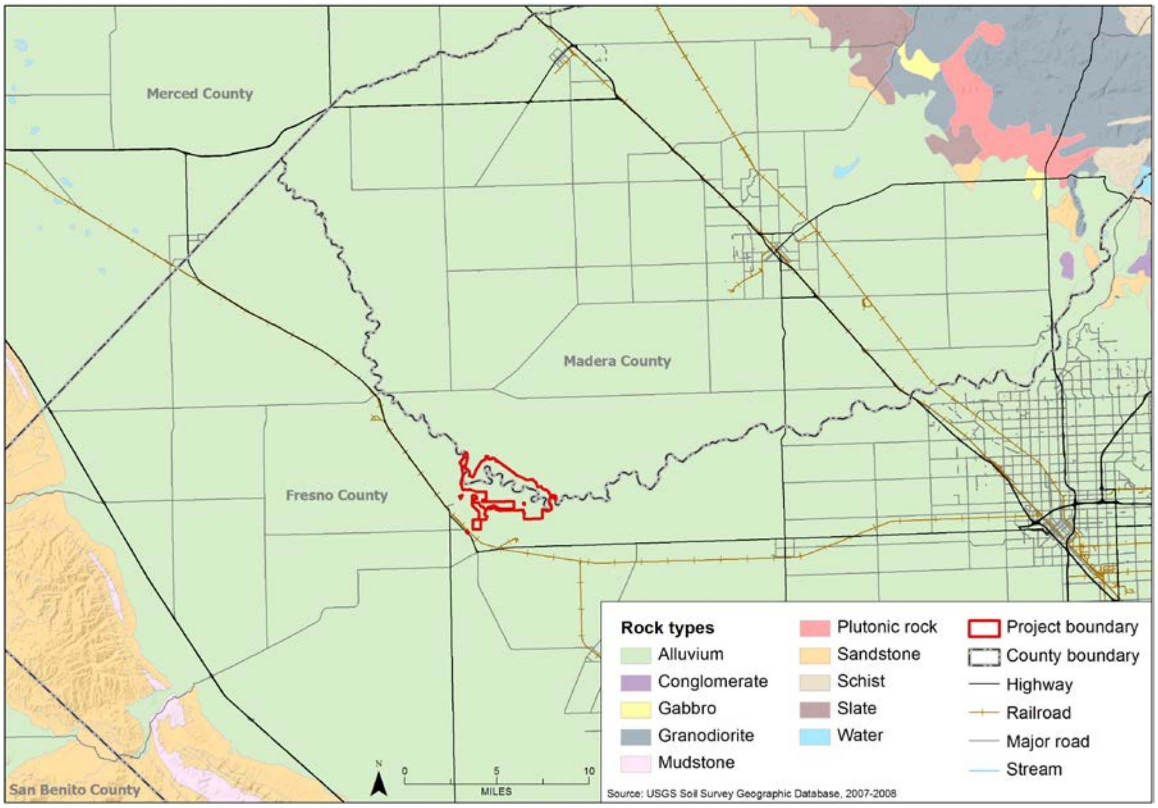


Figure 11-1.
Regional Geology

The San Joaquin Valley is a structural trough into which sediments have been deposited as much as 6 miles deep. Some of these sediments eroded from the Sierra Nevada and were transported and deposited in the Central Valley. Tectonic activity during the Tertiary Period strongly influenced the evolution of the Central Valley, alternately trapping water in the San Joaquin Valley or entire Central Valley to form inland seas that deposited marine sediments, and opening to allow drainage to the ocean, as under current conditions.

Surficial geology along Reach 2B is dominated by Holocene age alluvial deposits. These geologically young deposits cover the entire central San Joaquin Valley area. No bedrock is present on the ground surface. Sedimentary rock is exposed to the west in the Coast Ranges and igneous and metamorphic rocks are present in the Sierra Nevada to the east.

11.1.2 Soils

Soil development depends on parent material, climate, associated plants, topography, and age. Because these factors are similar within physiographic regions, soils within a physiographic region are often similar.

Soil Type

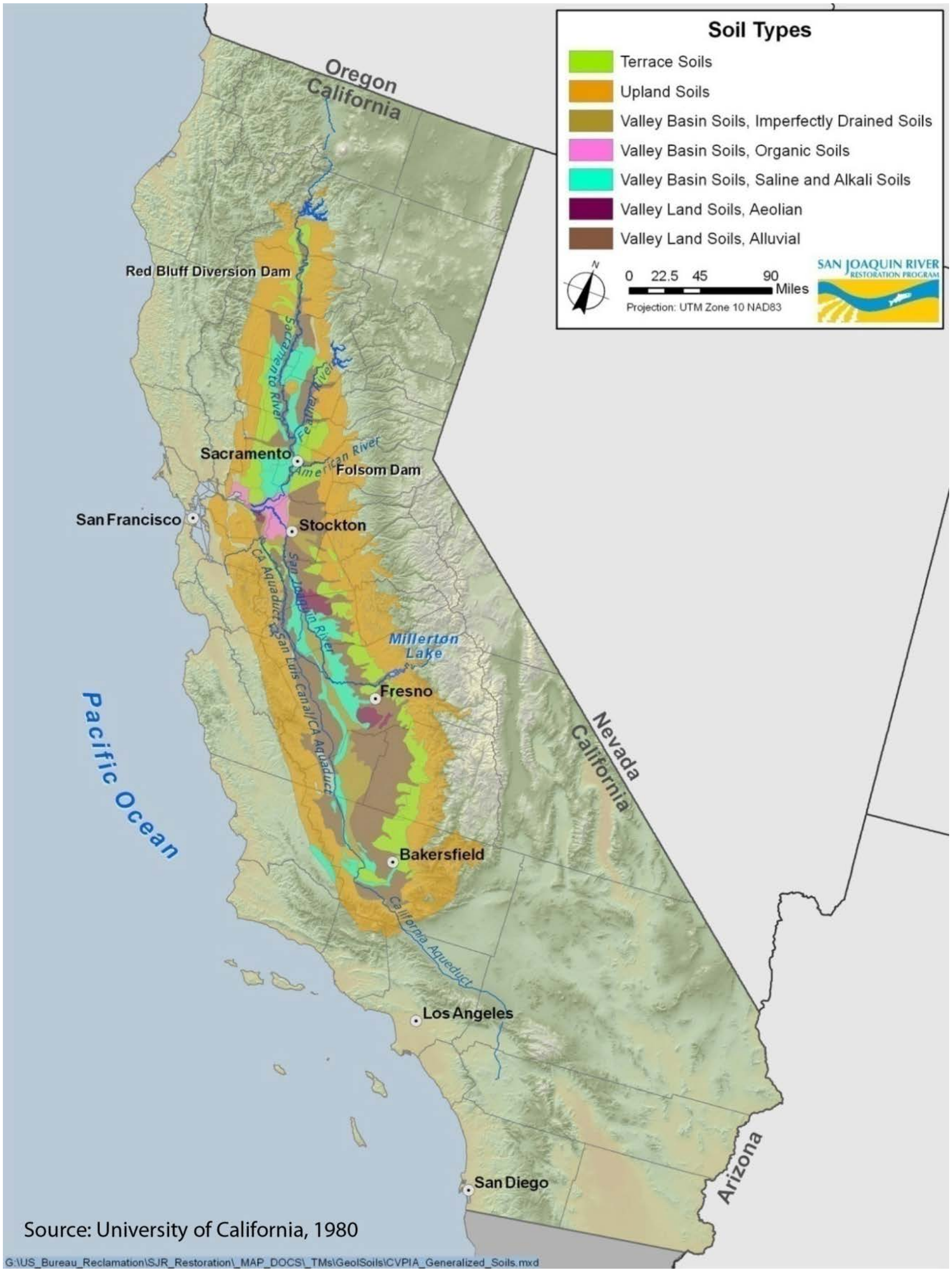
Soils in the Project area are described as valley basin soils on the regional soil map (University of California Division of Agricultural Sciences 1980) (Figure 11-2). Valley Basin soils consist of organic soils, imperfectly drained soils, and saline and alkali soils in the valley trough and on the basin rims.

The Valley Basin imperfectly drained soils generally contain dark clays, have a high water table, and are subject to overflow. These soils are found in the trough of the San Joaquin Valley, and consist in part of several thick lake bed deposits.

The Valley Basin saline/alkali soils are characterized by excess salts (saline), excess sodium (sodic), or both (saline-sodic). In many of the older soil surveys, salinity and sodicity were jointly referred to as alkaline. A distinction was sometimes made because the saline soil many times formed a white crust on the surface and was called “white alkali,” and the soils with excess sodium appeared to be “black,” thus, black alkali. Both are fairly common throughout the San Joaquin Valley. In uncultivated areas, saline soils are used for saltgrass pasture and native range. Some of these soils support seasonal salt marshes. In areas of intermediate to low rainfall, these soils are saline-sodic. Many of these soils are irrigated with moderately saline Delta surface water, imported via the Delta-Mendota Canal (DMC), or with slightly saline groundwater. In addition, salts are added through application of fertilizers or other additives needed for cropping.

The accumulation of salts in the soils of the San Joaquin Valley is due to a combination of the regional geology, high water table, intensive irrigation practices, and the importation of water from the Delta that is moderate in salinity and application to lands in the region. The Corcoran Clay and other clay layers contribute to a naturally high water table in the valley, concentrating salts in the root zone by evaporation through the soil. Farmers actively leach these salts from the soil into drainage water with irrigation and subsurface drainage practices. Drainage water with high concentrations of salts may be reused for irrigation (with or without treatment), accumulate in groundwater, or be discharged to evaporation ponds or tributaries to the San Joaquin River. Salinization caused by concentrations of naturally-occurring soil salts is exacerbated by the use of more saline Delta water, imported via the DMC and California Aqueduct, as a major source of irrigation water.

Additionally, naturally occurring trace elements in soils may be mobilized and concentrated along with salts. Soils throughout the San Joaquin Valley typically contain some selenium, and soils on the west side of the valley are particularly selenium-rich. These soils have developed on alluvial deposits comprising eroded material from the Coast Range, where selenium is found in marine deposits. Selenium can pose a hazard to fish and wildlife when it becomes highly concentrated in surface waters.

1 

2 **Figure 11-2.**
3 **Physiographic Soil Types in the Central Valley and Delta**

A soil map of the Project footprint is shown on Figure 11-3 and the acreage of each soil type is presented in Table 11-1. The main soil types mapped in the area are Grangeville fine sandy loam, Chino fine sandy loam, and Chino loam (National Resources Conservation Service [NRCS] 2008). All of these soils are mixtures of sand, silt, and clay derived primarily from the weathering of granitic bedrock; the soils are differentiated based upon several soil properties such as amount of calcium carbonate or salt or organic matter content, for example. The primary use of soils within the Project area is for farming.

Table 11-1.
General Soils Data in the Project Footprint

Soil Type	Acreage
Cajon loamy sand	0.5
Calflax clay loam	3.0
Chino fine sandy loam	325
Chino loam	1,812
Chino sandy loam	105
Columbia fine sandy loam	7.4
Columbia loamy sand	98
Columbia soils	19
Dello sandy loam	64
Elnido sandy loam	51
Foster loams	1.8
Grangeville fine sandy loam	1,651
Grangeville sandy loam	158
Merced clay	8.2
Palazzo sandy loam	31
Posochanet clay loam	2.5
Riverwash	68
Tachi clay	358
Tranquillity clay	81
Traver fine sandy loam	7.5
Traver loam	60
Traver sandy loam	14
Tujunga loamy sand	391
Visalia fine sandy loam	16
Visalia sandy loam	21
Water	442
Wunjey very fine sandy loam	97
Total Acreage	5,894

Source: NRCS 2008

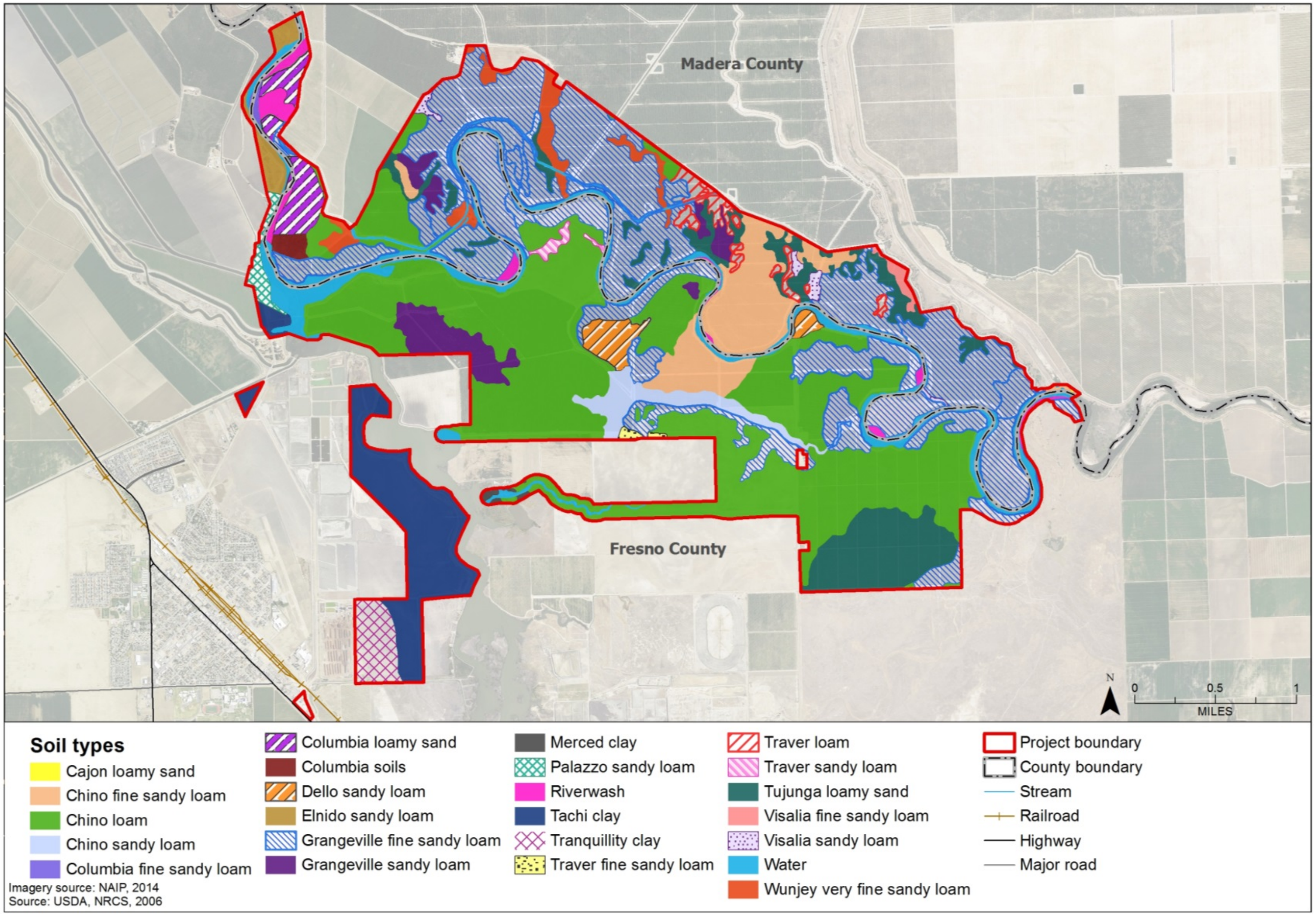


Figure 11-3.
General Soils Type in the Project Footprint

Generalized Soil Texture

Soils and sediments in the Project area and vicinity are composed of a heterogeneous mix of recent river channel deposits, recent floodplain deposits, and older deposits. The texture of these sediments ranges from coarse-grained gravels to fine-grained clays, and the distribution of these textures can have a strong influence on the hydrogeology of the underlying aquifer system. Table 11-2 contains the calculated areas in acres for each generalized soil texture in the Project area. Soils are predominantly classified as sandy loam and loam.

Table 11-2.
Acreages of Soil Textures in Project Footprint

Soil Texture	Acreage
Clay/Clay Loam	453
Loam	1,875
Sand	489
Sandy Loam	2,547
Variable[1]	530
Total Acreage	5,894

Source: NRCS 2008

Note:

[1] The category "variable" includes soils of undifferentiated texture and areas that were not mapped by the National Resources Conservation Service (i.e., areas covered by water during the mapping period).

Levee seepage has been a concern in the Project area and vicinity. Under-seepage, water that seeps laterally by travelling under a dam or levee section, can occur when structures are underlain by permeable native soils. Movement of water through or underneath levees, commonly appearing as boils or piping (seeps), may saturate the levee or transport foundation materials and compromise the short- or long-term integrity of the levee. Levee seepage can also raise groundwater surface elevations in adjacent areas, thereby increasing soil saturation and potentially reducing crop yields and/or increasing crop mortality.

11.1.3 Erosion and Sedimentation

The sediment load of the San Joaquin River and its tributaries originates from the erosion of soil and rock in the watershed. The sediment load of the San Joaquin River, like most rivers, generally becomes finer grained with distance downstream.

Soil Erosion Potential

Soil erosion is a natural physical process of wearing away and transport of soil materials by wind, water, ice, and gravity. Erosion can remove soils, undermining structures like bridges, and can lead to unstable steep slopes. Erosion is followed by deposition of the eroded materials, typically in low-lying areas, causing sedimentation of streams and reservoirs. Erosion also can result in landslides that may damage roads, buildings, and other infrastructure. Soil characteristics that affect the erosion rate are soil surface texture and structure, particle size, permeability, infiltration rate, and the presence of organic or other cementing materials. Other key factors determining erosion potential are the extent of vegetation, type of cover (vegetative or otherwise), human or other disturbance, topography, and rainfall.

Human activities can also effectively accelerate natural erosion processes. Localized sedimentation problems can occur with construction and development or agricultural activities, which usually involve vegetation removal, compaction of porous soils, and concentrated drainage from large areas. Improper agricultural management practices can accelerate erosion. Overgrazing and land clearing, particularly on steep slopes, but also on flat areas, make surfaces vulnerable to topsoil loss. Elevation measurements made from 1922 to 1981 indicate that even typical agricultural practices, regardless of crop type, may cause up to 1 to 3 inches of soil loss per year (Rojstaczer et al. 1991).

Infrastructure Effects on Sediment Transport

A significant effect of dams and water storage reservoirs on a watershed is on sediment supply because they serve as impediments to downstream sediment transport. Because of the slowing of stream flow velocity in the reservoir, sediment settles out of the water column and onto the reservoir bottom. Although the water and some of its fine sediment may be released on the downstream side of the dam, the majority of the sediment load, particularly the coarser materials (gravel, sand, and some silt), remains on the upstream side. Friant Dam stops most of the sediment from the upper San Joaquin River watershed from moving downstream. Reservoirs also create a transport-limited system downstream of the dam by reducing the frequency and/or intensity of natural high-flow regimes that were prevalent prior to dam construction. This limits gravel mobility and promotes bed coarsening/bed armoring.

Under unaltered conditions, fluvial processes, including sediment transport, are naturally adjusted along the length of a river to match the channel gradient, stream discharge, and sediment load. Flow energy in the river channel is dissipated gradually. Bridges and culverts constrict the natural channel and disrupt these processes. This may occur at high and/or low flows, depending on the size of the structure.

Effects of channel constrictions caused by bridge and culvert crossings include the following:

- Sediment deposition upstream from the constriction (backwater effects).
- Scour at the constriction due to an elevated water surface and increased water velocity.
- Sediment deposition downstream from the constriction due to flow expansion, leading to the formation of splay bars.
- Reduced flood conveyance capacity due to filling in of floodplain space when building bridge and culvert abutments.
- Catastrophic erosion of bridge or culvert crossing (and possibly surrounding areas) during large storm events due to channel blockage at constriction by debris such as trees, bushes, or other natural or man-made materials.

The function and operation of the water supply and flood control infrastructure present in the Project area and vicinity also affect fluvial processes of the San Joaquin River. Such infrastructure includes diversion structures, bypasses and bypass diversions, other hydraulic control structures, off-stream flood control dams, levees, and canals. These structures divert base flows and/or flood flows and constrict flood flows and thereby significantly alter fluvial processes. The processes most affected are sediment transport, local incision and deposition, and channel migration (Table 11-3).

Table 11-3.
Generalized Effects on Geomorphic Processes of Major Flood Control and Water Supply Infrastructure

Infrastructure	Effects
Diversion structures	Backwater effects cause disruption of local incision and deposition patterns; riprap protection prevents channel migration and avulsion; reroute sediment load
Bypasses	Reroute sediment load within the Project area
Bypass diversion structures	Backwater effects cause disruption of local incision and deposition patterns; reroute sediment load within the Project area
Other hydraulic control structures	Backwater effects cause disruption of local incision and deposition patterns; reroute sediment load within the Project area
Offstream flood control dams	Reroute sediment load within the Project area and vicinity
Levees	Dissect the historic floodplain, stop channel migration and avulsion, increase river velocity and, thus, also increase incision, bed armoring, and channel simplification
Canals	Embankments dissect the historic floodplain, stop channel migration and avulsion, increase river velocity and, thus, also increase incision, bed armoring, and channel simplification; reroute sediment load

Sediment load is carried by stream flow, and infrastructure that reroutes these flows alters sediment transport. Levees and canal embankments, especially those that are constructed within the floodplain and not sufficiently set back from the channel, dissect the historic floodplain preventing channel migration and avulsion.[3] This prevents oxbow formation and also increases river velocity, which encourages channel incision, bed armoring, and channel simplification.

Specific flood control and water supply infrastructure in the Project area and its effects on sediment transport are discussed below.

Local Erosion and Sedimentation

With the combination of agricultural development, reduction of the high-flow regime under controlled releases from Friant Dam, construction of levees, and incorporation of flood control structures with bypass channels, such as the Chowchilla Bypass, the river channel became simplified. High-flow scour channels were eliminated, the main channel footprint was reduced, and side channels were cut off from the main river. Prior to

[3] Avulsion is the rapid abandonment of a river channel and the formation of a new river channel.

implementation of Interim Flows, most sediment was routed through the Chowchilla Bypass and very little sediment moved through Reach 2B. Instead, most sediment was routed with flows into the bypass, or accumulated in sand traps immediately upstream of the bypass.

Historically, when flows through Reach 2 were more consistent, sediment supply and transport capacity decreased gradually from Reach 1B through Reach 2 as sediment was deposited on the floodplain and multiple side channels evolved across the floodplain. This is demonstrated by the presence of remnant channel deposits and relic floodplain features.[4] As water infrastructure was built in Reach 2B, sediment transport was affected. Small diversion structures, like Mendota Dam, affect sediment transport by modifying the delivery of sediment downstream. The culvert at the San Mateo Avenue crossing is a constriction in the stream channel during low stream flows, which can cause backwater, scour, and deposition. At higher discharge levels, the culvert becomes overwhelmed and the river flows over the crossing.

Lack of vegetation and the sandy substrate would cause the riverbed to be easily eroded when flows pass through the reach. Bed mobility can occur at most baseflows, and bed scour could occur throughout the reach at moderate to high flows. As a result of this erosion, channel avulsion and migration could occur between the levees if the levees were not constraining the channel. The river banks are another area where soil erosion is occurring in the Project footprint and are likely areas where soil erosion would occur in the future. U.S. Geological Survey (USGS) data (USGS 2007 and 2008) indicate that soils, primarily on the left bank, may be highly erodible (Figure 11-4).

11.1.4 Geomorphology

The San Joaquin Valley floor is divided into several geomorphic land types, including dissected uplands, alluvial fans and plains, river channels and floodplains, and overflow lands and lake bottoms. The alluvial plains cover most of the valley floor and make up some of the intensely developed agricultural lands in the San Joaquin Valley. River floodplains and channels lie along the major rivers and to a lesser extent the smaller streams that drain into the valley from the Sierra Nevada. Some floodplains are well-defined where rivers incise their alluvial fans. These deposits tend to be coarse and sandy in the channels and finer and silty in the floodplains. Lake bottoms of overflow lands include historical beds of Tulare Lake, Buena Vista Lake, and Kern Lake as well as other less defined areas in the valley trough.

The Project footprint extends downstream from the Chowchilla Bifurcation Structure to about 2 miles below Mendota Dam. The lack of confining features and the reduced gradient in Reach 2B both cause the channel to change to sand-bedded, meandering morphology. Meanders become more sinuous in Reach 2B than upstream as the river runs up against the alluvial deposits of the Coast Range drainages. This is also the point of diversion for the Chowchilla Bifurcation Structure, which, prior to Interim Flows, diverted most of the flows that enter Reach 2B into the Chowchilla Bypass. Lone Willow

[4] Relic floodplain features, which have coarser sediment than the adjacent floodplain, may provide a lateral conduit for levee seepage.

Slough is a historical side channel that begins near the Chowchilla Bifurcation Structure and terminates in Reach 3. Today, this channel carries riparian diversions for irrigation, agricultural return flows, and runoff.

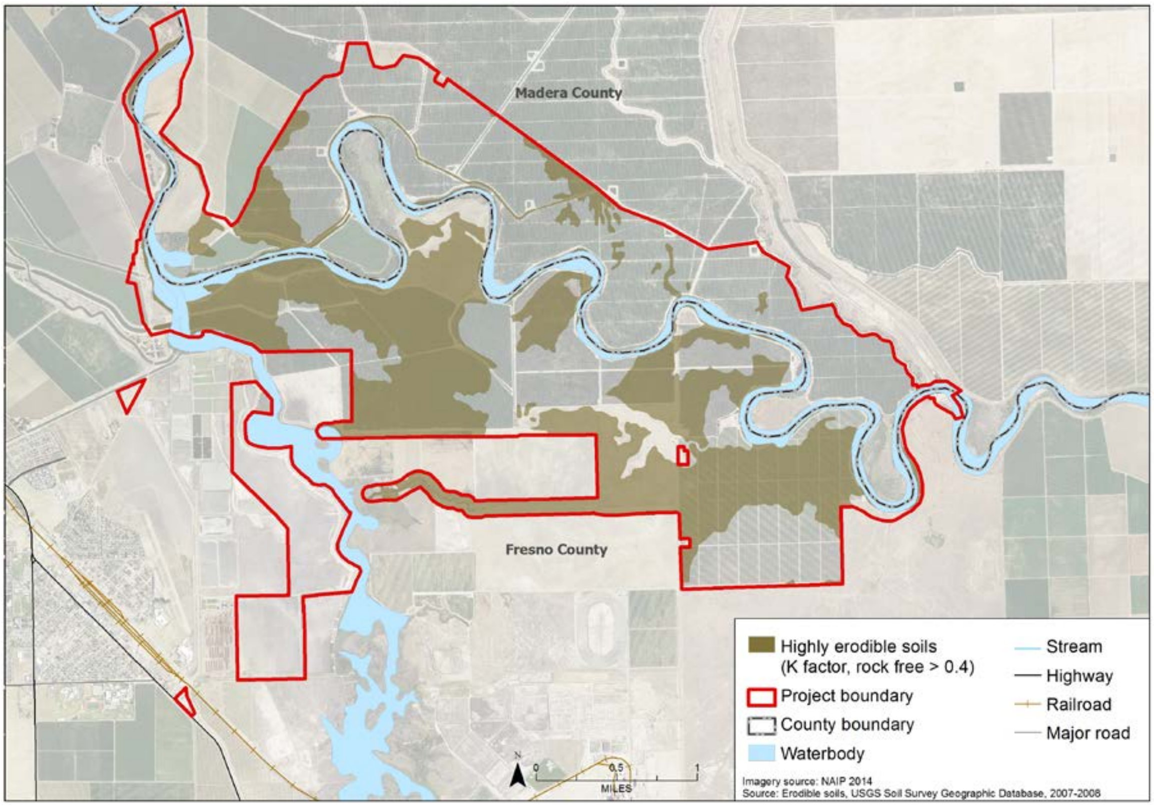


Figure 11-4.
Erodible Soils in the Project Footprint

The river slope in Reach 2B decreases to 0.00022 or about 1 foot per mile, which is almost a factor of 2 less than the slope in Reach 2A. The median bed material diameter is approximately 0.026 inches (Mussetter Engineering, Inc. 2002). Currently, water operations allow a maximum flow of approximately 810 cubic feet per second (cfs) in this reach with all excess flow diverted into the Chowchilla Bypass. The geomorphology of Reach 2B is discussed in depth in Chapter 14.0, “Hydrology – Surface Water Resources and Water Quality.”

11.1.5 Soil Hazards

Reach 2 soils have natural selenium content. According to a soil survey from the mid-1980s, soils in the upper portion of the Project footprint contain 0.10 to 0.13 parts per million (ppm) of selenium in the top 12 inches of soil. The lower portion of the Project footprint contains 0.14 to 0.36 ppm selenium in the top 12 inches of soil (San Joaquin Valley Drainage Implementation Program [SJVDP] 1990). Data collected more recently from Mendota Pool found selenium concentrations in sediments up to 0.95 ppm, but aqueous concentrations in soil elutriate were less than 3 parts per billion (ppb) which is below the aquatic life criteria of 5 ppb (San Joaquin River Restoration Program [SJRRP] 2012). The presence of selenium can affect surface water quality and is discussed in Chapter 14, "Hydrology – Surface Water Resources and Water Quality."

Soil corrosivity involves the measure of the potential of corrosion for steel and concrete caused by contact with some types of soil. Knowledge of potential soil corrosivity is often critical for the effective design of cathodic protection of buried steel and concrete elements. Factors including soil composition, soil chemistry, moisture content, and pH affect the response of steel and concrete to soil corrosion. Soils with high moisture content, high electrical conductivity, high acidity, or high dissolved salts content are most corrosive. In general, sandy soils have high resistivities and are the least corrosive. Clay soils, including those that contain interstitial salt water, can be highly corrosive.

Figure 11-5 indicates that the soils in the Project footprint generally have low corrosivity to buried concrete elements except in the Fresno Slough area were soils are moderately corrosive to concrete. Figure 11-6 shows that the soils generally have high corrosivity to buried steel.

Expansive soils are those that undergo a significant increase in volume during wetting, and shrink in volume as they decrease in water content, also known as shrink-swell soils. Expansive soils can cause significant damage to structures due to increases in uplift pressures. Soils are generally classified as having low, moderate, and high expansive potentials. Soils containing a high percentage of clay types particularly susceptible to expansion usually have high expansive potentials, and more granular sands and gravels generally have low expansive potential. Figure 11-7 shows that nearly all of the soils within the Project footprint have low shrink-swell potential. The southwest portion of the site west of Fresno Slough has very high shrink-swell potential.

11.1.6 Mineral Resources

In 2006, California ranked third in the nation in nonfuel mineral production. In that year, California yielded $4.6 billion in nonfuel minerals, totaling 7 percent of the Nation's entire production (Kohler 2006). Of these products, construction sand and gravel are the most widely mined resources in the vicinity of the San Joaquin River. Historically, gold was also extracted from the riverbed.

Sand, Gravel, and Other Rock Products

In 2006, California was the Nation's largest producer of construction sand and gravel ($1.5 billion) and Portland cement ($1.25 billion) (Kohler 2006). California also produced significant quantities of crushed stone ($481 million), industrial sand and gravel ($62.2 million), masonry cement ($87.8 million), and dimension stone ($11.2 million). Together, the market value of these products total $3.4 billion, almost 75 percent of the total value of State nonfuel mineral production. The San Joaquin River below Friant Dam is a significant source of sand and gravel in the State, and mining occurs at multiple locations on the floodplain and river terraces upstream of the Project area (Mussetter Engineering, Inc. 2002). One aggregate mine is present near the downstream limit of the Project footprint (Figure 11-8) (California Department of Conservation, Office of Mine Reclamation 2011).

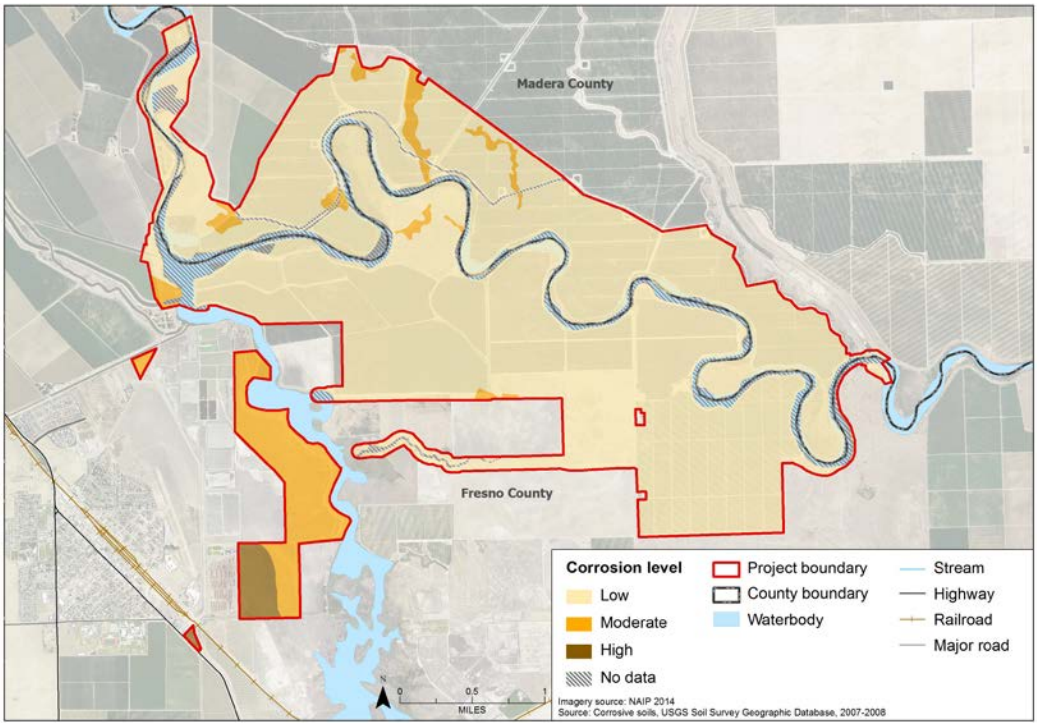


Figure 11-5.
Corrosion Level of Soils to Concrete in the Project Footprint

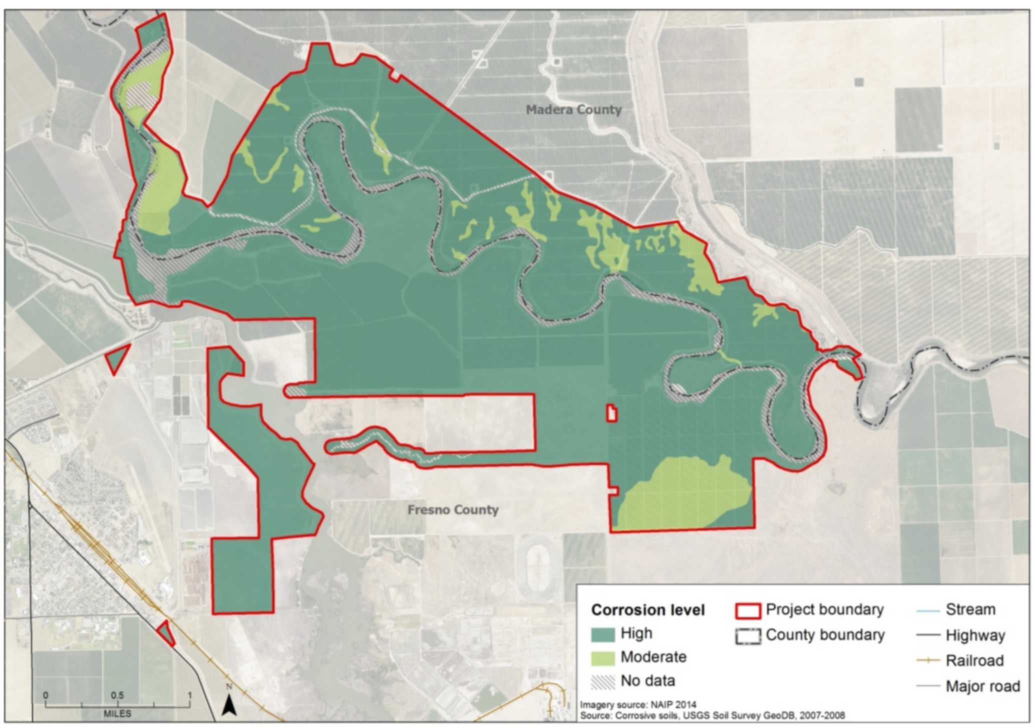


Figure 11-6.
Corrosion Level of Soils to Uncoated Steel in the Project Footprint

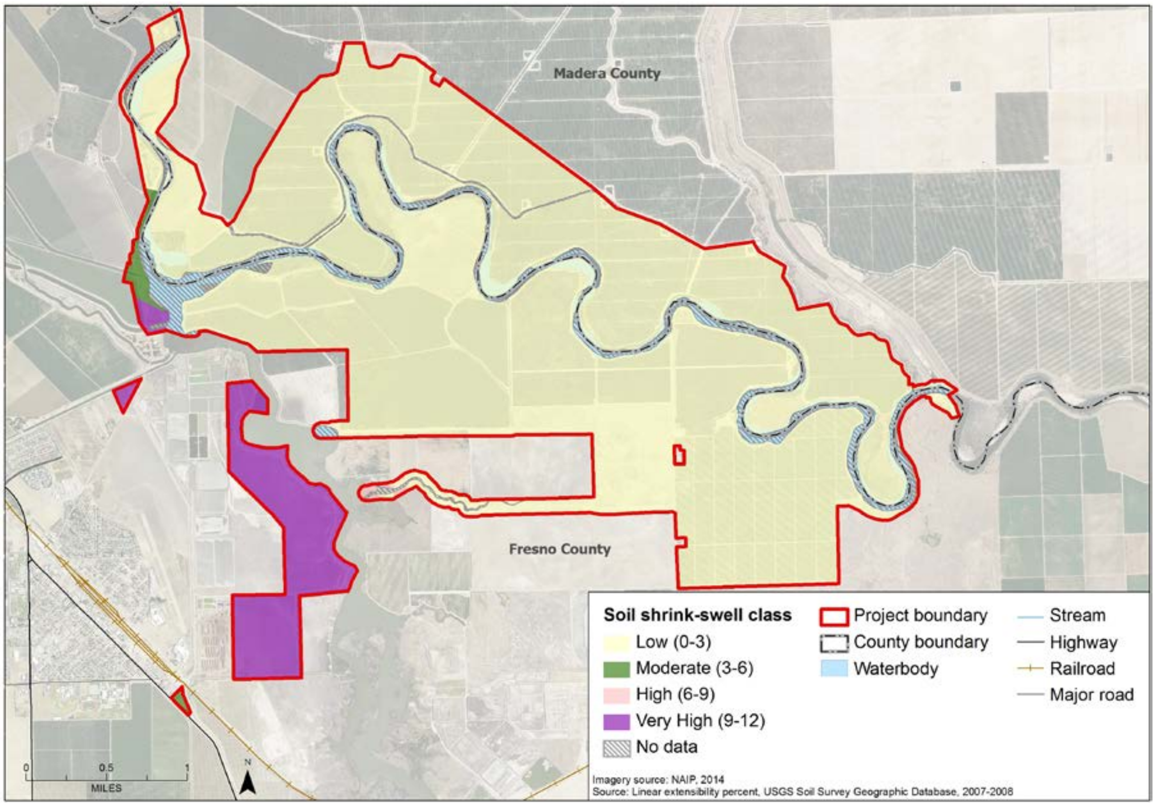


Figure 11-7.
Soil Shrink-Swell Classes in the Project Footprint

Gold

Gold has been mined from placer deposits in loosely consolidated alluvial sediments throughout the Sierra Nevada foothills. The San Joaquin River above Friant Dam was subject to some degree of placer mining from 1848 to 1880, followed by dredge mining from 1880 to the 1960s (Mussetter Engineering, Inc. 2002). These activities significantly reworked the riverine environments, redistributing sediments and altering channel forms. However, the San Joaquin River was less affected by dredge mining than the more northerly Sierra Nevada drainages, where gold was more plentiful (McBain and Trush 2002). Aside from recreational gold mining that has been observed to occur near the town of Friant, gold extraction does not currently occur on any part of the San Joaquin River.

Oil and Natural Gas

The San Joaquin Valley is one of the largest sources of oil in California, although most of the oil wells are south of the Project area. Figure 11-9 shows nearby oil fields. None are within the Project footprint.

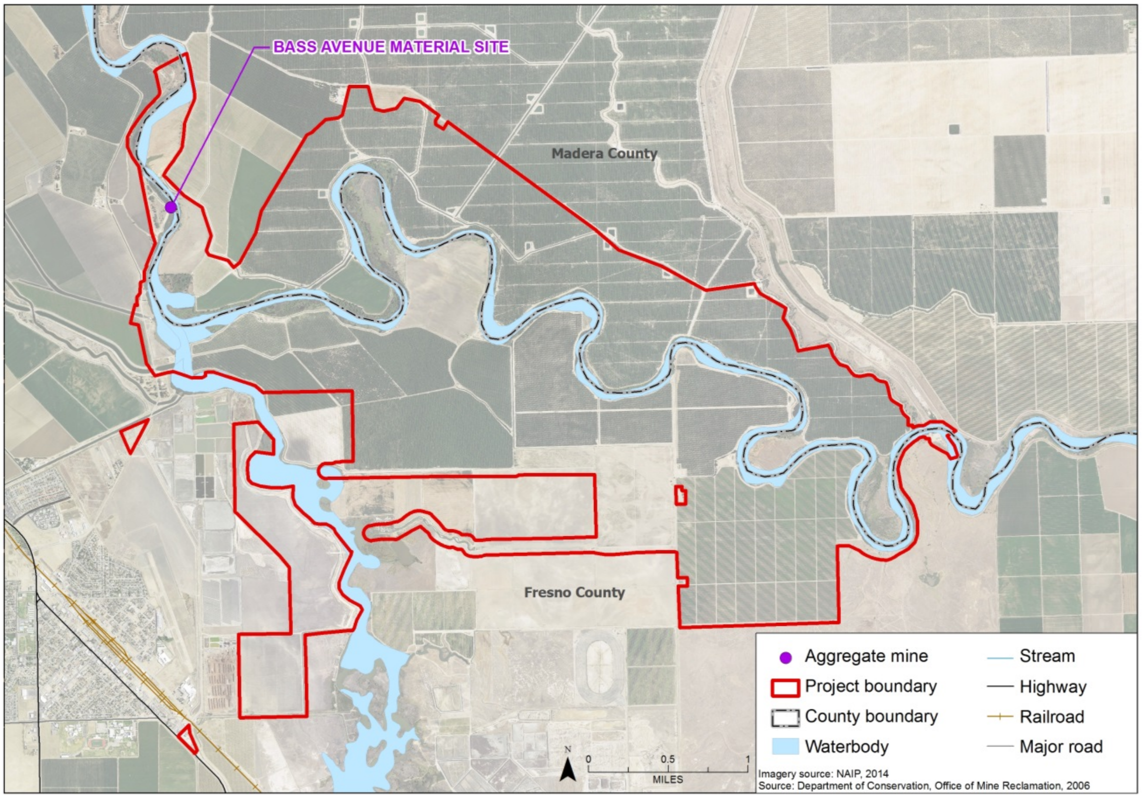


Figure 11-8.
Aggregate Mines in the Project Footprint

Local Mining

Local landowners perform some sand mining near the river channel, leaving pits 10 to 15 feet deep. The pits appear to fill after a single flood control release from Friant Dam. As stated above, one aggregate mine is present in the Project footprint near the downstream end below Mendota Pool (Figure 11-8). No gold is mined in the Project area.

11.1.7 Seismicity and Neotectonics

Both the Sierra and Central Valley geologic provinces continue to be subject to minor tectonic activity. Locally, normal faults are found in the Sierra Nevada foothills, probably because the west, or valley, side of the Sierra block is subsiding faster than uplift of the east side (Bartow 1991). The closest faults of the Foothills Fault System are located about 40 miles north of the Project area and the closest fault strands with activity within the last 700,000 years are more than 70 miles to the north (Jennings and Bryant 2010).

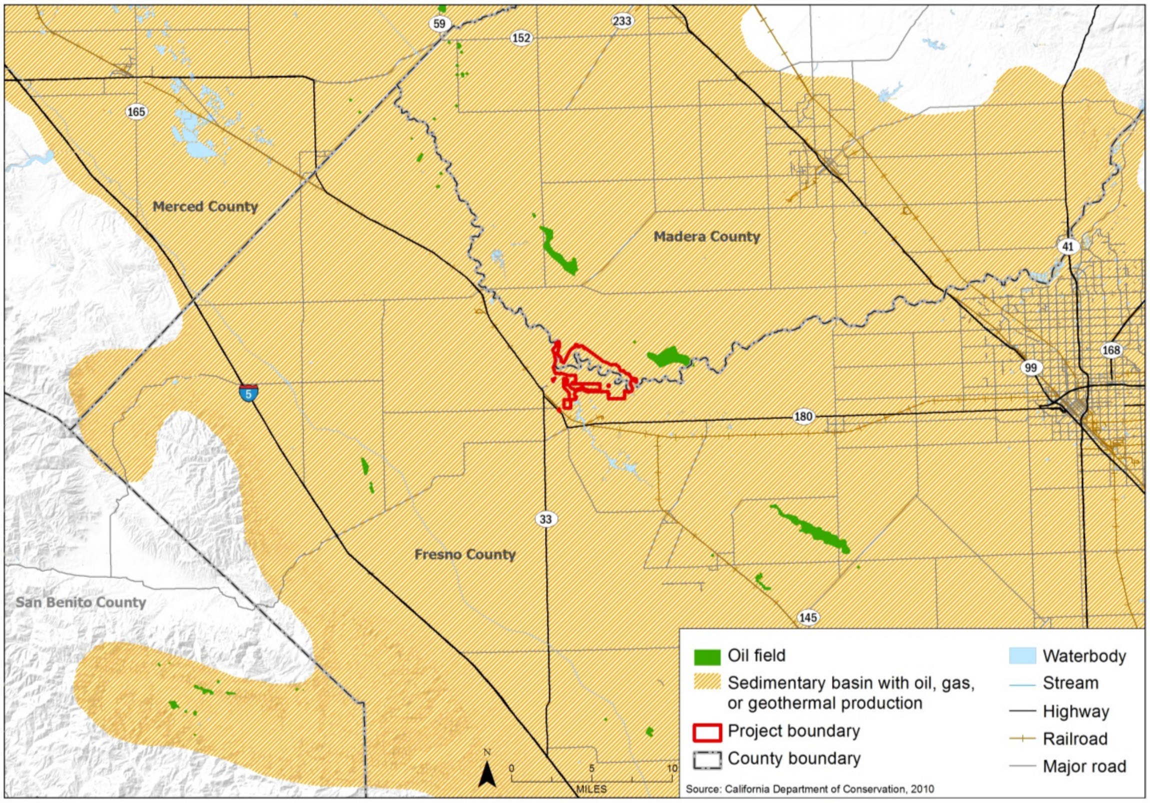


Figure 11-9.
Oil and Gas Fields in the Project Area and Vicinity

San Joaquin Valley Deformation and Subsidence

Regional deposition and deformation patterns of sediments in the San Joaquin Valley have been strongly controlled by recent tectonic activity (Bartow 1991). Quaternary deposits in the San Joaquin Valley are deformed into a broad, asymmetrical trough with its axis 12 to 19 miles west of the current course of the San Joaquin River (Lettis and Unruh 1991). Subsidence is probably due in part to the uplift and tilting of the Sierran block to the east and the Coast Ranges to the west, although the rate of valley subsidence is higher than that of Sierran uplift. Valley subsidence may also be due to sediment loading and compressional down warping or thrust loading from the Coast Ranges (Lettis and Unruh 1991).

Valley subsidence is also known to be occurring in some areas because of groundwater pumping, hydrocompaction, pumping from oil and gas fields, and oxidation of soils with high organic content. Of these factors, aquifer-system compaction by groundwater pumping has caused the largest magnitude and areal extent of land subsidence in the San Joaquin Valley (Sneed et al. 2013). Total subsidence near Mendota Pool reached nearly 9 feet by 2001 as compared to 1935 levels. Subsidence rates were greatest in the 1950s, with an average rate for areas near Mendota Pool of 4.4 inches per year (in/year), between 1953 and 1957. Subsidence rates near Mendota Pool have been reduced in more recent years with subsidence rates averaging 0.44 in/year between 1997 and 2001 and

0.04 in/year between 2003 and 2008 (Sneed et al. 2013). (Subsidence is also discussed in Chapter 13.0, “Hydrology – Groundwater” and Chapter 14.0, “Hydrology - Surface Water Resources and Water Quality.”)

Seismicity

Active faults are recognized on the west side of the San Joaquin Valley (Figure 11-10). Most of these faults are part of a series of buried thrust faults (blind faults) that separate the Central Valley from the Coast Ranges. The Great Valley thrust system comprises at least 14 segments over a length of more than 300 miles, although precise locations of surface traces are not well documented because these faults do not rupture to the surface (USGS 1996). The Great Valley thrust system is thought to accommodate a nominal 0.02 to 0.06 in/year of motion (CGS 2002c, USGS 1996). The closest segment to the Project area is the Panoche Segment, Great Valley Segment 10, which is located about 19 miles to the southwest (Figure 11-10).

Seismicity in the Project area and vicinity is dominated by ground shaking related to movement on the buried thrust faults mapped along the west side of the San Joaquin Valley that separate the Sierran Block from the Coast Ranges block (Figure 11-10). The closest of these faults is about 19 miles to the southwest. Therefore, surface fault rupture is not a significant hazard for the Project area. Figure 11-11 shows historic earthquake epicenters in this part of California. No earthquakes with a magnitude greater than 6.0 have occurred within about 38 miles of the site. Figure 11-12 shows that the calculated peak horizontal ground acceleration that has a 2 percent probability of exceedance in 50 years is 0.3 to 0.4 g (expressed as a fraction of the acceleration due to Earth's gravity). The horizontal acceleration pattern shown reflects movement on Coast Ranges faults.

Ground Shaking and Liquefaction Hazards

Although a fault rupture can cause significant damage along its narrow surface trace, earthquake damage is mainly caused by strong, sustained ground shaking (Working Group on California Earthquake Probabilities [WG02] 2003). Seismic ground shaking can cause soils and unconsolidated sediments to compact and settle. If compacted soils or sediments are saturated, pore water pressure increases during earthquake shaking and water can be forced upward to the ground surface, forming sand boils or mud spouts. Increased pore pressures also lead to a reduction in shear strength of the sediments such that they may behave like a viscous fluid. This soil deformation, called liquefaction, may cause minor to major damage to buildings and infrastructure. Earthquake ground shaking hazard potential is low in most of the San Joaquin Valley and Sierra Nevada foothills (California Seismic Safety Commission [CSSC] 2003). Although the San Joaquin Valley is not considered to be a high-risk liquefaction area because of its generally low earthquake and ground shaking hazard risk, it can be assumed that some liquefaction risk exists throughout the valley in areas where unconsolidated sediments and a high water table coincide, such as near rivers and in wetland areas (Merced County 2007).

Hazard Due to Dam Break Inundation

The entire Project area and surrounding portion of the central San Joaquin Valley are in an area of potential inundation if either Friant or Pine Flat dams fail (Figure 11-13).

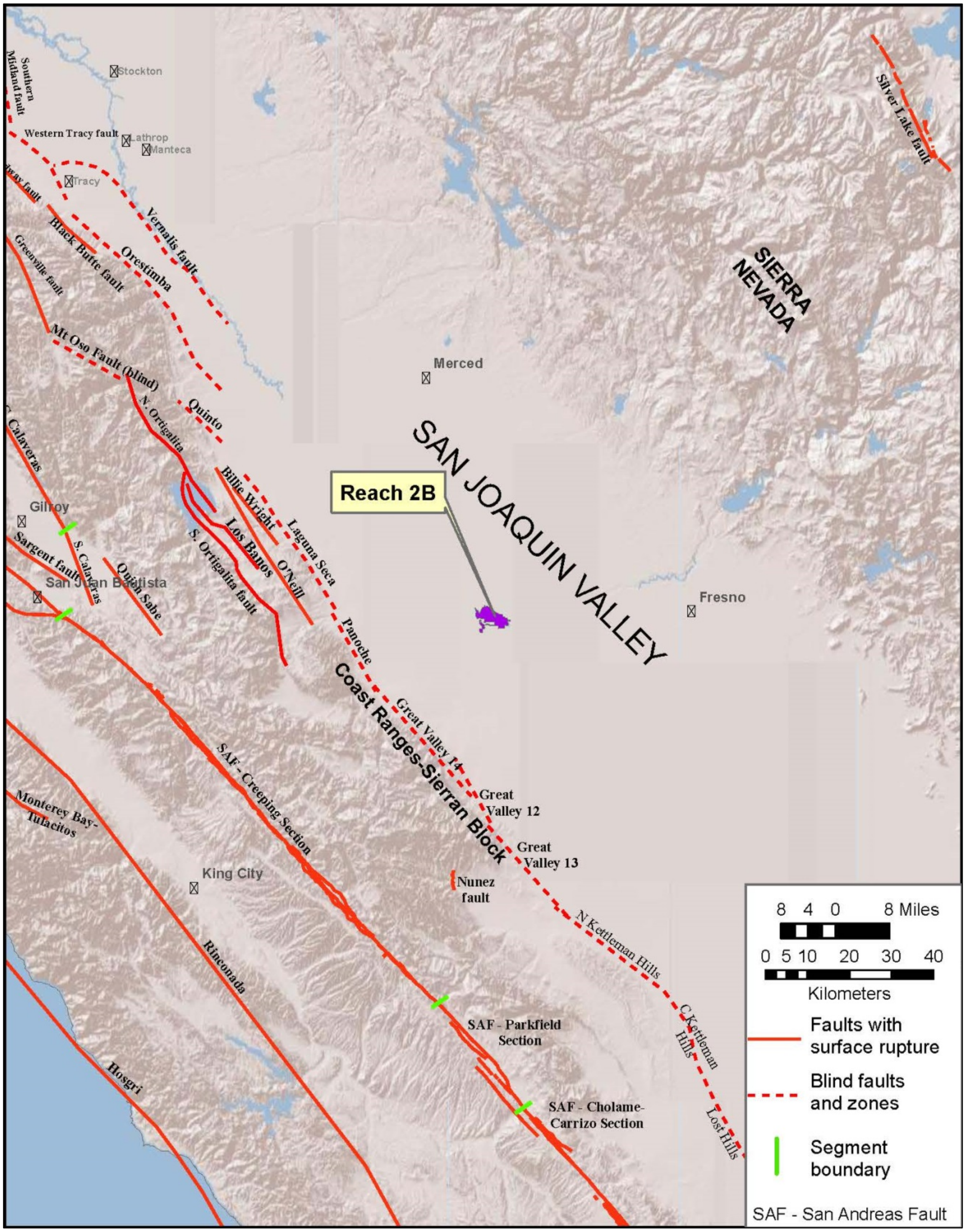


Figure 11-10.
Active Faults in the Project Area and Vicinity

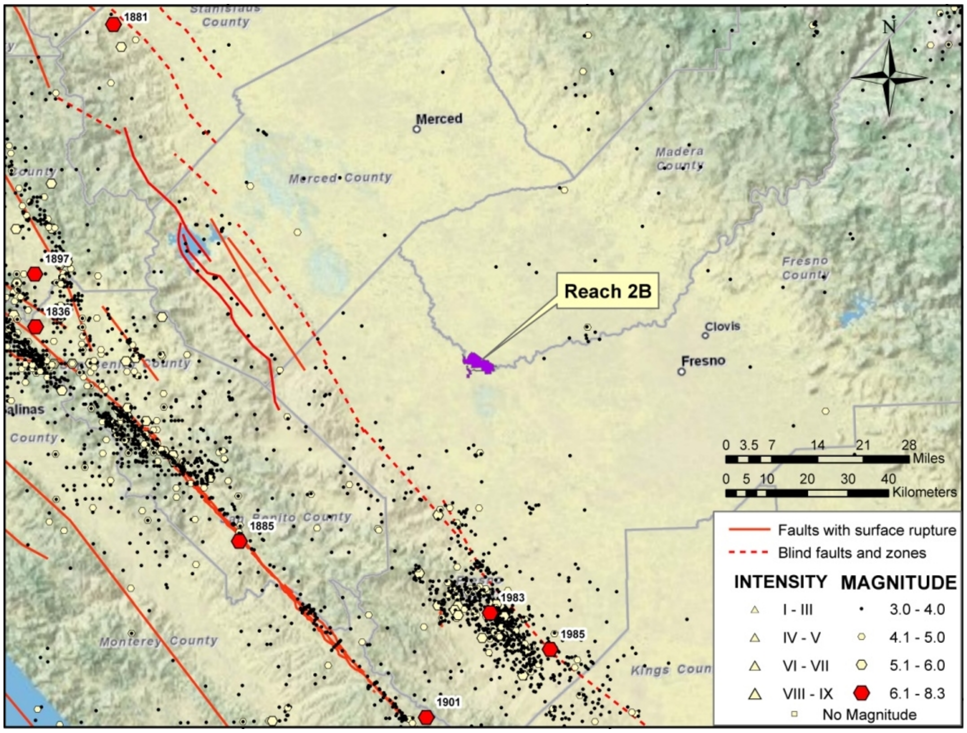
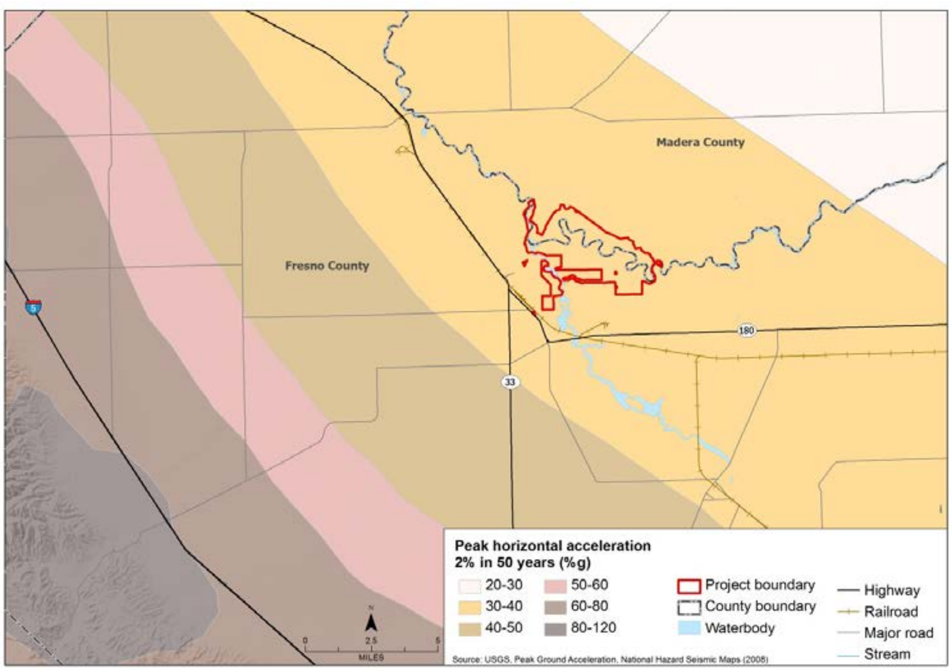


Figure 11-11.
Active Faults and Historical Seismicity in the Project Area and Vicinity (M>= 3.0) 1800-2009



Note: 2 percent probability of exceedance in 50 years

Figure 11-12.
Calculated Peak Ground Acceleration in the Project Area and Vicinity

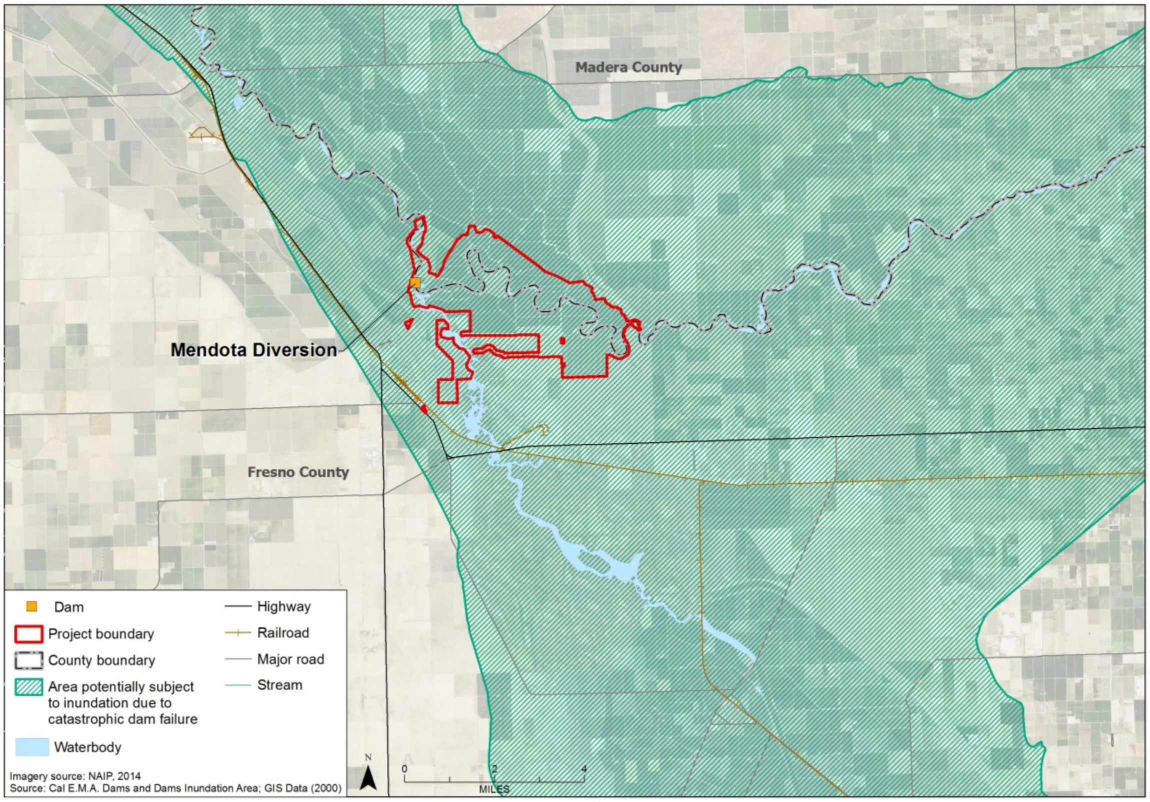


Figure 11-13.
Inundation in the Project Area and Vicinity due to Catastrophic Dam Failure

11.2 Regulatory Setting

This section presents applicable Federal, State, and local laws and regulations associated with geology and soils in the Project area.

11.2.1 Federal

Federal regulations associated with geology and soils in the Project area include the Clean Water Act (CWA) and National Pollutant Discharge Elimination System (NPDES) program, as well as the National Flood Insurance Program, which regulates construction of levees and other flood-related activities.

Clean Water Act Section 402

(See Chapter 14.0, “Hydrology - Surface Water Resources and Water Quality.”) CWA Section 402 is directly relevant to excavation and grading activities that may occur during restoration and other activities which may affect geology and soils in the Project area.

National Flood Insurance Program Regulations

(See Chapter 12.0, “Hydrology – Flood Management.”) Criteria in 44 Code of Federal Regulations (CFR) 65.10 apply to Mapping of Areas Protected by Levee Systems and to standards for levee design and performance.

11.2.2 State of California

Several codes and acts are in place in the State that may pertain to activities affecting geology and soils in the Project area.

Alquist-Priolo Earthquake Fault Zoning Act

California's Alquist-Priolo Earthquake Fault Zoning Act (Pub. Resources Code, § 2621 et seq.), originally enacted in 1972 as the Alquist-Priolo Special Studies Zones Act, and renamed in 1994, is intended to reduce the risk to life and property from surface fault rupture during earthquakes. The Alquist-Priolo Act prohibits the location of most types of structures intended for human occupancy across the traces of active faults, and strictly regulates construction in the corridors along active faults (earthquake fault zones). However, no active faults are mapped within the Project area (Jennings and Bryant, 2010).

California Building Standards Code

California's minimum standards for the design and construction of buildings, associated facilities, and equipment are given in the California Code of Regulations. Many of the applicable standards are found in the California Building Standards Code (Cal. Code Regs., tit. 24); other standards applicable to buildings are given in Titles 8, 19, 21, and 25 of the California Code of Regulations. Design and construction must satisfy these requirements.

Surface Mining and Reclamation Act

The California Surface Mining and Reclamation Act of 1975 (SMARA) (Pub. Resources Code, § 2710 et seq.) addresses surface mining. Activities subject to SMARA include, but are not limited to mining of minerals, gravel, and borrow material. SMARA applies to an individual or entity that would disturb more than 1 acre or remove more than 1,000 cubic yards of material through surface mining activities, including the excavation of borrow pits for soil material. SMARA also mandated that the State Geologist make an inventory, by county, of mineral resources of statewide and regional significance.

11.2.3 Regional and Local

Local policies and plans in the Project area may relate to implementation of project alternatives potentially affecting geology and soils.

County General Plans

As required by state law, counties in the Project area have developed their own general plans. At a minimum, these documents must address the topics of land use, transportation, housing, conservation, open space, noise, and safety. These documents serve as statements of county goals, policies, standards, and implementation programs for the physical development of a county.

Fresno County General Plan

The Fresno County General Plan Policy Document (Fresno County 2000) outlines several policies for geological resources and/or geological hazards.

- Policy OS-J.9 requires that the location of significant geological resources is considered prior to approval of new development.
- Policy HS-D.3 requires that a soil engineering and geologic-seismic analysis is performed in areas prone to geologic or seismic hazards.
- Policy HS-D.4 requires that structures are designed in accordance with relevant professional standards to minimize damage or loss and to minimize risk to public safety.

Madera County General Plan

The Madera County General Plan Policy Document (Madera County 1995) outlines several policies for geological resources.

- Policy 5.G.1 protects geological resources from incompatible development.
- Policies 6.A.1 to 6.A.4 address seismic and geological hazards.

11.3 Environmental Consequences and Mitigation Measures

11.3.1 Impact Assessment Methodology

The analysis presented in this section is qualitative and based on the general information on geology, soils, mineral resources, seismicity and neotectonics, and geomorphology documented for the region, as previously described. The analysis is also based on a review of published geologic and soils information for the Project area, and professional judgment, in accordance with the current standard of care for geotechnical engineering and engineering geology. The evaluation of impacts on geologic and soil resources considers how proposed changes associated with Project alternatives would affect these resources in Reach 2B.

Impacts to geologic and soil resources that could result from Project construction and operation were evaluated qualitatively based on expected construction practices, materials, locations, and duration of Project construction and related activities, as well as project operations including the effects of modified San Joaquin River flows. The potential loss of geologic and soil resources resulting from implementation of Project alternatives is also evaluated qualitatively. The effect of the Project on the San Joaquin River fluvial geomorphology including bank erosion, channel migration, sedimentation, scour, and changes in the river channel substrate are addressed in Chapter 14, "Hydrology - Surface Water Resources and Water Quality."

Site geology has been evaluated to identify the potential for adverse effects resulting from failure of engineered structures, such as dams, levees, and bifurcations, caused by adverse geologic conditions. The following geologic and soil conditions could affect engineered structures that are part of the Project:

- Unsuitable geologic foundation materials, including compressible soils, expansive soils, and levee under-seepage.
- Erosion of soils from around and beneath structures and their foundations.

- Seismic conditions, including fault rupture, strong ground motion, seismic-induced liquefaction, lateral spreading, settlement, and slope failure.

Impacts to existing infrastructure caused by adverse geologic conditions exacerbated by implementation of the Project were also evaluated qualitatively.

Consistent with the general program-wide design strategies identified in the SJRRP, the analysis assumes the following:

- A geotechnical and engineering geologic study would guide the final site-specific design.
- Earthwork would be designed and conducted in accordance with all relevant requirements of U.S. Department of the Interior, Bureau of Reclamation (Reclamation) design standards including Design Standards No. 3, Chapter 12, General Structural Considerations.
- All structures would be designed consistent with Reclamation design standards or equivalent standards, for example U.S. Army Corps of Engineers (Corps) engineering design standards EM 1110-2-2000 Concrete for Civil Works Structures, EM 1110-2-2100 Stability Analysis of Concrete Structures, EM 1110-2-2705 Structural Design of Closure Structures for Local Flood Protection Projects.
- Expansive soil hazards can be addressed through overexcavation and replacement with nonexpansive fill, amendment, or other measures consistent with Reclamation design standards.
- Corrosive soil hazards can be addressed by overexcavation and replacement with noncorrosive fill, by use of corrosion-protected materials, or by other measures consistent with Reclamation design standards.
- Construction would proceed in accordance with requirements of a Stormwater Pollution Prevention Plan (SWPPP).
- Post-construction soil erosion hazard would be addressed by overexcavation and replacement with non-erosive engineered fill, or by the use of geosynthetics, vegetation, riprap, or other suitable measures consistent with Reclamation design standards.

11.3.2 Significance Criteria

The Project is evaluated in accordance with the Geology and Soils section of Appendix G of the California Environmental Quality Act (CEQA) Environmental Checklist and professional judgment on anticipated impacts on existing geologic and soil resources. Under the National Environmental Policy Act (NEPA), effects must be evaluated in terms of their context and intensity. These factors have been considered when applying the State CEQA Guidelines in Appendix G. Impacts associated with Project implementation have been determined to be significant if they would do any of the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault.
  - Strong seismic ground shaking.
  - Seismic-related ground failure, including liquefaction.
  - Landslides.
- Result in substantial soil erosion or the loss of topsoil.
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse.
- Be located on expansive soil, as defined in Table 18-1-B of the 1994 Uniform Building Code, creating substantial risks to life or property.
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State.
- Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan.
- Cause changes in conditions resulting in destabilization of existing infrastructure, such as levees, dams, other structures.
- Cause a proposed structure to fail, exposing people, existing infrastructure, and environmental, economic or cultural resources to potential substantial adverse effects.

11.3.3 Impacts and Mitigation Measures

This section provides an evaluation of direct and indirect effects of the Project Alternatives on geologic and soils resources. The analysis considers the short-term construction phase as well as the long-term operational phase. Table 11-4 provides a summary of environmental concerns by resource type or hazard.

This section includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential impacts compared to existing conditions to meet CEQA requirements. The analysis is organized by Project alternative with specific impact topics numbered sequentially under each alternative.

With respect to geologic and soils resources, the environmental impact issues and concerns are:

1. Effects on Mineral and Soil Resources.
2. Soil Erosion Effects.
3. Adverse Soil Conditions.
4. Adverse Seismicity Effects.

Table 11-4.
Summary of Environmental Concerns

Resource or Hazard	Construction Phase (Short-Term Effects)	Operational Phase (Long-Term Effects)
Mineral resources	None	None
Soil resources	Potential effects	Potential long-term effects
Ground subsidence	None	Project designed for resource/hazard
Expansive soils	None	None
Corrosive soils	None	Project designed for resource/hazard
Collapsible soils	None	None
Difficult excavation	None	None
Soil erosion	Project designed for resource/hazard	Project designed for resource/hazard
Surface fault rupture	None	None
Seismic ground shaking	Unlikely during construction period	Project designed for resource/hazard
Liquefaction	Unlikely during construction period	Project designed for resource/hazard
Lateral spreading	Unlikely during construction period	Project designed for resource/hazard
Seismically induced flooding	Unlikely during construction period	Potential long-term effects
Landslide and rockfall	None	None
Subsurface gas	None	None

Note: Several hazards are unlikely to occur during the relatively short construction period. Nevertheless, they are included because they could theoretically be experienced during construction.

Other geologic and soils resource-related issues covered in the Program Environmental Impact Statement/Report (PEIS/R) are not covered here because they are programmatic in nature and/or are not relevant to the Project area.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. (See Section 2.2.3 for a detailed description of the No-Action Alternative.) However, other proposed actions under the SJRRP would be implemented, including habitat restoration, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these Program-level activities would not achieve full Settlement goals. This section provides an analysis of the No-Action Alternative. The analysis is a comparison to existing conditions, and no mitigation is required for No-Action.

Impact GEO-1 (No-Action Alternative): ***Effects on Mineral and Soil Resources*****.** Under the No-Action Alternative, the Project would not be implemented and there would be no changes to existing geologic and soils conditions in the Project area as a result of construction activities or the placement of new Project facilities. As a result, there would be **no impact** on existing geologic and soils resources due to Project construction. (Potential impacts due to changes in erosion and deposition rates are discussed below.)

Impact GEO-2 (No-Action Alternative): ***Soil Erosion Effects*****.** Under the No-Action Alternative, the Project would not be implemented and there would be no new construction within Reach 2B. The No-Action Alternative would maintain the existing levee alignments and heights and maximum conveyance would continue to be limited to the existing capacity. As a result, there would be no erosion impacts related to or affecting new Reach 2B structures. However, compared to existing conditions (i.e., pre-Interim Flow conditions as of July 2009), the Program would implement changes to the management of discharges into the San Joaquin River from Friant Dam and these flows could affect sediment transport conditions within Reach 2B. Recent sediment continuity studies have predicted that sand inputs from Reach 2A under Restoration Flows would likely result in net deposition in the upper segment of Reach 2B and potentially down to the Mendota Pool. Net deposition also occurs in Reach 2B under existing conditions (SJRRP 2011, page 10-34).

Compared to existing conditions, soil erosion and deposition rates could change with implementation of Restoration Flows by the Program; however, maximum conveyance in Reach 2B would continue to be limited to the existing capacity and the reach would continue to experience net deposition. As a result, impacts to soil resources as a result of erosion and deposition within Reach 2B would be **less than significant**.

Impact GEO-3 (No-Action Alternative): ***Adverse Soil Conditions*.** Under the No-Action Alternative, the Project would not be implemented and there would be no new construction within Reach 2B. As a result, potentially corrosive soils or potential ground subsidence within Reach 2B would not impact Project structures. Compared to existing conditions, potential impacts to existing structures due to potentially corrosive soils or potential ground subsidence would remain unchanged and there would be no increase in risk that existing or proposed structures would fail as a result of adverse soil conditions. Therefore, there would be **no impact.**

Impact GEO-4 (No-Action Alternative): ***Adverse Seismicity Effects*.** Under the No-Action Alternative, the Project would not be implemented and there would be no new construction within Reach 2B. As a result, seismicity effects (e.g., seismic ground shaking, liquefaction, lateral spreading, and seismically induced flooding) would not impact Project structures. Compared to existing conditions, potential impacts to existing structures as a result of seismicity effects would remain unchanged. The likelihood of seismicity affecting the Project area would remain unchanged under this or any of the action alternatives and there would be no increase in risk that existing structures would fail as a result of these potential seismicity effects. Therefore, there would be **no impact**.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would include construction of Project facilities capable of conveying up to 4,500 cfs including a Compact Bypass channel, a new levee system encompassing the river channel with a narrow floodplain, and the South Canal. Other key features include construction of the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, and the South Canal bifurcation structure and fish passage facility, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure. (See Section 2.2.5 for a detailed description of the Alternative A.) No construction activities are proposed at or near Mendota Dam, which falls outside the Project boundary.

Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

Impact GEO-1 (Alternative A): *Effects on Mineral and Soil Resources*. Compared to the No-Action Alternative, Project construction for Alternative A would include the Compact Bypass, the South Canal, a 3,000-foot-wide floodplain, and levees along both sides of the floodplain. Currently soils within the footprints of these structures (i.e., the Compact Bypass, South Canal, and narrow floodplain levees) include about 1,410 acres that are farmed. Also, the approximately 3,000-foot-wide floodplain area between the two new levees would be unavailable for farming many current crops under Alternative A, but a portion of the floodplain would be available for annual crops, pasture, or floodplain-compatible permanent crops. Areas where there would be temporary construction impacts include construction office sites, equipment maintenance and parking areas, and material storage areas. It is estimated that approximately 62 acres would temporarily be impacted by this construction; most of these areas are currently in agricultural production. A more detailed discussion of impacts to farming is presented in Chapter 16, "Land Use Planning and Agricultural Resources."

Borrow material would primarily be required for the construction of the levees, but it may also be used in the construction of other structures for foundation or backfill material. Levees may be constructed entirely of local borrow material, a mix of local and imported borrow material, or just imported borrow material. Borrow locations would be determined after a geotechnical exploration of potential local borrow areas is complete (see Section 2.2.4). It is estimated that up to 350 acres of land would be needed for borrow areas. Some of the soils excavated to construct the Compact Bypass and the South Canal might be used for levee construction, and if this is possible, then the size of the borrow areas may be reduced. Excavation of borrow materials would be done in accordance with Reclamation design standards permit requirements.

When comparing Alternative A to existing conditions, impacts to soil resources from construction activities would be similar to those described above (i.e., the comparison of Alternative A to the No-Action Alternative). Because borrow material would be excavated in accordance with Reclamation guidelines designed to be protective of soil resources, impacts to soil resources would be **less than significant**.

Impact GEO-2 (Alternative A): *Soil Erosion Effects*. Compared to the No-Action Alternative, short-term increases in erosion could occur during construction as a result of disturbed soils. However, Reclamation would prepare and implement a SWPPP that complies with applicable Federal NPDES regulations concerning construction activities. Implementation of erosion control best management practices (BMPs) consistent with the Project's construction SWPPP would minimize soil erosion during construction.

Under Alternative A, the long-term flow conveyance capacity of Reach 2B would increase to 4,500 cfs and Reach 2B would receive increased flows that could lead to changes in sediment transport conditions within the new Compact Bypass, the floodplain, and the South Canal. However, standard erosion protection measures, such as revetment, and proper hydraulic engineering design would be implemented to minimize erosion near

Project structures and levees (see Section 2.2.4). Proper engineering design of the new Project features, such as larger culverts that can pass higher flows with reduced scour, would minimize potential increases in soil erosion in the Project area following construction.

When comparing Alternative A to existing conditions, impacts from soil erosion effects would be similar to those described above (i.e., the comparison of Alternative A to the No-Action Alternative). As a result, the impact on erosion would be **less than significant**.

Impact GEO-3 (Alternative A): *Adverse Soil Conditions*. Compared to the No-Action Alternative, the Project design under Alternative A would include new earth structures, such as the Compact Bypass, South Canal, and levees, as well as other smaller reinforced concrete structures such as the South Canal bifurcation structure, fish passage facility, and fish screen; grade control structures in the Compact Bypass; and a fish barrier below Mendota Dam in Reach 3. Adverse soil conditions could negatively affect the long-term stability of Project features.

Under-seepage, water that seeps laterally by travelling under a dam or levee section, can occur when structures are underlain by permeable native soils. This may cause instability in the structures built on these soils. Seepage control measures would be included, as part of the Project, in areas where under-seepage is likely to affect adjacent land uses. Seepage control measures could include slurry walls, interceptor drains, seepage wells, seepage berms, land acquisition (fee title or seepage easements), and other measures that can be implemented within the Project area (see Section 2.2.4).[5]

Other adverse soil conditions within Reach 2B could include soils corrosive to buried concrete and/or steel and soils susceptible to consolidation and the related settlement of overlying structures. Site specific geotechnical exploration, testing, and analysis prior to final design would allow for the characterization of the site soils and appropriate design of all proposed structures such that potentially corrosive soils or subsidence conditions should not impact Project facilities. All design work would be completed in general accordance with Reclamation design standards, applicable design codes, and commonly accepted industry standards (see Section 2.2.4).

When comparing Alternative A to existing conditions, impacts from adverse soil conditions would be similar to those described above (i.e., the comparison of Alternative A to the No-Action Alternative). As a result, impacts of potentially adverse soils within Reach 2B on Project structures would be **less than significant**.

[5] A slurry wall is a construction technique to reinforce areas of soft earth that are near open water or a high groundwater table with a mixture of soil, bentonite, and cement. Interceptor drains are buried perforated pipes which intercept groundwater and redirect it to a discharge point. Because the drains have lower resistance to flow, the groundwater table can be kept artificially low in areas near the pipe. Seepage wells are groundwater wells that are used to pump and draw down the water table where seepage is occurring. Seepage berms are berms placed on the landside of a levee to add additional weight and width to the levee to counteract seepage.

Impact GEO-4 (Alternative A): *Adverse Seismicity Effects.* Compared to the No-Action Alternative, potential impacts to existing structures as a result of seismicity effects would remain unchanged. However, Reach 2B would be modified under Alternative A with the construction of the Compact Bypass, levees on the north and south sides of the expanded floodplain, the South Canal, and several other structures. Each of these structures would be built according to Reclamation design standards, the Corps engineering design standards, or equivalent standards (see Section 2.2.4). As a result, the new structures would be designed as necessary to withstand seismic forces, and foundations would be designed to protect the structure from the deleterious effects of strong ground shaking, liquefaction, and lateral spreading. The potential for flooding related to seismically induced dam failure cannot be lessened through the design of Project facilities; however, the Project would not include development that would put additional people at risk or increase flood risk at occupied structures.

Compared to existing conditions, potential impacts to existing structures as a result of seismicity effects would remain unchanged. The likelihood of seismicity affecting the existing Reach 2B area would remain unchanged under this or any of the other alternatives. Proposed structures would be designed to withstand seismic forces and protect against the deleterious effects of liquefaction and lateral spreading. Therefore, there would be **no impact.**

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would include construction of Project features capable of conveying up to 4,500 cfs including a Compact Bypass channel, a new levee system with a wide, consensus-based floodplain encompassing the river channel, and the Compact Bypass Bifurcation Structure with fish passage facility. Other key features include construction of a fish passage facility at the San Joaquin River control structure at the Chowchilla Bifurcation Structure, the re-route of Drive 10 ½ (across the Compact Bypass control structure), and removal of the San Mateo Avenue crossing. (See Section 2.2.6 for a detailed description of the Alternative B.) No construction activities are proposed at or near Mendota Dam, which falls outside the Project boundary. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

Impact GEO-1 (Alternative B): *Effects on Mineral and Soil Resources.* Compared to the No-Action Alternative, Project construction for Alternative B would include the Compact Bypass and an approximately 4,200-foot-wide floodplain with levees along both sides of the floodplain. Currently soils within the footprints of these two areas (Compact Bypass and wide, consensus-based floodplain levees) include about 1,600 acres that are farmed. A portion of this area would include a mixture of active and passive riparian and floodplain habitat restoration and would no longer be available for farming. Other areas where there would be temporary construction impacts include construction office sites, equipment maintenance and parking areas, and materials storage areas. It is estimated that approximately 60 acres would temporarily be impacted by this construction; most of these areas are currently in agricultural production. A more detailed discussion of impacts to farming is presented in Chapter 16, "Land Use Planning and Agricultural Resources."

Borrow material would primarily be required for the construction of the levees, but it may also be used in the construction of other structures for foundation or backfill material. Levees may be constructed entirely of local borrow material, a mix of local and imported borrow material, or just imported borrow material. Borrow locations would be determined after a geotechnical exploration of potential local borrow areas is complete; the exploration would determine the suitability of local soils for use as borrow material (see Section 2.2.4). It is estimated that up to 350 acres of land would be needed for borrow areas. Some of the soils excavated to construct the Compact Bypass might be used for levee construction, and if this is possible, then the size of the borrow areas may be reduced. Excavation of borrow materials would be done in accordance Reclamation design standards and permit requirements.

When comparing Alternative B to existing conditions, impacts to soil resources from construction activities would be the same as those described above (i.e., the comparison of Alternative B to the No-Action Alternative). Because borrow material would be excavated in accordance with Reclamation guidelines designed to be protective of soil resources, impacts to soil resources would be **less than significant**.

Impact GEO-2 (Alternative B): *Soil Erosion Effects*. Compared to the No-Action Alternative, short-term increases in erosion could occur during construction as a result of disturbed soils. However, Reclamation would prepare and implement a SWPPP that complies with applicable Federal NPDES regulations concerning construction activities. Implementation of erosion control BMPs consistent with the Project's construction SWPPP would minimize soil erosion during construction.

Under Alternative B, the long-term flow conveyance capacity of Reach 2B would increase to 4,500 cfs and Reach 2B would receive increased flows that could lead to changes in sediment transport conditions within the new Compact Bypass, the floodplain, and adjacent to new structures. However, standard erosion protection measures such as revetment and proper hydraulic engineering design would be implemented to minimize erosion near Project structures and levees (see Section 2.2.4). Proper engineering design of the new Project features would minimize potential increases in soil erosion in the Project area following construction.

When comparing Alternative B to existing conditions, impacts from soil erosion effects would be similar to those described above (i.e., the comparison of Alternative B to the No-Action Alternative). As a result, the impact on erosion would be **less than significant** due to construction of Alternative B.

Impact GEO-3 (Alternative B): *Adverse Soil Conditions*. Compared to the No-Action Alternative, the Project under Alternative B would include new earth structures such as the Compact Bypass and levees, as well as other reinforced concrete structures such as the Compact Bypass Bifurcation Structure, fish passage facility, and grade control structures in the Compact Bypass. Adverse soil conditions could negatively affect the long-term stability of Project features.

Under-seepage, water that seeps laterally by travelling under a dam or levee section, can occur when structures are underlain by permeable native soils. This may cause instability in the structures built on these soils. Seepage control measures (as described above for Impact GEO-3 [Alternative A]) would be included, as part of the Project, in areas where under-seepage is likely to affect adjacent land uses (see Section 2.2.4).

Other adverse soil conditions within Reach 2B could include soils corrosive to buried concrete and/or steel and soils susceptible to consolidation and the related settlement of overlying structures. Site-specific geotechnical exploration, testing, and analysis prior to final design would allow for the characterization of the site soils and appropriate design of all proposed structures such that potentially corrosive soils or subsidence conditions should not impact Project facilities. All design work would be completed in general accordance with Reclamation Design Standards, applicable design codes, and commonly accepted industry standards (see Section 2.2.4).

When comparing Alternative B to existing conditions, impacts from adverse soil conditions would be similar to those described above (i.e., the comparison of Alternative B to the No-Action Alternative). As a result, impacts of potentially adverse soils within Reach 2B on Project structures would be **less than significant**.

Impact GEO-4 (Alternative B): ***Adverse Seismicity Effects*****.** Compared to the No-Action Alternative, potential impacts to existing structures as a result of seismicity effects would remain unchanged. However, Reach 2B would be modified under Alternative B with new construction of the Compact Bypass and bypass control structure, levees on the north and south sides of the expanded floodplain, and other structures. Each of these structures would be built according to Reclamation design standards, the Corps engineering design standards, or equivalent standards (see Section 2.2.4). As a result, the new structures would be designed as necessary to withstand seismic forces, and foundations would be designed to protect the structure from the deleterious effects of liquefaction and lateral spreading. The potential for flooding related to seismically induced dam failure cannot be lessened through the design of Project facilities; however, the Project would not include development that would put additional people at risk or increase flood risk at occupied structures.

Compared to existing conditions, potential impacts to existing structures as a result of seismicity effects would remain unchanged. The likelihood of seismicity affecting the existing Reach 2B area would remain unchanged under this or any of the other alternatives. Proposed structures would be designed to withstand seismic forces and protect against the deleterious effects of liquefaction and lateral spreading. Therefore, there would be **no impact.**

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would include construction of Project features including Fresno Slough Dam, a new levee system with a narrow floodplain encompassing the river channel, and the Short Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the Short Canal control structure and fish screen, the Chowchilla Bifurcation Structure fish passage facility, modification of San

Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. (See Section 2.2.7 for a detailed description of the Alternative C.) Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Impact GEO-1 (Alternative C): *Effects on Mineral and Soil Resources*. Compared to No-Action, Project construction for Alternative C would include the new Fresno Slough Dam, adjacent Short Canal, floodplain, and levees along both sides of the floodplain. The Fresno Slough Dam would be constructed in an area that is not farmed. Currently soils within the footprint of the new levees and South Canal include about 1,170 acres that are farmed. These areas would no longer be available for farming. The approximately 3,000-foot-wide area between the two new floodplain levees would be revegetated as part of the habitat restoration program and would not be available for farming under Alternative C. Other areas where there would be temporary construction impacts include construction office sites, equipment maintenance and parking areas, and materials storage areas. It is estimated that approximately 62 acres would temporarily be impacted by this construction; most of these areas are currently in agricultural production. A more detailed discussion of impacts to farming is presented in Chapter 16, “Land Use Planning and Agricultural Resources.”

Borrow material would primarily be required for the construction of the levees, but it may also be utilized in the construction of other structures for foundation or backfill material. Levees may be constructed entirely of local borrow material, a mix of local and imported borrow material, or just imported borrow material. Borrow locations would be determined after a geotechnical exploration of potential local borrow areas is complete; the exploration would determine the suitability of local soils for use as borrow material (see Section 2.2.4). It is estimated that up to 350 acres of land would be needed for borrow areas. Some of the soils excavated to construct the Short Canal might be used for levee construction, and if this is possible, then the size of the borrow areas may be reduced. Excavation of borrow materials would be done in accordance with Reclamation design standards and permit requirements.

When comparing Alternative C to existing conditions, impacts to soil resources from construction activities would be the same as those described above (i.e., the comparison of Alternative C to the No-Action Alternative). Because borrow material would be excavated in accordance with Reclamation guidelines designed to be protective of soil resources, impacts to soil resources would be **less than significant**.

Impact GEO-2 (Alternative C): *Soil Erosion Effects*. Compared to the No-Action Alternative, short-term increases in erosion could occur during construction as a result of disturbed soils. However, Reclamation would prepare and implement a SWPPP that complies with applicable Federal NPDES regulations concerning construction activities. Implementation of erosion control BMPs consistent with the Project’s construction SWPPP would minimize soil erosion during construction.

Under Alternative C, the long-term flow conveyance capacity of Reach 2B would increase to 4,500 cfs and Reach 2B would receive increased flows that could lead to changes in sediment transport conditions within the floodplain and adjacent to structures.

However, standard erosion protection measures such as revetment and proper hydraulic engineering design would be implemented to minimize erosion near Project structures and levees (see Section 2.2.4). Proper engineering design of the new Project features would minimize potential increases in soil erosion in the Project area following construction.

When comparing Alternative C to existing conditions, impacts from soil erosion effects would be similar to those described above (i.e., the comparison of Alternative C to the No-Action Alternative). As a result, the impact on erosion would be **less than significant** due to construction of Alternative C.

Impact GEO-3 (Alternative C): ***Adverse Soil Conditions*.** Compared to the No-Action Alternative, the Project design under Alternative C would include new earth structures such as the floodplain and levees, as well as reinforced concrete structures such as the Fresno Slough Dam, fish passage facilities at Mendota Dam and Chowchilla Bypass, grade control structures downstream of Mendota Dam, Short Canal, and improved San Mateo Avenue crossing. Adverse soil conditions could negatively affect the long-term stability of Project features.

Under-seepage, water that seeps laterally by travelling under a dam or levee section, can occur when structures are underlain by permeable native soils. This may cause instability in the structures built on these soils. Seepage control measures (as described above for Impact GEO-3 [Alternative A]) would be included, as part of the Project, in areas where under-seepage is likely to affect adjacent land uses (see Section 2.2.4).

Other adverse soil conditions within Reach 2B could include soils corrosive to buried concrete and/or steel and soils susceptible to consolidation and the resultant settlement of overlying structures. Site specific geotechnical exploration, testing, and analysis prior to final design would allow for the characterization of the site soils and appropriate design of all proposed structures such that potentially corrosive soils or subsidence conditions should not impact Project facilities. All design work would be completed in general accordance with Reclamation Design Standards, applicable design codes, and commonly accepted industry standards (see Section 2.2.4).

When comparing Alternative C to existing conditions, impacts from adverse soil conditions would be similar to those described above (i.e., the comparison of Alternative C to the No-Action Alternative). As a result, impacts of potentially adverse soils within Reach 2B on Project structures would be **less than significant**.

Impact GEO-4 (Alternative C): ***Adverse Seismicity Effects*.** Compared to the No-Action Alternative, potential impacts to existing structures as a result of seismicity effects would remain unchanged. However, Reach 2B would be modified under Alternative C with construction of the Fresno Slough Dam, adjacent Short Canal, and floodplain and levees along both sides of the river, as well as several other structures. Each of these structures would be built according to Reclamation design standards, the Corps engineering design standards, or equivalent standards (see Section 2.2.4). As a result, the new structures would be designed as necessary to withstand seismic forces, and foundations would be designed to protect the structure from the deleterious effects of liquefaction and lateral spreading. The potential for flooding related to seismically induced dam failure cannot be lessened through the design of Project facilities; however, the Project would not include development that would put additional people at risk or increase flood risk at occupied structures.

Compared to existing conditions, potential impacts to existing structures as a result of seismicity effects would remain unchanged. The likelihood of seismicity affecting the existing Reach 2B area would remain unchanged under this or any of the other alternatives. Proposed structures would be designed to withstand seismic forces and protect against the deleterious effects of liquefaction and lateral spreading. Therefore, there would be **no impact.**

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would include construction of Project features including Fresno Slough Dam, a new levee system with a wide floodplain encompassing the river channel, and the North Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough Dam fish barrier, the North Canal bifurcation structure, fish passage facility, and fish screen, removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure, removal of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. (See Section 2.2.8 for a detailed description of the Alternative D.) Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Impact GEO-1 (Alternative D): ***Effects on Mineral and Soil Resources*****.** Compared to No-Action, Project construction for Alternative D would include the Fresno Slough Dam, floodplain and levees along both sides of the river and the North Canal. The Fresno Slough Dam would be constructed in an area that is not farmed. Currently soils within the footprint of the new levees and North Canal include about 1,900 acres that are farmed. Also, the approximately 4,200-foot-wide floodplain would be unavailable for farming many current crops under Alternative D, but a portion of the floodplain would be available for annual crops, pasture, or floodplain-compatible permanent crops. Other areas where there would be temporary construction impacts include construction office sites, equipment maintenance and parking areas, and materials storage areas. It is estimated that approximately 62 acres would temporarily be impacted by this construction; most of these areas are currently in agricultural production. A more detailed discussion of impacts to farming are presented in Chapter 16, “Land Use Planning and Agricultural Resources.”

Borrow material would primarily be required for the construction of the levees, but it may also be utilized in the construction of other structures for foundation or backfill material. Levees may be constructed entirely of local borrow material, a mix of local and imported borrow material, or just imported borrow material. Borrow locations would be determined after a geotechnical exploration of potential local borrow areas is complete; the exploration would determine the suitability of local soils for use as borrow material (see Section 2.2.4). It is estimated that up to 350 acres of land would be needed for borrow areas. Some of the soils excavated to construct the North Canal might be used for levee construction, and if this is possible, then the size of the borrow areas may be reduced. Excavation of borrow materials would be done in accordance with Reclamation design standards and permit requirements.

When comparing Alternative D to existing conditions, impacts to soil resources from construction activities would be similar to those described above (i.e., the comparison of Alternative D to the No-Action Alternative). Because borrow material would be excavated in accordance with Reclamation guidelines designed to be protective of soil resources, impacts to soil resources would be **less than significant**.

Impact GEO-2 (Alternative D): ***Soil Erosion Effects*****.** Compared to the No-Action Alternative, short-term increases in erosion could occur during construction as a result of disturbed soils. However, Reclamation would prepare and implement a SWPPP that complies with applicable Federal NPDES regulations concerning construction activities. Implementation of erosion control BMPs consistent with the Project's construction SWPPP would minimize soil erosion during construction.

Under Alternative D, the long-term flow conveyance capacity of Reach 2B would increase to 4,500 cfs and Reach 2B would receive increased flows that could lead to changes in sediment transport conditions within the expanded floodplain and adjacent to new structures. However, standard erosion protection measures such as revetment and proper hydraulic engineering design would be implemented to minimize erosion near Project structures and levees (see Section 2.2.4). Proper engineering design of the new Project features would minimize potential increases in soil erosion in the Project area following construction.

When comparing Alternative D to existing conditions, impacts from soil erosion effects would be similar to those described above (i.e., the comparison of Alternative D to the No-Action Alternative). As a result, the impact on erosion would be **less than significant** due to construction of Alternative D.

Impact GEO-3 (Alternative D): ***Adverse Soil Conditions*****.** Compared to the No-Action Alternative, the Project design under Alternative D would include new earth structures such as the floodplain, levees, and North Canal, as well as reinforced concrete structures such as the Fresno Slough Dam, fish passage facilities at Mendota Dam, grade control structures downstream of Mendota Dam, and North Canal bifurcation structure, fish passage facility, and fish screen. Adverse soil conditions could negatively affect the long-term stability of Project features.

Under-seepage, water that seeps laterally by travelling under a dam or levee section, can occur when structures are underlain by permeable native soils. This may cause instability in the structures built on these soils. Seepage control measures (as described above for Impact GEO-3 [Alternative A]) would be included, as part of the Project, in areas where under-seepage is likely to affect adjacent land uses (see Section 2.2.4).

Other adverse soil conditions within Reach 2B could include soils corrosive to buried concrete and/or steel and soils susceptible to consolidation and the resultant settlement of overlying structures. Site specific geotechnical exploration, testing, and analysis prior to final design would allow for the characterization of the site soils and appropriate design of all proposed structures such that potentially corrosive soils or subsidence conditions should not impact Project facilities. All design work would be completed in general accordance with Reclamation Design Standards, applicable design codes, and commonly accepted industry standards (see Section 2.2.4).

When comparing Alternative D to existing conditions, impacts from adverse soil conditions would be similar to those described above (i.e., the comparison of Alternative D to the No-Action Alternative). As a result, impacts of potentially adverse soils within Reach 2B on Project structures would be **less than significant**.

Impact GEO-4 (Alternative D): ***Adverse Seismicity Effects*.** Compared to the No-Action Alternative, potential impacts to existing structures as a result of seismicity effects would remain unchanged. However, Reach 2B would be modified under Alternative D with the construction of the Fresno Slough Dam, floodplain and levees along both sides of the river, and North Canal, and as well as several other structures. Each of these structures would be built according to Reclamation design standards, the Corps engineering design standards, or equivalent standards (see Section 2.2.4). As a result, the new structures would be designed as necessary to withstand seismic forces, and foundations would be designed to protect the structure from the deleterious effects of liquefaction and lateral spreading. The potential for flooding related to seismically induced dam failure cannot be lessened through the design of Project facilities; however, the Project would not include development that would put additional people at risk or increase flood risk at occupied structures.

Compared to existing conditions, potential impacts to existing structures as a result of seismicity effects would remain unchanged. The likelihood of seismicity affecting the existing Reach 2B area would remain unchanged under this or any of the other alternatives. Proposed structures would be designed to withstand seismic forces and protect against the deleterious effects of liquefaction and lateral spreading. Therefore, there would be **no impact.**

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